GEOLOGY AND MINERAL RESOURCES OF SAN DIEGO COUNTY, CALIFORNIA

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With sections on *Sand and gravel, and crushed and broken stone,* by F. Harold Weber Jr. and Roy M. Kepner Jr.; and *Clay,* by George B. Cleveland; and *Arsenic,* and parts of several sections, by R. M. Stewart

COUNTY REPORT 3

California Division of Mines and Geology
Ferry Building, San Francisco, 1963

THE GREAT SEAL OF THE STATE OF CALIFORNIA
EUREKA

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COUNTY REPORT 3
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ABSTRACT

San Diego County, which comprises 4,258 square miles, is the most southwesterly county in the continental United States. The county is almost square in shape. It contains three northwest-trending geomorphic provinces, which from west to east are: (1) a narrow coastal plain; (2) a broad, interior upland of ranges (as high as 6,500 feet in elevation) and intermediate valleys (Peninsular Range province); and (3) part of the western edge of the Salton (Imperial) Basin, which constitutes a desert.

The oldest rocks in the county are mildly to moderately metamorphosed sedimentary rocks which consist mainly of inclusions, pendants and screens of quartz-biotite schist and gneiss. These rocks, which are widespread in the county, have been dated as Triassic, but some may be as old as Precambrian and others may be as young as Cretaceous. Metavolcanic rocks, of possible Jurassic or Cretaceous age, are exposed in a belt along the west edge of the interior upland province. These rocks are commonly andesitic flows. The interior upland province is underlain largely by intrusive rocks of the batholith of Southern California. These rocks consist of individually intruded bodies which most commonly are tonalite (quartz diorite), and less commonly are granodiorite, gabbro, or granite. The batholith is Cretaceous in age. Hybrid gneisses and associated granodiorite and quartz diorite occur in the central part of the county. Pegmatite dikes cut most of the rocks described above.

The post-batholith rocks of the coastal plain are mainly clastic, marine sedimentary deposits which overlie the older rocks and most commonly dip gently toward the west and southwest. These rocks range in age from Cretaceous to Quaternary and consist chiefly of beds of sandstone, shale and conglomerate. Two small bodies of volcanic rocks cut Eocene sedimentary rocks. The post-batholith rocks of the Salton Basin region range in age from Miocene to Pleistocene and consist mainly of clastic, marine and nonmarine sedimentary rocks which are composed chiefly of fanglomerate, conglomerate, sandstone and breccia. Volcanic flow rocks occur in the southeast part of the county. Within the interior upland province are landslide deposits, dissected alluvium, and lake bed deposits. Playa deposits of Recent age occur in the Salton Basin region, and undissected alluvial deposits of Recent age are abundant throughout the county. The most prominent structural features of the county are numerous, extensive, northwest-trending faults, the principal one of which is the Elsinore Fault.

The total value of the mineral production of San Diego County from 1870 through 1959 is estimated to be about $125,000,000. Of this value, slightly more than $75,000,000 was recorded from the end of World War II through 1959. The value of the recorded mineral production for 1959 is $14,489,600. The tremendous growth in population of the county since the end of World War II, and the consequent growth of the building industry, resulted by 1959 in a nearly seven-fold increase in the production of sand and gravel, and crushed and broken stone. In 1959 these commodities accounted for about 94 percent of the value of minerals produced. Processed sand and gravel are produced mainly in the San Diego region, from river bed deposits of Recent age, and the Poway conglomerate of Eocene age, and are used chiefly as concrete aggregate. Crushed stone, which includes decomposed granite, is produced from granitic and metavolcanic rocks, and is used principally as road base, fill, and concrete aggregate. Broken stone, which is quarried from metavolcanic and granitic rocks, is used almost entirely as riprap.

Since the early 1900's other nonmetallic minerals also have risen to importance. Metallic commodities, on the other hand, have been mined mostly during national emergencies. Dimension stone has been produced in the county since 1898, now mainly from granitic rocks near Foster, and from gabbroic rocks near Escondido and Vista. It is used as surface plates, and as building and monument stone. One operator produces dimension stone from quartzite. Salt has been produced since 1869 along the edge of San Diego Bay by evaporating sea water, and now is produced by one operator. Sea water bittern retained from this operation is utilized by another company to produce magnesium chloride. Common clay from the Rose Canyon shale, of Eocene age, is utilized in the manufacture of bricks. Clay for other ceramic uses is mined from

deposits of probable Paleocene age. Bentonitic clay mined formerly in the Otay area was used as an absorbent in petroleum refining. A single company produces specialty sands from sandstone of Eocene age at a locality in Oceanside. Pyrophyllite for use as an insecticide carrier has been mined since 1946 from altered metavolcanic rocks near Rancho Santa Fe.

Gem minerals, including tourmaline, spodumene variety kunzite, topaz, garnet, and quartz, have been mined from pegmatite deposits since the late 1890's, but mainly between 1900 and 1912. The principal gem mines are in the Pala and Mesa Grande districts. Small tonnages of common quartz have been mined intermittently for various uses. Small quantities of celestite (strontium sulfate) are mined occasionally from a single deposit in the county. Limestone and dolomite produced intermittently from crystalline metasedimentary rocks, mainly in the southeast part of the county, are used chiefly as roofing granules.

Nonmetallic minerals that have been produced in the county in the past, but which were not produced in the middle or late 1950's, include potash (World War I); pebbles for grinding and filtering (1915-1949); bromine (1926-1945); feldspar (1918-1943), of which the Pacific deposit once was the principal source in the State; lithium mica (lepidolite), obtained mainly from the Stewart deposit (1892-1928); optical calcite (World War II); peat (late 1940's); quartz crystal (electronic and fusing grade); and vermiculite. Unmined deposits of the following nonmetallic minerals occur in the county: graphite, gypsum, dumortierite-sillimanite, mica, expansible shale, volcanic ash, and wollastonite. Petroleum has been explored for unsuccessfully in the coastal area and at one locality on the eastern edge of the county.

The principal metallic commodities that have been mined in the county are gold, tungsten and copper, but the value of production of these is relatively small. Gold has been mined intermittently in the county since about 1870, but mainly from 1870 to 1875 and from the late 1880's to 1900. The value of the total production is estimated to be between $5½ and $6 million. Although many deposits have been worked, most of the gold mined came from quartz vein deposits in the Julian district and from the Stonewall deposit. Tungsten has been mined from several tactite and quartz vein deposits in the county, during World War II and during the early and mid 1950's. Copper has been mined from two deposits, chiefly during World War I. Very small quantities of molybdenite and silver also have been produced. Small, unmined, and/or low grade metallic deposits include those of nickel-cobalt-copper, arsenic, beryllium, iron, lead, manganese, and uranium-thorium.

GEOLOGY AND MINERAL RESOURCES OF SAN DIEGO COUNTY, CALIFORNIA*

By F. HAROLD WEBER, JR.

INTRODUCTION

PURPOSE AND SCOPE

One of the functions of the California Division of Mines and Geology is the publication of reports that contain reviews of the mineral resources and mineral industries of the counties of California, with emphasis on descriptions of individual mineral deposits. Reports of this type on San Diego County have been published by the division (and its predecessor, the California Mining Bureau) in 1888, 1914, 1925, and 1939; and descriptions of from one to several deposits have been given in many other reports.

The present report contains discussions of the individual mineral commodities of the county, with each discussion followed by descriptions of deposits pertinent to that commodity. Descriptions of more than 500 deposits are given, either within the text or in tabulated lists. Also included in the report are reviews of the history of mining and the mineral production, and discussions of the problems of land entry and water for mining. Preceding the section on mineral commodities is a review of the geologic features of the county, with emphasis on descriptions of rocks. A comprehensive bibliography on geology and mineral deposits also is provided. The locations of the mineral deposits and the geologic features of the county are shown on a map that accompanies the report.

CULTURE

San Diego County, the most southwesterly county in the continental United States, is bounded on the west by the Pacific Ocean, on the north by Orange and Riverside Counties, on the east by Imperial County, and on the south by Baja California, Mexico (Fig. 1). It is cut by meridian 117°00′ and parallel 33°00′.

* Manuscript submitted September 1959 for publication, and partially supplemented by additional data through June 1961.

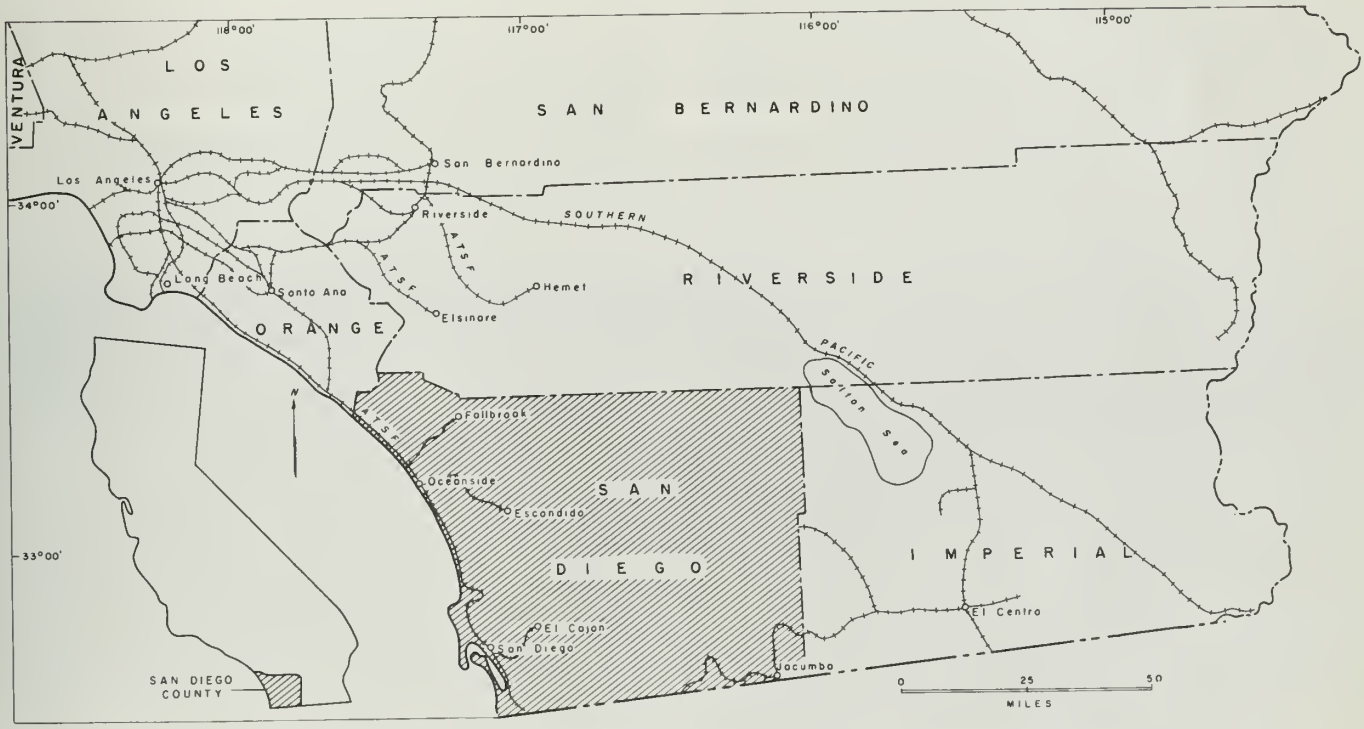


Figure 1. Index map showing San Diego County and railroad network of most of southern California.

The county was one of the original 27 created in 1850, when California became a state. It was named after San Diego Bay, and vicinity, which had been christened first by Cabrillo in 1542 as San Miguel Bay, then rechristened San Diego Bay by Viscaino on November 12, 1602. November 12 was the birthday of the patron saint of his flagship—San Diego de Alcala. Originally the county was one of the two largest in the State, and included all of California east of a line of longitude between 117°15′ and 117°30′. Its size was diminished as additional counties were formed in Central and Southern California, and its present size and shape was established with the formation of Riverside County in 1893 and Imperial County in 1907.

San Diego County is roughly rectangular in shape. Its maximum east-west dimension is about 88 miles; its maximum north-south dimension is about 63 miles; and its coastline is about 70 miles long. The county comprises 4,258 square miles (2,725,120 acres).

The County and City of San Diego have shown a remarkable growth since World War II, mainly because of an increase in defense activities, and industries associated with defense, and because of the mild climate of the coastal region, which has attracted new residents. In 1940 the population of the county was about 289,000, and by 1960 it had risen to about 1,033,000. Most of the residents live in the city and suburbs of San Diego, which are in the southwest corner of the county, near San Diego and Mission Bays. By 1960 the population of the City of San Diego was roughly 573,000. Most of the remaining residents of the county live along the coast, north of San Diego, and in inland communities adjacent to the coast. Only a very small part of the population lives more than 20 miles inland from the ocean. The most important fields of employment in the San Diego region are the U.S. Navy, the aircraft industry, tourism, and related industries and businesses. The major port is San Diego and the major airport also is at San Diego.

The county is served by two railroads and three United States highways. A line of the Atchison, Topeka and Santa Fe Railroad extends from Los Angeles, along the coast, to San Diego, with branch lines in the county serving Fallbrook and Escondido (see Fig. 1 or Pl. 1). The San Diego and Arizona Eastern Railroad (now a division of Southern Pacific) runs from San Diego eastward to El Centro in Imperial County, via Chula Vista, Tijuana (in Mexico), Campo and Jacumba. A branch of this road extends from San Diego to El Cajon. The three United States highways extend outward from the City of San Diego. These are: U.S. 101, which skirts the coast of the Pacific Coast states; U.S. 395, which extends northward from San Diego, via Escondido to Riverside in Riverside County, San Bernardino in San Bernardino County, and beyond; and U.S. 80, which runs eastward from San Diego, via El Cajon, Jacumba, and El Centro, to the southeastern United States. The paved roads of the State of California and paved and unpaved roads of the County of San Diego link all communities within the

Photo 1. View east toward coastal plain province from top of Torrey Pines grade, U.S. Highway 101. Dissected Linda Vista terrace is underlain by Torrey sand of Eocene age (white exposures on left) and Rose Canyon shale of Eocene age (dark, subdued exposures on right). Foothills of Peninsular Range province border coastal plain on east (far background). Mountains of the Peninsular Range province underlie skyline.

Photo 2. View north toward El Cajon Mountain (3,675 feet), which is about 7 miles northeast of Lakeside. Difference in elevation between top of mountain and San Diego River valley is 3,125 feet. Mountain consists of striking exposure of Woodson Mountain (?) granodiorite which is bordered on south and east by Green Valley (?) tonalite. Quarry on side of mountain was source of broken stone used in construction of El Capitan dam, about a mile to the southeast.

county and connect the border communities with points outside the county. In addition, the United States Forest Service, the State of California, and the County of San Diego maintain a network of unpaved firetruck roads (or trails) for which public use is limited, especially during fire season. All federal, state, and county roads are shown on Plate 1.

PHYSICAL GEOGRAPHY

PHYSICAL FEATURES

San Diego County includes parts of three northwest-trending natural provinces, which from west to east are the coastal plain of southern California, the interior upland of ranges and valleys (Peninsular Range province), and the Salton (Imperial) Basin, which includes the Colorado Desert.

Coastal Plain. The coastal plain of San Diego County ranges in width from less than one mile at the north boundary of the county to about 12 miles at the south boundary. The province is composed of dissected, mesa-like terraces which grade inland into rolling hills commonly topped by remnants of terraces. This terrain is underlain by nearly flat-lying sedimentary rocks composed mainly of beds of sandstone, shale and conglomerate (see section herein on "Geologic Features"). The elevations of most of the terraces lie within the range of 300 to 500 feet (Ellis and Lee, 1919). The most extensive of them are in the San Diego region, and these have been named the Poway, Linda Vista (Photo 1), and Otay terraces (or mesas). Rolling hills characterize the inland region between Oceanside and Del Mar (Photo 77), and the area east and northeast of Chula Vista. The province is dissected by intermittent rivers and streams which flow westward and southwestward. The most prominent rivers are, from north to south, the Santa Margarita, San Luis Rey, San Diego, Sweetwater, Otay, and Tia Juana (see Pl. 1). Tidal marshes are common at the mouths of the rivers.

The coastline is curved westward very gently from the north boundary of the county southward to La Jolla Peninsula. The south part of the coastline is broken by La Jolla and Point Loma Peninsulas, which are separated by Mission (False) Bay. San Diego Bay is on the southeast side of Point Loma Peninsula. The coastal plain is bounded on the east by the foothills of the interior upland province.

Interior Upland of Ranges and Intermediate Valleys (Peninsular Range Province). By far the largest part of San Diego County consists of the interior upland (Peninsular Range) province which is bordered on the west by the coastal plain and on the east by the Salton Basin. The province is composed of ranges of steep-sloped hills and mountains separated by intermediate valleys which are generally of small extent. Most of the slopes that are underlain by granitic rocks are boulder-covered (Photo 10), and some mountains and ranges underlain by these rocks are almost ledge-like (Photo 2). Terrain underlain by metamorphic rocks is subdued in the moist, coastal areas, but more resistant in the drier, inland areas. Metavolcanic rocks along the coast comprise resistant hills and mountains (see section herein on "Geologic Features").

The province ranges in elevation from points slightly less than 1,000 feet on the west side to mountain tops slightly more than 6,500 feet on the east side. The highest part of the province consists of a belt of mountains and mountain ranges which extends southeastward from the Riverside County line, near Pala, to Jacumba. These include (from northwest to southeast) the Agua Tibia Mountains, Palomar Mountain (6,138 feet), San Ysidro Mountain (6,147 feet), Volcan Mountain (5,700 feet), Hot Springs Mountain (6,533 feet) and vicinity, Cuyamaca Peaks (including Cuyamaca Peak, 6,375 feet), and the Oriflamme (Photo 9), Vallecito, Tierra Blanca, In-ko-Pah and Jacumba Mountains (Photo 6). The higher ranges in the northwest part of the province are the Santa Margarita, San Marcos, and Merriam Mountains, in the southwest part are the San Ysidro and San Miguel Mountains, and in the northeast part are the Santa Rosa Mountains. High plateaus or mesas, such as Julian and La Cresta-Suncrest mesas, are common in higher parts of the province. Very steep slopes are common in the south-central and eastern parts of the province. Especially steep are the west slopes of Palomar Mountain (Photo 22) and the Santa Rosa Mountains, and the east slopes of the Laguna Mountains (Photo 3), and the mountains on the west side of Borrego Valley (Photo 4). Major valleys in the province are San Jose (Photo 5), San Felipe, Earthquake, Vallecito, and Jacumba. The major drainage to the west is via the San Luis Rey, San Dieguito, and San Diego Rivers and tributaries, and by Cottonwood Creek (which flows into the Tia Juana

Photo 3. Laguno Mountoins. View northeastword down Cottonwood Creek from Sunrise highwoy. Vallecito Valley is in middleground. Rocks in range on for side of Vollecita Valley ore chiefly schist ond hybrid rocks. Rocks in left foreground are schist. Elevotion of locolity from which photogroph wos token is abaut 5,500 feet; paint in volley below, where northeost-trending conyon (Cattonwood Creek) in right foreground widens, is obout 2,500 feet.

Phato 4. View narth across Hellhole Conyon toward steep slopes on west side of Borrego Valley. Racks in foreground and in low parts of ridges in bockgraund are mainly schist and gneiss. Highest mountoin to left is composed of gronitic racks, probably Bonsoll tonalite.

River, in Mexico) and tributaries. The major drainage systems to the east are those of Carrizo and San Felipe Creeks.

Salton (Imperial) Basin. The Salton (Imperial) Basin province bounds the interior upland province on the east. Elevations in the Salton Basin range from about 2,000 feet on its western edge to below sea level in its lowest parts, which are in the vicinity of the Salton Sea, in Imperial County. The lowest part of this province in San Diego County is about 35 feet, on the county line at a point southeast of Ocotillo Wells. The province is characterized by wide, boulder-strewn valleys that are separated by groups of low, irregular hills. These hills commonly are multihued badlands composed of beds of sandstone, shale and conglomerate. Within San Diego County the province is enclosed by Anza-Borrego Desert State Park. Part of the eastern edge of the county is enclosed by the Colorado Desert which is mostly in Imperial County.

CLIMATE AND VEGETATION

The climate of San Diego County ranges from very mild along the coast, to relatively extreme in the mountains and desert. Along the coast, the average Fahrenheit temperatures during the summer range from the 60's and lower 70's at night to the high 70's during the day. In the winter they range from about 50 degrees at night to the upper 60's during the day. Fifteen to 30 miles inland, at localities such as Escondido and El Cajon, the average temperatures during the summer range from

Photo 5. Son Jose Volley oreo, view southeost. Loke Henshaw is in middleground. Scarp olong Elsinore foult forms west side of volley.

the 50's at night to the 80's and 90's during the day; and during the winter range from the 40's at night to the 60's and 70's in the daytime. In the mountainous areas of the county, the daily summer temperatures range from 60 degrees at night to the 70's and 80's during the day; and during the winter range from the 30's and 40's at night, to the 40's and 50's during the day. Daytime temperatures on the desert during the summer are commonly well over 100 degrees and in the winter are about 70 degrees F.

Precipitation occurs mainly during the winter months as rain, with snow common only in the high mountains. Annual precipitation along the coast is about 10 inches, and ranges upward inland to about 50 inches in some of the highest mountain areas, then drops to 5 inches or less on the desert.

Vegetation along the coast consists of chaparral, sagebrush and some grass. Oak, pine and other varieties of trees are common in the higher areas.

FIELD WORK

The present investigation was started in January 1953 by Richard M. Stewart who was then assigned to the Los Angeles office of the Division of Mines. The project was interrupted with Mr. Stewart's transfer to the San Francisco office in November 1955. It was resumed in September 1956 by F. Harold Weber, Jr., who worked nearly full time on the project until its completion in July 1959. George B. Cleveland, of the Division of Mines and Geology, and Roy M. Kepner, Jr., of the San Diego County Division of Natural Resources, also contributed, as indicated in the acknowledgments.

The data presented in the descriptions of mineral deposits in the text and tabulated lists were prepared mainly from notes taken during short visits to properties. Visits ranged in duration from a few minutes to one day, and probably averaged between one and three hours. Some deposits were mapped in detail by Brunton compass and tape survey. Geologic reconnaissance mapping to complete unmapped areas for the base map (Pl. 1) was compiled on U.S. Geological Survey topographic maps of 1:62,500 and 1:24,000 scales. A total of about 210 days was spent in the field by all investigators.

Other information included in descriptions, such as that on property ownership and holdings, historical data, and the nature of inaccessible workings, was obtained from previously published reports, property owners, longtime residents of the county with a knowledge of the mining activities, and Mr. Kepner. Property ownership data also were obtained from the offices of the San Diego County Recorder and Assessor.

ACKNOWLEDGMENTS

For the part of the report on "Mineral Resources and Mining," George B. Cleveland prepared the section on "Clay," and Roy M. Kepner, Jr., gathered and tabulated most of the data for the section on "Sand and Gravel, and Crushed and Broken Stone." Richard M. Stewart prepared the section on "Arsenic," and many of the descriptions of deposits in the tabulated lists, especially for metallic commodities. The project was supervised by Dr. Lauren A. Wright, who also reviewed and edited the report. In addition, William E. Ver Planck furnished valuable criticism.

The members of the staff of the Division of Mines and Geology who worked on this report are indebted to Mr. Roy M. Kepner, Jr. and Miss Barbara Biewener, of the San Diego County Division of Natural Resources, for their continuing interest in the entire project, and for their assistance with many problems involving fieldwork and compilation of the report. In addition, Mr. Kepner arranged flying trips to take photographs for the report.

Dr. Richard H. Jahns, California Institute of Technology, kindly furnished the division with unpublished data on the areal geology, pegmatites and mines of the Mesa Grande district. Dr. Richard Merriam, University of Southern California, lent unpublished geologic maps of the Escondido region which were used in compiling the base map. Mr. T. W. Dibblee of the U.S. Geological Survey modified for this report a previously published geologic map. Dr. Cordell Durrell, University of California at Los Angeles, lent reports and maps of the Hilton calcite deposit.

The writers would also like to thank mine owners and others who assisted them during the fieldwork and compilation of the report, especially to L. B. Spaulding of Ramona, Frank Herron of Julian, Fred Elliot of Manzanita, H. J. Phillips of El Cajon, C. C. Pease of San Diego, Robert Harris of Rancho Santa Fe, R. R. Dye of Warner Springs, and H. J. Jory of South Pasadena. The late Frank Lane of Julian furnished information regarding the Julian district.

The maps in this report were drafted by Richard A. Crippen, Jr., Supervising Geological Draftsman, and Dorismae Weber. The manuscript, in various stages, was typed by Mrs. Geraldine Saddler, Mrs. Mary Marchbanks, and Mrs. Elizabeth Clark.

The cover was designed by Elinor H. Rhodes and Sarah Ann Davis.

GEOLOGIC FEATURES

PREVIOUS INVESTIGATIONS

The first published reference to the geology of San Diego County apparently was that written in 1792 by Jose Longinos Martinez, who had noted occurrences of garnet and tourmaline on the mainland during a Spanish expedition to California. Reports dealing specifically with geologic features of the county were first published in the 1850's. These were travelog-like accounts written mainly in conjunction with: (1) surveys for possible railroad routes (Thomas Antisell, 1856; W. P. Blake, 1858); (2) a coast survey report (W. P. Blake, 1856); and (3) the survey from 1849 to 1851 of the boundary between the United States and Mexico (C. C. Parry and A. Schott, 1857; C. C. Parry, 1857; T. A. Conrad, 1857;

J. Hall, 1857). The region that now is San Diego County was first included on a geologic map by Blake (1858). During the 1860's W. M. Gabb (1864, 1869) prepared descriptions of Cretaceous and Eocene fossils, including many from the San Diego region, for the second Geological Survey of California.

The Eighth Annual Report of the California State Mining Bureau, published in 1888, contains a short, informal account of the geology of the county in "Mineral resources of San Diego County" by W. A. Goodyear. Part of this report was written from notes taken by Goodyear in 1872 for the second Geological Survey of California, which had been disbanded in 1874. In 1893 the bureau published a longer, more descriptive account entitled "Geology of San Diego County: also of portions of Orange and San Bernardino Counties" by H. W. Fairbanks (at that time San Diego County also included Riverside and Imperial Counties). This account still is a useful geologic reference. In 1914 the bureau published a report by F. J. H. Merrill which included a short section on geology, but was mainly about the mineral resources.

The first detailed geologic report, with an accompanying geologic map, to cover a large part of the county, was written in connection with a ground water study of the western part of the county by A. J. Ellis and C. H. Lee, and published by the U.S. Geological Survey in 1919.

During the 1920's, the general geology of the county became much better known through the work of A. O. Woodford (1925) in the north coastal region; M. A. Hanna (1926a, b) in the La Jolla region; J. S. Brown (1922, 1923) in the Salton Basin region; F. S. Hudson (1922) in the Cuyamaca region; and others. During this time and before, W. T. Schaller and others studied the pegmatite deposits in the central part of the county.

During the 1930's, the granitic and metamorphic rocks were studied, principally by E. S. Larsen, Jr. (1941, 1945, 1948) in the northwest part of the county. Other workers were C. S. Hurlbut, Jr. (1935), F. S. Miller (1937) and W. J. Miller (1935a, 1946). During the period from the 1930's to the 1950's, studies of the stratigraphy and paleontology of sedimentary rocks of the south coastal area were continued, mainly by L. G. Hertlein and U. S. Grant, IV (1939, 1943, 1944, 1954). During the 1940's and 1950's, additional studies were made of the batholithic rocks in the central and southeast parts of the county by Richard Merriam (1941, 1946, 1953, 1954, 1955, 1959); D. L. Everhardt (1951); and Baylor Brooks and Ellis Roberts (1954). Studies of pegmatite deposits were continued, mainly by R. H. Jahns (Jahns and L. A. Wright, 1951; Jahns, 1954c; Jahns and J. B. Hanley) and Hanley (1951). Studies of (1) ground water were carried out by the California Department (formerly Division) of Water Resources (California Division of Water Resources, 1935, 1936, 1949, 1951, 1954, 1956); (2) marine geology by Scripps Institute of Oceanography (F. P. Shepard, with others, 1940 to 1951; K. O. Emery, with others, 1941 to 1960; and others); and (3) soil studies by the United States Forest Service (United States Forest Service, 1957). In 1954 two important papers dealing partly with the county were published in California Division of Mines Bulletin 170, "Geology of Southern California": (1) "Geology of the Imperial Valley Region" by T. W. Dibblee, and (2) "Geology of the Peninsular Range Province" by R. H. Jahns. In the late 1950's studies of the geology of the San Diego region were being made by Gordon Gastil, E. D. Milow, and students of San Diego State College, San Diego.

DESCRIPTIONS OF THE ROCKS

METAMORPHIC ROCKS (CRETACEOUS AND/OR OLDER)

Rocks in San Diego County that are older than the batholith of Southern California consist mostly of metasedimentary rocks which in a few places are interbedded with metavolcanic rocks. Some of these rocks may be as old as Paleozoic, or perhaps even Precambrian, and others may be as young as Early Cretaceous. The metasedimentary rocks are overlain unconformably by mildly metamorphosed volcanic rocks which may range in age from Jurassic to Cretaceous.

Metasedimentary Rocks (Cretaceous and/or Older)

Metasedimentary rocks are exposed throughout the Peninsular Range province in Riverside and San Diego Counties of California and in Baja California. Such rocks in San Diego County were first described in detail in reports that dealt with the Julian gold mining district. Metasedimentary rocks in that district were first named the Julian group by Merrill (1914), and then mapped and renamed the Julian schist series by Hudson (1922). The latter term was shortened to Julian schist by Donnelly (1934), and this name has been widely used by more recent workers in the central and southeastern parts of the county (Merriam, 1946, 1959; unpublished 1955; Everhardt, 1951; Brooks and Roberts, 1954). In the northwestern part of the county the metasedimentary rocks were mapped and described by Larsen (1948) as the Bedford Canyon formation, whose type section is in the Santa Ana Mountains, Riverside County. In 1954, in a paper on the geology of the Peninsular Range province, Jahns (1954b, Pl. 3) differentiated the rocks in the west and central parts of the county from those in the north-central and eastern parts by referring to the former as "younger metamorphic series" and to the latter as "older metamorphic series." Previously unmapped bodies of metamorphic rocks in the eastern part of the county have been outlined by reconnaissance mapping for this report (see Pl. 1).

Distribution. The metasedimentary rocks occur as inclusions, pendants, and screens which are bounded mainly by younger granitic rocks of the batholith of Southern California. These bodies range in size from small inclusions less than several feet in length, which are distributed through certain granitic rocks (e.g. Bonsall tonalite) (Photo 11), to bodies as much as several miles

wide and many miles long (see Pl. 1). About 280 square miles in San Diego County are underlain by these rocks, excluding bodies too small to be mapped—those which are part of granitic rocks, and those included with "Hybrid Gneisses and Associated Quartz Diorite and Granodiorite" (which see).

Most bodies of metamorphic rocks, except necessarily the screens, trend north to northwest, parallel to the structural trend of the region. Exceptions also include the rocks on the north and south sides of the Elsinore Fault, in the southeast corner of the county, which trend north to northeast. Lateral contacts of bodies in the east-central part of the county appear to dip inward, suggesting that those bodies are wedge-like downward in vertical cross section. Some of the other bodies, however, appear to dip steeply eastward. Layering within bodies, except in their central parts, commonly is parallel to the attitude of contacts of the bodies with surrounding rocks. In central parts of many bodies the layering commonly dips eastward or northeastward.

Lithology. The metasedimentary rocks of San Diego County are predominantly quartz-mica schist. Less abundant types are quartz-mica-feldspar schist, mica schist, and gneiss. Uncommon to rare varieties of schist contain various proportions of secondary amphibole, sillimanite, andalusite, and graphite. Minor accessory minerals include magnetite-ilmenite, red garnet and zircon. Quartzite commonly is interlayered with schist. The quartzite layers generally are one foot or less in thickness, but some are as much as 100 to 300 feet thick and nearly two miles long (Hudson, 1922, p. 183; Merriam, 1946, p. 227). Relict structures suggestive of cross-bedding were noted in quartzite near Ramona by Merriam (1946, p. 227), and by the present writer at Dos Cabezas.

The schist is coarser grained in the eastern part of the county than in the western part, and gneissic rocks are more common in the eastern part, especially in the area west of Dos Cabezas, in the western part of the Coyote Mountains (Dibblee, 1954, p. 21), and in Coyote Mountain (near Borrego Springs). Abundant pegmatite and other minor intrusive bodies cut the metamorphic rocks in the area between the Coyote Mountains and Jacumba (Photo 6) and in the area north of Warner Springs, along the north boundary of the county.

Injection gneiss probably is common in the metamorphic rocks (Hudson, 1922, p. 184-187; Larson, 1948, p. 20; Merriam, 1946, p. 232), but appears to be limited to areas along contacts between the metamorphic rocks and younger granitic rocks. Amphibolite has been described in the Julian-Ramona region by Everhardt (1951, p. 58-60), Hudson (1922, p. 183), and Merriam (1946, p. 229). Hybrid rocks composed of granitic bodies and a relatively large proportion of included metamorphic rocks are common in the middle of the county (see section on "Hybrid Gneisses and Associated Quartz Diorite and Granodiorite").

Crystalline limestone-dolomite and tactite occur mainly as small inclusions, pendants and layers in the metasedimentary, hybrid and granitic rocks, and are limited almost entirely to the eastern part of the county—east of meridian 116° 45′ (Photo 93, Fig. 58). In the extreme eastern part of the county—in the Coyote Mountains (Fig. 40), Dos Cabezas area (see Fig. 42 and Photo 50) and the Santa Rosa Mountains—layers of crystalline limestone and dolomite, interlayered with schist and/or gneiss and/or quartzite are as long as one to three miles and are as thick as several hundreds of feet. The broad distribution of metasedimentary rocks in San Diego County is similar to that in western Riverside County, as described by Larsen (1948). In both counties, layers of crystalline limestone and dolomite are more common in the eastern part of the batholith than in the western part.

Phata 6. View narth alang Carriza Canyan in Jacumba Mauntains in sautheast part af caunty. Metamarphic racks in faregraund and middlegraund are cut by abundant pegmatite dikes; thase in left backgraund are cut by irregular intrusive badies af granitic racks. Fish Creek Mauntains are in left distant backgraund.

Before metamorphism the metasedimentary rocks of San Diego County consisted chiefly of shale, siltstone, and claystone, with a minor proportion of quartz sandstone, arkose and probably graywacke. The latter three rocks were probably most common in the central and eastern parts of the county. Conglomeratic units probably were rare, as they have been noted only in the Pala area (Jahns and Wright, 1951, p. 9). The previous existence of volcanic rocks in the central part of the region is indicated by the presence of amphibolite bodies, as described by Everhardt (1951), Hudson (1922), and Merriam (1946).

Age, Correlation, Structure, and Thickness. The only diagnostic fossil noted in the metamorphic rocks of San Diego County was described by Hudson (1922, p. 190) as follows:

> A fossil was found by Mr. D. D. Bailey of Julian in the small area of metamorphic rock that lies in the granite about a mile southeast of Banner. This was submitted by Mr. H. L. Huston of San Francisco to Dr. J. P. Smith, who pronounced it "a slender ammonite that is without much doubt Triassic." The fossil is an imprint of an ammonite on the surface of an angular pebble of dark gray, quartzite rock. It was found as float.

On the basis of this scanty evidence a Triassic age for the metamorphic rocks of the central and southeast-central parts of the county has been accepted tentatively by most recent workers in the region. On this evidence also, and on the basis of lithologic similarity, these rocks have been correlated with the Bedford Canyon formation of Larsen (1948). The type locality for that formation is in the Santa Ana Mountains, Riverside County, but it has been traced as far southeastward by Larsen (1948, Pl. 1) as the Escondido and Pala areas of San Diego County. The Bedford Canyon formation has been considered as Triassic in age, but recent work by Silbering, Schoellhamer and Gray (1961) has shown that at least part of the formation may be Middle or Late Jurassic in age.

Additional fossil occurrences outside of the county suggest that some of the prebatholith rocks of San Diego County are older than Triassic and Jurassic in age. At a locality in Riverside County, about 30 miles east of the Santa Ana Mountains, a fragment of limestone containing a coral was found in talus at the base of a limestone cliff. The fossil was identified as Mississippian in age (Webb, 1939, p. 198-201). On the east edge of the San Jacinto Mountains, also in Riverside County, fragments of possible crinoids of Paleozoic age have been found (Miller, 1944, p. 25). In Baja California fossils as young as early Upper Cretaceous have been found in prebatholith rocks (Böse and Wittich, 1913; Woodford and Harriss, 1938, p. 1330-1331).

On the basis of the fossil evidence in western Riverside County, and the general increase in metamorphism from west to east in both San Diego and western Riverside Counties, the rocks may range in age from younger to older from west to east. This has been suggested in part by Larsen (1948, Pl. 1), who separated rocks of Triassic age on the west from rocks of Paleozoic age on the east, and by Jahns (1954b, Pl. 3), who separated the metasedimentary rocks along the eastern edge of the county as "older metasedimentary series" in contrast to "younger metasedimentary series" in the west. The general dip of the rocks in most parts of the country is to the east, however, and a single indistinct graded bed observed by the writer in the Chieftain Mine in the Julian district suggested that its top is to the east, and therefore up. Thus, if the older rocks are to the east, the sections at Julian and in other areas probably would have to be at least partly overturned. Although the structure of the rocks appears simple through most parts of the county, tight folds noted at several localities suggest that isoclinal folding may be much more common than has been indicated by mapping. These folds are (1) a tight isoclinal fold exposed on the north side of Box Canyon in the Oriflamme Mountains (Photo 7), (2) a suggested isoclinal fold that contains layers of the Verruga limestone deposit near Ranchita, (3) a possible tight fold that contains the Sentenac limestone deposit near Ranchita, and (4) tight folds, including isoclinal folds, which contain layers of limestone, at Dos Cabezas (see Fig. 42).

An estimate of the thickness of the rocks cannot even be suggested from the meager evidence at hand. As exposures are as wide as several miles, however, and there is a fairly distinct change in lithology from west to east, the total thickness must be many thousands of feet.

Photo 7. View north toward lower slopes of Oriflamme Mountains across Box Canyon, from Seyer tungsten deposit. Tightly folded metamorphic rocks (darker rocks) are intruded concordantly to discordantly by granitic rocks (lighter colored rocks). Eastern edge of body of granitic rocks that constitutes higher part of the mountains is at upper left corner of photo.

Economic Significance. The gold-bearing deposits of the Julian and other lesser districts in the east-central part of the county are mostly in schist (see "Gold" under "Mineral Resources and Mining"). Tungsten deposits, chiefly in tactite bodies in metamorphic rocks, are scattered through the central and eastern parts of the county. Crystalline limestone and dolomite deposits interlayered chiefly with schist are found mainly in the northeast and southeast parts. Manganese and graphite deposits occur in metamorphic rocks in the county, but none has been mined. Quartzite has been quarried at one locality for use as dimension stone.

Metavolcanic Rocks (Jurassic and/or Cretaceous)

Mildly metamorphosed volcanic rocks, probably of Jurassic or Cretaceous age, are exposed discontinuously as a north-northwest trending belt that lies within a few miles of the coast (see pl. 1). The rocks were first named the "Black Mountain volcanics" (photo 1) by Hanna (1926a, p. 199), but later were renamed "Santiago Peak volcanics" by Larsen (1948, p. 22-23), because "the name Black Mountain had been used for a basalt of Pliocene or Pleistocene age in Northern California."

Distribution. Of about 170 square miles in the county underlain by metavolcanic rocks, nearly 85 square miles are underlain by a large mass which is exposed continuously from the Mexican border to La Mesa, mainly as a group of rugged mountains and hills. The metavolcanics are bounded by other metamorphic rocks, which in general are older than the volcanics, and by younger igneous and sedimentary rocks of Cretaceous and Tertiary age. The widest continuous exposure of these rocks in the county is 11 miles, near the Mexican border, across the

San Ysidro Mountains (photo 26). Surface exposures and well data (Hanna, 1926a, p. 200; Jennings and Hart, 1955, p. 71) show that the belt of rocks bends seaward beneath younger sedimentary rocks in the area east of La Jolla and that at depth it probably extends westward beneath the sea throughout the San Diego region. The metavolcanics are very resistant to erosion, and perhaps, during Cretaceous and Tertiary times, hills and mountains composed of these rocks acted partly as a barrier which limited the access of the sea and consequently restricted deposition of Cretaceous and Tertiary marine sedimentary rocks to a relatively narrow belt along the present-day coast.

The regional strike of the layering in the metavolcanic rocks is north to northwest, most commonly north-northwest to northwest, and parallel to the trend of the entire belt. The metavolcanics dip moderately to steeply southwest along the west slope of the Santa Ana Mountains, in Riverside Couty, and in the area near the border between San Diego and Riverside Counties (Engel, 1959, pl. 1; Larsen, 1948, p. 23-24); the rocks dip moderately to steeply northeast in the pyrophyllite-bearing area northeast of Rancho Santa Fe (Jahns and Lance, 1950) and in the Dulzura district, which is in the eastern part of the San Ysidro Mountains; the rocks dip steeply east on the northwest edge of Black Mountain (Hanna, 1926a, p. 202); in other areas the structure is obscure.

Lithology. The metavolcanic rocks consist of flows, tuffs, breccias, and agglomerates, with a very small proportion of interbedded clastic sedimentary rocks. The metavolcanic rocks range in composition from rhyolite to basalt, but andesite, dacite and quartz latite are the most prevalent types. In the San Ysidro Mountains rocks that range from rhyolite to quartz latite are common. The rocks generally are porphyritic, commonly with dark minerals completely altered and the feldspars slightly to moderately altered. Hanna (1926a, p. 200) and Larsen (1948, p. 33) both recognized that the rocks show a slight increase in regional metamorphism from west to east. The most common alteration mineral probably is chlorite; other common to uncommon ones are quartz, serpentine, hornblende, epidote, carbonate minerals, albite, pyrite, and pyrrhotite. The rocks are variously colored. The andesitic and latitic phases, however, are dark grayish-green to almost black and commonly are known as "greenstone." Because of the presence of iron-bearing minerals, most phases of the rocks weather pale brown to reddish brown.

Age, Correlation, and Thickness. In Riverside County the metavolcanic rocks rest unconformably on the Bedford Canyon formation which perhaps ranges in age from Triassic to Jurassic. Throughout San Diego County the metavolcanics have been intruded by plutonic rocks of the batholith of Southern California which are probably early Late Cretaceous in age. These relationships suggest that the metavolcanic rocks in San Diego County may be as old as Late Triassic or Early Jurassic and as young as Early Cretaceous. The interbedded metavolcanic and metasedimentary rocks of the San Diego region have been correlated tentatively by Milow (1961) with the Early Cretaceous Alisitos formation of Baja California (also see Allison, 1955).

The total thickness of these rocks has not been determined: a continuous section 2,000 feet thick was examined by Hanna (1926a, p. 203) north of La Zanja Canyon; and Larsen (1948, p. 23) stated simply "that the thickness of the volcanic rocks cannot be measured, but it must have been thousands of feet and probably many thousands of feet."

Economic Significance. Three pyrophyllite deposits in metavolcanic rocks northeast of Rancho Santa Fe were being worked in 1958 (see "Pyrophyllite" under "Mineral Resources and Mining"). In the same general area are two deposits of "greenstone" which have been worked for roofing granules. In the San Diego region two companies quarry metavolcanic rocks for use as broken and crushed stone (see under "Sand and Gravel, and Crushed and Broken Stone"). In addition, deposits of clay, gold, copper, arsenic, and iron in these rocks have been worked in the county.

Hypabyssal Intrusive Rocks Associated With the Metavolcanic Rocks

Fine-grained, hypabyssal intrusive rocks associated with the metavolcanic rocks discussed above were considered by Larsen (1948, p. 27-32) to be about the same age as the metavolcanics and hence older than other intrusive rocks of San Diego County. These rocks range from granite to granodiorite porphyry and, their volcanic equivalents, rhyolite to dacite. At least 25 square miles are underlain by these rocks. They have not been mapped, however, south of latitude 33°00′.

Economic Significance. A single locality in these rocks, near Oceanside, has been worked unsuccessfully for riprap (see Marron Quarry in tabulated list under "Sand and Gravel, and Crushed and Broken Stone").

HYBRID GNEISSES AND ASSOCIATED QUARTZ DIORITE AND GRANODIORITE (CRETACEOUS AND/OR OLDER)

Rocks shown on the geologic map that accompanies this report as "Hybrid Gneisses ("Mixed Rocks") and Associated Quartz Diorite and Granodiorite" underlie about 270 square miles of San Diego County. The rocks were first described by Fairbanks (1893a, p. 78, 82) from exposures near Jacumba and in the Deer Park area, north of Pine Valley. The name "mixed rocks" was first applied by W. J. Miller (1935a, p. 134-137) who mapped and described the rocks along U.S. Highway 80. This name was retained by Everhardt (1951) and Merriam (1958, 1959, 1955). The term "hybrid gneisses and associated quartz diorite and granodiorite" was initiated by Jahns (1954b).

Hybrid gneisses and associated intrusive rocks are exposed discontinuously in a crude, northwest-trending belt which extends northwestward from the Jacumba area to the Palomar Mountain region. The largest region

Photo 8. View east toward contact between "hybrid rocks" and associated quartz diorite, at right, and Julian schist, at left; east side of State Highway 79 about 2 miles south-southeast of Julian.

Photo 9 (below). Julian region, view southeast. Oriflamme Mountains in right middleground. Trace of Elsinore fault shows from lower left to upper right. Earthquake Valley in left background. Rocks exposed in background are mostly hybrid gneiss and schist with a minor proportion of granitic rocks. Upper part of Oriflamme Mountains is composed of granitic rocks. Foreground underlain by Julian schist. Ranchito gold mine is just above trees in small valley along Elsinore fault, directly below top of Oriflamme Mountains.

underlain by these rocks is near the center of the belt, and includes the Santa Ysabel-Julian area.

These hybrid rocks include two general types: (1) rocks that range from migmatite (or injection gneiss) to banded gneiss; and (2) rocks that are mainly granitic or metamorphic and contain, respectively, very abundant bodies of metamorphic or granitic rocks.

(1) In the Santa Ysabel-Julian and Laguna Mountains regions the hybrid rocks range from migmatite (or injection gneiss) to banded gneiss. The migmatite is believed to have been formed by lit-par-lit injection of granitic magma into schist, whereas the banded gneiss may have either a granitic or metamorphic origin (Everhardt, 1951; Merriam, 1959). Relict textures in the banded gneiss suggest that the rocks are derived, at least in part, from the Julian schist (Donnelly, 1934, p. 340-345). Some of the contacts between the schist and hybrid rocks are sharp, however, as shown in a roadcut near Julian (Photo 8). In addition to the layers of granodiorite and quartz diorite that occur as part of the migmatite, small irregular bodies of Stonewall quartz diorite (Hudson, 1922; Merriam, 1959) and Stonewall granodiorite (Donnelly, 1934; Everhardt, 1951) are associated with the hybrid rocks. Some of these bodies have been mapped by Merriam (1946, 1959, 1955), Everhardt (1951), and Jahns and Hanley (in preparation).

(2) Also included as hybrid rocks on the accompanying geologic map are: (a) rocks that are mainly granitic but with a major proportion of schist inclusions, and (b)

rocks that are mainly metamorphic, but which contain abundant granitic bodies. Many of these terranes could be divided into granitic and metamorphic rocks by detailed mapping on a large scale. Included as hybrid rocks of this type are parts of the Palomar Mountain, Oriflamme Mountains, and Jacumba regions.

Geologic relationships have suggested to the latest workers in the region (Everhardt, 1951; Merriam, 1955, 1959) that the Stonewall quartz diorite and granodiorite are older than the intrusive rocks of the batholith of Southern California, and they have dated them tentatively as Jurassic. However, one sample of Stonewall granodiorite has been dated by the lead-alpha method as 96 million years old, which suggests that the unit is Cretaceous in age (Larsen and Schmidt, 1958, p. 19), and hence part of the batholith.

Economic Significance. Some of the gold mines in the Julian and Boulder Creek districts and in the Laguna Mountains region are in hybrid (or "mixed") rocks (see "Gold" under "Mineral Resources and Mining"). Tungsten minerals occur in small bodies of tactite in hybrid rocks in the hills northeast of San Felipe Valley and in the Laguna Mountains region (see "Tungsten").

INTRUSIVE ROCKS OF THE BATHOLITH OF SOUTHERN CALIFORNIA (CRETACEOUS)

The granitic and gabbroic rocks* of San Diego County are part of the batholith of Southern California, which is exposed southward from Riverside, in Riverside County, to the tip of Baja California, a distance of about 1,000 miles (Larsen, 1948, p. 134, fig. 3). Within San Diego County the batholith is as much as 70 miles wide, and underlies areas which comprise nearly 1,900 square miles, or about two-fifths of the county. Hybrid rocks, which contain a significant proportion of granitic rocks, underlie an additional 270 square miles. In other areas, rocks of the batholith are covered by younger sedimentary deposits.

A large part of the batholith in San Diego County was first mapped and studied in detail by E. S. Larsen, Jr. (1948). The results of his study include a map of the northwest part of the county, south to parallel 33°00′, and east to meridian 117°00′. South of Larsen's area, Hanna (1926a) divided the batholithic rocks into "quartz diorite" and "gabbro." East of Larsen's area, Merriam (1946; 1954; 1955, unpublished) has used Larsen's nomenclature for the geologic units in his studies in the west-central, central and southeast parts of the county. Several workers in the Julian region, in addition to Merriam, have mapped and/or named intrusive units (Hudson, 1922; Donnelly, 1934; Everhardt, 1951). In the southern part of the county, Miller (1935a) mapped and named several units. In the Jacumba region, Brooks and Roberts (1954) mapped intrusive rocks, using Miller's names. In the central and northern part of the county, Jahns has mapped several small to wide areas in detail or reconnaissance (Jahns, 1954a,b,c; Jahns and Wright, 1951).

The batholithic rocks were emplaced as many distinct units, each of which is believed to have been intruded after the preceding unit had crystallized or nearly crystallized (Larsen, 1948, p. 137). Several of the units (e.g. Bonsall tonalite and Green Valley tonalite), which were intruded as small to large bodies, underlie substantial areas through large regions of the batholith. The sequence of intrusion of the rocks is believed to have ranged chronologically from gabbro, through tonalite, and granodiorite, to granite (Larsen, 1948). Tonalite and granodiorite are the most common types. The time required for crystallization of the batholith was estimated by Larsen (1945) to be on the order of a few million years. The age of the batholith on the basis of fossil evidence in Baja California, is believed to be early Late Cretaceous (Böse and Wittich, 1913; Woodford and Harriss, 1938; Larsen, 1948). By the lead-alpha method of age dating, the rocks have been dated as 110 ± 13 million years (Larsen, Gottfried and others, 1958, p. 49).

Gabbroic Rocks

The oldest intrusive rocks of the batholith are bodies of closely related gabbroic rocks which are widespread in the western part of the county. They cover a total area of about 160 square miles. The rocks are limited to the area southwest of the Elsinore Fault Zone, except in the Pala area, where a body of gabbro is cut by faults of the Elsinore zone. In the southeast corner of the county, only one body of gabbro is known. This is a small, altered body northeast of Jacumba which contains the Circle Group Vermiculite Deposit.

The gabbroic bodies are mostly irregular in plan, except in the northwest corner of the county, where many are elongate northwestward. Most of them are rather small—one to five square miles. The largest one—about 25 square miles in area—underlies a large part of the Cuyamaca region, in the central part of the county. From this body, two elongated groups of smaller bodies extend to the southwest and south (see Pl. 1).

The gabbroic rocks of San Diego County were first studied in detail by Hudson (1922, p. 193-207) who recognized 15 varieties of basic plutonic rocks in the north part of the Cuyamaca body. Because these rocks ranged from diorite to peridotite, he called the body the "Cuyamaca basic intrusive." Similar rocks in the western part of the county were first described by Hurlbut (1935) who named them the "San Marcos Mountain gabbro." F. S. Miller (1937, p. 1397-1426) described the gabbroic rocks in the northwest part of the county in great detail, shortening Hurlbut's term to "San Marcos gabbro." This name has been used to the north and west of Hurlbut's area by Larsen (1948), and in the central and southeast parts of the county by Merriam (1946; 1959; 1955). In the Cuyamaca region, Creasey (1946) and Everhardt (1951) modified Hudson's original term to "Cuyamaca gabbro." In the south part of the county, W. J. Miller (1935a, 1946) used the term "Viejas Moun-

* In this report the term granitic rocks refers to the group of plutonic igneous rocks which ranges from granite to diorite in composition. The term gabbroic refers to rocks which range from diorite, through gabbro, to peridotite.

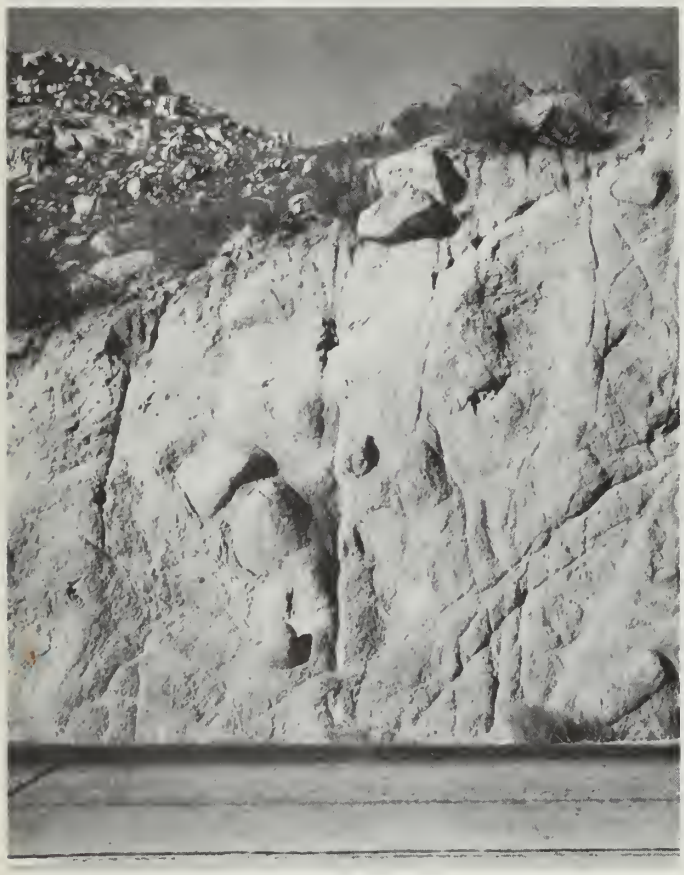
tain gabbro-diorite," as well as San Marcos gabbro and Cuyamaca gabbro.

Gabbroic rocks in the interior part of the county form bold hills and mountains, with somewhat smooth, brush-covered slopes. Where soil forms it is dark reddish brown. Some of the hills and mountains underlain by gabbroic rocks resemble volcanic cones.

The rocks are of many types, which range from diorite to peridotite; most common are varieties of gabbro and norite. The rocks range in texture from fine- to coarse-grained. In the Vista region, F. S. Miller (1937, p. 1399-1400) found that the average rock was a medium-grained, dark-gray norite. In the Cuyamaca Peak quadrangle, hornblende gabbro and norite are the most common types (Everhardt, 1951, p. 66-72). In the Pala area, olivine-hornblende-hypersthene gabbro is most common (Jahns and Wright, 1951, p. 9).

Economic Significance. The gabbroic rocks along the western edge of the exposed part of the batholith are an important source of "black granite" for use as dimension stone (see "Dimension Stone" under "Mineral Resources and Mining"). In the Pala and Mesa Grande districts, these rocks contain important gem-bearing pegmatite dikes (see under "Gem Minerals"). Several nickel-cobalt-copper bearing deposits in gabbroic rocks in the central part of the county have been prospected, but not mined (see under "Nickel").

Photo 10. Roadcut showing fracture-controlled weathering of granitic rocks. View north across U.S. Highway 80, about 4 miles west of Descanso Junction. Slopes in left background comprise boulders of disintegration which have weathered in place.



Granitic Rocks

The granitic rocks of the county consist mainly of bodies of tonalite (quartz diorite) and granodiorite, and a few bodies of granite. These bodies range in size from dikes and small irregular bodies of less than several hundred square feet in area, to bodies as much as many tens of square miles in area. The bodies are mostly irregular in outline, but commonly are elongate. Contacts between the units generally are sharp. The known mappable units are described briefly below, from the probable oldest to the youngest.

Green Valley Tonalite. The name Green Valley tonalite was used first by F. S. Miller (1937) for rocks in Green Valley, betwen U.S. Highway 395 and Ramona. The Green Valley tonalite is exposed widely in the western part of the county, where its medium- to dark-gray exposures characteristically form deeply weathered lowland to hilly topography. Boulders of disintegration weather commonly from its outcrops (Photo 10). The Green Valley resembles the Bonsall tonalite, but lacks abundant streaked inclusions (Larsen, 1948, p. 53) and is somewhat darker.

Bonsall Tonalite. The name Bonsall tonalite was applied first by Hurlbut (1935, p. 611) for exposures, near Bonsall, of a hornblende tonalite which contains abundant inclusions. The name was used later by Larsen (1948) in preference to two others which had been suggested for similar rocks in Riverside County. The rock ranges from light to dark gray; hornblende is the chief dark mineral. The unit is lighter than the Green Valley tonalite, and darker than the Lakeview Mountain tonalite.

The Bonsall tonalite is probably the most widespread batholithic unit in the county. It underlies a large area in the Fallbrook-Bonsall-Lake Wohlford region (Larsen 1948, Pl. 1) and extends discontinuously eastward through the north parts of the Ramona and Santa Ysabel Quadrangles. The same rocks may extend discontinuously northward, northeastward, and eastward into the Palomar Mountain region, into the Warner Springs and Clark Lake quadrangles (Photo 4), and into the north half of the Borrego quadrangle. The Bonsall tonalite also is exposed widely in the south part of the county—south of the Ramona area and west of the Campo area.

Lakeview Mountain Tonalite. The name "Lakeview Mountain tonalite" is a modification by Larsen (1948, p. 57) of the term "Lakeview tonalite" which had been used previously in Riverside County. The Lakeview Mountain tonalite resembles the Bonsall tonalite, but lacks the abundant inclusions of the latter unit. In the eastern part of the county the Lakeview Mountain tonalite forms mountains with bouldery, resistant slopes.

This unit underlies much of the region in the middle east and southeast parts of the county, where commonly it comprises mountains and hills with bouldery, resistant slopes (Merriam, 1955). It comprises the In-Ko-Pah and the Vallecito Mountains and underlies a large part of the region that extends from Campo east to beyond the Imperial County line. The intrusive rocks in the southeast corner of the county also have been mapped as La Posta quartz diorite (W. J. Miller, 1935a; Brooks and Roberts, 1954) (Photos 17, 45, and 88).

Lake Wohlford Leucogranodiorite. The Lake Wohlford leucogranodiorite was named by Larsen (1948, p. 82) for exposures near Lake Wohlford, in San Diego County. The unit has been recognized only in the area between Escondido and Lake Wohlford. It is light gray and fine grained.

Woodson Mountain Granodiorite. Woodson Mountain granodiorite is a pale-brownish gray rock which commonly forms bold, almost ledge-like ridges (photo 2). The unit was named by F. S. Miller (1937, p. 1399) for its exposures on Woodson Mountain, a few miles southwest of Ramona. The rocks occur as large bodies over a wide area in the western part of the county, in about the same general area as the Green Valley tonalite.

The Woodson Mountain granodiorite is coarse-grained commonly, and also is commonly stained with hydrous yellow-brown iron oxides. Many bodies of these rocks have a gneissic or banded structure along their edges (Larsen, 1948, p. 77).

Indian Mountain Leucogranodiorite. The Indian Mountain leucogranodiorite is exposed along both sides of the San Luis Rey River, within a few miles southwest of Pala (Larsen, 1948, Pl. 1). The rock is very light gray and fine-grained.

Escondido Creek Leucogranodiorite. The Escondido Creek leucogranodiorite is exposed as two bodies, four to six miles southwest and west of Escondido (Larsen, 1948, Pl. 1). It is a light-colored, fine-grained rock which contains inclusions of tonalite.

Roblar Leucogranite. The Roblar leucogranite is exposed along the north edge of the county, in the Roblar Canyon area, near Deluz (Larsen, 1948, Pl. 1). It is flesh-colored, and aplitic in appearance.

Other Intrusive Bodies. A small part of the granitic rocks of San Diego County have been mapped by Larsen (1948, Pl. 1) as "miscellaneous granodiorites."

In the Cuyamaca region, small bodies of granite and diorite that have been mapped have not been correlated with rocks of western San Diego County (Everhardt, 1951; Merriam, 1955).

Pegmatite and Aplite Dikes. Granite pegmatite dikes cut granitic and metamorphic rocks in many parts of the county (Fig. 2, Photo 11). They are discussed herein under "Gem Minerals" in the section on "Mineral Resources and Mining." Aplite dikes are common in the western part of the county, in parts of the Escondido region, where they cut Green Valley and Bonsall tonalites (Larsen, 1948, p. 101).

Economic Significance. The granitic rocks of San Diego County are a source of dimension stone (see "Dimension Stone" under "Mineral Resources and Mining"), "decomposed granite," and broken stone for use as riprap (see under "Sand and Gravel, and Crushed and Broken Stone"). Granitic rocks are hosts for several gold-bearing deposits in the western part of the county, and several tungsten prospects.

In the Pala and Mesa Grande districts, and several lesser districts, granite pegmatite dikes have been a source of tourmaline and other gem minerals (see under "Gem Minerals"). Pegmatite dikes also have been an important source of feldspar and a lesser source of common quartz and quartz crystal. Several granite aplite dikes in the county contain small deposits of molybdenite.

CRETACEOUS AND TERTIARY ROCKS OF THE SAN DIEGO COASTAL PLAIN REGION

Cretaceous System

Marine sedimentary rocks of Late Cretaceous age are exposed discontinuously along the coastal plain from the border between San Diego and Orange-and-Riverside Counties southward to Point Loma, near San Diego.

The largest area underlain by these rocks extends southward from the north border of the county to within one mile of Las Pulgas Canyon, in Camp Pendleton (see Pl. 1). In this area the rocks consist chiefly of brown sandstone with a minor proportion of interbedded shale layers and conglomerate lenses (Woodford, 1925, p. 173; Southwick, 1928). They dip gently to the southwest and overlie metamorphic and intrusive rocks of probable early Late Cretaceous and older age. The strata are resistant and form rugged hills along the west side of the Santa Margarita Mountains. The widest part of the Cretaceous belt in San Diego County is between San Mateo Canyon on the west and San Juan Creek on the east, a distance of about four miles. A thickness of several thousand feet is suggested. Additional exposures of these rocks may occur several miles to the southeast, along Vandergrift Road, between the San Luis Rey and Santa Margarita Rivers (Smith and others, ca. 1920-25).

About 4½ miles south of Carlsbad, brown shale interbedded with thin layers of sandstone is exposed beneath an area of about one square mile (Jones, 1958). The shale rests on granitic rocks and is overlain by sandstone of Eocene age. It is believed by Jones to be about 250 feet thick. Foraminifera described from these rocks by Bandy (1951) are Late Cretaceous (Tracian) in age.

Along the coast, at La Jolla and at Point Loma, resistant sandstone interbedded with shale is exposed (Photo 12). The maximum thickness of these rocks is not known, but is believed to be about 500 feet (Hertlein and Grant, 1954, p. 55). About six miles south of San Diego, "red beds," about 269 feet thick and similar to the Trabuco formation, were intersected by a well (Hertlein and Grant, 1954, p. 55-56). At a locality about two miles

Phata 11. Raadcut in sauthwest side of Parayne Hill, an Lake Henshaw-Palamar Mountain road, view narth-nartheast. Granitic boulders af disintegration pratrude fram cut. Nearly harizantal pegmatite dikes, which range in thickness fram 1 to 2 inches ta nearly 2 feet, are cut by many step faults at lawer right. A nearly vertical, elangate schist inclusian in the granitic rocks is shown in left middlegraund.

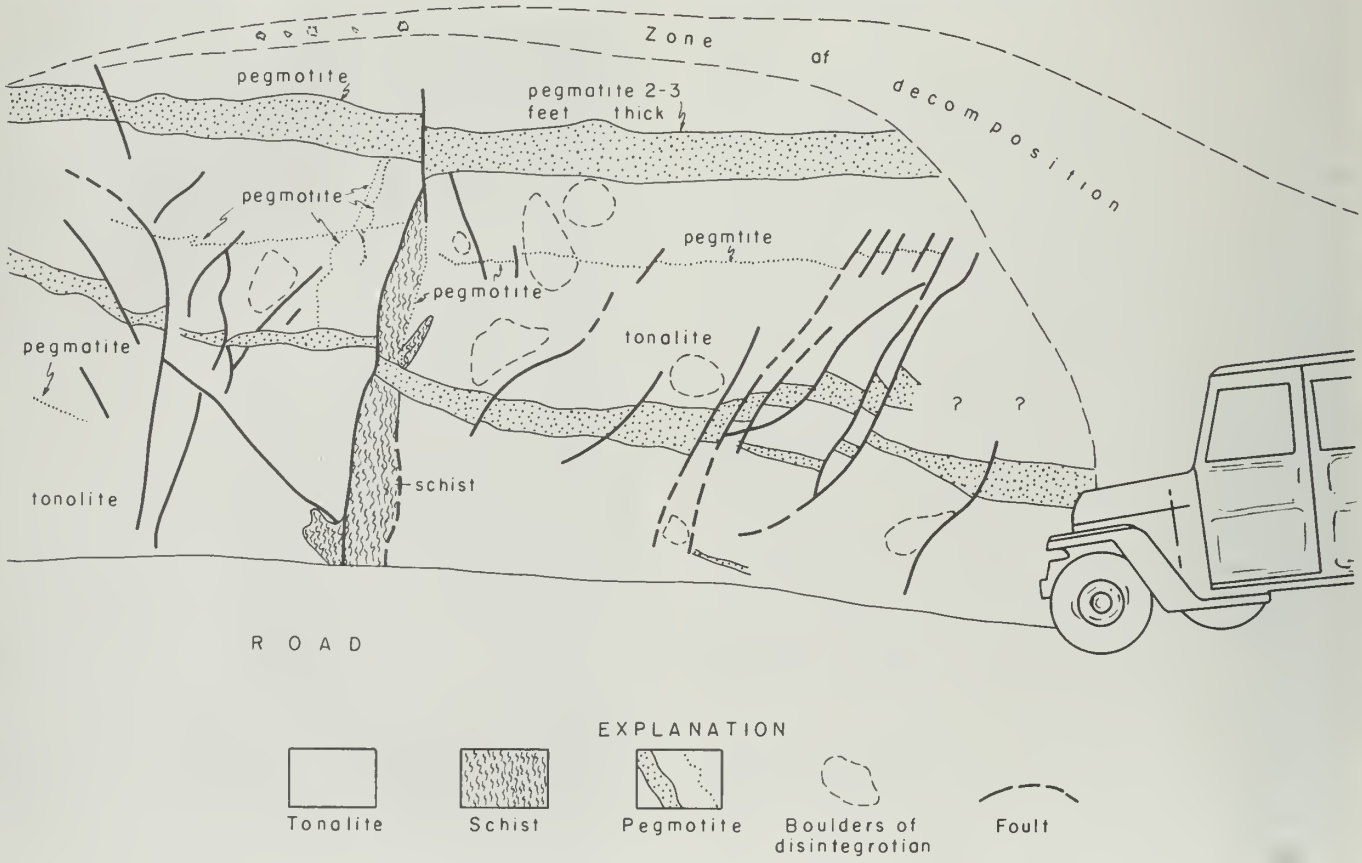


Figure 2. Geologic sketch of road cut shown in phota 11.

Photo 12. View west toward La Jolla area. Goldfish Point in middleground. Sandstone of Cretaceous age forms resistant wave-cut cliffs.

south of the south end of San Diego Bay, a well intersected strata of Cretaceous age, at a depth between 3,900 and 5,529 feet. These strata lie on metavolcanic rocks. At this locality the basal 30 feet of the Cretaceous rocks is conglomerate.

The Cretaceous age of the rocks in the San Diego region was determined first by Gabb (1864), then verified later by Cooper (1894, p. 37-38) who described a suite of fossils collected by Fairbanks (1893a, p. 94-96; 1893c, p. 473-478). The latest discussion of the age of these rocks is by Anderson (1958, p. 66-67, 196). Most workers have accepted the rocks as correlative with the Chico formation of Northern California. Recent work by Milow (1961), however, has shown that the Late Cretaceous rocks of the San Diego region probably can be correlated with the Rosario formation of Baja California.

Tertiary System

Paleocene Rocks

The only unit of known Paleocene age in San Diego County is the Tierra del Colorado clay zone, which extends southward into the county a few hundred feet from Orange County (Stauffer, 1945; Davies and Bramlette, 1943; Southwick, 1928). A similar reddish zone of weathering of probable Paleocene age or early Eocene age is exposed at several known localities in San Diego County, as far south as Olivenhain. These localities are (1) south edge of Basilone road in Camp Pendleton, about two miles north of the Santa Margarita River (SE.¼ Sec. 35, T. 9 S., R. 5 W., S.B.M. (projected)); (2) one-half mile southwest of Breeze Hill, southwest of Vista (south edge Sec. 26, T. 11 S., R. 4 W., S.B.M.); (3) Kelly Ranch Mine area, 4½ miles southeast of Carlsbad; and (4) about one mile north-northeast of Olivenhain. (See also Clay Prospect, Kelly Ranch Mine, Gladding, McBean and Company Mine, and Vitrified Products Company Mine herein under "Clay" by G. B. Cleveland.)

Eocene Rocks

Clastic sedimentary rocks of Eocene age are exposed in the county along the coastal plain from Orange County to Point Loma, and also have been encountered in wells as far south as the Tia Juana River Valley. In the north part of the plain these strata dip gently to very gently westward, and in the south part they dip most commonly very gently westward to southwestward. In the northwest corner of the county the rocks overlie Cretaceous sedimentary rocks with a slight unconformity, and in the central and southern parts overlie granitic and metavolcanic rocks mainly. The Eocene rocks commonly are overlain by sedimentary rocks of Miocene and Pliocene age.

In La Jolla Quadrangle, north of San Diego, the Eocene rocks have been divided into La Jolla formation (Hanna, 1926a) and the Poway conglomerate (Ellis and Lee, 1919). La Jolla formation consists of three members: Delmar sand, Torrey sand, and Rose Canyon shale. North of La Jolla Quadrangle the Eocene rocks consist chiefly of sandstone, and in the northern corner of the county were correlated with the Tejon formation of upper Eocene age by Dickerson (1916), Woodford (1925) and others. However, Hanna (1926a, p. 215) considered the Poway conglomerate to be correlative with the Tejon formation.

During the late 1950's, Eocene and other rocks of the San Diego region were being restudied in great detail, and partially redefined, by Milow (1961). Milow has recognized an additional unit between the Rose Canyon shale and the Poway conglomerate. In addition, he has

Photo 13. Torrey Pines area. View north-northwest from U.S. Highway 101. Contact between gently dipping strata of Torrey sand (at right) and Rose Canyon shale (at left), both Eocene in age, extends north-northwest from deposit of Linda Vista Terrace in foreground. The Delmar sand, also of Eocene age, is exposed in outcrops shown in upper right part of photo.

concluded that much of the so-called Poway conglomerate actually consists of reworked deposits which are younger than Eocene in age.

Sandstone Undivided (Includes Delmar and Torrey Sand Members of La Jolla Formation). The lower part of the Eocene sedimentary rocks of San Diego County is exposed as a nearly continuous belt as wide as seven miles which extends southward from the Orange county line to Torrey Pines State Park. The Delmar sand, about 200 feet thick, is exposed along the coast near the town of Del Mar (Photo 13). The Torrey sand, 25 to 200 feet thick, is exposed northeastward and northward from Torrey Pines Park (Photos 1, 13, and 14). The Delmar

Photo 14. Roadcut in Torrey Pines State Park, view northwest. Torrey sand (Eocene) is overlain by deposits of the Linda Vista Terrace (Pleistocene) which at this locality are several feet thick.

is distinguishable from the Torrey sand chiefly because it contains abundant interbedded clay and silt layers and it is not as white as the Torrey.

The Eocene sandstone that lies north of La Jolla Quadrangle generally resembles the Torrey sand of Hanna (1926a), and consists chiefly of white, uncemented sandstone with a very small proportion of thin layers of shale, siltstone and conglomerate. The sandstone is mainly fine- to medium-grained, and composed nearly wholly of feldspar and quartz with a very small proportion of silt, clay, and dark minerals. In contrast to the Cretaceous and Pliocene sands of the county, these sands contain only a trace of biotite (Woodford, 1925, p. 174; Southwick, 1928). The sandstone is exposed in rolling hills (Photo 77), and in sides of steep-walled canyons whose slopes are snow white to slightly brown-stained, and commonly exhibit rill-like erosional features (Photo 1). A detailed discussion of the lithology of the sands in the San Luis Rey Quadrangle is provided by Jones (1958).

The thickness of the sandstone increases northward, reaching a maximum of about 3,300 to 3,400 feet in the San Mateo Canyon area, near San Onofre (Woodford, 1925; Southwick, 1928).

The sandstone of Eocene age in San Diego County is a source of plaster sand and specialty sands (see under "Sand and Gravel, and Crushed and Broken Stone" and "Specialty Sands" in the "Mineral Resources and Mining" section of the report).

Rose Canyon Shale (Upper Member La Jolla Formation). The Rose Canyon shale is exposed in La Jolla Quadrangle and for a short distance to the north (Hanna, 1926a). The unit consists of gray to brown shale, mudstone, and siltstone, and has a maximum thickness of about 300 feet (Photos 1, 13, 28). In the northwest corner of the county, near San Onofre, a shale unit about 100 feet thick occurs between Eocene sandstone and San Onofre breccia, in a stratigraphic position similar to that of the Rose Canyon shale (Southwick, 1928).

The Rose Canyon shale is a source of common clay in the San Diego region (see under "Clay" in "Mineral Resources and Mining" section of report). The shale has been considered as a possible source of expansible shale (see under "Sand and Gravel, and Crushed and Broken Stone").

Poway Conglomerate. The Poway conglomerate underlies irregular areas, which total about 70 square miles, in the center of the southwest part of the county (see Pl. 1). The rocks are exposed in canyons and steep bluffs north of San Diego and underlie wide areas as low, elongate hills north-northwest and west of El Cajon Valley. From the eastern edge of the hills north of El Cajon Valley (Photo 15), a series of discontinuous outcrops of the conglomeratic gravels extend to the northeast as far as Whale Mountain, near Ballena. These outcrops probably are remnants of a filled stream channel, of probable Eocene or younger age (see under "Gold").

The Poway conglomerage consists of massive, poorly consolidated to well-cemented sandy conglomerate and conglomeratic sandstone, with small proportions of interbedded sand and shale layers (Photos 64, 65, and 68). Caliche is common in the upper parts of the unit, as noted by Hanna (1926a, p. 213-215). The clasts in the conglomeratic beds generally are rounded and range in size from pebbles to boulders, with an average size range of one inch to two inches (Bellemin and Merriam, 1958,

Photo 15. View northeost toward San Vicente Reservoir from point about 2 miles west of Foster. On ridges in foreground and middle bockground is the Powoy conglomerote, which in this oreo is as much as several hundred feet thick. It overlies granitic rocks of Cretoceous oge.

p. 208). The clasts are composed chiefly of silicic metavolcanic rocks, a small proportion of quartzite, and a very small proportion of granitic, rocks. The matrix of the conglomeratic units is sand, silt and clay.

As the unit probably was laid down over irregular terrain, its thickness probably varies greatly. A well drilled at the upper end of San Clemente Canyon passed through 875 feet of conglomeratic material (Ellis and Lee, 1919, p. 68). The thickness of the unit is estimated by Milow (1961), however, as about 450 feet.

The Poway conglomerate was first dated as Eocene by Hanna (1926b). This date was verified by the work of Cushman and Hanna (1927), Dusenbury (1932), Cushman and Dusenbury (1934), and Stock (1937, 1938). The origin of the unit was discussed by Bellemin and Merriam (1958).

The Poway conglomerate is the source of much of the sand and gravel produced in the San Diego region (see under "Sand and Gravel, and Crushed and Broken Stone"); and the conglomeratic gravels of the Ballena area once were the source of a small amount of placer gold (see under "Gold").

Intrusive Dacite and Latite of Eocene Age or Younger

Intrusive volcanic rocks of Eocene or younger age are exposed beneath a total area of less than one square mile at three localities in the northwest part of the county: four miles east of Carlsbad (Cerro de la Calavera); three miles west of Bonsall (Morro Hill); and eight miles east of San Onofre.

Cerro de la Calavera is a hill composed of dacite which is part of a volcanic neck (Larsen, 1948; Larsen and Switzer, 1939). The body intrudes sandstone of Eocene age.

Morro Hill is composed of dacite and is a part of a volcanic neck which intruded granitic rocks (Waring and Waring, 1917; Larsen, 1948). Several adjacent outcrops are composed of associated flow and pyroclastic rocks.

At the locality eight miles east of San Onofre a small intrusive body of andesite or quartz latite is exposed which cuts Cretaceous sedimentary rocks (Larsen, 1948, p. 111).

Crushed stone has been produced from the dacite which composes Cerro de la Calavera (see Calavera Rock Company in tabulated list under "Sand and Gravel, and Crushed and Broken Stone").

Miocene Rocks

San Onofre Breccia. In San Diego County the San Onofre breccia is exposed as a narrow belt, two miles and less in width, which extends southeast along the north part of the coast, from San Mateo Canyon, near San Onofre, to a point midway between Oceanside and Carlsbad. The breccia overlies sandstone of Eocene age, and adjacent to the coast is overlain partly by terrace deposits of Quaternary age. The rocks were described in detail by Woodford (1925) who postulated that the sediments composing the breccia were derived from the west and deposited as a fanglomerate. The unit consists of poorly sorted, poorly to well-consolidated sandy breccia and sandy conglomerate, with a minor proportion of sand layers (Photo 16). The clasts are mainly varieties of schist whose main constituents are quartz and blue to green amphibole (including varieties of actinolite, crossite, and glaucophane). The breccia of the northern two-thirds of the belt is more consolidated than that of the southern one-third, and comprises a group of prominent hills; the rocks in the southern part are poorly consolidated, thus are mainly eroded, and are overlain nearly wholly by terrace deposits. The steeply dipping section in the San Onofre Mountain area appears to be 4,000 feet or more in thickness. The San Onofre breccia was named and dated as Miocene by Ellis and Lee (1919).

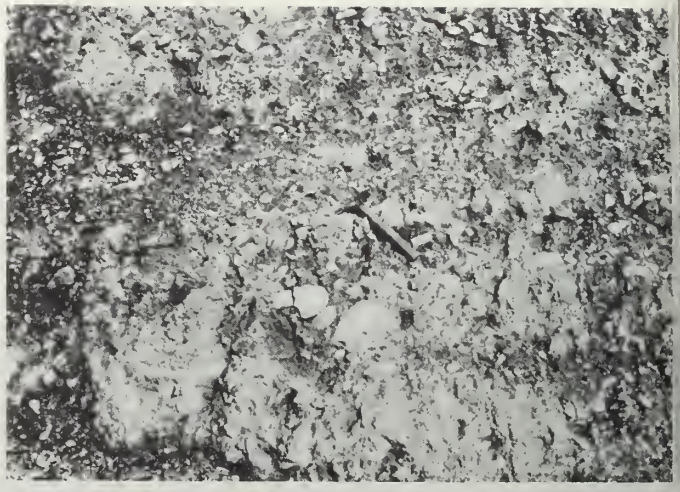


Photo 16. San Onofre breccia in north wall of pit of H. W. Rohl Company sand and gravel operation, Oceanside. *Photo by Thomas E. Gay, Jr.*

At one locality in Oceanside, the San Onofre breccia is mined for use as sand and gravel (see "Sand and Gravel, and Crushed and Broken Stone").

Monterey Shale. An area of one square mile or less in the northwest corner of the county is underlain by Monterey shale composed of diatomaceous and cherty shale, and layers of hard sandstone (Woodford, 1925; Southwick, 1928). It is also exposed in the sea cliffs southeast of San Onofre. The Monterey shale is Upper Miocene in age.

Miocene-Pliocene Rocks

Capistrano Formation. The Capistrano formation is exposed in the county only along its northwest boundary, on the northwest side of San Mateo Canyon. The unit is composed of sandy shale and sandstone, and is believed to be either Miocene and/or Pliocene in age (Woodford, 1925, p. 216-217).

Pliocene Rocks Undivided

Nearly flat-lying sandstone of Pliocene age, which overlies unconformably rocks of Eocene age and older, is exposed widely from the south side of Mission Valley to the Mexican border. The sandstone is fine- to medium-

Photo 17. Table Mountain, northeast of Jacumba. Volcanic flow and pyroclastic rocks overlie conglomeratic sandstone which overlies granitic rocks. View northeast. U.S. Highway 80 in lower middleground. (See also photo 18.)

Photo 18. Table Mountain, about 3½ miles northeast of Jacumba. Volcanic flow and pyroclastic rocks of probable Miocene age overlie conglomeratic sandstone which is underlain by granitic rocks of Cretaceous age which contain a large proportion of metamorphic rocks. View north.

grained, pale gray to pale yellowish brown, and contains a small proportion of siltstone layers. A bentonite layer that is widespread in the Otay Valley area can be traced almost to Mission Valley (Cleveland, 1960) (Photo 26). These rocks have a total thickness of about 1,250 feet, according to Hertlein and Grant (1954, p. 60). They were named the San Diego formation by Dall (1874). Later paleontologic work by Orcutt (1889), Dall (1898), Arnold (1906), Kew (1920), Hertlein (1929b), Grant and Gale (1931), Hertlein and Grant (1944), and others, has established the age as Pliocene.

Rocks similar to those described above, and of probable Pliocene age, are exposed discontinuously between Cardiff-by-the-Sea and Oceanside. At San Onofre, quartz sandstone of Pliocene age has been named the San Mateo formation (Woodford, 1925; Southwick, 1928).

One locality in the City of San Diego formerly was a source of specialty sands (see "Specialty Sands" in "Mineral Resources and Mining" part of report). The layer of bentonite formerly was mined in the Otay Valley area (see under "Clay").

TERTIARY AND OLDER QUATERNARY ROCKS OF THE SALTON BASIN

Tertiary and older Quaternary rocks are exposed in the Salton Basin along the eastern edge of the county (see Pl. 1). These have been mapped and described by Dibblee (1954, p. 21-28), from whose work most of the following information was compiled.

Tertiary System

Miocene Rocks

Split Mountain Formation. The Split Mountain formation is mainly a gray, basal conglomerate which rests on a surface underlain by granitic and metamorphic rocks. The rocks crop out over an area of several square miles in the Split Mountain area, which is south of Ocotillo Wells, and in a small patch of less than one square mile in the Santa Rosa Mountains. The unit is composed mainly of fanglomerate, sandstone, and breccia, and ranges in thickness from 0 to 2,700 feet (Dibblee, 1954, p. 22).

Alverson Andesite Lava and Associated Pyroclastic and Sedimentary Rocks. The Alverson andesite lava, which was named by Dibblee (1954) from exposures in Imperial County, is exposed in the area north of Dos Cabezas (Photo 46) and at a locality near the mouth of Rockhouse Canyon. The rocks in these areas very closely resemble volcanic rocks in the Jacumba area, which have been called the Jacumba volcanics (Miller, 1935b; Brooks and Roberts, 1954) The andesite lava occurrences at both Rockhouse Canyon and the Jacumba area (Photos 17, 18) are underlain by basal beds of conglomeratic sandstone. Thus the Rockhouse Canyon outcrop, and perhaps the outcrops north of Dos Cabezas, may be remnants of flows which once extended northward from Jacumba for several fives of miles.

The layer of reddish tuff that underlies the volcanics is a source of crushed stone (see under "Sand and Gravel, and Crushed and Broken Stone").

Fish Creek Gypsum. A relatively extensive deposit o gypsum occurs along the border between Imperial anc San Diego Counties at the west side and northwest enc of the Fish Creek Mountains (Photo 46). Of severa square miles underlain by gypsum, only a very small part is in San Diego County. The most northerly exposure in the area is overlain by a few remnants of a layer of celestite (strontium sulfate).

See also under "Gypsum" and "Strontium" in the "Mineral Resources and Mining" part of the report.

Miocene-Pliocene Rocks

Imperial Formation. The Imperial formation, which was named by Woodring (1931), is exposed in San Diego County: (1) immediately south of Split Mountain, within an area of slightly more than 10 square miles; (2) north of Ocotillo Wells, in outcrops of less than one square mile; and (3) in the Coyote Mountains. At Split Mountain the unit is about 3,500 feet thick. The formation is composed of clay with a minor proportion of interbedded sandstone.

The Imperial formation in San Diego County is a possible source of common clay (see under "Clay").

Canebrake Conglomerate. The Canebrake conglomerate underlies several tens of square miles in the eastern part of the county, principally in the following areas: on the east flank of the Santa Rosa Mountains; northwest of Coyote Mountain; on the southeast slopes of the Vallecito Mountains; and at the west end of the Coyote Mountains. The unit was named by Dibblee (1954, p. 23), who described it as "the coarse marginal conglomerate facies of the Palm Spring and Imperial formations." The rock ranges in composition from fanglomerate to pebble conglomerate and is composed mainly of granitic detritus (Photo 24).

In the Santa Rosa Mountains the Canebrake conglomerate contains veins of calcite which have been mined. The calcite has been used in the optical systems of gunsights (see "Optical calcite").

Truckhaven Rhyolite. A thin wedge of rhyolite, named the Truckhaven rhyolite by Dibblee (1954), crops out about 4½ miles directly south of the northeast corner of the county.

Pliocene Rocks

Palm Spring Formation. The Palm Spring formation (Woodring, 1931) is exposed over several tens of square miles in San Diego County, mainly along the east sides of exposed parts of the Canebrake conglomerate, which in part is the torrential facies of the Palm Spring formation (Dibblee, 1954). The unit is composed of continental sandstone and reddish clays, and grades downward into the Imperial formation. It is Pliocene in age.

Borrego Formation. The Borrego formation (Tarbet, 1944) was mapped by Dibblee (1954) as the lacustrine facies of the Palm Spring formation, and in the Borrego Badlands grades downward into that formation. The unit is composed of light-gray claystone and interbedded sandstone.

Upper Tertiary and Lower Quaternary Systems Undivided

Pliocene-Pleistocene Rocks

Ocotillo Conglomerate. The Ocotillo conglomerate (Dibblee, 1954) unconformably overlies the Borrego clays in the Clay Hills area and in the area north of Ocotillo Wells. The unit is a gray, granitic-pebble conglomerate (Dibblee, 1954, p. 74).

Brawley Formation. The Brawley formation is "the lacustrine and continental basinward facies of the Ocotillo conglomerate" (Dibblee, 1954, p. 24). It is chiefly claystone with interbedded sandstone and conglomerate.

QUATERNARY ROCKS OF THE COASTAL PLAIN AND PENINSULAR RANGE PROVINCE, AND YOUNGER QUATERNARY ROCKS OF THE SALTON BASIN

Quaternary System

Pleistocene Rocks

Basaltic Flows. Basaltic flow rocks cap granitic rocks along the extreme north edge of the county, northwest of Deluz, and extend eastward into Riverside County (Larsen, 1948, p. 111-112).

Terrace Deposits and Dissected Alluvium. Pleistocene terrace deposits of marine and nonmarine origin are common along the coast of San Diego County, especially in the San Diego region, where the deposits overlie sedimentary rocks of Eocene and Pliocene age. The deposits generally are very thin and are composed of poorly consolidated to unconsolidated, and poorly sorted to unsorted aggregates of silt, sand, pebbles, cobbles, and a minor proportion of boulders. The most widespread of these deposits comprise the Linda Vista and Otay marine terraces, and lower, more seaward nonmarine deposits. The Linda Vista deposits contain reddish-brown pebbles which contain small proportions of iron oxide and phosphate (see under "Iron" and "Phosphates"). The Sweitzer formation is a terrace-like deposit of conglomerate which is common in San Diego and to the south, and has a maximum thickness of about 65 feet (Goldstein, 1956).

Parts of the Otay, Linda Vista, and other terraces, and the floor of San Marcos Valley, consist of low mounds which compose a gently rolling topography (Ellis and Lee, 1919; G. B. Cleveland, personal communication, 1958; personal observation, 1958). These are reported by Cleveland to have warped the landing strip at Brown Naval Air Station during wet periods.

Photo 19. Earthslide depasits in raadcut af Nigger grade, near Pauma Valley. Rock fragments are monalithic and campased af schist and gneiss.

Dissected alluvium and fanglomerate and nonmarine terrace deposits occur in the Pauma, San Jose, and Dameron Valleys in the central part of the county and in the desert region in the eastern part of the county. These deposits range in composition from arkose to fanglomerate, and are composed of fragments which range from silt to very large boulders. Most deposits are poorly consolidated to unconsolidated and poorly sorted to unsorted. The deposits in the San Jose Valley region were correlated tentatively by Merriam (1959) with the Pauba formation mapped by Mann (1951) in the Temecula region.

Nonmarine terrace deposits in the San Diego region constitute a source of sand and gravel (see under "Sand and Gravel, and Crushed and Broken Stone").

Landslide Deposits. Landslide deposits composed mainly of angular fragments of schist and gneiss are widespread in the peninsular ranges and are especially abundant along the base of the steep, southwest-facing scarp of the Elsinore Fault (see Photo 19).

Lakebed Deposits. Lakebed deposits composed of gray to dark-gray mudstone, siltstone and sandstone underlie Pine Valley and a small valley at Harrison Park, south of Julian.

Recent Rocks

Playa Deposits. Playa deposits composed of fine siltstone and mudstone underlie the following dry lakes in the eastern part of the county: Clark, Halfill, Bensons, and Blair Valley. None of these deposits is known to contain saline minerals.

Alluvium. River and stream channel deposits occur in western San Diego County and streambed deposits occur in the eastern part of the county. These are unconsolidated deposits composed mainly of clay-sized fragments, silt, sand and pebbles, with minor proportions of cobbles and boulders. Clasts generally represent various granitic and metamorphic rock types.

In the interior part of the county alluvium consists mainly of valley fill, which underlies many tens of square miles. In the eastern part of the county, flood plain and fan deposits slope outward from mountain ranges and merge with valley fill deposits.

Other types of alluvial deposits in the county include beach sand deposits, swamp (or bog) deposits in the upper coastal valleys, and sand dunes along the southeast side of Clark Lake.

As the rivers and streams of the county are dry, except for a few days each year, their bed deposits constitute sources and possible sources of sand and gravel. Of present value are chiefly river bottom deposits in the San Diego region which are major sources of sand and minor sources of gravel (see section on "Sand and Gravel, and

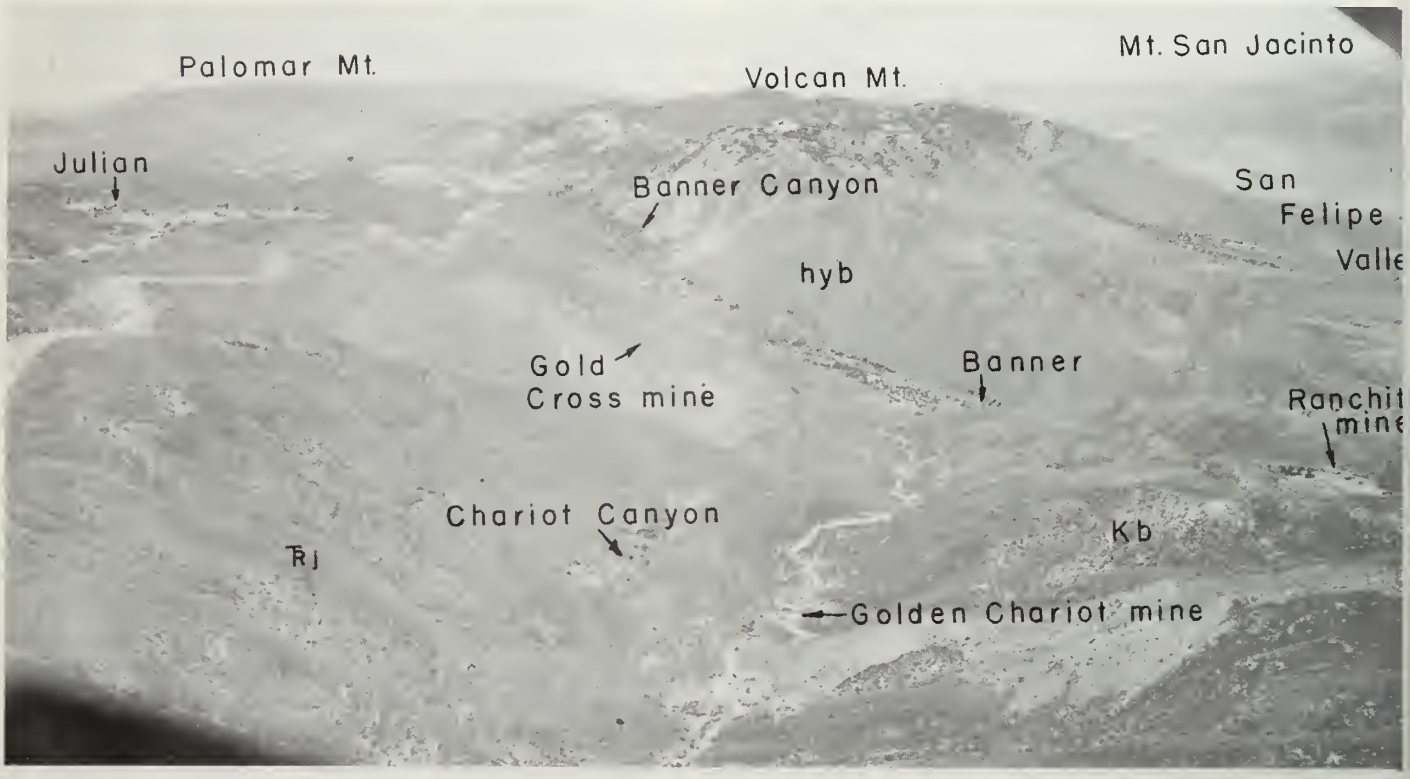


Photo 20. Aerial view north-northwest shows Julion gold mining district ond vicinity. Trace of Elsinore foult extends diogonolly ocross view in trough from point neor left edge of skyline to lower port of right edge of photogroph. Light-colored, boulder-covered slopes in lower right port of photogroph ore underloin chiefly by Bonsoll tonolite (Kb); dork-colored rocks on steep slope ot lower left ore mainly underloin by Julion schist (Ꞧj).

Photo 21. Julion oreo, view north. Bonner Conyon in middleground, Volcon Mountoin in bockground. Elsinore fault cuts through orea olong bose of Volcon Mountain in Bonner Conyon. Dump from gold prospect is in center of lower middleground.

Crushed and Broken Stone"). A single peat deposit is known in the county (see under "Peat"). Beach and dune sands are a possible source of specialty sands (see under "Specialty Sands"). Pebbles for grinding and filtering once were recovered from beach deposits along the south coast.

STRUCTURAL GEOLOGY

A discussion of the structural features of the peninsular ranges has been provided by Jahns (1954b, p. 41-45); and a similar discussion of the Salton Basin, which includes the eastern part of San Diego County, has been written by Dibblee (1954, p. 26-27).

The dominating structural features of San Diego County are the northwest-trending fault zones which cut the north-central and eastern parts of the county. Of these, the principal zones are the Elsinore, Agua Tibia-Earthquake Valley, San Jacinto, and Santa Rosa (see Pl. 1). The desert mountain ranges and hills have been elevated along these faults; and a complex folding of Tertiary sedimentary rocks, along the eastern edge of the county, also is associated with them. The fault traces are characterized by erosional depressions bordered by steep scarps, which generally face westward (Photos 5, 9, 20, 21, 22). Landslides are particularly prominent along the steep scarps of the Elsinore Fault Zone (Photo 21).

Maximum apparent lateral displacement of several miles is indicated for the rocks along the Elsinore Fault in the Coyote Mountains region of San Diego and Imperial Counties. In this region, interlayered marble and schist of pre early late Cretaceous age at Dos Cabezas, about three miles south of the fault, very closely resemble similar rocks in the western and eastern parts of the Coyote Mountains, less than one mile to several miles north of the fault (Pl. 1). These relationships, however, do not seem to readily indicate the direction of movement along the fault. To the northwest, in the Julian district, apparent right lateral movement of similar rocks along the fault is estimated to be about 2,000 feet.

Southwest of the Elsinore Fault Zone major faults are uncommon. An erosional depression that extends from McGinty Mountain east-southeast along Lyons Valley to Campo, suggests an extensive fault, but with small displacement.

Faults that contain hydrothermal mineralization occur mainly in the part of the county that lies southwest of the Elsinore fault. Gold-bearing quartz deposits at Julian, and in the Laguna Mountains, occur in shear zones in schist; and similar deposits near Dulzura occur in a northwest-trending fault zone which cuts metavolcanic rocks. Quartz veins that contain tungsten, lead, gold and silver fill north-trending shear zones which cut schist at Metal Mountain, north of Buckman Springs. Copper and iron minerals occur in shear zones that cut metavolcanic rocks near Olivenhain, and in the San Mateo Canyon area at the north edge of the county.

MARINE GEOLOGY

Studies of the marine geology along the coast of San Diego County have been made by workers at Scripps Institute of Oceanography, at La Jolla. These studies have resulted in papers by F. P. Shepard with others (1940 to 1951) on beach erosion and sand movement; and by K. O. Emery with others (1941-1960) on the submarine geology of the ocean floor. For additional references see the bibliography on "Marine Geology" at the back of the text.

Photo 22. View southeost olong steep west slope of Polomar Mountoin, showing troce of Elsinore foult zone. Warner Volley ond Loke Henshow in bockground.

MINERAL RESOURCES AND MINING

Many mineral commodities have been produced in San Diego County, but by far the principal ones in recent years have been sand and gravel, and crushed and broken stone. The value of these commodities produced in 1959 constituted about 94 percent of the value of the total mineral output of the county. Other important commodities to be produced in recent years are dimension stone, salt, magnesium chloride, clay, pyrophyllite, and specialty sands. Important commodities produced in former years include gold (1870-1875, and 1887 to about 1900); gem minerals (especially tourmaline and kunzite; mainly 1900-1912); feldspar (1918-1943); and lithium mica (1892-1928).

HISTORY OF MINING *

The history of mining in San Diego County might be said to have started with the discovery of San Diego Bay by Cabrillo in 1542, for one of the purposes of such voyages as Cabrillo's was to find mineral riches for Spain. Cabrillo discovered only a beautiful harbor, however, and more than 300 years was to pass before a mineral deposit in the county would be worked commercially.

During the late 1700's and early 1800's, some noncommercial mining was done by the early Spanish settlers. These people recovered stone and adobe for construction of buildings, small dams, and walls. In addition, salt was produced by evaporation of sea water in marshes along the edge of San Diego Bay at least as early as 1869.

During the 1840's and 1850's, emigrants from the eastern United States passed into Southern California over several trails which crossed present-day San Diego County. These trails included the Butterfield Route to Los Angeles, via Vallecito, Warner Springs, and Oak Grove; the Kearney Route to San Diego, via Vallecito, Warner Springs and Ramona; and routes along the coast and the Mexican border, approximately following respectively the routes of present U.S. Highways 101 and 80. In addition, several United States government surveys during this period traversed the county. In spite of this activity, none of the gold deposits of the county was discovered and mined, although it is said that Indians and early-day Spanish and Mexican inhabitants recovered small amounts of gold from the deposits southeast of present-day Escondido.

In early 1869, San Diego was a small community of only a few hundred people, but one of these was A. E. Horton, a real estate promoter. During that year, the promotions of Mr. Horton, and news of plans to build a railroad from El Paso to San Diego, began to attract people to San Diego; and by the end of the year the town was booming. Perhaps this boom was at least partly responsible for the attraction of the prospectors who discovered placer gold in the central part of the present-day county in November 1869. These men were Mike and Webb Julian and James and Drury Bailey, ex-Confederate soldiers attracted to the West following the economic collapse of the South at the end of the Civil War. About three months after the discovery of placer gold, on February 21, 1870, lode gold was discovered at a locality two to three miles east of the placer fields. On February 22, papers for the Van Wert and George Washington Claims were filed on the site, and in a small valley just south of the George Washington Claim a camp, soon to be named Julian, began to grow.

During the spring of 1870 people seeking gold came to the Julian area by the hundreds, and consequently the Owens, Helvetia and other deposits were discovered and developed. In addition, the search for more deposits in the area branched out. Thus, the Stonewall Jackson (Stonewall) Deposit—to be the most prolific mine in the county—was discovered in March at a point about seven miles south of Julian; and in August 1870 deposits were discovered along canyon slopes three to four miles southeast of Julian. Banner Camp arose in the canyon near these deposits, and subsequently the Bailey Brothers, Hubbard, and Golden Chariot Mines were developed. Thus, as the town of San Diego boomed so did the mining camps in the mountains to the east. By the end of 1870 an estimated 2,000 people lived in San Diego and a total of about 1,000 lived in Julian, Banner, Coleman City and other camps. In 1870 an attempt was made to have the government construct a mint at San Diego to coin gold from the hills, but this failed.

By 1873 the population of San Diego had risen to 4,000, and that of Julian and the other gold camps to perhaps 2,000. During that year the Democratic county convention was held in Julian; Mike Julian was elected county assessor; and the citizens of Julian attempted, without success, to have the county seat moved from San Diego to their town. During 1873, the total value of gold shipped from the mining camps of the county rose to $500,000. But in December of that year, plans for the El Paso and Pacific Railroad collapsed, and the boom in San Diego was finished. During 1874, production of gold began to fall, and by the end of 1875 nearly all of the mines were idle. The population of San Diego had dropped to 1,500 or less by the end of 1874, and by 1876 probably less than 100 people lived in Julian. During the years from 1870 to 1875 the mines had yielded nearly $2,000,000 in gold, a small figure when compared to the production from the Mother Lode in Northern California, but significant in the history of San Diego County.

The decade from 1875 to 1885 in the county was quiet. A new gold discovery was made at Dulzura in 1877, but this time no bonanza followed. Finally, however, in 1885, a railroad finally arrived in San Diego; and even though it was only a branch of the Santa Fe from Los Angeles, another boom began in the region. The population of the city rose to an estimated 40,000 during the boom's crest, which lasted from the summer of 1886 to February 1888, then dropped to 17,000 by 1890, after the boom had ended.

* This account was compiled from descriptions of mineral deposits in the text and tabulated list of this report and from many of the entries in the bibliography listed under "Mineral resources and mining."

Photo 23. Union Brick Company, Rose Canyon, showing famous leaning smokestack constructed in 1888. View north-northwest.

During this boom, mining was very active in the county. In 1887, stone was quarried for Sweetwater Dam —the first large dam constructed in the county. In 1886, Robert W. Waterman, Governor of California from 1887 to 1891, purchased the Cuyamaca Rancho and the inactive Stonewall Mine, which was at the north edge of the rancho (Photo 43). Waterman reopened the mine in 1887, and from 1888 to 1891 it yielded nearly $1,000,000 worth of gold. Waterman reportedly had paid about $75,000 for the mine. The success of this venture helped to create renewed interest in gold mining in other parts of the county. During the late 1880's and 1890's several mines were reopened in the Julian district, including the Owens and Helvetia (Photo 41); and several previously overlooked deposits in the district were discovered and developed. Also during this period, the Shenandoah and other deposits near Mesa Grande were worked; and the Cleveland-Pacific and additional deposits near Escondido were active.

During the late 1880's, the Waterman family also undertook two other important ventures. One was the planning of the San Diego and Cuyamaca Eastern Railroad from San Diego to Cuyamaca, and by 1888 its construction to Foster, the ultimate destination. The other venture was the construction of the Cuyamaca Dam on the Cuyamaca Rancho and a flume to carry water from the reservoir the dam created to San Diego. The flume was dedicated in December 1889.

The construction of the railroad enabled a new phase of the mining industry to begin in the county—large-scale quarrying of stone. In 1888 the Simpson-Pirnie Company opened a quarry adjacent to the railroad south of Lakeside, and was to operate it until 1932. The company quarried blocks of granite which were transported by rail to the company yard in San Diego where they could be processed and distributed for sale as riprap and rubble, later as paving blocks, and beginning in 1898, as polished monument and building stone. In 1894, stone quarried from the Waterman Deposit at Foster was used to construct the jetty at the entrance to San Diego Bay. By 1900 several other dimension stone producers had begun to operate in the Foster-Lakeside area.

Also in 1888, a brick plant was constructed in Rose Canyon adjacent to the Santa Fe Railroad. A stack was built on the property which, until it fell recently, was referred to as the "leaning stack" of the Union Brick Company, which moved to the site about 1912 (Photo 23). In 1889 a cement plant to be built on the Jamul Ranch was being planned by the Jamul Portland Cement Company. The company began production in early 1891, but operated only for a few months. The company's product is said to have been unable to compete with portland cement being shipped to San Diego from England by water. In addition, by then the prosperous effects of the boom of 1886-1888 had ended. This attempt was only the second to produce portland cement in California. The remnants of the kilns still stand (Photo 52).

After the boom of the late 1880's, prospecting for gold was carried on in many parts of the county. The Rice brothers and others prospected in the Montezuma district; the Donahoe brothers and others worked deposits in the Dulzura district; the Noble brothers and other men worked deposits in the Laguna Mountains, and in the Deer Park and Boulder Creek districts; activity increased near Escondido; a Mr. Campfield prospected for lead, silver, and gold on Metal Mountain, north of Live Oak Springs; and placer gold deposits near Ballena were worked. None of these ventures, except possibly that of the Noble brothers, was economically successful, however. In 1893, after Waterman had died, the Stonewall Mine was closed, probably not to be opened again. But by then it had yielded the largest total value of gold of any mine in the county—about $2,000,000.

In the 1890's, as gold mining declined, the mining of minerals from pegmatite deposits began. In 1892 production of lithium mica (lepidolite) began at the Stewart

Deposit near Pala. In the late 1890's gem mining was introduced with production of gem-quality tourmaline and spodumene from deposits near Pala, and tourmaline and other minerals from the remarkable Himalaya and other deposits near Mesa Grande. Deposits near Ramona, Rincon and in other areas also were being worked, and yielded small quantities of gems. The deposits were mined most ambitiously from about 1901 to 1912, and between 1902 and 1910 yielded about $1,300,000 worth of gem minerals. The production of gems dropped considerably after 1911, with the fall of the Chinese dynasty that had favored tourmaline as a gem stone, and with a corresponding drop in prices.

As the population of the county gradually increased during the early 1900's, production of sand, gravel and stone, for use in construction, also increased. Several of the present-day rock product companies began operation during this period, including the Jamacha Sand and Gravel Company in 1906, and the Mission Rock Company (now part of the Daley Corporation) in 1913.

During the period before World War I, from 1910 to 1915, mineral production was relatively low. During this period, also, several wells were drilled along the coast in an unsuccessful search for petroleum. In 1912, the Union Brick Company moved from downtown San Diego to its present location in Rose Canyon. During the mid-1910's production began of magnesium salts from sea water bittern, but in 1916 both the salt and magnesium chloride operations at the south end of San Diego Bay were washed out by the flood caused by the break of the Otay Dam. The salt works was rebuilt soon, but magnesium salts were not produced again until late 1919 or early 1920, when the California Chemical Company resumed the operation.

During the years 1917 to 1919, when the United States was most affected by World War I, mineral production increased several fold in the county, mainly because of production of potash (see Table 1 and Figure 3). During the war, foreign sources of potash to the United States were cut off, its price increased about ten-fold, and production of the commodity from kelp was made economically possible. About $3,400,000 worth of potash was produced in the county from 1916 to 1919, of which nearly $3,000,000 was produced by four companies from 1917 to 1918. Also during the war, foreign sources of pebbles used in grinding mills were cut off, and production of these from beaches of San Diego County started in 1915, and was to continue until 1949. A rise in the price of copper, from about 13 cents per pound in early 1914 to about 27 cents per pound by 1916, enabled two small copper deposits in the county to be worked between 1915 and 1919. These were shut down in 1919 when the price returned to normal. In 1917, small quantities of molybdenum, strontium minerals, and possibly tungsten also were mined in the county. From 1918 to 1920, the Stewart Mine reached its maximum yield of lithium mica, and in 1918 feldspar was first produced in the county.

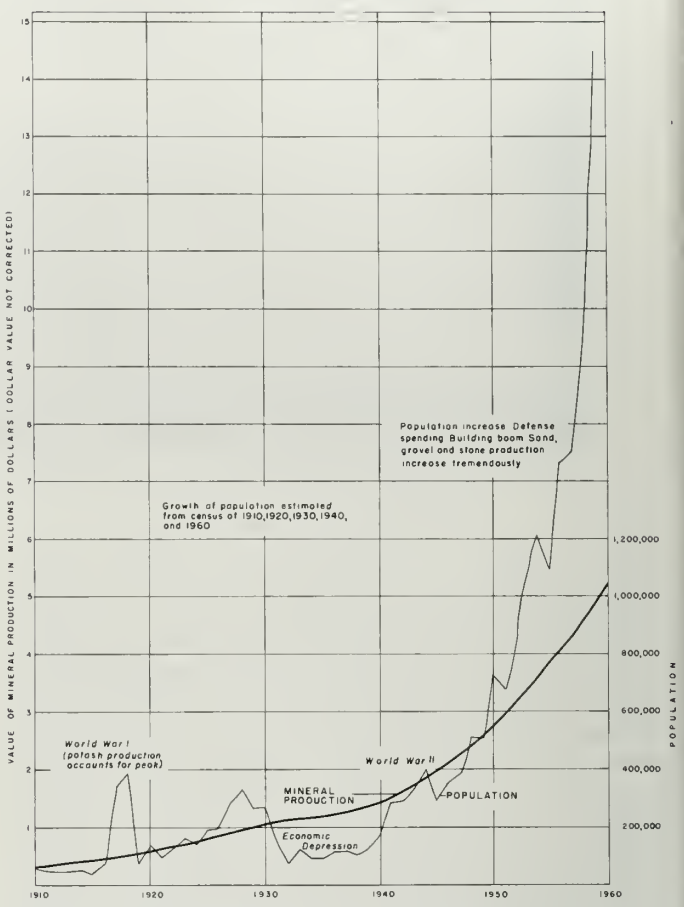


Figure 3. Graph comparing yearly value of mineral production of San Diego County with growth in population, 1910 to 1957.

In the early 1920's, after a brief economic letdown following World War I, the population and mineral production of San Diego County continued to grow. By then metal mining had almost stopped, but large tonnages of sand, gravel and stone, and other non-metallic minerals were being produced. The production of clay became significant, when in about 1919 Standard Oil Company of California and General Petroleum Company began to produce bentonite from deposits near Otay, for use in petroleum refining, and Pacific Clay Products began working a deposit near Carlsbad.

In 1921, a predecessor of Standard Sanitary Manufacturing Company began to mine feldspar and quartz from a deposit near Campo. The company constructed a mill to process the rock mined at a site adjacent to the San Diego and Arizona Eastern Railroad (Photo 32). This railroad had been completed in 1919, to at last link San Diego and the Imperial Valley. The deposit was to be the principal source of feldspar in California from 1921 through 1942. Other feldspar producers also began operation in the county during the early 1920's, and gem mining continued on a small scale. In 1923, Nelson and Sloan began production of sand and gravel on the Otay River

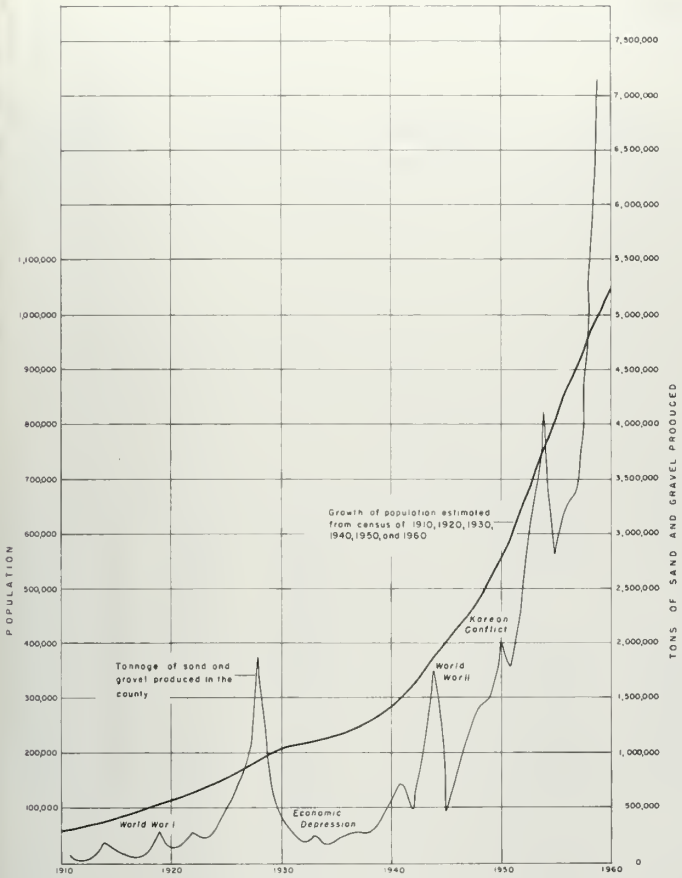


Figure 4. Graph showing relationship between yearly production of sand and gravel in San Diego County and growth of population.

bed. At this time, also, Fenton-Sumption-Barnes merged with the Independent Stone Company to become Fenton-Parker Company (which was to be renamed H. G. Fenton Material Company in the early 1930's). From 1921 to 1923, marble for buildings and monuments was quarried from the Verruga Deposit near Ranchita. During the early and mid-1920's several more wells were drilled unsuccessfully for oil. In 1923 the California Chemical Company of Chula Vista was purchased by National Kellestone Company and was known thereafter as the California Chemical Corporation. This corporation began to produce bromine, in addition to magnesium chloride, in 1926.

During the mid- and late-1920's production of sand and gravel, dimension stone, and clay reached remarkable heights (see Table 1 and Fig. 3). In 1928, Crystal Silica Company began production of high quality quartz sand from a deposit near Oceanside. But this was the last year in which lithium mica was produced from the Stewart Deposit. In 1929, V. R. Dennis' Canyon Rock Company began operations at its present site north of Grantville.

With the beginning of the depression in 1929, mineral production of the county dropped markedly and continued low through the 1930's (see Fig. 3). In 1932, the Simpson-Pirnie Company, which had produced dimension stone continuously in the county since 1888, stopped operation. During the 1930's, gold mines were reactivated at Julian, but generally with little success. Small gold deposits south of El Cajon were worked; and from 1939 to 1942 several deposits south of Pine Valley were worked for gold with minor success. In 1937, the Beryllium Alloys Company began to develop a supposed large beryllium-bearing deposit near Vista, but no ore was mined. Also in 1937, Caudell and Johnson began producing sand, gravel, and stone in the San Diego region, and the operations of the California Chemical Corporation at Chula Vista were taken over by Westvaco Chlorine Products Corporation.

During World War II, as during World War I, mineral production rose sharply in San Diego County. During World War II, the rise in production was caused mainly by the increased output of sand, gravel and stone for use in military construction in the coastal area. Tungsten also was produced, between 1941 and 1945, from the Pawnee and other deposits; strontium minerals were produced at the Roberts and Peeler deposit, south of Ocotillo Wells; molybdenum ore was mined briefly at the Lippner Deposit at Campo; and optical calcite for use in gun sights was mined at the Hilton Deposit on the east side of the Santa Rosa Mountains. In 1942 the Pacific Feldspar Mine near Campo was shut down, reportedly because the operator could not compete in wages with the U.S. Army which hired civilians to work on a military base at Campo. In 1944, the Friday nickel-bearing deposit near Julian was investigated by the United States Government as a possible source of nickel, for use at the newly completed Kaiser Steel Plant at Fontana, but the deposit was found to be too small.

Near the end of the war, military construction ceased, and in 1945 mineral production dropped markedly. Subsequently, however, as the population of San Diego and environs continued to grow, housing and other construction were needed. Consequently, output of sand and gravel rose from only 475,000 tons in 1945 to more than 4,000,000 tons in 1954 (Fig. 4). By that year both civilian and military construction were consuming large amounts of these commodities. In 1945 recovery of pyrophyllite began from deposits near Rancho Santa Fe, and production of crushed stone for use as roofing granules began from deposits near Rancho Santa Fe and in the southeast part of the county. In the late 1940's, a small quantity of peat also was produced.

From about 1950 to 1956, a government purchase program for tungsten stimulated development and mining of several such deposits in the county, including the Pawnee and Payoff. During the early- and mid-1950's, uranium prospecting also was popular in the county, but only radioactive minerals in pegmatite deposits were found, and no ore was uncovered. During the mid- and late-1950's large quantities of broken stone was being used for construction of both civilian and military sea front projects, including the Mission Bay Park. Gem minerals also were produced in the county

Table 1. Recorded Mineral Production of San Diego County
1880-1959 [1]

Year	Gold[1] (Value)	Silver[1] (Value)	Copper and tungsten (See below)		Gem minerals[1] (Value)	Feldspar[1, 26] (Tons)	Feldspar[1, 26] (Value)	Lepidolite and amblygonite, pyrophyllite (See below)		Salt[1, 27] (Tons)	Salt[1, 27] (Value)	Clay and clay products: Bentonite[13] (Tons)	Bentonite[13] (Value)	Pottery clay (Tons)	Pottery clay (Value)	Brick[14] (M)	Brick[14] (Value)
1880[6]	[11]$81,558																
1881[6]	60,000																
1882[6]	100,000																
1883[6]	50,000	[11]$5,000															
1884[6]	65,000	5,000															
1885[6]	95,125	2,000															
1886[6]	140,450	78,758															
1887[6]	66,900	198,537															
1888[6]	[6]160,000	192,000															
1889[6]	[6]275,440	25,740															
1890	[6]11,620	30															
1891	[6]25,460																
1892	[6]62,900																
1893	68,140																
1894	37,160							Lepidolite and amblygonite[2, 23]		700	[11, 23, 27]$5,000						
1895	1,120									700	5,000						
1896	62,000	30								600	4,800						
1897	72,680		Copper[1]							650	5,850						
1898	72,860							(Tons)	(Value)	600	5,000					650	[7, 11, 23]2,700
1899	28,680									600	5,000					850	[7]4,300
1900	63,040	990			[23]$500			1,200	[10, 23]$29,000	600	4,000					750	[7]3,250
1901	65,840	980			20,000			1,400	37,500	1,050	9,600					1,150	[7]5,800
1902	26,940		Pounds	Value	150,000			800	31,900	7,900	7,900					700	[7]3,450
1903	34,140	15			100,000			50	100							2,150	[7]11,150
1904	79,700	[31]7,460	[31]104,477	$14,627	136,000			800	16,000							3,800	[7]23,700
1905	6,780	550	4,808	750	66,000			600	9,500							3,200	[7]28,350
1906	340	100			284,500			50	700	6,000	5,000					3,950	[7]34,900
1907	7,455	35	13,246	2,659	206,300					7,000	55,000					4,450	36,400
1908	6,920	86			121,500					7,000	60,000					2,100	16,700
1909	12,812	1,721			125,000					15,000	60,000					5,850	38,950
1910	[24]				110,300					8,000	24,000					8,800	62,650
1911	[24]				25,000			120	2,000	13,000	37,500					9,500	68,000
1912					12,500					12,450	31,350			400	500	10,500	80,000
1913					7,500			30	500	20,500	51,750			850	2,850	9,400	68,400
1914			30	4	1,500					15,300	46,200					5,450	56,400
1915	1,364	9	3,008	526	2,450			90	1,400	17,600	19,600					1,250	21,000
1916			16,806	4,134	2,700			70	1,000		[8]			300	600	4,000	36,850
1917		[8]	153,349	43,502	[8]			880	8,800	4,500	9,750				[8, 29]		21,400
1918			4,143	1,023		700	[26]$3,600	4,110	74,000	10,650	61,700						29,100
1919	1,470	12		[8]	[8]			800	14,400	12,400	52,800				[22]62,930		[12]
1920					2,100	2,950	17,700	10,080	153,500	15,300	77,100			5,850	57,500		87,600
1921	[8]	[8]			1,405	1,850	11,100	700	10,600	16,000	[27]96,000				[22]92,600		[12]
1922	[8]	[8]			400	3,500	29,500	670	10,200	13,000	60,000		[8]		[22, 29]93,050		[12]
1923	822	144			8,550	6,100	42,800			17,000	115,000		[8]	5,600	[29, 30]101,000		[8]
1924	4,830	97			1,900	6,850	47,950	110	2,300	25,000	100,000		[8]	12,800	[29]36,950		232,100
1925	5,134	58			9,400	5,800	40,600			27,000	100,000		[8]	27,000	[29]66,450		119,200
1926	10,543	340		[8]	4,000	7,000	54,000	40	1,000	25,000	120,000		[8]	30,200	[29]58,250		230,500
1927	11,490	92			3,500	9,000	72,000	500	12,500	12,000	60,000	7,400	69,650	16,200	31,750		165,200
1928	2,671	13			1,700	12,850	82,300	400	16,000	22,000	80,000	5,500	47,750	33,400	63,900		101,500
1929	1,282	5			2,210	11,500	69,600			27,000	100,000	8,400	78,950	20,150	34,000		146,200
1930	2,234	10			[8]	4,450	31,400			27,000	110,000	5,300	55,700	15,500	25,800		[8]
1931	3,988	15			[8]	4,150	54,600			37,600	150,400	6,400	69,000	11,400	15,500		79,600
1932	5,573	32			[8]	2,500	27,450				[8]		[8]		[8]		[8]
1933	5,894	24			[8]	1,000	14,200			35,000	125,000	500	4,200		[8]		[8]
1934	25,514	187		[8]		1,650	16,400			40,000	150,000	2,600	9,800		[8]		24,500
1935	10,367	65			[8]	3,250	21,850			34,000	120,000	1,400	5,900		[8]		[8]
1936	2,170	12			[8]	3,400	24,700			34,500	125,000	600	2,600		[8]		[8]
1937	2,100	14			[8]	2,650	11,700			32,000	120,000	900	3,100		[8]		[8]
1938	3,080	20	7,023	688	[8]	1,350	6,650			37,000	135,000	600	2,000		[8]		[8]
			Tungsten ore														
1939	14,630	166			[8]	1,800	10,000			34,500	130,000	1,100	5,400		[8]		[8]
1940	16,975	128	(Units)	(Value)	[8]	2,150	11,500			40,000	150,000	600	2,100		[8]		[8]
1941	10,535	36		[8]	[8]	2,750	15,000			32,000	120,000	4,100	4,500		[8]		[8]
1942	245	2				2,100	11,000			45,000	200,000		[8]	9,900	12,250		[8]
1943										50,000	210,000		[8]	18,700	15,200		[8]
								Pyrophyllite[1]				Pottery clay and bentonite					
								(Tons)	(Value)								
1944	70	1								52,000	210,000		[13]	10,800	10,500		[8]
1945									[8]	53,000	210,000			100	300		[8]

Table 1. Recorded Mineral Production of San Diego County—Continued

Pebbles for grinding (and filtering)[28]		Stone, dimension[3]		Stone, crushed and broken[1, 16]		Sand and gravel[1, 4]		Unapportioned and miscellaneous[1, 23]		Total yearly value	Year
(Tons)	(Value)	(Cu. ft.)	(Value)	(Tons)	(Value)	(Tons)	(Value)	(Value)	(Description)		
											1880[5, 6]
											1881[6]
											1882[6]
											1883[6]
											1884[6]
											1885[6]
											1886[6]
											1887[6]
											1888[6]
											1889[6]
											1890
											1891
											1892
											1893
					[11, 16, 23, 7]$49,400			$2,250	Asbestos (50 tons)[20]	[23]93,800	1894
					[7]25,000					31,100	1895
					[7]3,600					70,400	1896
					[7]23,400					101,900	1897
		6,600	[15, 23, 11]$4,850		[7]5,400					90,800	1898
		11,000	[15]8,150		[7]18,200			1,317	Lead (31,000 pounds)[9]	65,600	1899
		7,300	[15]9,900		[7]14,400					125,100	1900
		13,900	[15]22,400		[7]6,900					169,000	1901
		20,600	[15]13,200		[7]14,200					247,600	1902
		10,800	[15, 7]13,550		[7]42,600					201,600	1903
		7,800	[15, 7]7,850		[7]200,200					485,500	1904
		9,500	[15, 7]10,250		[7]16,500					138,700	1905
		9,500	[15, 7]10,250		[7]49,400					385,200	1906
		19,900	[15]23,650		28,500			12,052	Lead (971 pounds, $52); Marble (4,000 cu. ft., $12,000)	372,100	1907
		9,000	[15]10,000		37,100					252,300	1908
			[15]		33,500			214,600	Miscellaneous unapportioned, 1900-09	486,600	1909
			[15]		147,800					344,800	1910
			[15]		138,700	77,200	[4, 23]$62,800			334,000	1911
		2,200	[15]2,200		148,600	25,800	[18]13,300			288,400	1912
		18,300	[15]21,700		130,600	37,400	[18]17,700			301,000	1913
		5,400	[15]6,400		133,000	186,100	70,900			314,400	1914
	[33]	6,900	[15]8,300		84,400	120,700	[18]71,000	1,350	Lead (23 pounds, $1); other minerals	211,400	1915
	[33]	6,900	[15]8,300		130,900	58,200	[18]33,000	[21]180,650	Potash (2,150 T, $175,800), mineral water, salt, strontium minerals[24]	398,100	1916
	[33]	5,500	[15]6,150		103,500	53,000	[18]22,300	[21]1,498,200	Potash (5,250 T, $1,492,100), pottery clay, gem minerals, minerals, mineral water, molybdenum, glass sand, silver	1,713,600	1917
	[33]	5,600	[15]9,200		98,500	107,300	[18]85,600	1,578,850	Potash (10,392 tons)	1,941,600	1918
2,600	19,303	6,700	15,200		41,800	290,700	100,200	[21]54,400	Copper, gem minerals, mineral water, potash, quartz sand	343,200	1919
2,100	18,000	2,500	7,850		205,400	128,400	[18]128,500	[21]57,000	Quartz sand (7,557 T, $18,900), magnesium salts, mineral water, tantalum ore	794,200	1920
	[33]	8,500	22,400		[16]187,900		[4]	70,150	Quartz sand ($750), gold, magnesium salts, marble, silver	492,200	1921
	[33]	15,900	35,700		60,400	268,500	[18]295,400	62,190	Bentonite, gold, magnesium salts, marble, quartz sand, silver	647,600	1922
	[33]	19,700	40,600		127,900	219,500	[18]216,000	[22]162,400	Bentonite, brick and tile, lead, magnesium chloride, marble, quartz	815,200	1923
	[33]	26,800	76,500		72,100	323,900	[18]307,000	105,300	Arsenic, bentonite, lime, magnesium chloride	987,000	1924
	[33]	28,500	108,700		123,600	539,200	[18]385,000	150,600	Bentonite, lime, magnesium chloride, quartz sand	1,108,700	1925
	[33]	16,300	45,300		51,200	689,600	[18]478,400	164,500	Bentonite, bromine, copper, lead, magnesium chloride, zinc	1,218,000	1926
	[33]	18,900	[17]63,100		215,400	946,200	[18]674,300	188,900	Bromine, heptane, magnesium chloride, paving blocks	1,567,900	1927
	[33]	14,200	47,600		105,300	1,867,900	[18]1,179,500	44,600	Bromine, magnesium chloride, quartz	1,772,800	1928
150	[28]1,100	15,800	28,900		267,600	78,800	[18]509,900	[21]207,600	Bromine, magnesium chloride, mineral water, quartz sand	1,447,300	1929
15	130	10,000	27,400		238,600	497,600	413,300	[21, 22]398,450	Brick and tile, bromine, gem minerals, magnesium chloride, mineral water, quartz sand	1,303,000	1930
21	170	4,700	[15]11,400		52,600	316,700	358,400	[21]57,950	Bromine, gem minerals, magnesium chloride, mineral water, paving blocks, quartz	853,600	1931
	[8]	6,200	9,700		40,800	184,200	146,900	[21]145,500	Bentonite, brick and tile, bromine, pottery clay, gem minerals, magnesium chloride, mineral water, pebbles for grinding, quartz, salt	376,000	1932
4	44	5,300	10,100		126,500	310,800	248,300	[21, 22]90,850	Brick and tile, bromine, pottery clay, gem minerals, magnesium chloride, mineral water, quartz	625,100	1933
2¼	23	6,300	11,200		64,700	167,600	148,200	[21]36,800	Bromine, pottery clay, copper, magnesium chloride, mineral water, quartz	487,300	1934
1½	16	6,200	10,600		28,900	195,400	169,200	[21, 22]104,500	Brick and tile, bromine, pottery clay, gem minerals, lead (8,323 lbs., $333), magnesium chloride, mineral water, quartz	471,400	1935
		14,100	28,000		39,500	261,300	274,300	[21, 22]88,900	Brick and tile, bromine, pottery clay, gem minerals, magnesium chloride, mineral water, quartz	585,200	1936
		10,900	29,000		57,100	298,800	255,800	[21, 22]115,700	Brick and tile, bromine, pottery clay, gem minerals, magnesium chloride, mineral water, quartz sand	594,500	1937
			[8]		57,500	283,000	[18]227,700	[21, 22]103,100	Brick and tile, bromine, pottery clay, gem minerals, magnesium chloride, mineral water, dimension stone	535,700	1938
			[8]		46,100	368,900	[18]312,500	[22]108,900	Brick and tile, bromine, pottery clay, gem minerals, magnesium chloride, mineral water, quartz, dimension stone	627,700	1939
2½	22	6,000	14,200		71,400	556,700	[18]479,500	[21, 22]101,400	Brick and tile, bromine, pottery clay, gem minerals, magnesium chloride, mineral water, strontium minerals	847,200	1940
120	500	7,200	15,400		449,300	709,000	[18]679,500	[21, 22]121,700	Brick and tile, bromine, pottery clay, gem minerals, magnesium chloride, mineral water, quartz, strontium minerals, tungsten concentrates	1,416,500	1941
63	500		[8]		247,700	470,600	[18]574,200	[21, 22]393,100	Bentonite, brick and tile, bromine, magnesium chloride, mineral water, quartz, dimension stone, strontium minerals	1,439,000	1942
10	100		[8]		213,900	1,058,000	[18]1,082,900	[21, 22]143,600	Bentonite, brick and tile, bromine, magnesium chloride, mineral water, dimension stone, strontium minerals[24]	1,665,700	1943
151	1,300	12,600	43,900		110,200	1,726,000	[18]1,519,300	[21, 22]100,200	Brick and tile, bromine, magnesium chloride, mineral water, strontium minerals[24]	1,995,500	1944
225	2,200	28,300	85,900		241,200	475,900	[18]404,600	[21, 22]198,500	Brick and tile, bromine, magnesium chloride, mineral water, pyrophyllite, quartz sand, strontium minerals[24]	1,142,700	1945

Table 1. Recorded Mineral Production of San Diego County—Continued
1880-1959 [1]

Year	Gold[1] (Value)	Silver[1] (Value)	Copper and tungsten (See below)		Gem minerals[1] (Value)	Feldspar[1,26] (Tons)	Feldspar[1,26] (Value)	Lepidolite and amblygonite, pyrophyllite (See below)		Salt[1,27] (Tons)	Salt[1,27] (Value)	Clay and clay products: Bentonite[12] (Tons)	Bentonite[12] (Value)	Pottery clay (Tons)	Pottery clay (Value)	Brick[14] (M)	Brick[14] (Value)
1946	70	----	----	----	----	----	----	----	[8]	54,000	220,000	----	----	3,600	11,300	----	[8]
												All clay					
1947	455	5	----	----	----	----	----	----	[8]	----	[8]	[13]		14,550	[30]15,000	----	[14]
1948	280	3	----	----	----	----	----	----	[8]	----	[8]	----		35,200	[30]60,900	----	[14]
1949	105	2	----	----	----	----	----	----	[8]	----	[8]	----		21,100	17,500	----	[14]
1950	1,925	11	----	----	----	----	----	----	[8]	----	[8]	----		29,100	21,800	----	[14]
1951	----	----	----	----	----	----	----	----	[19]	----	[8]	----		33,800	25,400	----	[14]
1952	----	----	----	----	----	----	----	----	[19]	----	[8]	----		34,100	26,600	----	[14]
1953	[8]	[8]	145	[23]$9,100	----	----	----	----	[19]	----	[8]	----		28,500	21,400	----	[14]
1954	175	[8]	10 tons	38,500	----	----	----	----	[8]	----	[8]	----		26,300	13,200	----	[14]
1955	[8]	----	----	[8]	[8]	----	----	----	[8]	----	[8]	----		22,100	22,100	----	[14]
1956	[8]	----	----	[8]	[8]	----	----	3,000	$7,300	----	[8]	----		40,700	40,700	----	[14]
1957	[8]	[8]	----	----	[8]	----	----	----	[8]	----	[8]	----		----	[8]	----	[14]
1958	[8]	[8]	----	----	[8]	----	----	----	[8]	----	[8]	----		----	[8]	----	[14]
1959	[8]	[8]	----	----	[8]	----	----	----	[8]	----	[8]	----		----	[8]	----	[14]

[1] Most of the statistics in this table are from (1) reports generally titled "California Mineral Production" of the California Division of Mines (and its predecessors, the California Mining Bureau and the California Division of Mines and Mining) and (2) files of the U.S. Bureau of Mines and the California Division of Mines. Statistics in published reports were collected and compiled by the Division of Mines (and its predecessors) prior to 1946 and by the U.S. Bureau of Mines after that year. Statistics for gold and silver produced in the county were first collected in 1880; statistics for most other commodities were first collected in 1894.
[2] Statistics from California Division of Mines Special Report 7A, "Gem- and Lithium-bearing Pegmatites of the Pala District, San Diego County, California," by R. H. Jahns and L. A. Wright.
[3] Statistics are mainly from (1) California Division of Mines Special Report 3, "Commercial Black Granite of San Diego County, California," by R. A. Hoppin and L. A. Norman, Jr.; and (2) reports of the California Division of Mines entitled "California Mineral Production."
[4] Before 1911 and in 1921 value of production of "Sand and gravel" included with "Crushed and broken stone."
[5] Statistics do not include large output from the Stonewall Mine (see text).
[6] Includes production for most of present-day Imperial and Riverside Counties.
[7] Includes production of present-day Imperial County.
[8] Included with "Unapportioned and miscellaneous" so as not to reveal output of single producer.
[9] Source of output is probably Imperial County.
[10] Includes value of 800 tons produced from about 1892 to 1900.
[11] Statistics for commodity apparently not collected and compiled before this year.
[12] Includes value of "Brick and tile" produced. Value of production included with "Pottery clay."
[13] Statistics for bentonite produced after 1946 are included with "Clay."
[14] The production of brick in the county was recorded from 1898 to 1946. Since 1946 the production of common clay used in the manufacture of brick has been compiled with "Clay." Statistics for brick production prior to 1917 include only brick, after that date include both brick and tile.
[15] Value of production of "Paving blocks" included with "Crushed and broken stone."

during the 1950's: kunzite was mined at Pala; garnet at Ramona; and in 1958 tourmaline again was being mined at the famous Himalaya mine in the Mesa Grande district. But the real highlight of San Diego County's mineral industry during the postwar period was the growth in production of sand, gravel and stone, and the leading producers of these commodities: Caudell and Johnson; H. G. Fenton Material Company; Nelson and Sloan; Canyon Rock Company; Daley Corporation; H. W. Rohl Company; and others.

MINERAL PRODUCTION

The total value of the mineral production of San Diego County from 1870 to the end of 1959 is estimated to be about $125,000,000, of which slightly more than $75,000,000 was recorded from the end of World War II through 1959 (Fig. 3 and 4). In 1959 the total value of mineral output was about $14,489,600, to place San Diego 14th among the counties of California (California Division of Mines, Mineral Information Service, October 1960, p. 5, 7).

The recorded amount and value of mineral commodities produced annually in the county from 1880 to 1959 are shown herein on Table 1. Statistics shown for the period from 1880 to 1894, which include only production of gold and silver, were compiled by the California State Mining Bureau from records and publications of the U.S. Mint and the U.S. Geological Survey. In 1894, the California State Mining Bureau (older name for the California Division of Mines and Geology) began to compile statistics for all commodities by canvass of all known mine operators, and, as the California Division of Mines, continued its compilation until 1946. Since 1946, the U.S. Bureau of Mines has compiled all statewide production statistics. In addition, since 1944 statistics for San Diego County also have been compiled by the San Diego County Division of Natural Resources.

Statistics for the production of "mineral water" and "brick and hollow tile" were included with mineral production data compiled from the late 1890's to 1946, but as these are not true mineral commodities their production has not been compiled since 1946. Statistics for the production of "mineral water" collected before 1946 have been eliminated wherever possible from the present table; statistics for "brick and tile" have not been deleted, however, because they represent the only record during that period of the production of common

Table 1. Recorded Mineral Production of San Diego County—Continued

Pebbles for grinding (and filtering)[28]		Stone, dimension[3]		Stone, crushed and broken[1, 16]		Sand and gravel[1, 4]		Unapportioned and miscellaneous[1, 23]		Total yearly value	Year
(Tons)	(Value)	(Cu. ft.)	(Value)	(Tons)	(Value)	(Tons)	(Value)	(Value)	(Description)		
73	1,000	29,500	92,800	----------	139,100	921,900	988,800	[21, 22]287,700	Brick and tile, limestone, magnesium chloride, mineral water, pyrophyllite, quartz sand, strontium minerals[24]	1,740,800	1946
											M
----------	[8]	31,100	115,100	76,600	80,900	1,195,000	1,324,800	346,100	Magnesium chloride, pebbles for grinding, pyrophyllite, salt	1,882,400	1947
----------	[8]	25,300	95,000	89,400	185,700	1,395,700	1,830,000	422,200	Magnesium chloride, pebbles for grinding, pyrophyllite, salt	2,594,100	1948
----------	[8]	24,400	91,100	69,200	168,500	1,461,900	1,906,900	360,500	Magnesium chloride, peat, pebbles for grinding, pyrophyllite, salt	2,544,600	1949
----------	----------	22,100	83,600	----------	[8]	2,016,200	2,850,600	731,200	Limestone, magnesium chloride, peat, pyrophyllite, crushed and broken stone, salt	3,689,100	1950
----------	----------	23,000	87,300	242,100	378,200	1,788,100	2,501,400	388,800	Magnesium chloride, salt	3,381,100	1951
----------	----------	29,000	113,600	----------	[8]	2,653,400	3,302,900	846,200	Limestone, magnesium chloride, salt, crushed and broken stone	4,289,300	1952
----------	----------	17,700	54,100	340,200	562,400	3,100,500	4,287,400	442,000	Gold, magnesium chloride, salt, silver	5,376,400	1953
----------	----------	15,500	70,700	504,600	744,000	4,079,300	4,718,800	450,900	Magnesium chloride, pyrophyllite, salt, quartz sand, silver	6,036,300	1954
----------	----------	----------	[25]	164,700	[32]397,800	2,793,500	4,557,600	479,300	Gem minerals, gold, magnesium chloride, pyrophyllite, tungsten concentrates, salt	5,456,800	1955
----------	----------	----------	[25]	400,800	[32]1,347,900	3,231,200	5,375,600	550,900	Gem minerals, gold, magnesium chloride, salt, strontium minerals, tungsten concentrates	7,322,400	1956
----------	----------	----------	[25]	600,400	[32]1,502,300	3,392,100	5,472,400	587,600	Clay, gem minerals, gold, magnesium chloride, pyrophyllite, salt, silver, strontium minerals, tungsten concentrates	7,562,300	1957
----------	----------	----------	[25]	825,600	[32]1,675,100	4,860,300	6,922,800	615,000	Clay, gem minerals, gold, magnesium chloride, pyrophyllite, salt, silver	9,212,900	1958
----------	----------	----------	[25]	1,430,600	[32]2,356,800	7,229,200	11,426,300	706,500	Clay, gem minerals, gold, magnesium chloride, pyrophyllite, salt, silver	14,489,600	1959

Total (Recorded production, 1894-1959) $110,600,000
Estimated total mineral production (1870-1960) $125,000,000

[6] "Crushed and broken stone" includes value of "Sand and gravel" produced before 1911 and in 1921, and value of production of rubble, riprap, paving blocks, ornamental stone, and pebbles for grinding (1915-18, 1921-28).
[7] Value of paving blocks produced during the year is included with "Unapportioned and Miscellaneous."
[8] Includes tonnage and value of production of certain specialty sands: molding, blasting, engine, and filter sand, and sand for asphalt finishing.
[9] Known production apparently is not recorded.
[10] No deposits of asbestos known in San Diego County; perhaps production is from Riverside County.
[11] Includes some value of production of "Mineral Water," which was formerly considered a mineral commodity. The production of mineral water has not been recorded as a mineral commodity since 1946. For production until 1943 see the report by Dolbear (1944, pp. 92-95).
[12] Includes value of production of "Brick and tile," formerly considered a mineral commodity (see footnote 14).
[23] Figures rounded to nearest "10," "50," or "100."
[24] Production included with statistics for Imperial County.
[25] Statistics included with "Crushed and broken stone."
[26] Statistics for years 1925, 1927, 1928, and 1931-1943 are published by permission of single producer.
[27] Statistics for years 1921-46 are published by permission of single producer.
[28] Statistics are published by permission of single producer.
[29] During 1917 and 1922-26 statistics for production of additional tonnages of clay were combined with other commodities.
[30] Does not include value and tonnage of "Clay products, heavy clay (other than pottery and refactories)" because U. S. Bureau of Census was not at liberty to publish figures.
[31] Production may represent ore milled in county but mined outside.
[32] Includes production of "Dimension stone."
[33] Production of pebbles for grinding and filtering included with "Stone, crushed and broken."

clay for manufacture of brick. Since 1946, statistics for all types of clay produced have been published together as "clay."

LAND OWNERSHIP AND ENTRY

The general pattern of ownership and administration of land in the county, as of 1955, is shown herein on Pl. 11. Ownership for most individual mineral properties, as of the period 1955 to 1960, is provided in the descriptions of mines and mineral deposits in the text and tabulated lists of the report. Up-to-date information on ownership data should be sought as follows: (1) patented property in general, San Diego County Assessor; (2) patented claims and claims for which patents have been applied, United States Bureau of Land Management, Riverside; (3) unpatented mining claims, San Diego County Recorder. The up-to-date status of various U.S. government lands should also be sought from the U.S. Bureau of Land Management, Riverside.

Mining law, as it pertains to locating claims, the use of water, safety regulations, and other points, is explained in a booklet entitled "Legal Guide for California Prospectors and Miners" which is published and sold by the California Division of Mines and Geology.

Maps that are most useful to the prospector for location of deposits and delineation of claims are included in the series of topographic maps published by the United States Geological Survey, Washington 25, D.C. Maps of this series published at scales of 1:62,500 and 1:24,000 cover San Diego County, as shown on Plate 2 (see also Fig. 5). The location of one of three mineral monuments in the county is shown in Figure 6. Vertical aerial photographic coverage of the county may be obtained from the United States Department of Agriculture, Commodity Stabilization Service, Salt Lake City, Utah. Other agencies, in addition to the California Division of Mines and Geology, which may have information of value to a prospector in the county are the San Diego County Division of Natural Resources, San Diego; California Division of Industrial Safety, Los Angeles; California Department of Water Resources, Escondido office; United States Soil Conservation Service, Escondido office; and the United States Forest Service, Escondido and Descanso stations, and the San Diego office. Information

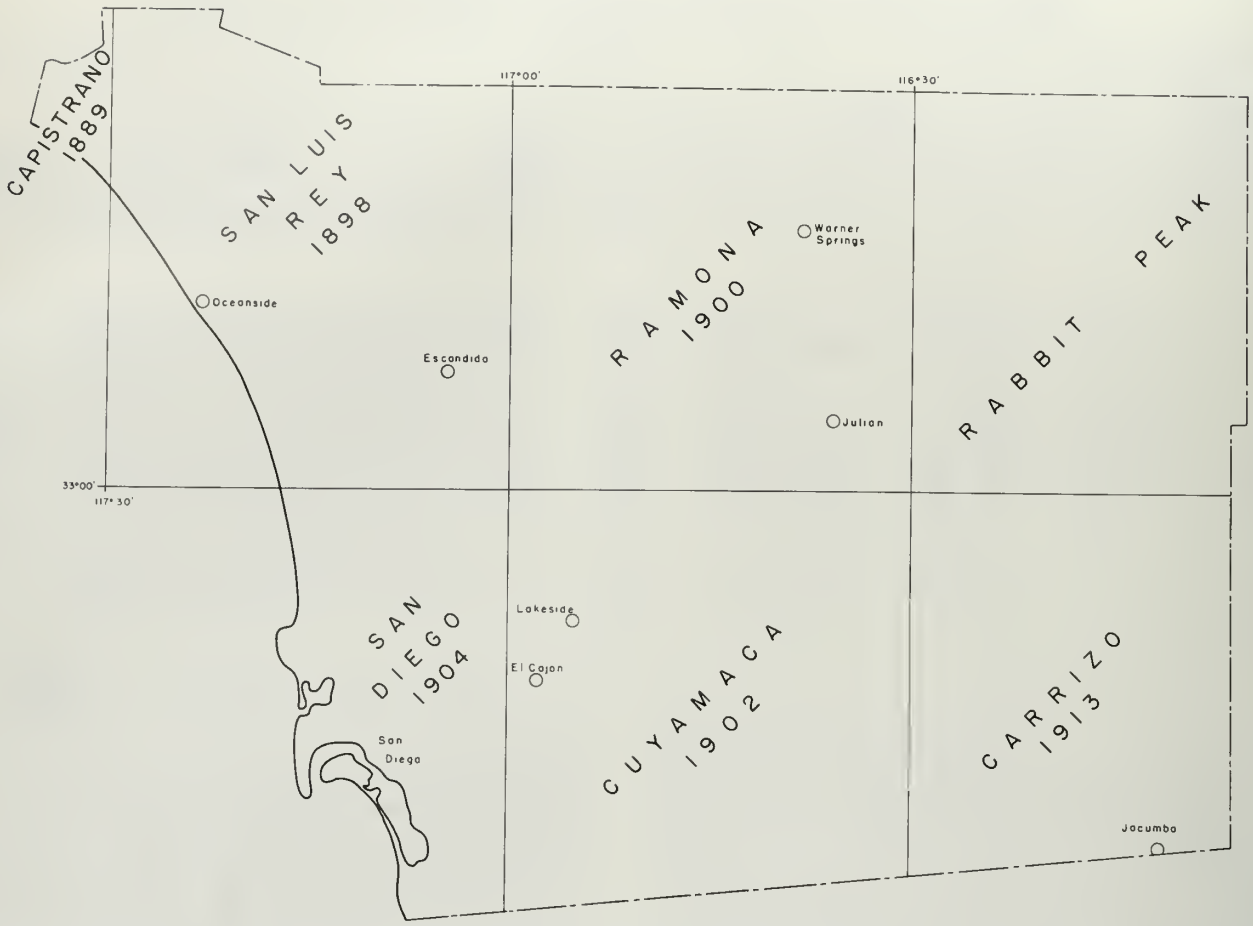


Figure 5. Map showing first coverage of San Diego County by topographic maps of the United States Geological Survey. For modern coverage, see plate 2.

regarding county use permits, which are required for surface mining and petroleum exploration operations, may be obtained from the County Planning Commission, San Diego.

For this discussion, land is divided into three categories: (1) land open to prospecting and location of mining claims; (2) land possibly open to prospecting by permit, but closed to location of mining claims; and (3) land closed to prospecting and location of mining claims.

LAND OPEN TO PROSPECTING AND LOCATION OF MINING CLAIMS

Land open to prospecting and location of mining claims consists of vacant, unappropriated public land (public domain) which is administered by the United States government. As of 1955, about 15 percent (409,397 acres) of the total land area in San Diego County consisted of unappropriated public domain. All of this land was in the mountainous areas of the county, especially along the west edge of Anza-Borrego Desert State Park; along the Mexican border, between the west side of the San Ysidro Mountains and the Campo area; in the Cleveland National Forest; and in the Rincon area (see Pl. 11). In 1957, however, parts of the public domain in the McCain Valley and Jacumba areas, and in the San Ysidro Mountains were being considered for withdrawal into "wildlife management areas." Regulations of the United States and the State of California that apply to location of claims on the public domain are explained in the legal guide, previously described.

Most of the Cleveland National Forest is open to prospecting and location of mining claims, except private lands within the forest, campgrounds, picnic areas, forestry station sites, fire lookout sites, summer home tracts, and lands which are operated privately by permit as organization camps and recreation areas. Access to many parts of the forest is restricted, however, during the fire season and no part of the forest off paved roads should be entered during this season before contacting a ranger. Under the Multiple Use Act, the government retains the right to manage the surface resources, which remain public property. The claim holder may use timber from the mining claim for development of the claim, but it must be cut by use of proper forest management, as prescribed by the Forest Service. Before a claim holder may build an access road to his claim, he must obtain a permit from the Forest Service. Patents may be applied for claims in the national forest, as on the public domain outside.

For information regarding prospecting in the Cleveland National Forest, the prospector should contact the office of Forest Service concerned with the part of the forest he is in:

(1) Trabuco District (Santa Margarita Mountains in San Diego County; and Riverside County)
Santa Ana

(2) Palomar District (Palomar Mountain region)
Escondido

(3) Descanso District (central and southeastern San Diego County)
Descanso

LAND POSSIBLY OPEN TO PROSPECTING BY PERMIT, BUT CLOSED TO LOCATION OF CLAIMS

Lands that are closed to location of mining claims, but possibly open to prospecting include Indian reservations, lands owned by the State of California, and privately owned lands.

Indian Reservations

Indian reservations comprise 110,036 acres of San Diego County, as shown on Pl. 11. One who desires to prospect or to develop a mineral deposit on an Indian reservation must first obtain permission to do so from the tribe concerned, then make application to the United States Bureau of Indian Affairs. The person to contact in each tribe can be identified through the Area Field Representative, Riverside Area Field Office, United States Bureau of Indian Affairs, Riverside.

The following description of the procedure for making application to the Bureau of Indian Affairs for a prospecting permit on Indian lands was extracted from a letter received by the Division of Mines from the Sacramento office of the bureau in December 1957:

1. The authority from the tribe to grant a permit for prospecting must be in writing and contain the following information:

a. The name and mailing address of the person to whom the permit is to be issued.

b. A description of the tract of land to be prospected. This description should be in accordance with the public survey, if possible, otherwise a description by known and readily discernible landmarks encompassing the area should be given. An estimate of the acreage involved should also be included.

c. The period of time for which the permit is desired. Prospecting permits are issued for periods of time varying from 30 days to one year from the date of the approval by the area director.

d. The type of prospecting permit desired. There are two types of permits that we are authorized to issue without an advertised sale, (1) a nonexclusive without option to lease and (2) a nonexclusive with option to lease 40 acres.

e. The amount of remuneration that the tribe will receive for granting the permit.

2. When the authorization is secured, the prospective permittee must submit it and the following additional documents to our Riverside area field representative:

a. If the prospective permittee is other than an individual (i.e., company, partnership, corporation), a copy of the articles of incorporation as approved by the state in which incorporated (and if out-of-state, approval by the State of California), and a copy of the minutes of the meeting in which the present corporate officers were elected.

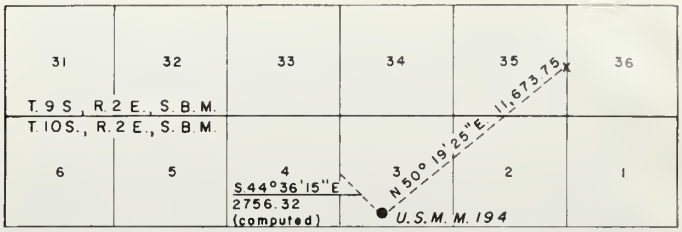


Figure 6. Map showing location of U.S. mineral monument in San Diego County, about 8½ mi. west-northwest of Warner Springs on Aguanga Mountain. Description: M.M. No. 194 Sec. 3, T. 10 S., R. 2 E., S.B.M.S. 50° 19′ 25″ W. from ¼ corner common to secs. 35 & 36, T. 9 S., R. 2 E., S.B.M. 11,673.75 ft.

b. A remittance made payable to the Bureau of Indian Affairs for the amount specified in the petition. (If the prospecting permit is not issued, the remittance will be refunded.)

3. The field representative at Riverside will verify the signatures on the authorization and forward all of the documents to this office for the preparation of the prospecting permit.

4. The prospecting permit will be prepared and sent to you for signature and securing of a performance bond from an acceptable surety company, in an amount that will be specified within the permit. (The amount of bond is determined by this office and is dependent on the amount and type of land involved.) After signature, the permit and bond must be submitted to this office for the approval of the area director.

A prospecting permit gives the permittee authority to prospect only, and to remove ore samples for the purpose of testing and assay. No mining can be done and ores cannot be removed for any other purposes. (Refer to Section 186.27a, Part 186, CFR-25, which is available from U.S. Bureau of Indian Affairs.)

Mining operations can be conducted on tribally owned trust land only with a valid lease prepared in accordance with Part 186, CFR-25. In general the requirements for a mining lease are as follows:

1. It must be proven that there are minerals in sufficient quantity to make the mine financially feasible. We are required to have the U.S. Geological Survey examine the mine site and submit a full report on their findings including a recommendation concerning the feasibility of the proposed mine.

2. If a satisfactory deposit has been located, the lease is issued in the following manner:

a. By negotiation with the holder of a valid prospecting permit which covers the land to be leased and contains the option to lease 40 acres, or

b. If subparagraph (a) does not apply, by advertised sale.

3. The proposed lessee must be able to submit a plan for the proper development of the mine and show that he has the necessary assets to carry out the plan of development.

4. The proposed lessee must submit six copies of a plat of the area to be leased, drawn to scale. If the land to be leased cannot be described by metes and bounds in accordance with the public survey, the proposed lessee at his own expense, must have the land surveyed. The surveyor's traverse computations must also be submitted.

In answer to your other questions concerning mining claims on lands set aside as Indian reservations, the following information is furnished:

1. When reservations are established, there is usually an exception that states the land is subject to all valid claims and rights in existence.

2. If a claim is proved to be valid, it is under the jurisdiction of the Bureau of Land Management to determine if the claim can be patented.

3. If a claim, which was valid at the time the reservation was established, is abandoned, it cannot be relocated or renewed since any action which affects the land after the establishment of the reservation must be in accordance with the applicable federal regulations.

State Lands

State lands in San Diego County include: (1) state-owned lands—land deeded to the State by the United States government for support of schools (generally Sections 16 and 36 within each township), and (2) Anza-Borrego Desert State Park. The methods for obtaining permission to prospect on these two types are described below.

State-owned Lands. Application for a permit to prospect on state-owned lands may be issued by the State Lands Commission, State Building, Los Angeles 12. Such permits are issued to qualified applicants only for land that is not known to contain valuable mineral deposits at the time of issuance of the permit. Lands that contain valuable mineral deposits are subject to lease by the State on a rental and royalty basis pursuant to competitive public bidding. Copies of the regulations that pertain to prospecting permits and mineral leases may be obtained from the State Lands Commission. In December 1957 only about 10 parcels of state-owned land in San Diego County were available for issuance of prospecting permits.

Anza-Borrego Desert State Park. Anza-Borrego Desert State Park is the only state park in California open to prospecting. A large part of the park was acquired by patent from the United States government which withheld the mineral rights and instituted a procedure by which valuable mineral deposits could be developed.

A prospector who wishes to prospect in Anza-Borrego Park should first register with a ranger in the park. The prospector must follow very carefully the State Administrative Code that covers the rules and regulations of the park. When the prospector finds a deposit, he must apply to the United States Bureau of Land Management in Los Angeles for a mineral lease. This application must be in accord with the directions described in Circular 1673: "Code of Federal Regulations Title 43, Public Lands: Interior, Chapter I, Bureau of Land Management, Part 199, Mineral Leases in Lands Patented for Park and Other Public Purposes." After the lease is obtained, the prospector must apply for an easement for a right-of-way from the State Park Commission.

The procedure for application to the Bureau of Land Management and the State Park Commission is extracted from a mimeographed statement distributed by the Division of Beaches and Parks:

Application to the U.S. Bureau of Land Management may, in accord with their procedure, be by letter. It must show the applicant's name and address, proof of citizenship, a statement of holdings by the applicant of leases under Sections 199.40 to 199.56 inclusive; pending applications therefore; interests, directly or indirectly held in such leases, etc. A description of the land by which the legal subdivisions may be determined, must be included. A statement regarding the nature and extent of the proposed use, type and kind of minerals, the estimated duration of exploratory operations, the extent of operations, etc., must be given in the application.

Leases may be issued for a period of five years. Applications must be accompanied by a minimum fee of $10 for each application embracing not more than 800 acres. If leases are entered into, each lessee will be required to furnish to the U.S. Government a bond in such sum as may be determined adequate, in no case less than $1,000, to insure compliance with the terms of the lease, and for the protection of the surface owner, the State of California.

Following the issuance of a mining lease, and prior to the commencement of any work, the lessee must apply to the State of California, Department of Natural Resources, Division of Beaches and Parks (Southern California office is District 6, P.O. Box 1328, San Clemente, California) for a right-of-way for an access road to the mining operations, in compliance with Section 5003.5 of the Public Resources Code, State of California. All applications must be submitted on Form BP-26. Eight (8) copies should be submitted to the District 6 Office in San Clemente, California; and must be accompanied by eight (8) copies of a map resulting from a survey by instrument of the road, etc., as noted and called for in the instructions for filing the application, Form BP-26. These instructions will be sent with the application forms upon request.

The State Park Commission will require a bond in connection with the granting of any easement for access roads, and this will be in an amount of not less than $1,000. This is for the purpose of guaranteeing compliance with the terms and conditions of the Right-of-Way Agreement, and will be in addition to any bond required by the Federal Government in connection with the mining lease.

Additional information may be obtained from Park Supervisor, Anza-Borrego Desert State Park, Borrego Springs, California; and District Superintendent, District 6, Division of Beaches and Parks, P.O. Box 1328, San Clemente, California.

Privately Owned Land

A prospector who wishes to prospect on private land may contact the owner through local inquiry or from information obtained at the county assessor's office. Private land composes most of the western part of the county.

LAND CLOSED TO PROSPECTING AND MINING

All military reservations, and state, county, and city parks are closed to prospecting and mining (except Anza-Borrego Desert State Park, which see). Also closed are rights-of-way for public utilities, highways, and reservoir sites.

CITY AND COUNTY ZONING

Zoning is one of the major problems that confronts any company which plans to begin, or move, a mining operation. Zoning ordinances in regard to such operations have been established by most incorporated communities in the county, and the unincorporated areas are covered by a county ordinance. Although the ordinances vary in detail, all provide that applications for the establishment of rock products operations are subject to a public hearing and consideration by a planning commission, city council or other designated authority. The ordinances also provide that rock product operations be specific distances from residential districts, schools, churches and certain types of businesses.

WATER FOR MINING OPERATIONS

Water has become very dear in San Diego County, as population and industry have grown and drought years have continued. There are three principal sources of water in the county: wells; storage reservoirs which hold runoff from precipitation; and the Colorado River aqueduct. The principal use of water by the mining industry of San Diego County in 1959 was for washing sand, gravel and stone products. Water for this and allied purposes is obtained chiefly from company-owned or leased wells in the major stream valleys in the San Diego region. In 1959, the H. W. Rohl Company, Oceanside, was operating a well which pumped brackish water, suitable only for industrial use. The Crystal Silica Company, also in Oceanside, was rationed water by the City of Oceanside and therefore was forced to reclaim used water by recycling through a series of settling ponds. Additional water for mining in areas north of San Diego possibly may be obtained from wells drilled in sandstone of Eocene age which forms a narrow belt along the coast from Del Mar northward to the Orange County line (see Pl. 1). Water from these rocks is reported to be too brackish for agricultural use and only barely suitable for domestic use (Ellis and Lee, 1919, p. 253-254; Babcock, 1958).

In the interior of the county, wells drilled in bedrock composed of granitic or metamorphic rocks may be the only source of water for mining operations, if sources such as springs, streams, valley fill and privately or publicly owned lines are not available or suitable. In sedimentary rocks, such as those along the coast, faults may create impermeable, waterless barriers, but in granitic and metamorphic rocks, fault zones commonly comprise permeable, water-bearing zones which should be considered as possible drilling targets (Merriam, 1951). In addition, dikes, contacts, minor planar features (such as joints, schistosity and rock cleavage), and intersections of any of these features, also are possible targets. The water-bearing potential of these features can be evaluated by geologists, through detailed field studies and by use of detailed geologic maps and/or relatively large scale vertical aerial photographs. Vertical aerial photographs of San Diego County may be purchased from the Commodity Stabilization Service, United States Department of Agriculture, Salt Lake City, Utah. As yield from wells driven in bedrock is generally much lower than from wells driven in sedimentary rocks, radials driven outward from the bottom of drill holes are used to increase flow.

The principal references that deal with groundwater in San Diego County are: Ellis and Lee (1919); Merriam (1951); Babcock (1958); and publications of the California Department of Water Resources (before 1956, Division of Water Resources). These and other references that deal with ground water are listed in the bibliography on "Water Resources, Soils, and Engineering Geology" at the back of the text. For local information concerning water in San Diego, contact the California Department of Water Resources office in Escondido.

PREVIOUS DESCRIPTIONS OF MINERAL DEPOSITS

Descriptions of mineral deposits and mining activities in San Diego County have been provided by the California Division of Mines and Geology (which before 1928 was named the California Mining Bureau) since 1886. Early, rather short descriptions and accounts were provided in the annual reports of the State Mineralogist by Hanks (1886), Goodyear (1888, 1890), Preston (1890), Storms (1893), and Crawford (1894, 1896). The annual reports were not published from 1896 to 1916, but in 1902 a tabulated list of the mines in the county prepared by Hubon was published as a Register of Mines. In 1914, a comprehensive report entitled "Geology and Mineral Resources of San Diego and Imperial Counties" by F. J. H. Merrill was published separately by the bureau, then reprinted in its 14th report, which was published in 1916. Reports on mining in the county were prepared between 1921 and 1943 by W. B. Tucker, of the Mining Bureau's Los Angeles office, which was created in 1920. The most detailed and comprehensive of these reports was published in 1925. R. J. Sampson assisted Tucker, and prepared reports from 1930 and 1943.

The last general report on the county was written by Tucker, assisted by C. H. Reed of the San Diego Mining Bureau, and was published in 1939. Since 1943 the San Diego County Division of Natural Resources has prepared yearly a short summary of the mining activity in the county.

Descriptive reports of particular deposits, districts, or commodities have been written by Hudson (1922), Donnelly (1934), Creasey (1946), Hoppin and Norman (1950), Jahns and Lance (1950), Durrell (1953), Jahns and Wright (1951), Hanley (1951), Cleveland (1960), and others. Short descriptions or notations of San Diego County deposits are given in California Division of Mines Bulletin 176, "Mineral Commodities of California," which was published in 1957. Additional references concerning mineral deposits and mining activity are provided in the subject bibliographies entitled "Mineral Resources and Mining" and "Pegmatites" at the back of the text.

MINERAL COMMODITIES AND DESCRIPTIONS OF MINERAL DEPOSITS

The principal mineral commodities of commerce, and selected mineral-use groups, as they apply to the mineral industry of San Diego County, are discussed below in alphabetical order. In these discussions data is provided on the character and distribution of deposits, the history of mining operations, the methods of mining and milling, products and value of production, and other material. Descriptions of the deposits, and of present and former mining operations, follow the pertinent commodity discussions, either within the text, or in tabulated lists. Also in the tabulated lists are names and descriptions of claims, groups of claims, prospects and mills. Synonyms are given in the lists for all types of entries, and are cross indexed.

Those descriptions, within the tabulated lists, that are initialed "R.M.S." were prepared by Richard M. Stewart.

The following mineral commodities are not known to occur in the county: barite, cadmium, chromium, mercury, platinum, sulfur, talc and soapstone, and titanium.

For readers unfamiliar with the subdivision of the township and range system, as used herein to describe location and property holdings, diagrams illustrating its use are given in the "Legal Guide for California Prospectors and Miners" published by the Division of Mines and Geology. Ownership data provided in the report are changeable and should be confirmed with the offices of the San Diego County Assessor (patented property) or San Diego County Recorder (unpatented property). Full descriptions of all references cited within the text or tabulated sections are given in the "Collective Bibliography" at the back of the text.

ABRASIVES

The beaches between Oceanside and San Diego were the principal sources of pebbles for grinding in California from 1915 to 1949 (Troxel, 1957, p. 27). During the early years of production an important locality was the beach near Bird Rock, south of La Jolla (Bradley, 1917, p. 80). Later, the principal localities were the beaches between Carlsbad and Encinitas, and especially at Ponto. John Momand, of Carlsbad, recovered pebbles for grinding and filtering from Ponto Beach and other localities from 1929, or before, to 1949. His output of the later years was purchased mainly by the Crystal Silica Company for use in filtering systems (see Ponto Beach under "Sand and Gravel, and Crushed and Broken Stone").

The pebbles marketed for grinding ranged in diameter from three to six inches, and were sold for $65 per short ton (Troxel, 1957, p. 27). They were composed mainly of silicified metamorphic and igneous rock types. Porcelain balls generally now have replaced pebbles for grinding, but for businesses where they have not, pebbles must be purchased from midwest United States or foreign sources.

Garnet, which is used as the abrasive for some types of sandpaper, is found in very small proportions in pegmatite dikes (see "Gem Minerals") and in tactite bodies (see "Tungsten"). At the present time, however, none of the deposits in the county are potential sources of garnet for use as an abrasive.

An undeveloped deposit of volcanic ash (pumicite) occurs north of Borrego Springs (see Pompai group under "Volcanic Ash" in tabulated list). Volcanic ash is used as a mild abrasive.

AGRICULTURAL MINERALS AND SOIL AMENDMENTS *

The Circle Group Deposit near Jacumba might be considered as a possible source of vermiculite for use as an agricultural mineral (see description in section on "Vermiculite"). Expanded vermiculite improves the texture of heavy clay soils (Rollins, 1951, p. 98). Expanded shale also has been considered for the latter use (see "Expansible Shale"). Bentonite from the Otay Deposits (see description under "Clay"), near Otay and San Ysidro, might be suitable as an additive to coarse-grained soils, to improve their water-holding ability.

Other minerals that occur in San Diego County which may be of possible value as agricultural minerals are gypsum (see under "Gypsum"), which occurs along the east edge of the county; limestone (see section on "Limestone-dolomite"), which may be added to acid soils; and phosphate-bearing nodules in the Linda Vista terrace deposits, which occur between Mission and San Dieguito Valleys (see under "Phosphates"). The latter deposits may be too low grade, however, even to be considered as possible economic sources.

Peat from the San Luis Rey Deposit has been used as a soil amendment (see under "Peat").

* As defined in the fertilizing materials article of the Agricultural Code of California. (See Rollins, 1951, p. 80.)

Abrasives

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
1	Bird Rock deposit	On the sea coast, about 2 miles south of downtown La Jolla.		Beach pebbles.	An early source of pebbles for grinding. See text. (Bradley 17:80).
	Golden Stump Ext. #1	"Laguna Mountains".	Undetermined (1958) J. N. Sexton (1939)		Listed as a "garnet" claim by Tucker and Reed (1939). No additional published information. See also Golden Stump in tabulated list under "Gold." (Tucker and Reed 39:54).
	Ponto Beach (Abizaid)	South of Oceanside.			Formerly a source of pebbles for grinding and for filtering. See tabulated list under "Sand and gravel, and crushed and broken stone." (Troxel 57:27).
	Unnamed	Fish Creek area, about 10 miles south of Ocotillo Wells, in Anza-Borrego Desert State Park.			Merrill (1914) reported that Bert Simmons of El Cajon, and Homer Bailey of San Diego had located claims on a deposit of massive garnet in sec. 25, T13S, R8E, SBM. Occurrence has not been substantiated. (Merrill 14:705).

ALUMINUM MINERALS

The most alumina-rich rocks in San Diego County are (1) beds of clay in the western and eastern parts of the county which probably contain less than 20 percent alumina (aluminum oxide); (2) the granitic rocks of intermediate composition in the middle of the county, which probably contain about 15 percent alumina; and (3) feldspar-bearing beach sands, and sandstone deposits of Eocene age. These rocks, however, all contain much smaller proportions of alumina than alumina-rich and high-alumina clays which have been considered as possible sources of aluminum ore in other parts of the United States.

ANTIMONY

Commercial deposits containing antimony have not been found in San Diego County. The only reported occurrence of this element in the county is in the Mesa Grande district where stibiotantalite (oxide of antimony and tantalum) and stibiocolumbite (oxide of antimony and columbium) occur in extremely small proportions in gem-bearing pegmatites (R. H. Jahns, California Institute of Technology, personal communication, 1957).

ARSENIC *

Arsenopyrite, the sulfarsenide of iron, is a common accessory mineral in the gold-bearing quartz veins in most of the gold districts of San Diego County. It is abundant locally in such veins. Large concentrations of arsenopyrite were found in, and near, the quartz bodies of the Gold Cross No. 1 Deposit in the Julian district (Donnelly, 1934, p. 360-361); and the ore from the Willhite Mine, in the Laguna Mountains, was reported to contain abundant arsenopyrite (Tucker and Reed, 1939, p. 12).

Only the Black Mountain Deposit, which contains arsenopyrite and minor proportions of gold, has received attention as a possible source of arsenic. A treatment plant to recover both arsenic and gold was erected near the deposit, and in 1924 a small amount of arsenical concentrates was shipped.

* By R. M. Stewart.

Black Mountain Group

Location: Sec. 5, T. 14 S., R. 2 W., S.B.M.; on the north slope of Black Mountain, about 6¾ miles north of Miramar. *Ownership:* Oliver Wylie Estate, c/o Mrs. Margaret W. Horner, 2008 Fremont Ave., South Pasadena (1955).

Efforts to recover arsenic and gold from this deposit were confined mostly to the 1920's. According to records made available by the owner, the Mace Company, Denver, Colorado conducted smelting tests on samples of the arsenical ore to produce a gold-bearing matte and recover arsenic trioxide as a fume. No plant for such a process was developed. A small concentrating plant was erected early in 1924 even though no ore reserves had been developed. This also was impractical because of an insufficient water supply and was shut down and dismantled in July of that year. Subsequently, but before 1930, a Gates rotary roaster (estimated from remaining brickwork to have been 15 feet long and 5 feet in diameter) was installed. A reinforced concrete stack, 5 by 6 feet in cross section and 180 feet long, was constructed directly upon the hillside and connected to the roaster by a metal pipe. A small crushing plant provided crushed material for the roaster. Presumably arsenic was to be recovered from condensed fumes in the stack. Three cyanide leaching tanks to treat the roasted ore for gold recovery also were installed but never used. Only a ton or two of ore was ever roasted. The only recorded shipment from the property consisted of 700 pounds of material containing 31.4 percent arsenic, plus a small amount of gold and silver, which was sent to a chemical plant at Martinez, California in 1924. Several unsuccessful efforts to develop the deposit have been made since 1930, but none recently. The concrete stack, crushing plant structure and brickwork for the roaster were all that remained of the plant in mid-1955.

Arsenopyrite is distributed rather sparsely as small masses as large as 3 cm. long and 0.5 cm. thick along fractures and seams in fine-grained quartzite which is a member of the Black Mountain volcanic rocks of probable Jurassic age (Hanna, 1926a, p. 199-201, map).

Arsenic

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
2	Black Mt. deposit	North of Miramar.			See text. (Tucker 25:329; Tucker and Reed 39:12, pl.1).
	Cedar Creek mine	San Ysidro Mts.		Arsenopyrite with galena and other minerals in quartz veins.	Developed for lead minerals. See tabulated list under "Lead". (F.H.W.)
	Gold Cross No. 1 claim	Julian district.		Large concentrations of arsenopyrite associated with gold in quartz vein.	Ore not mined as a source of arsenic. See tabulated list under "Gold". (Donnelly 34:360-361).
	Metal Mt. mine	Northwest of Live Oak Springs.		Arsenopyrite with galena and tungsten minerals in quartz veins.	Mined for tungsten. See text under "Tungsten." (F.H.W.)
	Willhite group	Laguna Mts.		Arsenopyrite in gold-bearing quartz vein.	Ore not mined as a source of arsenic. See tabulated list under "Gold". (Tucker 25:329; Tucker and Reed 39:12).

Lenses of arsenopyrite have been reported, but no dimensions for them have been given (Tucker, 1925, p. 329). Pyrite and chalcopyrite are present in minor proportions within the arsenopyrite concentrations. The sulphides are auriferous.

The arsenopyrite concentrations are distributed discontinuously for a distance of at least 200 feet. The deposit has been explored inextensively by adits, shafts and shallow pits and trenches. Two adits were driven about 30 feet apart on opposite sides of a small canyon. The longest extends S. 10° E. for 25 feet, then S. 28° E. for 50 feet. The other, to the north, extends N. 25° E. for about 30 feet. Two shafts now caved but reported to be 40 feet deep each (Tucker, 1925, p. 329), were sunk at the portal of each of the adits described above. There is no record of ore encountered in the shafts, and arsenopyrite-bearing material was found only in the first 25 feet of the longest adit (Harley Sill, 1930, private report). A shallow pit, 100 feet higher and 200 feet south of the main adit, exposed a zone containing arsenopyrite. A sample from that pit assayed 7.48 percent arsenic and 0.34 ounce of gold per ton (Harley Sill, op. cit.).

ASBESTOS

Asbestos occurs at the Circle Group Deposit, near Jacumba, which is described herein under "Vermiculite." It has been reported by Goodyear (1890, p. 148) to occur at a locality about three miles northeast of Warner Springs, but this was not verified by the present writer. A production of 50 tons reported from the county in 1894 was probably from Riverside County (see Table 1).

BERYLLIUM

The mineral beryl (a silicate of beryllium and aluminum) has been found in many of the gem mineral-bearing pegmatite deposits of San Diego County. The mineral has been mined from these deposits for gems and specimens, but none has been mined for beryllium. The known beryl deposits of the county, and the rest of California, average less than 1 percent beryllium oxide (BeO) and therefore never have constituted ore (Wright, 1957a, p. 75). Additional beryllium minerals that occur in the gem mineral deposits, but only rarely, are bertrandite, helvite, and phenakite.

The most significant beryllium deposits known in the county probably are the beryl-bearing pegmatite dikes of the Tule Mountain area, which is northwest of Jacumba. Beryl has been known to occur at one locality in this area since the early 1900's, and early in 1961 the mineral was discovered in several adjacent dikes as large, very pale green crystals (see description of Ruby group). The Jacumba region as a whole, and especially the Tule Mountain area, merit additional prospecting for beryllium minerals.

The only attempt, known to the writer, to develop a commercial beryllium deposit in San Diego County was in 1937 when the Beryllium Alloys Company, Vista, attempted to develop a reported beryl-bearing pegmatite

Beryllium

Map No	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Crystal Gem mine	North-northwest of Jacumba.			See Ruby group herein and Crystal Gem mine in the tabulated list under "Gem minerals". (Kunz 05:152; Merrill 14: 693, 703).
	Freeman	Northeast of Vista.			Map locality name used by Tucker and Reed (1939, pl.1) for a property described in their text as the Mountain Bell mine. Actually, "Freeman" was one of the owners of the Vista Chief property, to the north, in Moosa Canyon; Mountain Belle was one of the claims that composed the Vista Chief property (which is described in the tabulated list under "Gem minerals"). The "Mountain Bell" of Tucker and Reed (1939) probably is actually the Hogerman property, which see. (Tucker and Reed 39:13, pl.1).
3a	Hogerman property (Mountain Bell mine)	Secs. 8 and 9, T11S, R3W, SBM; about 3 miles northeast of Vista, on the west slope of the San Marcos Mts.	Mrs. Vera Strand, (address undetermined), La Mesa (1957)	Reported as a discovery of beryl in a northwest-trending pegmatite dike. Occurrence not substantiated by the present writer.	In 1937, Beryllium Alloys Company, San Francisco (W. E. Schoppe, president) began to develop a deposit that supposedly contained beryllium ore. The venture was short-lived and a failure, however. The site was a 160-acre tract owned by the late Edward Hogerman of Vista. Workings developed by the company reportedly consisted of a 60-ft. cut and a 40-ft. adit. In 1957, the present investigator could only find a few shallow cuts in the NE¼ sec. 8 and the NW¼ sec. 9. (Tucker and Reed 39:13).
	Mountain Bell mine				See Hogerman property. (Tucker and Reed 39:13).
3b	Ruby group	North-northwest of Jacumba.			See text. (Kunz 05:152).

deposit on the Hogerman (Mountain Belle) property, northeast of Vista. This venture failed, however, and no ore was mined (see description in the tabulated list).

Ruby Group

Location: Mainly in the SE.¼ Sec. 2 and the NE.¼ Sec. 11, T. 17 S., R. 7 E., S.B.M.; about seven miles north-northwest of Jacumba, north of Tule Mountain, in the Sacotone Spring area. *Ownership:* The group comprises three unpatented, north-northwest trending, contiguous claims which are owned by Don Weaver of Jacumba. Mr. Guida, also of Jacumba, owns a single claim at the south-southeast end of the group, in Secs. 11 and 12 (1961).

Beryl has been known to occur in the Sacotone Spring area since at least as early as 1904. In that year "Collier and Smith" were reported by Kunz (1905, p. 152) to have mined "10 pounds of fine essonite garnet and perhaps three or four pounds of beryl" from the Crystal Gem mine which he reported to be about 8½ miles northwest of Jacumba (see under "Gem Minerals"). Early in 1961, large crystals of beryl were discovered by Weaver in an area about one-third mile east of the deposit surmised by the present writer to be the site of the Crystal Gem mine. By mid-1961 Weaver had opened several shallow cuts and pits in the deposits.

The deposits covered by the Ruby group consist of several beryl-bearing granite pegmatite dikes which are enclosed in a diorite-like metamorphic rock. The dikes strike north-northwestward and dip gently to moderately west-southwest into the upper part of a steep northeast-facing mountain slope. The dikes range in length from several hundreds to perhaps several thousands of feet; and they range in thickness from less than 5 to as much as 15 feet or possibly more. Beryl occurs with quartz and feldspar in cores of the dikes as nearly colorless to pale-green crystals which range in length from less than one inch to at least two feet. Small crystals generally are pale green and glassy; large crystals tend to be irregular in shape, to be very pale in color, and to resemble feldspar. Two large, pale beryl crystals that were analyzed (Smith-Emery Company, Los Angeles, 1961) contained 12.36 and 12.17 percent BeO.

One of the principal prospects in the group, in the NW.¼ NE.¼ Sec. 2, was examined in detail. This prospect develops part of a dike which is about 10 feet thick and consists of a lower zone of line rock, an intermediate zone of fine-grained schorl-muscovite-quartz-perthite pegmatite, a core of coarse-grained beryl-quartz-perthite pegmatite, and an upper zone similar to the intermediate zone. The beryl-bearing part of the core extends laterally along the face of the dike for about 10 feet, pinching outward from a maximum thickness of about three feet in the middle. Additional minerals in the core are heterosite (purpurite?), pale green muscovite, and albite variety cleavelandite.

BISMUTH

Commercial deposits of bismuth have not been found in San Diego County. Extremely minor proportions of bismuth-bearing minerals occur in the gem-bearing pegmatites at Pala (Jahns and Wright, 1951, p. 38; Kunz, 1903a, p. 398-399), at Mesa Grande (R. H. Jahns, California Institute of Technology, personal communication, 1958), and at Rincon (Rogers, 1910, p. 208). These minerals include native bismuth, bismite (bismuth oxide), bismuthinite (bismuth sulfide), bismutite (bismuth oxycarbonate), and others.

BORON

Deposits that contain boron in commercial proportions have not been found in San Diego County. The only boron-bearing minerals known to occur in the county are tourmaline (a complex boro-silicate), axinite (calcium, aluminum boro-silicate), dumortierite (a hydrous aluminum boro-silicate), and hambergite (a beryllium borate). *Tourmaline* is found in minor proportions in pegmatite dikes in many parts of the county, but mainly in the Pala, Mesa Grande, Ramona, Rincon, Chihuahua Valley, and Jacumba areas (see "Gem Minerals"). *Axinite* occurs at the Vista Chief Deposit, near Bonsall, which is described herein in the tabulated list under "Gem Minerals." *Dumortierite* occurs at the Dehesa deposit described herein under "Kyanite and Related Minerals." *Hambergite* is a very rare mineral which has been found at the Little Three Gem Mine near Ramona.

Three dry lakes in the eastern part of the county have been listed as containing "borates in varying quantities" (Bailey, 1902, p. 69). These are Clark, Bensons and Halfhill Lakes. However, the occurrences have not been verified by the writer.

Boron

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
4	Unnamed	T11S, R8E, SBM; Benson Dry Lake, in northeastern San Diego County.			Reported in a list of unnamed dry lakes that "contain borates in varying quantities". An unsubstantiated occurrence. (Bailey 02:69).
5	Unnamed	T9S, R6 and 7E, SBM; Clark Lake, in northeastern San Diego County.			Reported in a list of unnamed dry lakes that "contain borates in varying quantities". An unsubstantiated occurrence. (Bailey 02:69).

Bromine

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	California Chemical Corporation				See Westvaco Chlorine Products Corp. (Ver Planck 57a:95; 58:115).
	Westvaco Chlorine Products Corp. (California Chemical Corp.)	Chula Vista.			California Chemical Corp. constructed a Kubierschky tower at Chula Vista in 1926 and in it produced bromine compounds from salt works bittern until 1937. During that year the operation was taken over and continued by Westvaco Chlorine Products Corp. (now Mineral Products Div., Food Mach. & Chem. Corp.) until 1945. The company produced ethylene dibromide and attempted to market liquid bromine. Mineral Products. Div. now produces only magnesium chloride. (Ver Planck 57a:95; 58:115).

BROMINE

Bromine was produced first in California in 1926 at Chula Vista, by the California Chemical Corporation (Ver Planck, 1957a, p. 95). This firm produced both magnesium and bromine from sea water bittern from 1926 to 1937, when it sold its operations at Chula Vista and Newark, California to Westvaco Chlorine Products Corporation. Westvaco continued to produce bromine at Chula Vista until 1945, but now, as Mineral Products Division, Food Machinery and Chemical Corporation, produces only magnesium chloride. The bromine was produced in a Kubierschky tower.

CALCITE (OPTICAL GRADE)

Calcite (calcium carbonate) is one of the most common minerals in the earth's crust. In San Diego County it occurs as the principal constituent of limestone deposits at Dos Cabezas, and near Ranchita, Jacumba, Pine Valley, and Jamul. However, deposits that contain large clear crystals (Iceland spar) of optical or suboptical grade are very rare, and only two such deposits have been mined in California (Wright, 1957b, p. 99). One of these deposits is the Hilton, in the northeastern part of San Diego County, which was operated during World War II for suboptical grade material used in gun sights. Since that time, optical calcite has been replaced partly by polaroid in the manufacture of optical objects (Wright, 1957b, p. 99).

Hilton Deposit *

Location: S.½ Sec. 14, and S.½ Sec. 15, T. 10 S., R. 8 E., S.B.M.; low on the east side of the Santa Rosa Mountains, about eight miles due west of Truckhaven, which is in Imperial County. The deposit can be reached by a fair but steep dirt road from the Truckhaven-Borrego Valley trail. The turnoff for the mine is about eight roadmiles west of Truckhaven. *Ownership:* Undetermined (1957). C. Jack Frost, Banning, and Robert R. Dye, Indio, owned five claims in 1947.

The Hilton deposit was discovered in 1936, and worked sporadically until 1942 by John Hilton and a Mr. Heather, who mined small quantities of unusual, thin, tabular calcite crystals which were sold as optical material. In 1942, the property was purchased by Calcite Operators, Incorporated, Thermal, which was managed by Arnold Hoffman. Calcite Operators worked the deposit from October 1942 to October 1943. During this period the corporation employed as many as 30 men and held about 25 claims. The operation was resumed for a short time, on a small scale, in 1944 by C. Jack Frost and Robert R. Dye, former employees of Calcite Operators. The deposit has been idle since 1944.

About 6,800 pounds of sub-optical grade calcite was accepted by Polaroid Corporation of Cambridge, Massachusetts, from material mined and shipped from the deposit during 1942-1944 (Durrell, 1944, p. 23). The calcite accepted was used in the manufacture of ring gunsights.

* The following description was taken mainly from an unpublished U.S. Geological Survey report written in 1944 by Cordell Durrell.

Calcite (optical)

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
6	Hilton deposit	Northeastern part of county.			Unique optical calcite occurrence. See text. (Bowles 21:1-6; Bramlette and Eakin 43:1-4; Durrell 44:1-28; Ricker 43; Wright 50:136-138; 57b: 99-100).

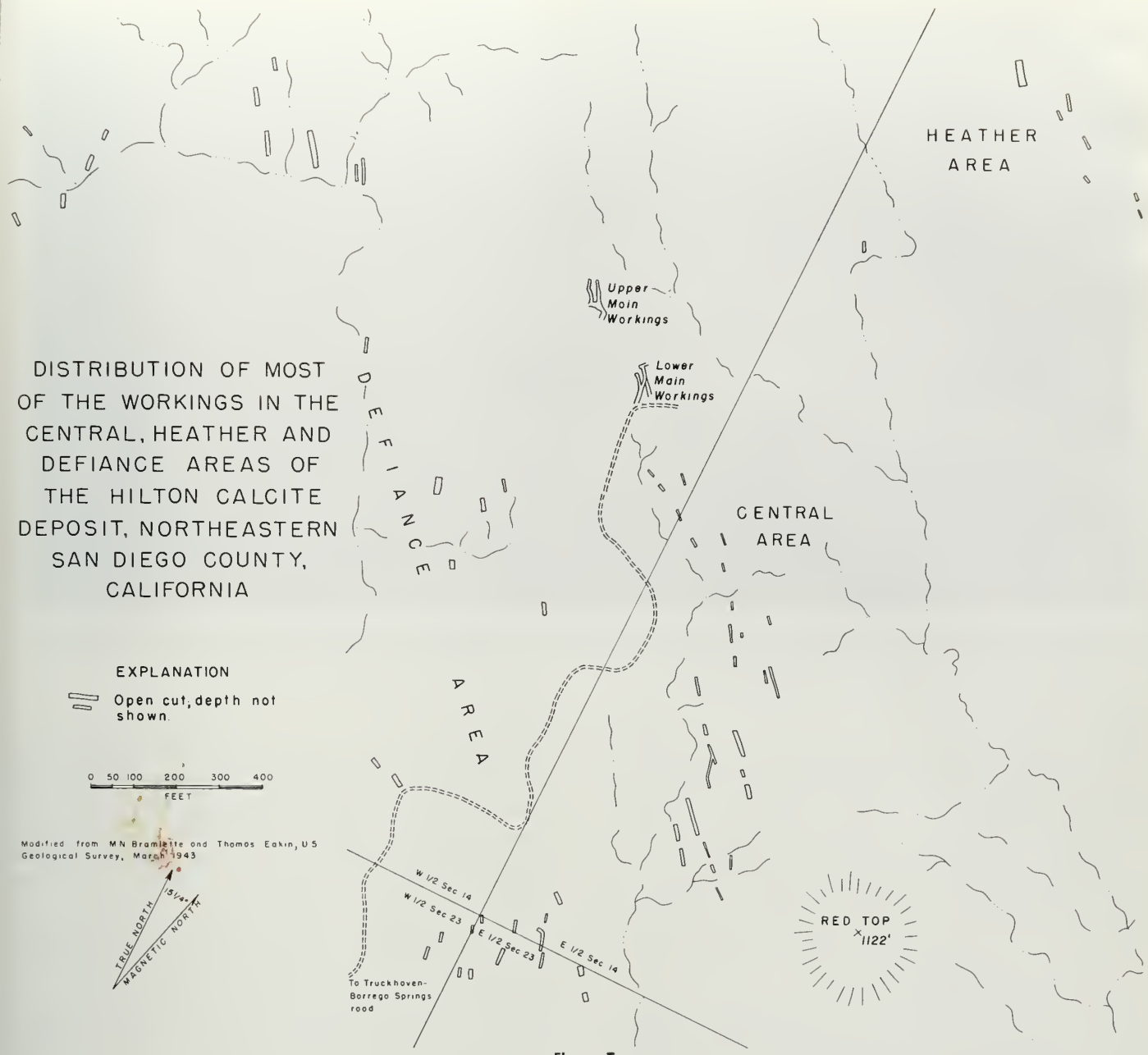


Figure 7.

Indicated reserves in the deposit were estimated by Durrell to be about 3,000 tons of useable calcite, to a depth of 48 feet.

The suboptical grade calcite occurs with common calcite and gypsum as veins which filled joints in the Canebrake conglomerate of Mio-Pliocene age (Dibblee, 1954, Pl. 2). This formation underlies much of the badland which extends eastward from the Santa Rosa Mountains. In the area of the Hilton deposit the rocks are mainly thick-bedded conglomeratic sandstone which strikes northeastward and dips generally from 15° to 20° southwest (Photo 24). The joints that contain calcite strike N. 25° - 45° W., and range in dip from 65° southwest to nearly vertical. They have a maximum length of about 300 feet. Most of the suboptical grade calcite occurs in cavities (or "pockets") at intersections of joints, with elongation of the cavities generally extending down the lines of intersection of the joints. The pockets are quite variable in size; one of the largest mined, as described by Durrell (1944, p. 11), was 22 feet long, 14 feet deep, and slightly more than two feet in maximum width. The useable calcite occurs mostly as basal plates which are as much as 18 inches in diameter and less than one-half inch in thickness. Growth lines and cleavages, either developed, or incipient, are common defects.

Four areas of calcite mineralization were designated and described by Durrell (1944) as follows: (1) the Central area, in the center of the S.½ Sec. 14, which has

Photo 24. View southwest toward Hilton optical calcite deposit. Rocks in foreground are conglomeratic sandstone of Canebrake conglomerate, of Mio-Pliocene age. Workings, which consist of trenches, are shown in center and right middleground. Segment of road to deposit from Truckhaven is shown at extreme right. Part of Salton Sea is barely visible at extreme upper left.

yielded 75 percent of the calcite mined in the region, and contains slightly more than half of the workings; (2) the Heather area, which is northeast of the Central area, in the NW.¼ SE.¼ Sec. 14, and is the second most intensely worked area; (3) the Defiance area, which is west of the Central area, in the S.½ SW.¼ Sec. 14, and is largely undeveloped; and (4) the Victory area, which is about one mile east of the Central area, in the S.½ Sec. 15, and is also largely undeveloped. Veins in the latter area, however, are largely gypsiferous, and cavities have not formed.

The veins were developed by about 75 trenches which range in length from 10 to at least 100 feet, in width from about 4 to 5 feet, and in depth to 30 feet (Photo 24, Fig. 7). Nearly all of the trenches are parallel to the strikes of the veins.

CESIUM

Pollucite (a hydrous silicate of aluminum and cesium) is a rare constituent of the gem pegmatite deposits of the Pala and Mesa Grande districts (W. T. Schaller *in* Murdoch and Webb, 1956, p. 255). Commercial quantities of this mineral were sought unsuccessfully in 1929 by the General Electric Company at the San Diego mine, Mesa Grande district. Cesium also occurs as a very minor constitutent of pink beryl crystals which have been found in the Pala and Mesa Grande districts, and at Aguanga Mountain. The element also may be a constituent of similar unanalyzed crystals which have been found in the Ramona and Rincon districts.

CLAY *

The principal clay deposits in San Diego County lie along the coastal plain from Oceanside south to the Mexican border. Some are predominately marine mudstone; others are claystone of residual origin; and still others consist of bentonite. Large and potentially useful claystone deposits occur in the eastern part of the county. Small deposits formed by hydrothermal alteration or weathering of pegmatites are in areas underlain by crystalline rocks. All of these deposits, with the exception of the bentonite deposits, yield clays that may be used in ceramics, mainly for making bricks, but also for sewer pipe and other heavy clay products. These clays are not pure minerals but are mixtures of clay minerals, silt, sand and organic matter and are called clay materials. The clay minerals present, those which bind the other constituents together when fired, are kaolinite and illite or commonly both. Bentonite is used chiefly as an adsorbent in industrial refining processes. This material is largely composed of the clay mineral montmorillonite. The properties and uses of both ceramic and bentonitic clays in California are summarized in Table 2.

The recorded output of clay in San Diego County from 1912 to 1956 is 559,438 tons valued at $1,406,031 (Symons, 1935; unpublished records of the California Division of Mines—U.S. Bureau of Mines co-operative program). However, the actual production may have

* By George B. Cleveland.

*Table 2. California Industrial Clays.**

Principal commercial types	Principal mineral or minerals	Significant characteristics and chemical composition	Significant physical characteristics	Fired color	Industrial applications
Ceramic Clays					
I. Fire clay	Kaolinite group	Principally silica (40-55%) and alumina (20-45%).	Highly refractory; generally plastic	White to red	Fire brick, ladle brick, fire clay mortar, drain tile, face tile, pottery.
II. Kaolin (China clay)	Kaolinite group	Free from iron and alkalies with total oxide impurities less than 3%. Often high in organic material.	Low plasticity	White	Whitewares, refractories, filler in paint, rubber, and paper.
III. Ball clay	Kaolinite and montmorillonite		High plasticity	White to light cream	Whitewares; generally mixed with other clays to increase strength, bonding, and plastic properties.
IV. Miscellaneous clay	Kaolinite and illite	Principally alumina and silica (high in ferric oxides and other fluxes).	Low heat resistance	Red	Heavy clay products, building brick, face brick, paving brick, drain tile, sewer pipe; source of silica and alumina in cement; rotary drilling mud.
Bentonitic Clays (General)	Montmorillonite, beidellite, and hectorite	Principally alumina, silica, magnesia and lime.			Suspending agent, filtering, decolorizing, filling agent.
I. Swelling bentonite		High in Na, low in Ca	Swells, forms a gel or suspension; high plasticity; non-activatable.		Well drilling muds, binder in foundry sands, pharmaceuticals; and beverage clarification.
II. Non-swelling bentonite (Adsorbent clays)		High in Ca, low in Na; good decolorizers			Filtering, filler, insecticide carrier, decolorizer, catalyst.
A. Naturally active (fullers earth)					Filtering; decolorizer for waxes, resins and petroleum oils; catalyst, insecticide carrier.
B. Activatable (activated)					Filtering; decolorizer for waxes, resins and petroleum oils; catalyst.

* Modified from Table 6, California Division of Mines Bull. 176, p. 144.

been nearly twice this much. Total clay production figures are unavailable for clay mined prior to 1912, clay used in cement, and clay used by the clay companies between 1933 and 1942.

Residual clay deposits that were derived from shale and conglomerate, and probably were formed in Paleocene time, occur east of Carlsbad and Cardiff. These deposits are overlain by the Delmar sand, which is the basal member of the Eocene La Jolla formation. The clay is exposed only in relatively small areas where erosion has removed the overlying rocks. The clay is probably a product of the intense period of weathering which formed the valuable, residual and sedimentary fire clays of the Silverado formation in the northern Santa Ana Mountains area in Riverside and Orange Counties. Where the clay has been observed in San Diego County, it rests in gradational contact on a greenish-gray shale probably of Cretaceous age. In the vicinity of Carlsbad the shale is mined for use in ceramic mixes to increase the strength of the fired body.

The Rose Canyon shale member of the Eocene La Jolla formation has been a continuous source of common clay in the San Diego area for over 70 years. It is distributed widely in the coastal plain between Mission and San Dieguito Valleys, where it is overlain locally by the Eocene Poway conglomerate and thin terrace deposits of Quaternary age. The clay is best exposed in Rose Canyon, north of San Diego, and mining operations there have centered near Elvira and Ladrillo (now abandoned) stations of the Santa Fe Railroad (Photos 27, 28). The shale member comprises two clay zones, one buff and the other bluish-gray, which have a total maximum thickness of about 250 feet. The two zones appear to be similar in composition, but they exhibit different drying characteristics. The shale in Rose Canyon proper contains only small proportions of soluble salts, but farther east, at the

Photo 25. Field or scove kilns on the Union Brick Company property. Bricks are dried in the sun, in fan-ventilated sheds or in hot air dryers, then fired in these kilns for 6 days. The leaning smokestack, which is a familiar landmark in Rose Canyon, was built in the late 1880's as part of an earlier brick plant.

Photo 26. View east toward Standard Oil Company mine workings on the south side of Otay Valley. Many thousands of tons of bentonitic clay were mined from this deposit for use in refining petroleum. The clay is in the middle or late Pliocene San Diego formation. Face at left is about 100 feet high. San Ysidro Mountains are in background.

Linda Vista deposit, the same rock contains deleterious proportions of gypsum ($CaSO_4.2H_2O$). The high concentration of soluble sulfate in this deposit, if not immobilized by treatment with barium and other compounds, will cause the finished clay ware to effloresce and therefore have a whitewashed appearance (Photo 25).

One of the principal deposits of high-grade bentonitic clay in California occurs along the Otay Valley near the Mexican border (Cleveland, 1960). This deposit was mined for more than 35 years and much clay still remains. The high-grade material is exposed only in an area of about 1.3 square miles, but it may be much more widely distributed (Photo 26).

Potentially useful deposits of low-grade clay occur in the Imperial formation which is probably early Pliocene in age. These clays, which are in the eastern part of the county, have not been thoroughly prospected and little is known of their properties and distribution. The clay, however, occurs in layers, at least several tens of feet thick, which underlie an area of over 100 square miles. Even if the clays prove to possess useful properties the remoteness from centers of population would limit their development.

Clay deposits formed by hydrothermal alteration or by the weathering of pegmatite dikes exist in San Diego County but are too small to be economic sources of clay.

Adobe bricks have been made from local deposits of clay material in the Escondido area for the past several years. The market for adobe bricks is small and unstable, however, and annual production in recent years has amounted only to about 20,000 standard bricks (4″ x 12″ x 16″).

Near Oceanside several thousand tons of clay material were recovered, and sold as a byproduct of the mining of silica sand. This material was used in heavy clay products.

Kelley Ranch Mine

Location: SE.¼ NW.¼ Sec. 14, T. 12 S., R. 4 W., S.B.M. (projected); about five miles east-southeast of Carlsbad. *Ownership:* Unapportioned estate of Lovinia I. Kelley (Irwin J. Kelley, Graham M. Kelley, Herbert C. Kelley, Jr., Thalia Kelley Considine, Barbara Jean Higdon, Charles David Kelley and others). *Address:* Graham M. Kelley, Room 1130, Bank of America Building, San Diego. The property comprises about 750 acres of patented ranch land.

Prior to 1913 the Hieatt Brick and Tile Company of San Diego recognized the value of the ceramic clay on the Kelley Ranch and leased 30 acres in the NW.¼ Sec. 15, T. 12 S., R. 4 W., S.B.M. (projected) from the Kelley interests. A small amount of clay was mined for testing before the lease terminated. The Pacific Clay Products Company of Los Angeles first opened the Kelley Ranch Deposit on a commercial basis in 1935 and mined clay from it until 1938. Beginning in 1948 the deposit was mined by Palomar Potteries of Vista, which produced small amounts of clay until about 1956. In 1954 this company conducted an exploratory program northwest of the mine in the vicinity of Letterbox Canyon, near the junction of Sections 10, 11, 14, and 15. Although several test holes were drilled and clay was found, no attempt was made to mine the clay. In 1957, Pacific Clay Products Company extensively drilled an area of about 300 acres west of the present workings and near their own property (Pacific Clay Products Company Mine) in Sec. 15, T. 12 S., R. 4 W., S.B.M. (projected). The total clay production from this property is unknown, but the size of the excavation suggests that only a few thousand tons were mined. The deposit was idle in early 1958.

The clay deposit on the Kelley Ranch consists of a single clay layer which grades downward into shale and conglomerate of Cretaceous(?) age and is overlain unconformably by sandstone of the Delmar sand member of La Jolla formation of Eocene age. The clay underlies the crest of a rolling hill and is distributed over an area of about one square mile. The Delmar sand has been eroded away near the crest of the hill where the clay is exposed; however, at lower elevations the sand is several tens of feet thick. The clay layer consists of pink, purple and white mottled claystone with reddish-brown blotches of iron oxide and abundant angular fragments of quartz. In the vicinity of the workings it ranges from 2 to 14 feet in thickness and is overlain by a thin sandstone bed and as much as 6 feet of soil (Fig. 8).

The clay has been developed by a shallow pit which is triangular in plan, and is about 125 feet long in a north-south direction and 100 feet long in an east-west direction.

The clay probably was formed on an irregular surface as a residual product of intense tropical weathering of the Cretaceous(?) shale during Paleocene(?) time. The area underlain by the clay is a nearly flat upland surface that is apparently the remnant of a Pleistocene(?) marine

Figure 8. Geologic sketch map, Kelley Ranch mine.

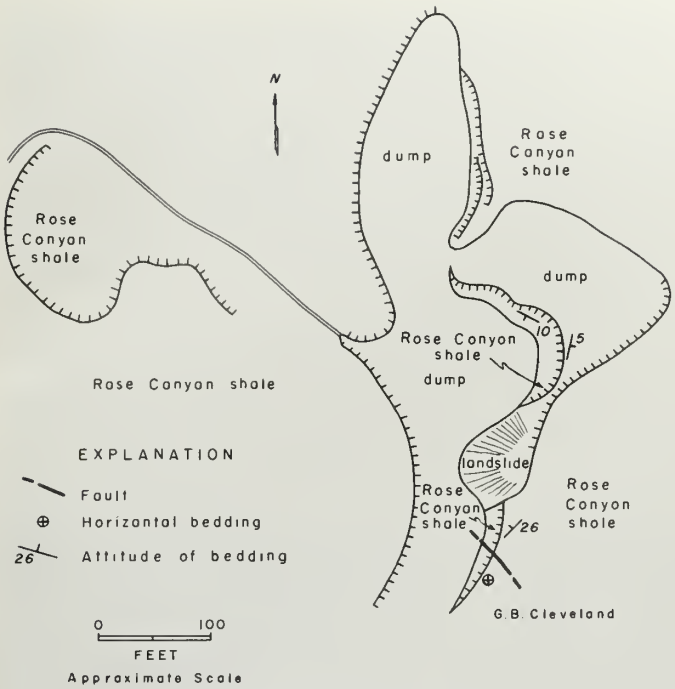


Figure 9. Geologic sketch map, Linda Vista mine.

Photo 27 (below). View north toward Mission Valley Brick Company's Linda Vista mine. Buff and blue-gray mudstone and shale are mined here for use in making brick. Clay material is part of the Rose Canyon shale member of the Eocene La Jolla formation.

terrace. The beveling effect of marine erosion apparently removed the younger Eocene rocks and possibly part of the residual claystone.

Linda Vista Mine

Location: The deposit is in the SE.¼ NW.¼ Sec. 9, T. 15 S., R. 3 W., S.B.M.; about 4.5 miles west of Miramar and U.S. Highway 395. The plant is 0.2 mile southeast of the intersection of Cabrillo Freeway (U.S. Highway 395) and Friars Road in San Diego and 8.2 miles southeast of the deposit. *Ownership:* Mission Valley Brick Company (R. E. Hazard Construction Company), P.O. Box 3217, San Diego 3, California.

The Linda Vista Clay Deposit was first mined about 1923 by the Vitrified Products Company of San Diego. This company produced about 10,000 tons of clay annually for ceramics during the succeeding few years, but production soon dwindled to only a few hundred tons and the property was abandoned prior to 1938. It remained idle until 1956 when the mine was reopened by the Mission Valley Brick Company. The present operation is a few hundred yards southeast of the old workings but still within the same clay layer. Total production statistics are unavailable. The present operation yielded about 15,000 tons of clay in 1956.

Clay material is mined from the Rose Canyon shale member of the Eocene La Jolla formation. At the deposit, the base of the member is composed of about 40 feet of alternating layers of buff and gray shale, which is overlain successively by 10 feet of buff mudstone, 100 feet of buff, manganese-stained shale and 2 to 3 feet of soil. Interbedded with the buff and gray shale is a layer of hard siltstone concretions which range widely in size, but are generally between 1 and 2 feet in greatest dimension. Gypsum ($CaSO_4.2H_2O$) is common throughout the

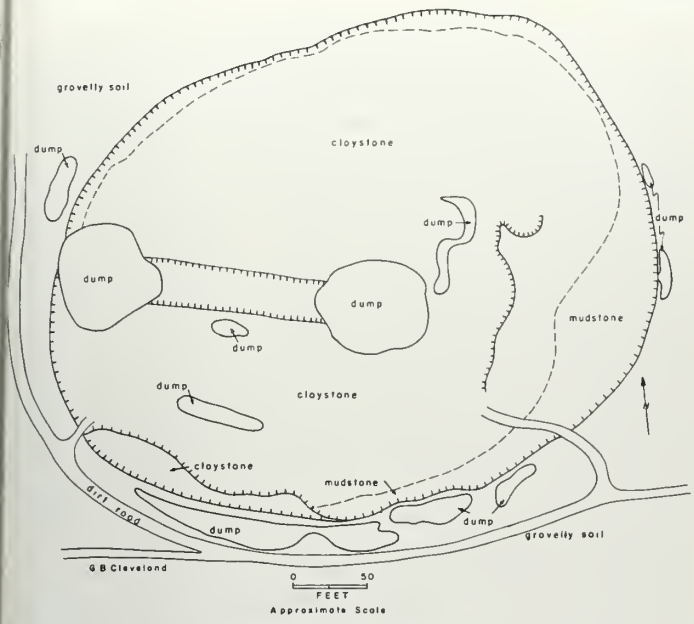


Figure 10. Geologic sketch map, Pacific Clay Products mine, East pit.

deposit and may in places compose as much as 10 percent of the rock. The gypsum ranges from thin coatings on fracture planes, to veins an inch or more in thickness. The gypsum appears to be more abundant in and below the concretion layer. The shale member has been folded considerably and dips range from 5 or less to 26 degrees or more. A normal fault of small displacement is exposed in the buff and gray shale beds in the southern part of the deposit (Fig. 9).

The clay has good plasticity, medium high dry strength, and a maximum total shrinkage of 11.2 percent at cone 1 (plastic basis). Some lime is present which causes a yellow-green color at high temperature. The best firing range is from cone 010 to cone 1 (Dietrich, 1928, p. 322).

The clay material is mined from an open pit on the west side of a low hill. The surface is stripped of soil prior to mining and the face undercut by power shovel from a single bench at the base of the cut. The clay material is allowed to slough off on to the floor of the bench where it is mucked into trucks and transported about 12 miles by road to the plant. The open cut was about 550 feet long and 250 feet at its widest point, in November 1957 (Photo 27).

The company controls 22 acres of land around the deposit. The property has been drilled randomly, and the clay layer is said to be 200 feet thick. Reserves are believed to be sufficient for a long-term operation.

At the plant the newly mined clay material is blended with various proportions of sand and finely ground brick rejects. These additives facilitate drying of the bricks prior to firing. The mix is reduced uniformly in size by a hammer mill to pass a ⅛ by ½ inch slot screen. Dry barium carbonate and other salts are added to reduce efflorescence caused by the presence of gypsum. The mix is then pugged with water, extruded as a cake, and wire-cut into bricks. The bricks are loaded on flat trucks, force dried, and fired in a tunnel kiln. Waste heat from the tunnel kiln supplies heat for the drying process. The plant capacity is about 240 tons of clay material or 40,000 finished bricks per day. The company makes the following shapes and sizes of bricks in both smooth and scratched face:

Type		*Size*	*Price* *
Modular face	Cored	2¼ x 3⅝ x 7⅝"	$42
Modular paver	Solid	2¼ x 3⅝ x 7⅝"	45
Standard face	Cored	2½ x 3¾ x 8⅛"	42
Standard paver	Solid	2½ x 3¾ x 8⅛"	45
Norman face	Cored	2¼ x 3⅓ x 11½"	70
Norman paver	Solid	2¼ x 3½ x 11½"	70
Mission norman	Cored	2¼ x 3½ x 11½"	70
Jumbo face	Cored	3½ x 3¼ x 11½"	70
Jumbo paver	Solid	3½ x 3¼ x 11½"	80

* Per thousand as of November 1957.

Pacific Clay Products Company (Kelley No. 1) Mine

Location: Nearly in the center of Sec. 15, T. 12 S., R. 4 W., S.B.M. (Projected); about four miles east-southeast of Carlsbad and one mile west of the Kelley Ranch Mine. *Ownership:* Pacific Clay Products Company, 1255 West Fourth Street, Los Angeles. The property is patented ranch land and comprises two contiguous parcels, one 20 acres and the other 25 acres.

The mining of ceramic clay at this deposit began in the early 1920's and continued until 1941 when access to nearby railroad facilities was withdrawn. In 1957, the company conducted a rather extensive exploratory program in this area and mining was resumed or a small scale. Total production figures for the operation are not available, but the size of the workings indicates that possibly as much as 70,000 tons of clay have been mined.

The geologic setting of this deposit is the same as that of the Kelley Ranch Mine and both operations are on the same clay layer. The deposit has been worked by means of two large open pits. The clay layer in the East Pit comprises about four feet of red, buff, and white mottled claystone and an equal thickness of brown mud-

Figure 11. Geologic sketch map, Pacific Clay Products mine, West pit.

stone. The nearly flat-lying clay layer is in gradational contact with the underlying greenish-gray shale of Cretaceous (?) age, and is overlain by about two feet of soil. The shale is at least 15 feet thick. Over much of the surface surrounding the pit the soil is veneered with small, limonite-impregnated fragments of clay, some of which are almost wholly limonite. The East Pit is roughly oval in shape; about 400 feet long in an east-west direction, and 250 feet long in a north-south direction (see Fig. 10). It has an average depth of about 10 feet. In 1957 a large trench was dug in an east-west direction near the middle of the pit to expose a section of the shale. This cut is about 25 feet wide, 100 feet long and 15 feet deep.

The West Pit is about 1,000 feet southwest of the East Pit. Here the clay layer has a maximum thickness of about 20 feet and consists of pink, buff and white mottled claystone. At the west end of the pit the clay layer is about six feet thick and unusually white. Much of the floor of the pit has been cut in greenish-gray shale and conglomerate. Overlying the clay layer is about three feet of brown, gravelly soil. This pit is also oval in outline (Fig. 11). It is about 400 feet long in an east-west direction, 150 feet long in a north-south direction and has an average depth of 10 feet. A small prospect pit is adjacent to, and east of, the East Pit and is cut in the same sequence of rocks.

The white claystone was tested by Dietrich (1928, p. 296) and found to be a buff-burning, high plasticity clay. It has a total linear shrinkage at cone 15 of 17.9 percent (plastic basis); the softening point is cone 29 and the best firing range from cone 1 to cone 15. Dietrich (1928, p. 322) found the buff claystone to be plastic, to have a high dry strength, and to contain 4.8 percent of + 200 mesh sand. The claystone is red-burning and has a long vitrification range. Maximum shrinkage was found to be 18.9 percent at cone 9 (plastic basis). The best firing range is from cone 02 to cone 13, but bloating begins above cone 5.

Standard Oil Company (Filtrol) Mine

Location: SW.¼ Sec. 17 and SE.¼ Sec. 18, T. 18 S., R. 1 W., S.B.M.; on the north slope of Otay Valley, three miles east of Otay. *Ownership:* Standard Oil Company of California, 605 West Olympic Blvd., Los Angeles (1957).

The deposit was opened and worked briefly as a source of bentonite by the General Petroleum Company in 1925. It was bought by the Standard Oil Company about a year later and operated by this company through 1944. In 1946, the Filtrol Corporation extensively core-drilled the property and an adjacent area on the Otay Ranch, and in January of 1947 leased the property from the Standard Oil Company. A small tonnage of clay was mined in 1947 and a large tonnage in 1948, but shortly afterward the Filtrol Corporation terminated its lease. For some years the recorded production of this mine was combined with that of the General Petroleum Mine, nearby. The combined recorded production of both mines is about 23,000 tons valued at about $90,000. The size of the workings and the values estimated from concealed production records, indicate that these two mines yielded at least 83,000 tons of clay valued at $670,000. The Standard Oil Company Mine appears to have been the larger mine.

The clay occurs as several beds in a sequence of pale-gray arkosic sandstones. These beds are part of the San Diego formation which is middle or upper Pliocene in age (Photo 26). The principal clay bed occurs at a nearly uniform elevation of 350 feet. This bed averages about three feet in observed thickness, and in some exposures is four feet or more thick. The clay is a relatively pure activatable bentonite and one sample collected contains only 4 percent impurities, which are largely sericite and quartz. The highest grade clay is mostly white, cream or pale pink but some of it ranges from dark brown to pale pinkish brown. The clay has a soapy consistency when hydrated and becomes powdery when thoroughly dried. On immersion in water it will expand slightly. It has a hardness of about 1 and a dull earthy to waxy luster.

Detailed section of the clay zone, Otay bentonite *

Description	*Thickness*
Cream to white, soft, waxy clay containing disseminated spots and coatings of manganese oxide; slightly gritty; fractures on curved surfaces to thin plates	6 inches
Dark pinkish brown, waxy clay, stained with manganese oxide; gritty granular fragments of calcium carbonate occur on fracture planes	7 inches
Grayish-brown to grayish-green waxy clay	6 inches
Light gray, hard, granular clay; fractures unevenly, contains biotite and manganese stains and calcite in small granular pods	9 inches
Light grayish-brown, gritty clay	5 inches
Light gray, impure, sandy clay; contains abundant biotite, some garnet and ferromagnesian minerals	12 inches
Light grayish-brown, gritty clay	7 inches
Total	4 feet, 4 inches

* Locality about 1 mile west of the mine.

The Otay bentonite, as indicated by the presence of relic ash structures, was derived from one or more volcanic ash falls. The ash appears to have fallen both on the land and on the sea. The water-laid ash may be represented in the Otay area by the principal clay bed. This bed is relatively free of clastic impurities, whereas other bentonite beds above and below it are considerably contaminated.

Open pit methods were used exclusively to mine the clay. Broad benches as much as 1,000 feet wide and vertical faces up to 100 feet high were cut into slopes. These faces are over 3,500 feet long and the excavations cover several acres. Clay was handled in the later years of the operation by modern earth moving equipment and shipped by truck and rail to the El Segundo plant of the Standard Oil Company for processing.

In general, the uses of Otay bentonite have been dependent upon its adsorptive properties, and the petro-

Table 3. Chemical Analyses of Otay Bentonite.

	1	2	3	4	5	6
SiO_2	52.52	50.30	49.56	63.04	55.68	51.19
Al_2O_3	16.10	15.96	15.08	18.44	17.66	15.13
Fe_2O_3	.51	.86	3.44	1.20	0.96	0.86
FeO	.26	--	--	--	--	--
MnO	.003	--	.01	.01	--	--
MgO	5.69	6.53	7.84	7.30	7.23	7.19
CaO	.47	1.24	1.08	.08	1.37	1.00
K_2O	.23	.45	--	.02	0.50	.12
Na_2O	.82	1.19	--	3.40	1.32	.73
P_2O_5	--	--	--	.05	--	--
TiO_2	.16	--	.40	.14	--	.16
Carbon tr.	--	--	--	--	--	--
H_2O-	14.68	--	--	--	--	15.80
		23.61	22.96	6.47	13.96	--
H_2O+	8.16	--	--	--	--	--
Ignition loss	--	--	--	--	--	7.57
Total	99.603	100.14	100.37	100.15	98.68	99.75

Sample 1. Kerr and others, (1950a, p. 53)
2, 3. Ross and Hendricks (1945, p. 34)
4. Osthaus (1955, p. 96)
5. Schroter and Campbell (1940, p. 6)
6. Speil and others, (1945, p. 11)

leum industry has used it for cleaning heavy lubricating oils, kerosene and gasoline. In addition the Otay clay has proved suitable in oil well drilling mud, paint (filler), water softener compounds, and cleaning compounds. It might also be useful as an insecticide carrier, soil conditioner and as an additive in cattle feed.

Union Brick Company Mine, East Pit (Union Brick and Tile Company)

Location: In N.½ NE.¼ Sec. 6, T. 16 S., R. 3 W., S.B.M. (projected); about 7.5 miles northwest of San Diego Civic Center and about 3.5 miles southeast of La Jolla, on U.S. Highway 101 on the east side of Rose Canyon. The plant is in SW.¼ NE.¼ Sec. 6, T. 16 S., R. 3 W., S.B.M. (projected) about 0.25 mile southwest of the deposit. *Ownership:* John W. Rice, Jr., Rambla de las Flores, Rancho Santa Fe, California. The property comprises about 220 acres of patented land.

The Union Brick Company Mine was opened about 1947, as a source of ceramic clay, and production through 1956 totaled 248,913 tons valued at 191,976 dollars. This company had mined at two other localities in Rose Canyon prior to the opening of the present workings. A deposit directly west of the plant was abandoned about 1947 (see Union Brick Company Mine, West Pit in tabulated list) and another, 2.5 miles north, near Elvira Station, on the Santa Fe Railroad, was abandoned about 1941. The latter locality was also the site of a brick plant which was operated for a short time by the Union Brick Company. Prior to its operation by the Union Brick Company the property was known as the Sunnyside Brick and Tile Company (see Union Brick Company Mine, North Pit in tabulated list and Fig. 12).

The Union plant occupies a site that has been a brickyard for 70 years or more. In 1888 the leaning smokestack, which was a familiar landmark in Rose Canyon, was constructed as part of an early brick plant. About 1912 the Union Brick Company moved from its location at the intersection of Harbor Drive and Crosby Street in San Diego to Rose Canyon, and brick and other clay products have been produced there continuously since. In addition to the Union Brick Company, the Rose Canyon Brick Company, the Hieatt Brick and Tile Company, the Hubbard Brick Company, the San Diego Vitrified Brick and Clay Products Company, and the San Diego Brick and Clay Products Company, have all mined clay and produced structural clay products in this area, but are now inactive.

Clay material is mined from a low hill composed principally of the Rose Canyon shale member of the Eocene La Jolla formation. The clay material is exposed over many tens of acres. The shale is nearly flat-lying and is overlain by a few feet of terrace deposits which contain pebble-to-boulder size clasts, which in turn are overlain by a thin soil covering. The Rose Canyon shale in this area comprises about 75 feet of pale to dark gray mottled mudstone overlain by about 175 feet of light buff-colored mudstone. These rocks are principally mixtures of clay,

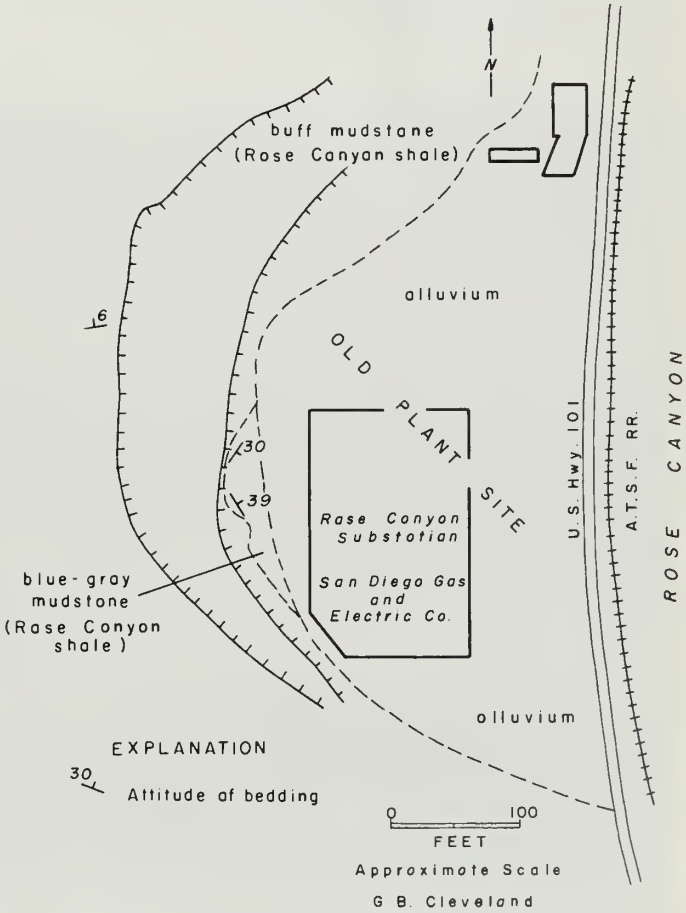


Figure 12. Geologic sketch map, Union Brick Company mine, North pit.

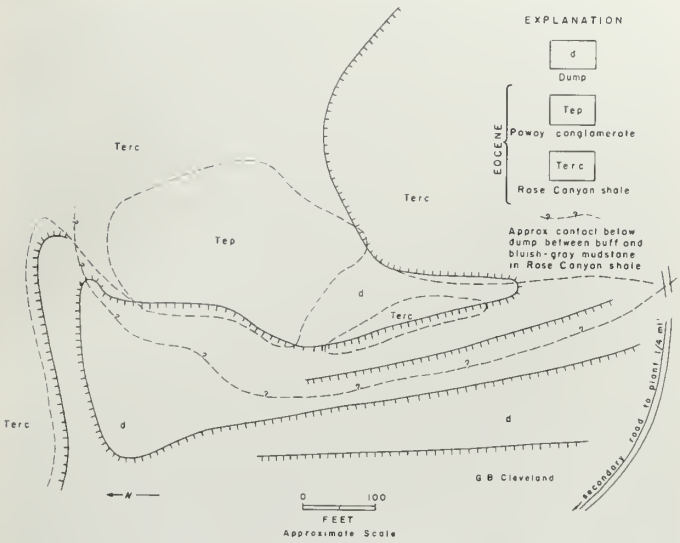


Figure 13. Geologic sketch map, Union Brick Company mine, East pit.

Photo 28. General view southeast of lower Rose Canyon, showing operations of the Union Brick Company. Clay is mined from a large open pit on the east side of the canyon and transported to the plant (arrow) by Carryall. Clay is in Rose Canyon shale member of the Eocene La Jolla formation. Large buildings in center are warehouse facilities of Convair Aircraft Company.

and silt-size fragments of quartz, and biotite. Both the buff and gray clay materials are used. They are mined by open pit methods on irregular benches by carryall and transported one quarter of a mile to the plant. In October 1957 the open cut was about 800 feet long and about 500 feet wide (Fig. 13, Photo 28).

At the plant the clay is reduced to minus ¼-inch in a primary crusher, ground in a dry pan mill and delivered to a screw-type pugging and extrusion machine. Water containing barium compounds is added to the clay to reduce scumming in the finished brick. Two hundred pounds of barium carbonate, which is imported from Germany, is mixed with each 500 gallons of water used. A vacuum of 24 pounds per square inch is maintained to remove any air that may be trapped in the mix. The bricks are wire cut from a continuous bar of clay extruded from the pugging machine. Different dies are used to produce the various shaped bricks made by the company. The wet bricks are dried five to six weeks in the sun or for a shorter time in fan-ventilated sheds and hot air dryers. After drying, the bricks are fired in field (scove) kilns for six days or for 24 hours in a shuttle kiln (Photo 25).

The plant processes approximately 16, eight-yard loads, or about 200 tons of clay, per day. It has a capacity of 80,000 bricks per eight-hour period. The company produces Standard (8 x 3¾ x 2½ inches), Norman (11½ x 3¼ x 2½ inches), Oversize (11½ x 3¼ x 3½ inches), and "Brik-Blok" (11½ x 5½ x 3½ and 15½ x 7½ x 3½

Clay

Map No	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	American Encaustic Tile Company (American Encaustic Tiling Company, West Coast Tile Company)	Undetermined (1957).	Gladding, McBean and Co., Los Angeles (1957)		No longer operating in county. Known as West Coast Tile Company prior to 1920. See also under "Feldspar" in tabulated list. (Boalich et al. 20:62).
	American Pottery Company	Undetermined (1958).	Undetermined (1958)		No longer operating in county. See El Cajon Kaolin deposit. (Tucker 25:354).
	Atlas Brick and Clay Company mine	Undetermined (1958).	Undetermined (1958)		No longer operating in county (1957). See Union Brick Company mine, North Pit. (Symons 28:264).
	Bay View Fuel Company mine	Undetermined (1958) San Diego (1942).	Undetermined (1958) Bay View Fuel Co., 10983 Clover Ave., Lynwood (1942)		No longer operating in county (1957). Formerly a producer of crude clay. (Symons 43:154).
	California China Clay Products Company (California China Products Company)	Undetermined (1958).	Undetermined (1958)		No longer operating in county. See El Cajon Kaolin deposit. (Merrill 14: 687; Boalich et al. 20:93).
	California Clay Products Company (Mission China Company, Southern California Clay Products Company)	Undetermined (1958) Los Angeles (1928).	Undetermined (1958)		No longer operating in county. See El Cajon Kaolin Deposit; Dorothy and Pearl claims; and Robert Charles and Thomas Hewitt claims. (Dietrich 28: 201; Tucker 25:354).
	California Clay Refining Company mine	Otay Valley area.	Undetermined (1958)		No longer operating in county. Small production 1923 to 1925. Patented land. (Tucker 25:360).
7	Clay prospect	SE¼ sec. 30, T8S, R6W, SBM; on the south side of Talega Canyon, in the Camp Pendleton Naval Reservation, about 4 miles northeast of San Clemente.	Within Camp Pendleton Naval Reservation (1958)	A clay zone 30 ft. thick, which is exposed at the head of a narrow canyon, is overlain by 150 ft. of light colored sandstone. It is red, yellow, yellowish-brown, gray and white; sandy; and flecked with pearly plates of anauxite (?).	Deposit is in southern extension of Tierra Colorado Clay District, Orange County. (Stauffer 45).
	Crystal Silica Co.	Oceanside area.			In 1958 Gladding, McBean and Co. was purchasing clay obtained from settling ponds of Crystal Silica Co. sand operation. See description in text under "Specialty sands."
	Dinero Ranch Clay deposit				See General Petroleum Company mine. (Tucker 21b:375).
8	Dorothy and Pearl claims (Pearl and Dorothy claims, Pearl and Dorothy Ann claims)	CW½ sec. 4, T13S, R3W, SBM; 5 miles northeast of Cardiff.	Undetermined (1958) California Clay Products Company (1925)	Red, buff and white residual claystone is exposed on south side of low hill. Clay appears to be derived from greenstone by weathering. Workings consist of two adits which have a common portal: one bearing N5E, about 25 ft. long; the other bearing N30W, about 15 ft. long; and one small open cut about 100 ft. above the adits. The alteration zone apparently covers many acres.	Patented placer claims. Ceramic properties reported by Dietrich. Was used with other clay to make chemical stoneware. Long idle. Borders Robert Charles and Thomas Hewitt claims on east(?). (Dietrich 28:201, 311; Tucker 25:355; Tucker and Reed 39:33).
9	El Cajon Kaolin deposit	NW¼(?) sec. 36, T14S, R1E, SBM; about 7 miles northeast of Lakeside.	Undetermined (1958)	The following is taken from Dietrich's (1928, p. 201) description: "The kaolin was formed by alteration in situ of an alaskite or similar pegmatitic derivative, containing but small quantities of ferro-manganesian minerals. The extent of alteration varies widely within comparatively short distances, so that the resultant material ranges from slightly-plastic kaolin containing an excess of free quartz and undecomposed feldspar, to extremely plastic, fine-grained	Deposit has not been operated since 1916. "It has been developed by a number of tunnels, shafts, and open cuts, the principal tunnel having been driven in a northwesterly direction for a distance of 75 feet, to a point 50 feet below the surface. This tunnel is connected by means of a raise to a small open pit, or glory hole. The material exposed by these workings shows all of the variations indicated above, with six feet of thoroughly altered plastic kaolin near the face. During 1914 and 1916, some kaolin from these workings was

Clay

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	El Cajon Kaolin deposit (Continued)			thoroughly-hydrated kaolin. Exposures of such material have been made at various points on the mountain, indicating that they occur in a zone that has a general northeast strike."	shipped to the faience tile plant of the former California China Clay Products Company at National City. The total quantity shipped probably did not exceed 400 tons, to judge fro the extent of the workings. The material was packed by mules over a rough and steep trail to a point on the San Diego River, then hauled by wagon to Lakeside, at a cost said to have been $7.50 per ton, exclusive of mining." (Dietrich, 1928, p. 201). (Aubury 06:227; Dietrich 28:201, 259; Tucker 25:354; Tucker and Reed 39:33)
	Filtrol Corporation				See Standard Oil Company mine in text. (Jenkins 50:380).
10	General Petroleum Company mine (Mosto Ranch deposit, Mosto Otaylite deposit, Hamburger Co., Dinero Ranch Clay deposit)	N½ sec. 30 and NW¼ sec. 29, T18S, R1W, SBM; on the south side of Otay Valley, 3 miles east of Otay.	C. A. Butler, 499 Hilltop St.; Henry W. Albert 74 E St.; L. B. Waller, Box 725, all of Chula Vista (1958)	White, pink, and brown waxy clay occurs in bed 2 to 4 ft. thick interbedded with flat-lying arkosic sandstones along south side of Otay Valley. Beds are in upper part of San Diego formation which is middle or upper Pliocene in age. See description of Standard Oil Company mine in text.	Mine yielded several tens of thousands of tons of high-grade bentonitic clay during the 1920's. Material was used as an adsorbent in petroleum refining. The mine was developed by cutting back slopes and forming benches 50 to 200 feet wide to provide a working and storage area. These areas were developed laterally for 4,500 ft. A series of adits was driven southward into the face of the cut and laterals were driven from the adits into the clay bed. The clay was moved to the floor of the cuts and allowed to dry. The clay was loaded into trucks and hauled to Palm City for rail shipment to Los Angeles. (Aubury 06:227; Cleveland 60:1-16; Goodyear 90:139; Newman 23:100; Symons 29a:171; Tucker 25:360).
11	Gladding, McBean and Company mine	NW¼SE¼ sec. 7, T13S, R3W, SBM (proj.); adjacent to Vitrified Products Co. mine, one mile north of Olivenhain and 4 miles east of Encinitas.	Undetermined (1958) Gladding, McBean and Company (1928)	About 30 ft. of red and white mottled sandy claystone is exposed on the east side of a low hill. Clay was mined from a pit 100 ft. long and 50 ft. wide. The clay layer is overlain by about 3 ft. of greenish-gray shale; its base is not exposed.	Property yielded 5000 to 7000 tons of clay annually in mid-1920's. Formerly operated by L. A. Pressed Brick Co. Ceramic properties reported by Dietrich. Idle in early 1958. (Dietrich 28:202, 322).
	Hamburger Company				See General Petroleum Company mine. (Tucker 25:360).
	Hieatt Brick and Tile Co.				No longer operating in county. See Union Brick Co.; Kelley Ranch deposit. (Merrill 14:686).
	Hubbard Brick Co Co.				No longer operating in county. See Union Brick Company mine, East pit, in text. (Aubury 06:254; Merrill 14:686).
12	Huchting Ranch deposit	Unable to locate (1958) NE¼ sec. 25, T13S, R4W, SBM; near La Costa Station, Santa Fe Railroad (1914).	Undetermined (1958)		Yellow-burning non-plastic clay. (Merrill 14:687).
	Jamul Ranch deposit	Undetermined (1957).	Undetermined (1957)		Bentonitic clay mined briefly by Otaylite Products Company and sold in Los Angeles for cleaning compound, water softener and as a filler in paint. (Tucker 21:376).
13	Kelley Ranch mine	East-southeast of Carlsbad.			See text.

Clay

Map No	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Kiellar Ranch deposit	Undetermined (1957) East of Cardiff.	Undetermined (1957)	"A deposit of red and mottled clay" (Tucker, 1921).	In 1920 the deposit was being developed by the St. Luis Fire Brick Company, and shipments were being made to the company's plant in Los Angeles. (Tucker 21b:375).
14	La Jolla Clay Products Company	SE¼ sec. 24, T15S, R4W, SBM (proj.); 2 miles northeast of La Jolla, on Torrey Pines Road.	Mr. Cornalio Rodriguez, P.O. Box 712, La Jolla (1956)	About 25 ft. of nearly flat lying buff and blue-gray mudstone as exposed on the southside of a small canyon. Clay material occurs in the Rose Canyon shale member of the La Jolla formation which is Eocene in age.	Clay material mined from small open cut and fabricated by hand. Fired in woodburning circular brick kiln. Clay material is mixed only with water, dried for 6 weeks, and fired for 18 hours. Ornamental pottery, flowerpots, water jugs, plates, roofing tile and chimneys are produced and sold on the property. About one ton of clay is mined per month. (Jenkins 50:380).
15	Linda Vista deposit	West of Miramar.			Formerly operated by Vitrified Products Company. See text. (Dietrich 28:205, 322; Tucker 25:357; Tucker and Reed 39:34).
	Los Angeles Pressed Brick Company mine				See Gladding, McBean and Company mine. (Tucker 25:355).
16	Merrick Kaolin deposit	N½NW¼NW¼ sec. 36, T14S, R1E, SBM; 2 miles southeast of Barona, on the west flank of El Cajon Mt.	Undetermined (1957) Owned by Michael Merrick, Barstow (1939)	Buff, dark-red and white clay is poorly exposed in a zone 20 to 40 ft. wide and about 200 ft. long. The zone strikes N60°E. The clay may be a product of hydrothermal alteration along a fault.	Property patented but has been long idle; no production. Developed by two small prospect pits. Because of poor accessibility and small size, the deposit is of little commercial interest. (Tucker and Reed 39:33).
	Mission China Company (California Clay Products Company)	Undetermined (1958)	Undetermined (1958)		No longer operating in county. See Robert Charles and Thomas Hewitt claims and California Clay Products Company. (Dietrich 28:201; Tucker 25:355).
	Mission Valley Brick Co. (R.E. Hazard Construction Company)				See Linda Vista deposit in text.
17	Morris Clay deposit	NW¼SW¼ sec. 18, T12S, R2W, SBM; about 2 miles southeast of San Marcos.	H. B. Jenne, Jesmond Dene (near Escondido) (1958)	Bentonite in a bed at least 30 ft. thick forms a low rounded hill in a saddle between ridges of tonalite. The clay is impure, greenish gray and forms a cracked soil.	A mill was built on property prior to 1928 but attempts to make brick and other ceramic ware were unsuccessful. Long idle. (Dietrich 28:202, 348; Tucker 25:355).
	Morton Clay deposit	Undetermined (1958).	Undetermined (1958)		Undeveloped (1925). Published information on location incomplete. (Tucker 25:355; Tucker and Reed 39:33).
	Mosto Ranch deposit				See General Petroleum Company mine.
18	National Brick Company	2500 Hoover Ave., National City.	Morgan Everding, Concrete Company, 2500 Hoover Ave., National City (1958)	Tidal flat deposit of reddish-brown, micaceous, silty mudstone.	No longer operating in county. Clay deposit long idle; site being used for concrete products plant. (Dietrich 28:203; Tucker 25:356).
	Old Mission Tile Company	Undetermined (1957).			No longer operating in county. (Dietrich 28:203; Symons 28:265).
	Otaylite Products Company				No longer operating in county. See Jamul Ranch deposit. (Tucker 21:376).
19	Pacific Clay Products Company (Kelley No. 1) mine	East-southeast of Carlsbad.			See text. (Dietrich 28:203, 322; Tucker 25:356; Tucker and Reed 39:33).
	Pearl and Dorothy claims				See Dorothy and Pearl claims.
	R. E. Hazard Construction Co.				See Linda Vista deposit in text.

Clay

Map No	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
20	Robert Charles and Thomas Hewitt claims	SW¼ sec. 4, T13S, R3W, SBM; about 2½ miles northeast of Olivenhain and 5 miles northeast of Cardiff.	Theodore and Francis Koons, Route 2, Box 2573, Encinitas (1958)	Buff and white residual claystone is exposed in a small open cut. Clay was derived from greenstone by weathering. Area of alteration covers many acres.	Property comprises two patented 20-acre placer claims and adjoins Dorothy and Pearl claims on the west(?). See Mission China Company. (Tucker 25: 355).
	Rose Canyon Brick Co.				No longer operating in county. See Union Brick Company Mine, East Pit, in text. (Aubury 06:254; Merrill 14:686)
	Saint Luis Fire Brick Company				No longer operating in county. See Kiellar Ranch deposit. (Tucker 21b: 375).
	San Diego Brick and Tile Company mine (San Diego Tile and Brick Company; Sunnyside Brick and Tile Company)				No longer operating in county. See Union Brick Company mine, North Pit, in text. (Dietrich 28:203; Tucker 24:368; 25:356).
	San Diego Vitrified Brick and Clay Products Co.	Undetermined (1958).	Undetermined (1958)		No longer operating in county. (Merrill 14:686).
21	Schier Clay deposit	NE¼ sec. 23, T10S, R4W, SBM; about 2 miles west of Bonsall.	Samuel S. Schier, P.O. Box 108, Bonsall (1958)	Dark grayish-brown impure bentonite(?), a few ins. to a few ft. in thickness, underlies an area of about one acre. Clay is overlain by 10 ft. of tuff and an undetermined thickness of dacite flows. Country rock is Cretaceous Bonsall tonalite.	No production. Clay layer has been prospected by numerous bulldozer cuts.
22	Sorrento Brick and Clay Products, Inc. mine	SW¼ sec. 5, T15S, R3W, SBM (proj.); about 5 miles southeast of Del Mar, in Soledad Canyon.	Sorrento Brick and Clay Products Inc., 10505 Sorrento Valley Road, Sorrento (1957)	Buff and bluish-gray mudstone of the Rose Canyon shale member of the Eocene La Jolla formation crops out on the north and south slopes of Soledad Canyon. The clay layer is about 20 ft. thick where exposed in an open cut on the Sorrento property. The clay is relatively pure and contains only small amounts of soluble salts. A few large manganese-stained concretions occur with the clay.	Deposit was opened in late 1956 and mining continued until August 1957. Clay was mined from an open cut 100 ft. long in an east-west direction and 75 ft. long in a north-south direction. A ceramic plant adjacent to the pit produced common brick, face brick and flower pots during 1957. Production has been curtailed and only flower pots were being made in late 1957. Clay for this use was drawn from a stockpile.
	Southern California Clay Products Company	Undetermined (1958).	Undetermined (1958)		No longer operating in county. (Boalich et al. 20:93; Tucker 21b:375).
23	Standard Oil Company (Filtrol) mine	3 miles east of Otay.			See text. (Cleveland 60:1-16; Symons 30: 171).
	Stell Clay deposit	Undetermined (1958).			Production in 1913. (W. B. Tucker, unpub. Div. of Mines field report, 1920).
	Sunnyside Brick and Tile Co. (San Diego Brick and Tile Company)				No longer operating in county. See Union Brick Company Mine, East Pit. (Merrill 14:686; Boalich et al.20:93; Dietrich 28:203).
	Thebo and Cogens deposit	Undetermined (1958).	Undetermined (1958)		No recorded production. (Boalich et al. 20:93).
24	Union Brick Company mine, East Pit (Union Brick and Tile Company)	About 7-3/4 miles northwest of San Diego Civic Center.			See text.

Clay

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
25	Union Brick Company mine, North Pit (San Diego Brick and Tile Company, Sunnyside Brick and Tile Company)	SW¼NW¼ sec. 30, T15S, R3W, SBM (proj.); about ½ mile southwest of Elvira station on Santa Fe Railroad and just off U.S. Highway 101 on the west side of Rose Canyon.	King Van Lines, 5129 Weeks St., San Diego (1958)	About 25 ft. of bluish-gray claystone is overlain by about 250 ft. of buff shale and mudstone of the Eocene Rose Canyon shale. The clay layers are nearly flat lying except the lower part of the clay layer which is folded into an east-plunging anticline. See geologic sketch map in text.	Idle since about 1941. Ceramic properties of the clay were reported by Dietrich. (Dietrich 28:203, 339; Merrill 14:686).
26	Union Brick Company mine, West Pit (Rose Canyon Brick Company, Hieatt Brick and Tile Company, Hubbard Brick Company, San Diego Vitrified Brick and Clay Products Company, and San Diego Brick and Clay Products Company)	SW¼NE¼ sec. 6, T16S, R3W, SBM (proj.); about 7½ miles northwest of San Diego Civic Center.	John W. Rice, Jr., Rambla de los Flores, Rancho Santa Fe (1958)	Nearly flat lying beds of brown claystone, with numerous lenses of brown pebble to cobble conglomerates and sandstone, are underlain by bluish-gray claystone.	Deposit idle since 1947. Ceramic properties of the clay were reported by Dietrich. (Aubury 06:375; Boalich et al. 20:94; Dietrich 28:204, 340; Merrill 14:686; Tucker 21b:375; 24:369; 25:357; Tucker and Reed 39:34).
	Unnamed	Lyons Peak Undetermined (1957) (Lyons Peak is in S½ sec. 10 and N½ sec. 15, T17S, R2E, SBM; about 7 miles east of Jamul).			Report of clay at this locality appears to be unfounded. (Merrill 14:687).
	Unnamed	Poway Peak Undetermined (1957).			Poway Peak could not be located on present topographic maps. (Merrill 14:687).
	Unnamed	San Vicente Mountain Undetermined (1957).			San Vicente Mountain could not be located on present topographic maps. (Merrill 14:687).
27	Vitrified Products Co. mine (Vitrified Clay Products Co., Wiro Mines)	NW¼SE¼ sec. 7, T13S, R3W, SBM (proj.); one mile north of Olivenhain and 4 miles east of Encinitas.	Undetermined (1958)		No longer operating in county. See Linda Vista mine in text. (Dietrich 28:205; Jenkins 50:380; Tucker 24:369; 25:355, 357; Tucker and Reed 39:34).
	West Coast Tile Company (American Encaustic Tile Company, American Encaustic Tiling Company)				No longer operating in county. Known as American Encaustic Tile Company after 1920. See El Cajon Kaolin deposit herein and McGinty Mt., under "Feldspar." (Boalich et al. 20:93).
	Wiro mines				See Vitrified Products Company mine. (Dietrich 28:205).

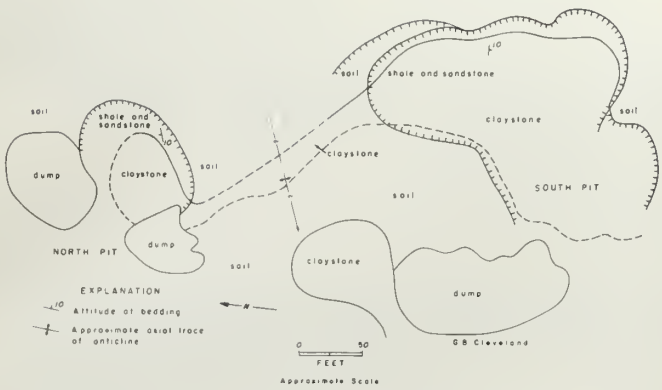


Figure 14. Geologic sketch map, Vitrified Products Company mine.

inches) smooth or scratch face brick. The prices as of October 1957 were 40, 55, 60, 95 and 165 dollars per thousand, respectively.

A separate organization headed by Leo Delgado, processes the damaged and warped bricks from the main plant at a small operation on the Union property. The material is crushed to minus one-half inch, packaged in 100-pound bags, and marketed in the San Diego area for roofing granules. The price in October 1957 was $1.25 per hundred pounds.

Vitrified Products Company Mine (Vitrified Clay Products Co., Wiro Mines)

Location: NW.¼ SE.¼ Sec. 7, T. 13 S., R. 3 W., S.B.M. (projected); one mile north of Olivenhain and four miles east of Encinitas. *Ownership:* Vitrified Products Company, San Diego (1942). The property comprises 16.6 acres of patented ranch land.

This deposit was a source of ceramic clay from about 1924 until about 1942. Although its total yield must have been many thousands of tons, no total production figures are available.

A clay layer is exposed in what appears to be an inlier cut through the nearly flat-lying beds of the Delmar sand member of the Eocene La Jolla formation. The best exposure of clay and the locality where it was mined, is on a north-trending ridge near the head of a small tributary of Escondido Creek. Headward erosion of this creek has exposed the clay along gentle slopes below an elevation of about 140 feet. Above this elevation the resistant beds of the Delmar sand are preserved.

The clay layer crops out discontinuously over an area of several tens of acres. The zone that contains the clay layer consists of a lower 20 feet of sandy, white to buff mottled claystone overlain by about 18 feet of lavender and buff mottled claystone. Blotches of reddish-brown limonite are conspicuous on the weathered surface of the clay. The clay layer grades downward into a coarse arkose and pebble to cobble conglomerate. It is overlain by two feet of buff sandstone and four feet of greenish-gray shale, both of which may be part of the Delmar sand, and soil. In the vicinity of the clay pits the strat are gently folded into a small anticline that plunges t the southwest (Fig. 14).

The clay has been mined from two open pits o the west face of the ridge. The more southerly pit is th largest and is nearly oval in outline. It trends north an is about 200 feet long and about 100 feet wide. The cla zone in this pit is about 30 feet thick and dips 10 degree to the southwest in the southern half of the pit. Th more northerly pit also is roughly oval in outline an trends northeastward. It is about 120 feet long and 8 feet wide. About 20 feet of red and white claystone i exposed on the east face of this pit. It is overlain by few feet of buff colored sandstone, sandy green shale an soil. The clay layer dips about 10 degrees to the north west.

One clay sample had a medium-high dry strength weak plasticity and contained 41 percent (+200 mesh sand. The total linear shrinkage (plastic basis) was 8. percent at cone 13. The best firing range was from con 1 to above cone 13 (Dietrich, 1928, p. 287). Anothe sample tested by Dietrich (1928, p. 288) showed nearl the same properties except it contained 31 percent +20 mesh sand, a linear shrinkage at cone 15 of 11.5 percent and its best firing range was from cone 1 to cone 15

COAL

Commercial deposits of coal are not known to occu in San Diego County. The only reported occurrence in the county are brown lignite 10 miles north of Sa Diego (Hanks, 1882, p. 240) and carboniferous shale a Torrey Pines State Park (Roy Kepner, San Diego Count Division of Natural Resources, personal communication 1958).

COBALT

Cobalt occurs at the Friday Mine and at the Old Iron sides Prospect, which are described herein unde "Nickel."

COLUMBIUM-TANTALUM

Columbium-tantalum bearing minerals are uncommo to rare constituents of the pegmatite deposits of Sa Diego County. Tantalum ore from the county is liste with Unapportioned under recorded mineral productio for 1920 (see Table 1).

COPPER *

Only an extremely small part of the copper productio of California has come from deposits in San Dieg County. The total recorded production for the count is slightly more than 300,000 pounds, of which slightl more than 100,000 pounds was produced from or custom-milled at the Owens and Eagle Gold Mines, i 1904 and 1938, respectively. The source of this ore wa not determined by the writers.

* By F. H. Weber and R. M. Stewart.

Coal

Map No	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Torrey Pines Beach State Park	Sec. 25 or 36, T14S, R4W, SBM (proj.); in sea cliffs along beach.	California Div. Beaches and Parks, State of California, Sacramento, Calif.	Carbon-bearing shale has been reported from the cliffs at the north end of the park.	(Roy Kepner, San Diego Div. Nat. Res., personal communication, 1958).
	Unnamed	See "Remarks..."		Hanks (1882) reported that an Oakland capitalist was developing a seam of brown lignite that ranged in thickness from 3 to 5 ft. "that could be traced for a long distance".	Hanks (1882) stated that the deposit was "on the sea shore about 10 miles north of San Diego". No additional published information. (Hanks 82: 240).

Cobalt

Map No	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Friday mine				See text under "Nickel".
	Old Ironsides prospect				See under "Nickel".

The only two deposits that have been mined mainly for copper are the Daley Deposit, south of Ramona, and the Encinitas Deposit, north of Rancho Santa Fe (see descriptions below). The Daley Deposit is reported to have yielded 175,000 pounds of copper during World War I, when the price of copper jumped from 17 cents per pound in 1915 to 27 cents by 1917. The Encinitas Deposit yielded about 12,000 pounds of copper from ore mined in 1905 and during World War I.

Deposits that have been prospected primarily for copper also are in the Defiance District which is in the extreme northwest part of the county, and partly in Riverside County. These deposits, which are listed under the "Defiance District" in the accompanying tabulated list, have not been mined.

Two deposits that contain significant proportions of copper are described under "Nickel." These are the Friday and Old Ironsides nickel-cobalt-copper bearing bodies which probably average between ¼ and 1 percent copper.

Daley (Barona) Mine

Location: Sec. 11, T. 14 S., R. 1 E., S.B.M. (projected); about five miles south of Ramona, on the Cañada de San Vicente y Mesa del Padre Barona. *Ownership:* Bank of America, Union Title and Trust Co., and Ed. and Florence Lindsay (address undetermined) own 100 acres of patented property (1958).

The Daley Deposit was discovered in 1894, and worked from 1915 to 1916 by the San Jacinto Mining and Milling Company, and from 1916 to 1919, or slightly longer, by the Southern California Mining and Milling Company, San Diego. The ore mined was smelted in a 50-ton reverbatory furnace on the property. The combined production of the two companies was about 175,000 pounds of copper, of which about 150,000 pounds was produced in 1917, when the price of copper reached a peak of 27 cents a pound.

The Daley Deposit lies in a terrace-like area on the northwest side of a small hill which slopes steeply west. The hill is one of several which lie east of a valley that contains the headwaters of Daley Creek. The deposit consists of a north-trending zone of copper-bearing mineralization which was reported by Tucker (1924, p. 370) to be 150 feet long and 50 feet wide. The zone occurs in a north-trending pendant of schist which is bordered by granitic rocks. Oxide minerals in the upper 30 feet of the deposit consist of limonite, black copper oxides, malachite, and azurite. Finely divided chalcopyrite, with pyrite, occurs below the oxide zone. The ore probably averaged between 2 and 3 percent copper, and six ounces of silver per ton.

The principal working is a vertical shaft that was sunk along the west edge of the terrace-like area to a depth of about 115 feet. Level workings are appended to the shaft, and shallow surface workings flank the collar of the shaft. An additional working is an adit of undetermined length which extends eastward toward the bottom of the shaft from a point on the side of the hill, about 750 feet due west of, and 125 feet lower than, the shaft's collar.

Encinitas (Danes Lea) Mine *

Location: SE.¼ Sec. 32 and SW.¼ SW.¼ Sec. 33, T. 12 S., R. 3 W., S.B.M.; and NW.¼ Sec. 4 and NE.¼ NE.¼ Sec. 5, T. 13 S., R. 3 W., S.B.M.; nearly four miles north of Rancho Santa Fe. *Ownership:* R. S. Perkins, 1376 San Ysidro Drive, Beverly Hills, owns 10 northwest-trending, contiguous, patented claims which comprise 133 acres (1955).

The Encinitas Deposit was discovered in 1887 and worked sporadically from that year until about 1917,

* Prepared by F. H. Weber from data gathered mainly by R. M. Stewart.

Copper

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
28	American Girl prospect	North edge SE¼ sec. 1, T8S, R6W, SBM (proj.); Defiance district, about 11 miles northeast of San Clemente, near the Riverside County line.	Undetermined (1958) W. A. Clark (?), Fallbrook (1914)	Shear zones in Santiago Peak metavolcanic rocks contain bodies which contain copper sulfide and oxide minerals.	Explored by shallow cuts and 100-ft. adit. Claim located after previous claims in Defiance district, as liste by Hubon (1902), had become invalid. See also Defiance district. (Hubon 02:6, 7; Merrill 14:665-666).
	American Queen property				See Defiance district. (Hubon 02:6).
	Barona				See Daley mine in text. (Aubury 05:260 08:345; Eric 48:320; Hubon 02:6; Merrill 14:667; Tucker 25:330; Tucker and Reed 39:13-14).
29	Beehive (Copper King?) prospect	North edge sec. 1, T8S, R6W, SBM (proj.); near the San Diego-Riverside County boundary. On the west slope of San Mateo Canyon, southwest of the junction of Nickel (Quail) and San Mateo Canyons.	Howard V. Harrison, Thomas Dunston, Paul Harris, Beth Harris French, Box 502, Fallbrook (1955)	Irregular bodies of sheared, chloritized granitic rocks within Santiago Peak metavolcanic rocks contain bornite, chalcopyrite, and malachite. Bodies elongated north-northwestward, parallel to shear zones of country rocks. Largest outcrop 50 ft. by 150 ft. Owner reported that ore contains as much as 7 percent copper, 4 dollars per ton in gold, and traces of silver.	Explored by 10-ft. and 100-ft. adits (latter now caved). Inactive since 1932 except for upkeep of access road, and sampling. See also Defianc district. (Engel, Gay, and Rogers 59:61, 111, pl.2; Hubon 02:6). (R.M.S.)
30	Clark prospect	SE¼ sec. 1, T8S, R6W, SBM (proj.); Defiance district, about 11 miles northeast of San Clemente.	Undetermined (1958) W. A. Clark (?), Fallbrook (1914)	Shear zones in Santiago Peak metavolcanic rocks contain bodies which contain copper sulfide and oxide minerals.	Explored by shallow cuts. Claims located in Defiance district after claims listed by Hubon (1902) invalid See also Defiance district. (Hubon 02:6, 7; Merrill 14:665-666).
	Coleman property				See Defiance district. (Hubon 02:6; Merrill 14:665-666).
	Copper Brick deposit	Julian district.			See tabulated list under "Nickel". (Merrill 14:667).
	Copper King property				See Defiance district. (Hubon 02:6).
31	Daley (Barona) mine	South of Ramona.			See text. (Aubury 05:260; 08:345; Eric 48:320; Hubon 02:6; Jenkins 48; Merrill 14:667; Tucker 24:370; 25:330 331; Tucker and Reed 39:13-14, pl.1).
	Danes Lea				See Encinitas mine in text. (Aubury 05:259; 08:344; Eric 48:320).
	Defiance district	Around mutual corner separating T's 7 and 8S, and R's 5 and 6 W, SBM (partly projected); along boundary between Riverside and San Diego counties, about 11 to 12 miles northeast of San Clemente.		Sparse chalcopyrite, bornite and copper oxide and carbonate minerals in northwest-trending zones in Santiago Peak metavolcanic rocks.	Hubon (1902) listed the following properties, which then comprised the Defiance district: American Queen, Coleman, Copper King, Della and Fisher. These were grouped in the NE¼ T8S, R6W, SBM (proj.). The properties noted by Hubon were not mentioned in subsequent California Division of Mines publications, however, and their exact locations are undetermined. More recent names that have been applied to the deposits, which are described elsewhere in this list, are as follows: Under "Copper" - Beehive, Silver Shine, American Girl and Clark prospects; under "Iron" - Mammoth deposit. (Hubon 02:6, 7; Merrill 14:665-666; Engel, Gay, and Rogers 59:111, pl.2).
	Della property				See Defiance district. (Hubon 02:6).
	Descanso (Magdalena, Ellis) mine	Near Descanso.			Primarily a gold mine, but a smelter shipment in 1935 yielded a very small quantity of copper. (Eric 48:320).

Copper

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Eagle mine	Julian district.			A smelter shipment in 1938 yielded 7,000 pounds of copper. This was probably from custom ore milled on the property. The Eagle mine is described in the tabulated list under "Gold". (Eric 48:320; Jenkins 48).
32	Encinitas (Danes Lea) mine				See text. (Aubury 05:259; 08:344; Eric 48:320; Hubon 02:7; Jenkins 48; Mahrholz, W. W., unpublished report of Bear Creek Mining Company, 1952, one page; Merrill 14:666; Tucker 25:331; Tucker and Reed 39:14, pl.1).
	Fisher property				See Defiance district. (Hubon 02:7).
	Friday deposit	Julian district.			A nickel prospect which also contains copper minerals. See text under "Nickel". (Calkins 16b:77; Eric 48:320; Hubon 02:7; Jenkins 48; Merrill 14:656, 666-667; Tucker 25:330; Tucker and Reed 39:13).
	Gold Star				See Barber Mountain mine in tabulated list under "Gold". (Merrill 14:667).
	Magdalena				See Descanso mine. (Eric 48:320).
	Napoles	Julian district.			See Gilson prospect in tabulated list under "Nickel". (Hubon 02:7).
	Old Ironsides prospect	Northeast of Ramona.			Gossan deposit which contains nickel, cobalt and copper. See tabulated list under "Nickel".
	Owens mine	Julian district.			A smelter shipment in 1904 yielded 104,000 pounds of copper. This was probably from custom ore milled on the property. The Owens mine is described in the text, under "Gold". (Eric 48:320; Jenkins 48).
33	Silver Shine prospect	SW¼ sec. 31 (?), T7S, R5W, SBM (proj.); about ¼ mile northeast of junction of Nickel (Quail) and San Mateo Canyons, along south edge of Riverside County. (Shown by Engel, 1959, pl.2, to be in San Diego County).	Howard V. Harrison, Thomas Dunston, Paul Harris, Beth Harris French, Box 502, Fallbrook (1955)	Chalcopyrite and secondary copper minerals in quartz vein in body of sheared diorite within andesite (Santiago Peak volcanics). Vein strikes N60°E, dips 88° southeast, and traceable for several hundred feet.	Adjacent to Mammoth iron deposit. Prospected by small open cut and short adit prior to 1932. No ore produced. Long idle. (Engel, Gay and Rogers 59:111-112, pl.2). (R.M.S.)
34	Undetermined	Sec. 32, T12S, R3W, SBM; about 5½ miles north of Encinitas, and 4½ miles north of Rancho Santa Fe.	Undetermined (1957)	Nearly vertical mineralized shear zone in fine-grained Black Mountain metavolcanic rocks. Zone strikes N. 55° W. and is about 5 ft. wide. Iron- and copper-stained rock, highly sericitized, on dump of untimbered and inacessible vertical shaft. (estimated depth 200 ft.). Probably no level workings.	Possibly part of Encinitas mine. (R.M.S.)

Cornwall Stone

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Dehesa Cornwall stone deposit				See McGinty Mountain deposit in text under "Feldspar". (Sampson and Tucker 31:427-428; Tucker 21:375; 25:358; Tucker and Reed 39:pl.1).

chiefly by the Encinitas Copper Company whose president was W. W. Harland of San Diego. Records show that ore from the deposit yielded about 5,000 pounds of copper in 1905 and 7,000 pounds between 1915 and 1917.

The Encinitas property encloses part of a northwest-trending zone of copper-bearing mineralization which is about one mile long and 10 to 50 feet in width. The zone extends northwestward from the NW.¼ Sec. 4, across the NE.¼ NE.¼ Sec. 5 and the SW.¼ SW.¼ Sec. 33, and into the SE.¼ Sec. 32. It is enclosed in metavolcanic rocks of probable Jurassic or Cretaceous age. The principal workings of the Encinitas property develop a mineralized shear zone, in the SW.¼ SW.¼ Sec. 33, which is subordinate to the main zone. The shear zone dips steeply northeast and is three to five feet in width (W. W. Mahrholz, unpublished report of the Bear Creek Mining Company, 1952, 1 p.). The common minerals at the surface of the deposit are limonite and malachite, which fill fractures; adjacent dump material contains pyrite, chalcopyrite, and very sparse galena. The grade of the mineralized zone was not determined during this investigation, but is estimated to be relatively low.

The principal workings are two shafts, about 100 feet apart, on opposite sides of the tributary of Escondido Creek. The main shaft, on the northwest bank, was partly filled with water in 1955. It was reported by Aubury (1905, p. 259) to be 280 feet deep. The shaft on the southeast bank is 100 feet deep, and also was filled with water. Two drift adits above this shaft, about 10 feet apart vertically, extend southeastward into the side of the canyon for about 35 to 40 feet. They are connected by a raise. A site near the main shaft once was occupied by a small concentration plant.

CORNWALL STONE

See McGinty Mountain Deposit in the section on "Feldspar."

DIATOMITE

The only reported occurrence of diatomite in San Diego County is "about 40 miles north of San Diego" (Eakle, 1914, p. 69). This was not confirmed by the present writers.

DUMORTIERITE

See section on "Kyanite, Andalusite, Sillimanite, Dumortierite, and Topaz."

FELDSPAR

San Diego County has been the principal source of feldspar in California, although none of its feldspar deposits has been worked since about 1946. The total recorded county production of nearly 100,000 tons, valued at about $600,000, was mined mainly during the 1920's and 1930's. Of the total, about 87,000 tons was mined from the Pacific Deposit, near Campo, which was worked from 1921 to 1943 by the American Radiator and Standard Sanitary Corporation and predecessors. The next most productive deposits are the Buckthorn Deposit near Live Oak Springs, and the McGinty Mountain Deposit near Jamacha. The Buckthorn Deposit probably yielded several thousand tons of feldspar and the McGinty Mountain Deposit about 7,000 tons of feldspar-like rock. Production from the following deposits ranges from 25 to several hundred tons: Black Canyon, Hoover, Langer, Marden, Moore, Spanish Bayonet, Stewart, Ward and Williams, and White Rose. These deposits, except the Stewart, are described herein in the accompanying tabulated list. The Stewart Deposit is described in the text under "Lithium Compounds."

The commercial feldspar deposits of San Diego County consist, with one exception, of granite pegmatite dikes which are enclosed in the granitic, and associated metamorphic rocks of the batholith of Southern California. The one exception is the McGinty Mountain Deposit, which consists of a silicified aplite dike composed of a mixture of quartz and feldspar, but used commercially similar to feldspar. Mineable feldspar in the pegmatite deposits consists chiefly of perthite (potash feldspar plus subordinate proportions of soda feldspar) which occurs in the inner zones of the dikes with quartz and small proportions of biotite, muscovite, tourmaline, and garnet. (The general characteristics of pegmatite deposits are discussed more thoroughly herein in the "Gem Minerals" section.) To constitute mineable material, feldspar crystals should be at least six inches in diameter and quartz should not constitute more than 25 percent of the rock (Wright, 1957c, p. 195). Iron-bearing minerals such as biotite, tourmaline, and garnet are deleterious and must be removed before final sale of the product. Most dikes in the county that have been mined for feldspar have formed dip slopes or cap-like remnants on ridges. They have ranged in thickness from two feet (White Rose deposit and others) to as much as 80 feet (Pacific Deposit). Their dip and strike-lengths have ranged from a few tens to many hundreds of feet. Only in the larger

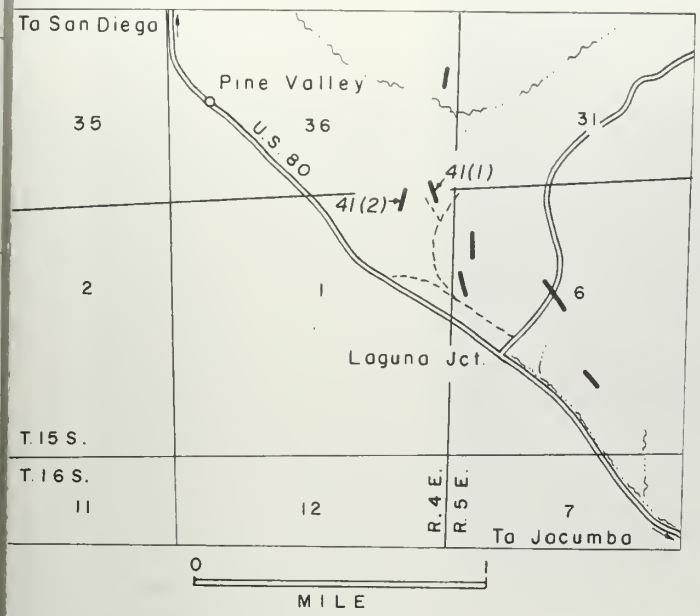


Figure 15. Map showing Laguna Junction and vicinity, and location of feldspar- and quartz-bearing pegmatite deposits. (See description under *Laguna Junction* in tabulated list.)

operations has the quartz been marketed. Most deposits mined have been worked almost wholly by surface methods.

The exposed feldspar-bearing pegmatite bodies of the county occur as swarms or, less commonly, as single deposits, such as that at the Pacific Mine. In four areas underlain by swarms of pegmatite dikes gem mining districts have originated. These are the Pala, Mesa Grande, Ramona, and Rincon districts, which are described herein under "Gem Minerals." In the Pala district the Stewart Lithium Mine once yielded a small amount of feldspar, and other dikes in this district perhaps contain mineable quantities of the mineral (Jahns and Wright, 1951, p. 47). In the Mesa Grande district, a small amount of feldspar has been mined from the Black Canyon Deposit, and a small mineable tonnage of the mineral is reported by R. H. Jahns (personal communication, 1957) to occur in the Rose Quartz Deposit. The pegmatite bodies of the Ramona district are rather thin dikes which contain chiefly soda feldspar. Deposits in the Rincon district were determined by Hanley (1951, p. 14, 15) to be void of commercial quantities of feldspar.

Additional feldspar-bearing dike swarms occur in the Jacumba-Boulevard and Warner Springs regions, in the Oriflamme Mountains area, in the Metal Mountain District, and in the Laguna Junction area (Fig. 15). The largest number of pegmatite bodies in the county occurs in the Jacumba-Boulevard region (Photo 6), but these (Marden, Moore, and Ward and Williams Deposits) have yielded only small tonnages of feldspar. The pegmatite dikes of the Metal Mountain District include the Buckthorn and Crestline Deposits.

Potash feldspar is no longer mined in the county for several reasons: (1) The three deposits that have yielded by far the greatest production—the Pacific, Buckthorn, and McGinty Mountain Deposits—contain very little additional feldspar which could be mined by surface methods. The Pacific and Buckthorn Deposits already contain minor underground workings, and additional mining would necessitate extensive underground development. (2) Most of the smaller deposits that have yielded small quantities of feldspar are not thick enough to be potential sources of sustained supply. (3) During the 1920's and 1930's operators of small deposits could have their crude material ground at the Pacific Mill at Campo, which was operated by Standard Sanitary Corporation. This is no longer possible, and in 1957 there was not a market for crude feldspar itself (Wright, 1957c, p. 199). (4) In addition to the above reasons, since the 1930's in California, feldspar has been largely replaced by talc as an ingredient in wall tile (Wright, 1957c, p. 199).

In 1955 between 5,000 and 10,000 tons of feldspar was consumed in California, mainly as an ingredient in pottery (from information furnished by Wright, 1957c, p. 199). The major part of this production was mined near Kingman, Arizona, and the remainder in San Bernardino County, at a captive deposit operated by Gladding, McBean and Company. In 1955 the price of potash feldspar mined near Kingman was $20.75 per short ton, carload lots, ground to 200-mesh.

Buckthorn (Flynt Silica and Spar Company, State Lease) Deposit

Location: SE.¼ Sec. 16, T. 16 S., R. 6 E., S.B.M.; about six miles north-northwest of Live Oak Springs, in the southwestern part of the In-Ko-Pah Mountains; in the Metal Mountain district. *Ownership:* California State Lands Commission, 217 W. First Street, Los Angeles (1959).

The Buckthorn deposit was opened in 1926 by the Flynt Silica and Spar Company, of Los Angeles, and worked by that company until 1928 (when its Los Angeles plant burned). The operation was continued in 1929 by the Mineral Milling Company, which mined the deposit intermittently until 1932. The Chamberlain Company (and its successor, Kennedy Minerals Co.) worked the deposit from about 1935 to 1937. It has been inactive since 1937. Total output from the deposit is estimated by the writer to be at least 2,500 tons of feldspar, with a lesser tonnage of quartz.

The deposit consists of three pegmatite dikes that cut across the crest and upper slopes of a southwest-trending interfluve which juts out from the long north-trending ridge east of Thing Valley. The dikes range in strike from westward to north-northwestward and dip to the west and west-southwest. The rocks cut by the dikes are chiefly dark-gray quartz-biotite schist and gneiss, with subordinate quartz diorite.

Nearly all of the feldspar and quartz produced from the deposit was obtained from the middle dike (Photo

Photo 29. Principal workings at Buckthorn feldspar deposit; view northwest. Feldspar was mined from glory hole and underground workings in left middleground and transported to surface by adit whose portal is at the right edge of the dump in the lower left corner of the photograph. Surface of a fault approximately follows the shadow on the left side of the glory hole.

Photo 30 (below). Northeast wall of glory hole, Buckthorn mine. In middle is feldspar-bearing rock which contains prisms of schorl (black tourmaline) as much as 2 feet long. Rim of pit is underlain chiefly by quartz.

29). This is a relatively short, but bulbous body which strikes north-northwestward across the crest of the interfluve and dips about 60° west-southwest. The dike is at least 200 feet long and 60 to 75 feet in maximum thickness. Where developed, it is compounded in thickness 1½ to 2 times by a fault which strikes N. 10° W. and dips very steeply west-southwest.

The exposed part of the dike consists of two layers, the lower of which is composed chiefly of coarse-grained quartz with sparse potash feldspar. It is at least 25 feet thick, and for the most part has not been mined. The upper layer, which is at least 35 feet thick, is composed chiefly of a coarse-grained aggregate of potash feldspar, quartz, muscovite and schorl. Maximum length of the schorl crystals is about 2 feet, and most have been partly replaced by muscovite (Photo 30). Within this layer are lenses of nearly pure potash feldspar as much as several feet in length. Most of the feldspar produced was mined from this layer.

The dike was first worked from an open pit which was later connected to underground workings to form a glory hole. The glory hole is crudely funnel-shaped downward, about 30 feet in diameter at the top, and 20 to 30 feet in depth. An adit used as a haulageway extends north-northwestward from a point about 125 feet southeast of the glory hole. Near the end of the adit, drifts extend east and west for about 140 feet in each direction (Sampson and Tucker, 1931, p. 428-429). In the western drift, a stope 35 feet long, 10 feet wide, and 40 feet high, is connected to the floor of the glory hole by a 10-foot raise.

Very little mineable feldspar remains in exposed parts of the main dike. Exploration for additional feldspar should be aimed at extensions of the dike underground,

Photo 31. McGinty Mountain silicified alaskite aplite deposit. The material formerly was used in the manufacture of vitrified tile. View is to the south from a point near the south end of the deposit.

below the glory hole. Large masses of quartz, totaling several thousand tons, are exposed around the glory hole. The dumps are composed mainly of quartz fragments.

The most northeasterly of the three dikes is exposed just southeast of the crest of the interfluve about 200 yards northeast of the main dike, described above. The dike is similar in lithology to the main dike, is about 50 feet thick, and several hundred feet long. The workings consist of north-trending adits, 75 and 100 feet long; a trench, 30 feet long; and a circular pit about 20 feet in diameter, which serves as a hub for two nearly north-trending adits 25 feet long. Additional mineable feldspar probably lies beneath the circular pit, within which is a large exposure of quartz.

The third of the dikes crops out less than 100 yards southwest of the main dike. It is of undetermined thickness and extent and was explored only by a trench 30 feet long.

McGinty Mountain (Dehesa Cornwall Stone) Deposit *

Location: E.½ NE.¼ Sec. 27, T. 16 S., R. 1 E., S.B.M.; about 6⅔ miles east-southeast of El Cajon, on the east edge of the crest of McGinty Mountain. The deposit can be reached on foot from Beaver Hollow via an abandoned road. *Ownership:* Undetermined (1957). American Encaustic Tiling Company, Los Angeles (1925).

The deposit consists of a silicified alaskite aplite dike which is enclosed in gabbro and is exposed along the east edge of the crest of McGinty Mountain for about 1,000 feet. The dike strikes northward and dips steeply to the west. As the top part of the dike has been mined for almost its entire length, exposures are rare, but the width of the workings indicates that the dike ranged in width from about 10 to perhaps 15 or 20 feet. Where not weathered, the rock is hard, creamy-white and composed chiefly of quartz and partly sericitized orthoclase, plus very minor proportions of plagioclase and chlorite (Photo 31). Its texture ranges from very fine- to medium-grained, and veinlets of quartz commonly cut the rock. Tucker (1925, p. 358) quoted the following analysis for a sample of the rock: silica, 77.68%; alumina, 15.97%; lime, 2.80%; iron, 0.13%; manganese, 0.72%; and alkalies, 2.04%; total, 99.34%.

The rock has been called "duroc" (Boalich and others, 1920, p. 93), "cornish stone" (Dietrich, 1928, p. 95), and "cornwall stone" (Tucker, 1925, p. 358). Cornwall stone is described by Burgess (1949, p. 346) as "a feldspar-quartz-kaolin product obtained from weathered alaskite-type granite" at Duroc, Cornwall, England. Thus, only weathered parts of the Dehesa Deposit could be correctly termed cornwall stone, as Boalich and others (1920, p. 63) reported that the material mined was "exceedingly hard."

The deposit was discovered in 1900 and worked as late as the early 1930's but probably most intensely during the 1920's. The American Encaustic Tiling Company (which was known as the West Coast Tile Company prior to 1920) used this feldspar-bearing rock in the manufacture of a hard, white, vitrified tile known as "Kaospar" (Boalich, 1920, p. 63). The deposit was mined intermittently to meet plant requirements and probably has been inactive since the early 1930's. Production figures are not available, but a total production on the order of 6,500 to 7,000 tons can be inferred from the size of the excavations.

The rock was mined from open cuts and hauled by truck to El Cajon for rail shipment to Los Angeles. The principal working is a shallow, north-trending trench 10 to 25 feet wide, 5 to 15 feet deep, and about 700 feet long, which follows the crest of the ridge upward to the south. From the south end of this trench, and above it 15-20 feet, a second trench extends southward for about 150 feet (Photo 31). In addition, a 50-foot cut

* Prepared partly from data gathered by R. M. Stewart.

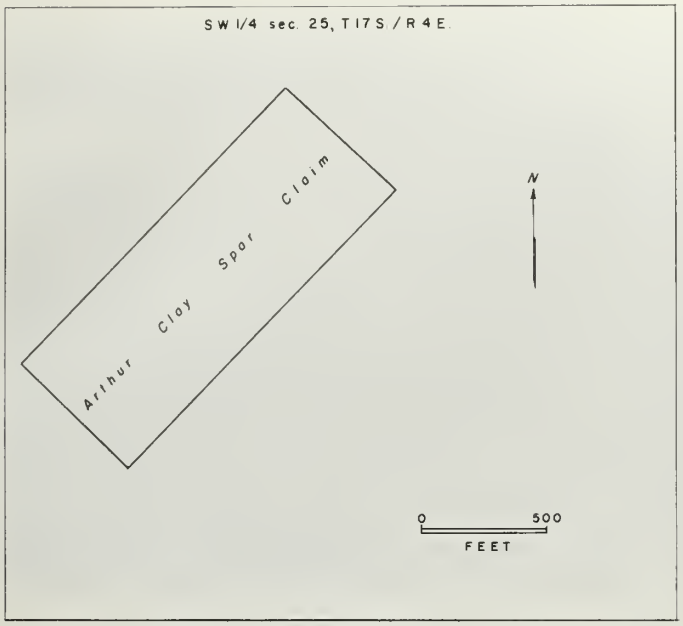


Figure 16. Map showing patented claim that covers the Pacific feldspar deposit, near Campo, San Diego County.

extends to the east from the south end of the main trench, and there is some indication that an adit may have been driven westward, under what is now this cut, to intersect the deposit. The only additional feldspar-bearing rock in this deposit, similar to that mined, lies beneath the floor of the previous workings. Similar dikes are exposed in the area, but those examined contain small proportions of detrimental, iron-bearing dark minerals.

Pacific Mine (Arthur Clay Spar Number One, Campo, Pacific Sanitary Porcelain Co., Standard Sanitary, Stell)

Location: Mine—center SW.¼ Sec. 25, T. 17 S., R. 4 E., S.B.M.; on the north side of Hauser Canyon, 5 miles northwest of Campo; *Mill*—near the north edge of the N.½ NW.¼ NE.¼ Sec. 10, T. 18 S., R. 5 E., S.B.M., about three-quarters of a mile east of Cameron Corners.

Ownership: Torrance Sand and Gravel Products Company, 25701 Crenshaw Boulevard, Torrance, owns one patented claim which covers the mine workings, and eight (?) contiguous, unpatented claims (1959).

In 1918 William Stell located 9 lode claims in the W.½ of Section 25, and in 1924 patented one of these claims, the Arthur Clay Spar Number One, which covers most of the deposit (Fig. 16). From 1921 to 1943, the deposit yielded about 87,000 tons of feldspar and was the principal source of this mineral in California. The deposit was operated during this period by the American Radiator and Standard Sanitary Corporation under three company names: Pacific Porcelain Ware, 1921 to 1923; Pacific Sanitary Company, 1923 to 1925; and Standard Sanitary Manufacturing Company, 1925 to 1943. Peak production was from 1927 to 1929, when about 32,000 tons was mined. A small tonnage of quartz also was produced. The Standard Sanitary Company ceased operations in 1943, partly because of increased labor costs, and partly because of a lack of reserves of easily mined feldspar. Since 1943 no attempt has been made to reopen the Pacific Deposit. In the early 1950's, however, the Campo Milling Corporation (first under the direction of T. J. Williams, then F. A. Matthews) produced two types of chicken grit (one of granite, and one of fossil shells) and other products, at the Pacific mill (Photo 32).

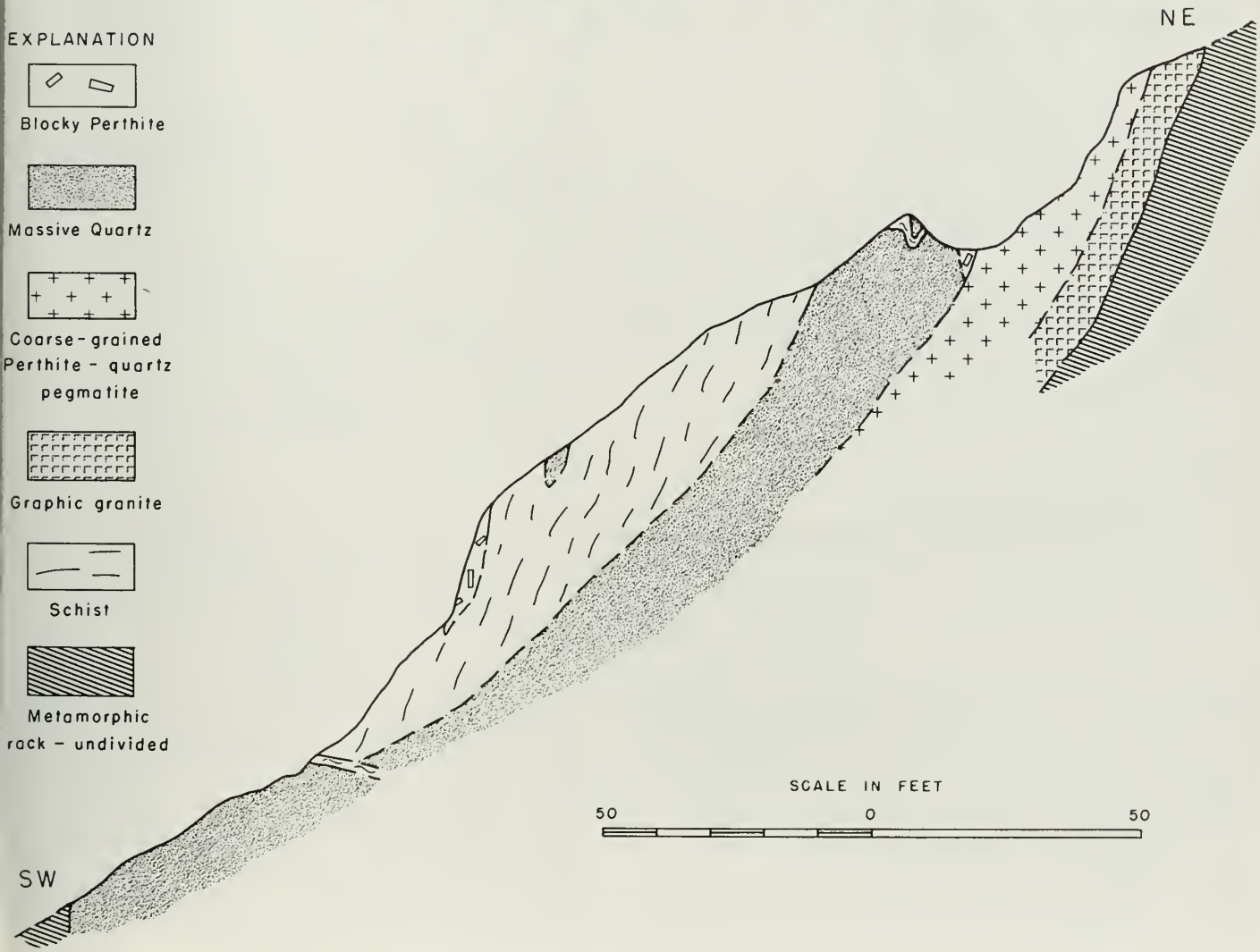
The deposit consists of a granite pegmatite dike which nearly forms a dip slope on the northeastern wall of Hauser Canyon (Photo 33, Fig. 17). The dike strikes northwestward and dips about 45° southwest. Its strike-length and dip-slope length are each about 500 feet, and its maximum exposed thickness is about 80 feet (Foote, 1951). Foote described four zones within the body: (1) a border zone, about 5 feet thick, composed mostly of graphic granite; (2) a wall zone, 5 to 20 feet thick, of coarse-grained, quartz-perthite pegmatite (Fig. 17); (3) an intermediate zone 5 to 30 feet thick of blocky perthite; and (4) a quartz core. Two inclusions that contain thorium-bearing monazite are related spatially to the core. Biotite is sparse and tourmaline is very sparse throughout the deposit. The body is bordered by granitic and metamorphic rocks and contains elongate inclusions of schist.

Potash feldspar-bearing rock was selectively mined from both the wall zone and the intermediate zone (Wright, 1957c, p. 196), and quartz-bearing rock was obtained from the wall zone and core. The deposit is developed by at least four terraced open cuts and limited underground workings (Fig. 18) which were driven from the upper, or main cut. This cut is about 220 feet high, and 50 to 200 feet wide (Wright, 1957c, p. 196).

Photo 32 (below). Pacific mill, just east of Cameron Corners and adjacent to San Diego and Arizona Eastern Railroad. Feldspar and quartz from the Pacific mine, about 5 miles to the northwest, were milled here until 1943. The Campo Milling Corporation operated the mill in the early 1950's.

Photo 33. Pacific feldspar deposit, bout 5 miles northwest of Campo. It was e principal source of feldspar in Cali-rnia from 1921 to 1943.

Figure 17 (below). Geologic section through pegmatite body at Pacific feldspar mine, San Diego County. *After Foote 1951, in Wright 1957c.*



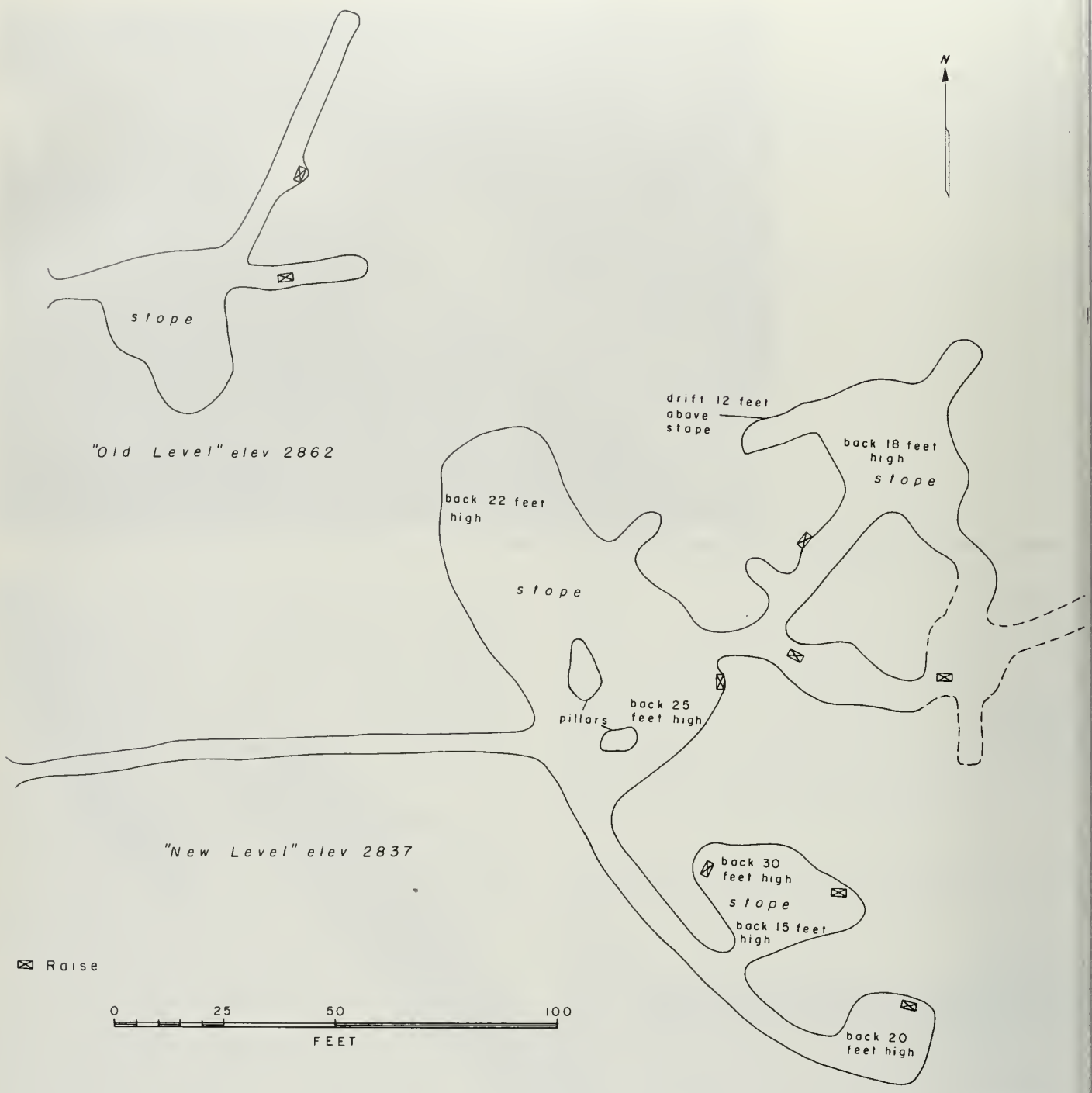


Figure 18. Plans of underground workings, Pacific mine.

Most of the high quality feldspar that could be mined from the surface has been removed; and a former mine operator stated that very little potash feldspar, that could be easily mined, remains underground. The underground workings no longer are open.

Crude feldspar- and quartz-bearing rock was hand-sorted, crushed, and screened to one-inch size at the deposit. Then it was trucked six miles to the company mill on a San Diego and Arizona Eastern Railroad siding east of Cameron Corners (Photo 32). There the rock was further crushed, screened, refined and bagged. Final feldspar products were (1) 200-mesh for the pottery industry, and (2) 100-150 mesh for the enamel ware industry. Quartz products were (1) 200 mesh for the pottery industry, and (2) 65-100 mesh for the glass industry. Capacity of the mill was 50 tons per day. Forty-nine people were employed during peak production. In February 1957 a large part of the plant was intact.

Feldspar

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	American Encaustic Tiling Company				See White Butte deposit in text under "Quartz and quartzite". (Miller 35:134; Sampson and Tucker 31:445; Tucker 25:375).
	American Radiator and Standard Sanitary Corporation				See Pacific mine in text.
	Arthur Clay Spar No. 1 claim				See Pacific mine in text. (Tucker and Reed 39:pl.1).
35	Bear deposit	S½NW¼ and NW¼SW¼ sec. 35, T11S, R1W, SBM; 9 miles northeast of Escondido, on southeast side of Bear Valley.	A. Dawson, P.O. Box 99, Rt.1, Del Mar (1957)	A small pegmatite deposit.	Four lode claims located by present owner in 1924. Developed only by minor, shallow workings. No production. Not examined during present investigation.
	Benton Ranch				See Laguna Junction deposits.
36	Black Canyon deposit	Nearly cut by line between E½NE¼ sec. 19, and W½ NW¼ sec. 20, T12S, R2E, SBM; about 6 miles north-northeast of Ramona.	Undetermined (1957)	A pegmatite body of undetermined extent exposed in road cut. Contains abundant potash feldspar, quartz (some of which is smoky), and biotite. Very shattered and iron-stained.	Exposed in face of road cut along east side of Black Canyon road. Face of cut is about 50 ft. long and as high as 20 ft. During mid-1930's about 5 tons of feldspar shipped to Los Angeles by L. B. Spaulding, Ramona. No further work done. (Tucker and Reed 39:54, pl.1).
37	Buckthorn (Flynt Silica and Spar Company, State Lease) deposit	In-Ko-Pah Mts.			See text. (Sampson and Tucker 31:428-429, 448; Tucker and Reed 39:34, pl.1).
	California China Products Co.				Probably same as McGinty Mountain deposit, which see in text. (Merrill 14:687).
	Campo				See Pacific mine in text. (Dietrich 28:201; Miller 35:134; Tucker 40:12; Tucker and Reed 39:34-37, pl.1; Tucker and Sampson 40:12).
38	Carlsbad deposit	West edge NW¼ sec. 26, T9S, R4E, SBM; about 7-3/4 miles northeast of Warner Springs, on the east edge of the Lost Valley plateau; in Anza-Borrego Desert State Park.	Undetermined (1958) W. F. Wheeler, Box 555, San Bernardino (about 1930)	Two pegmatite dikes were prospected: one strikes northeast, dips 45° west; the other strikes northwest, dips east (R. J. Sampson, California Div. of Mines, unpublished report, about 1930).	Wheeler and associates located 5 claims prior to 1930 and prospected deposits for feldspar and mica. No production. Dike no. 1 developed by cut 80 ft. long, 10 ft. wide, and 5 to 15 ft. deep; dike no. 2 developed by cut 30 ft. long, 7 ft. wide, and 9 ft. deep. Not visited during present investigation.
	Clark mine	Rincon district.			Small output of electronic-grade quartz crystals. See tabulated list under "Gem minerals". (Hanley 51:22).
39	Crestline and Gem Spar claims	E½ sec. 21, T16S, R6E, SBM; about 5½ miles north-northwest of Live Oak Springs, in the southwestern part of the In-Ko-Pah Mts.	L. B. Spaulding, P.O. Box 15, Ramona (1957)	Deposit consists of several pegmatite dikes which crop out of dark-gray quartz-biotite schist on a south- to southwest-facing hill slope. The dikes dip moderately south to southwest, slightly more steeply than the hill slopes. They range in dip length from about 50 to 300 ft. and in strike length from 100 to 150 ft. The dikes range in thickness from 2 or 3 to perhaps 6 ft. The core of one dike examined closely is 1 to 2 ft. thick and composed chiefly of quartz with a minor proportion of large feldspar crystals. The outer part of the dike is composed of graphic granite with muscovite.	Two unpatented north-trending claims. Developed only by shallow cuts and trenches. No production. (Tucker and Reed 39:37, pl.1).

Feldspar

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Dehesa				See McGinty Mt. deposit in text. (Wright 57c:197).
	Dos Cabezas prospects	Sec. 22, T16S, R8E, SBM; one mile north-northwest of Dos Cabezas siding; in Anza-Borrego Desert State Park.	Undetermined (1959)	Quartz-potash feldspar dikes in schist and diorite. Dikes vary widely in thickness and size of crystals.	Developed by shallow cuts and pits. Probably no production. (Sampson and Tucker 31:428; Tucker 25:359; Tucker and Reed 39:37).
	Elder deposit	Near Campo.	George W. Elder, 799 Oak St., San Francisco (1925)		Reported to have operated from 1920 to 1929 and yielded about 6200 tons of feldspar. Could not confirm existence of this deposit in 1957. Perhaps same as Buckthorn which see in text. (Wright 50:160; 57c:197).
	Elliot deposit		J. R. Elliott (1939)		Incorrectly plotted by Tucker and Reed (1939) in sec. 31, T17S, R8E, SBM. It is in the southwestern part of Imperial County. (Tucker and Reed 39:54, pl.1).
	Flynt Silica and Spar Company				See Buckthorn deposit in text. (Sampson and Tucker 31:428-429).
40	Hoover (Lakeside, Turner) deposit	SE¼NE¼ sec. 35, T15S, R1E, SBM; about 5-1/3 miles east-southeast of Lakeside. The deposit can be reached from the Harbison Canyon-La Cresta road.	Wellington I. Hoovery, Route 3, Box 363, Lakeside (1955)	Remnants of several pegmatite dikes are exposed on a ridge slope which faces southeast toward Harbison Canyon. The principal dike strikes eastward, and dips about 25° to the south. Its exposed portion contains two layers: the uppermost layer is at least 4 ft. thick and is composed chiefly of quartz with a minor proportion of potash feldspar crystals as large as 2 ft. in diameter; feldspar was selectively mined from this layer. The lower layer is about 5 ft. thick and is composed chiefly of glassy quartz, some of which is smoky. Very little additional feldspar, which can be mined easily from the surface, remains in the deposit.	Principal development is a north-trending trench 50 ft. long, 20 ft. wide, and 10 ft. deep. Sampson and Tucker (1931, p. 429) reported that "a considerable tonnage (of feldspar) has been shipped." According to present owner, feldspar was shipped to American Encaustic Tiling Company, Los Angeles. Pegmatite deposits to the northwest of the Hoover, in the S½ sec. 26, also have been worked for feldspar, and in the 1950's were prospected for radioactive minerals (see Fletcher deposit under Uranium and thorium). (Miller 35:134; Sampson and Tucker 31:429, 448; Tucker 21b; 376; 25:359, 375; Tucker and Reed 39:pl.1).
	Jacumba Copper Co. prospect	Sec. 26, T17S, R8E, SBM; about 4 miles northwest of Jacumba.	J. R. Elliott (1939)		No additional published information. (Tucker and Reed 39:55).
41	Laguna Junction (Benton Ranch) deposits	Sec. 36, T15S, R4E, SBM; sec.1, T16S, R4E, SBM; and sec. 6, T16S, R5E, SBM; within one mile north and east of Laguna Junction, as shown on map in text.	Undetermined (1957)	Deposits consist of exposures of pegmatite dikes, several of which can be seen from the two paved highways. The two largest deposits are described. Dike No. 1 (as shown on map) caps a small hill; this dike strikes N. 5°-15° W., dips 65° east, is about 100 ft. long, and is about 25-30 ft. thick. Its core, which is 8-10 ft. thick, is composed of quartz; layers adjacent to the quartz core are about 5 ft. thick and are composed of quartz and coarse-grained feldspar, with minor proportions of biotite. Dike No. 2 is composed of nearly pure quartz, with sparse biotite; it is between 100 and 125 ft. long, and is 15 to 25 ft. thick.	Dike No. 1. is developed by two short trenches. Production negligible. (Everhardt 51:pl.2; Miller 35:134; Sampson and Tucker 31:445; Tucker 25:375).
	Lakeside				See Hoover deposit. (Miller 35:134; Sampson and Tucker 31:429; Tucker 25:359; Tucker and Reed 39:pl.1).

Feldspar

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
2	Langer deposit	SW¼SE¼ sec. 26, T11S, R1W, SBM; about 9 miles northeast of Escondido.	H. G. Zanke, Box 823, Rt. 4, Escondido (1957)	A poorly exposed pegmatite dike which strikes N. 15°E. and dips steeply west. Length at least 150 ft. Thickness reaches at least 25 ft. The dike is composed chiefly of shattered anhedral to subhedral crystals of potash feldspar and quartz as much as several feet in diameter. Mica and other accessory minerals are very sparse.	Patented ranch land. Developed by 30-ft. stoped adit driven along the strike of the dike. Small output in 1928. (Sampson and Tucker 31:429, 448).
	Leonard and Leck prospect	"on Escondido-Ramona Highway..			Could not be located during present investigation. (Sampson and Tucker 31:429).
3	Lookout prospect	NW¼ sec. 25(?), T9S, R3E, SBM; south of Chihuahua Valley.	Undetermined (1958) Vincent Graner, Long Beach (1939)	A pegmatite dike 2½ ft. wide (Tucker and Reed, 1939).	Four unpatented claims. Explored by 2 open cuts, 8 ft. and 4 ft. long. (Tucker and Reed 39:37, pl.1).
4	Marden deposit	Probably secs. 25 and 36, T17S, R8E, SBM; northeast of Jacumba.	Undetermined (1957)	Main deposit consists chiefly of a nearly flat-lying pegmatite dike which crops out in the NE¼NW¼ sec. 36. It strikes northward, is about 500 ft. in exposed length, and 2 to 50 ft. in outcrop width. Its thickness ranges from 2 to 10 ft. The core of the dike, which has a maximum thickness of 5 ft., is composed of coarse-grained feldspar and quartz with minor muscovite and sparse garnet. The mica books average about 1 in. to 2 in. in diameter and the average length of the feldspar crystals is 2 ft.	Probably same area as that in which Tucker (1925) stated 15 claims had been located on an "outcrop of feldspar and silica that can be traced for a distance of five miles....Two hundred tons of spar and 50 tons of clear silica had been mined" in 1924 and shipped to Los Angeles. The original locator was Jack Marden of National City and in 1931 the owners were A. W. Smith and E. Carson of San Diego. The main deposit is developed by several shallow cuts and trenches. Sec. 36 now is owned privately and in 1957 most of sec. 25 was covered by part of the Mica Gem group which is described in the text under "Mica". (Miller 35:134; Sampson and Tucker 31:429; Tucker 25:359; Tucker and Reed 39:pl.1).
45	McGinty Mountain (Dehesa Cornwall stone) deposit	South-southeast of El Cajon.			See text. (Boalich 20:63, 93; Dietrich 28:95; Merrill 14:687; Sampson and Tucker 31:427-428; Tucker 21b:375; 25:358; Tucker and Reed 39:pl.1; Wright 57c:197).
46	Mesa Grande deposit	Sec. 26(?), T11S, R1E, SBM; Mesa Grande district, north of Ramona.	Undetermined (1957)	Reported by Sampson and Tucker (1931) to consist of a pegmatite deposit in granitic rocks which crops out for 1,000 ft. Working exposed feldspar 3 ft. thick.	Explored by a 25-ft. adit. No production. Relatively inaccessible. Not investigated by present writer. (Sampson and Tucker 31:429).
	Mica Gem group				See Mica Gem group in text under "Mica".
	Mica Springs (Mica Springs No. 1) claim	Sec. 35, T17S, R8E, SBM; about 3½ miles east-northeast of Jacumba.	Walter Horr (1939)		Claim located prior to 1939 by Walter Horr. Later abandoned. Now covered by part of Mica Gem group, which see in text under "Mica". (Tucker and Reed 39:55, pl.1).
	Mica Springs No. 1				See Mica Springs claim. (Tucker and Reed 39:pl.1).
	Modern prospect	Sec. 23, T17S, R8E, SBM; about 5 miles northeast of Jacumba.			Claim no longer valid. Deposit lies within Anza-Borrego State Park. (Tucker and Reed 39:pl.1).
47	Moore deposit	SE¼ sec. 36, T17S, R8E, and NE¼ sec. 1, T18S, R8E, SBM; about 5 miles east of Jacumba, adjacent to U. S. Highway 80 on the north.	Undetermined (1957) Armon Moore, Los Angeles (1925)	Pegmatite bodies that dip about 45° west occur in a northwest-trending zone approximately 1,000 feet long. The pegmatite contains feldspar aggregates and individual crystals to 3 ft. in diameter. Quartz layers are as much as 2 ft. in width. Muscovite and biotite are minor. Red garnets also occur.	Deposit was originally covered by a 20-acre lode claim which has been long inactive and is assumed no longer valid. Sec. 36 reportedly is now privately owned. Small output reported for 1928. Developed by 6 shallow pits. (Sampson and Tucker 31:429-430; Tucker 25:359; Tucker and Reed 39:pl.1).
48	Mykrantz (San Vicente) deposit	Sec. 3 (?), T14S, R1E, SBM (proj); south of Ramona.	J. W. Mykrantz, Ramona (1925)	A pegmatite deposit.	Patented land. Prospect only. (Sampson and Tucker 31:430, 449; Tucker 25:359, 376; Tucker and Reed 39:pl.1).

Feldspar

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Orion				See Quality deposit in text. (Tucker and Reed 39:pl.1).
	Osborne				See Quality deposit in text. (Tucker and Reed 39:37, pl.1).
49	Overlook deposit	NW¼NW¼ sec. 27, T17S, R8E, SBM; about 4 miles north-northeast of Jacumba.	Undetermined (1957)	A pegmatite dike which caps a small hillock. Where exposed the dike contains feldspar and quartz crystals which are as much as 2 ft. in diameter. No muscovite is present.	Developed by 2 shallow cuts. Probably no production. (Tucker and Reed 39: pl.1).
50a (mine) 50b (mill)	Pacific mine (Arthur Clay Spar No. 1, Campo, Pacific Sanitary Porcelain Co., Standard Sanitary, Stell)	Northwest of Campo.			See text. (Burchfiel 36:1-3; Dietrich 28:201; Foote 51; Miller 35:134; Sampson and Tucker 31:430-431, 449; Tucker 21b:376; 25:358, 359-360; 40:12; Tucker and Reed 39:34-37, pl. 1; Wright 57c:196, 197, 198).
	Pacific Sanitary Porcelain Company				See Pacific mine in text. (Tucker 25: 359-360).
	Pala district			"Many of the larger and more bulbous dikes in the Pala district contain large masses of perthite with so little biotite or other iron-bearing impurities that the proportion of quartz would be the principal consideration in any selective mining" (Jahns and Wright, 1951, p. 47).	See also Stewart mine. (Jahns and Wright 51:47).
	Patten (or Patton) Lode claim				See Powers group. (Tucker and Reed 39:55, pl.1).
51	Pearson deposit	SE¼ sec. 23, T9S, R3E, SBM; about 6 miles north of Warner Springs, in south eastern Chihuahua Valley.	Undetermined (1957) A. N Pearson, Aguanga (1939)	Pegmatite dike which strikes northeast, dips southeast, and is about 8 ft. thick. The upper and lower parts of the dike consist of graphic granite which grades inward to a muscovite-quartz-perthite core. The crystals of quartz and perthite in the core are as much as 1 ft. in diameter. Muscovite is sparse.	Probably on patented land. Long idle. No production. Developed by a 30-ft. trench (Tucker and Reed 39:37).
52	Pilz deposit	Sec. 28 (?), T18S, R3E, SBM; about 4 miles west of Tecate, on the southeastern slope of Tecate Peak, near the summit.	Undetermined (1957) P. W. Pilz, Tecate (1931)	Deposit consists of a pegmatite dike which contains "spar, which is of good grade...(and)...easily separated from the silica." (Sampson and Tucker, 1931).	Described incorrectly as in T18S, R2E, SBM by Sampson and Tucker (1931) who reported that holdings consisted of 6 claims. Developed by a 30-ft. trench. Not investigated by present writer. Probably no production. (Map location herein is approximate). (Sampson and Tucker 31:431).
53	Powers group	Secs. 19 (?) and 24 (?), T11S, R2E, SBM; Mesa Grande district, about 2 miles west-northwest of Mesa Grande.	Mary L. Powers, 2858 Monroe, San Diego (about 1955)		A prospect. Property consists of 8 unpatented claims including Patten (or Patton) Lode claim. No additional published information. (Map location herein is approximate). (Tucker and Reed 39:55, pl.1)
54	Quality (Orion, Osborne) deposit	Southwest of Campo.			See text. (Sampson and Tucker 31:430, 449; Tucker 25:359, 376; Tucker and Reed 39:37, pl.1).
	San Vicente				See Mykrantz deposit. (Sampson and Tucker 31:449; Tucker 25:376).
55	Spanish Bayonet deposit	Near center W½ sec. 35, T14S, R3E, SBM (proj.); about 7 miles north-northwest of Descanso Junction, and ¼ mile west of Boulder Creek road.	P. H. Weber, J. F. Dougherty, and Cecil Lewinson, Alpine (1945)	A pegmatite body which dips steeply to the southeast.	Developed by an open pit that is oval in plan and which strikes northeast; it is about 100 ft. long, 30-40 ft. wide, and 25 ft. deep. Probably several hundred tons of feldspar removed in mid-1940's. Massive quartz is exposed at the bottom of the pit; mineable feldspar remaining is very sparse. (Everhardt 51:114, pl.3).

Feldspar

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Spar King deposit	Sec. 13, T9S, R2W, SBM; Pala district, about 2½ miles northwest of Pala.		Orthoclase was reported by Tucker and Reed (1939) to have been mined by H. E. Dougherty, San Diego, from a thin pegmatite dike.	Reported to have been developed by two adits, 20 and 80 ft. long. Location of former operation could not be confirmed in 1957. (Tucker and Reed 39:37, pl.1).
	Standard Sanitary Manufacturing Company, Richmond				See Pacific mine in text. (Sampson and Tucker 31:430-431).
	State Lease				See Buckthorn deposit in text.
	Stell				See Pacific mine in text. (Tucker 21:376).
	Stewart deposit				Pala district. Notable principally for yield of lepidolite, but some potash feldspar recovered as a byproduct. See also in text under "Lithium compounds". (Jahns and Wright 51:47).
	Toms Dream deposit	Sec. 11(?), T16S, R7E, SBM; about 8 miles northwest of Jacumba.	Undeteremined (1957) T. J. McCain, Boulevard (1939)	Tucker and Reed (1939) reported a "2 ft. vein of orthoclase feldspar in schist on the east slope of Eagle Peak, northwest of Tula (e) Mountain."	A prospect; explored with shallow open cuts. A very small deposit probably located near the Crystal Gem beryl-bearing pegmatite in NW¼ sec. 11, and not in sec. 15, as placed by Tucker and Reed. (Tucker and Reed 39:37-38, pl.1).
	Turner				See Hoover deposit. (Tucker 21:376).
	Walker deposit				See tabulated list under "Quartz and quartzite."
56	Ward and Williams deposit	S½NW¼ sec. 15, T17S, R7E, SBM; on leased federal grazing land in southern part of McCain Valley, about 2 miles north-northeast of Boulevard.	See under "Location" column.	Deposit consists of a pegmatite dike that strikes N45°W and dips 25° west. It crops out of irregular but gentle terrain about ½ mile northeast of the McCain ranch house. The dike ranges in thickness from 15 to 20 ft. The layer that was mined for feldspar is adjacent to the core and ranges in thickness from 3 to 4 ft.; it is composed principally of feldspar with subordinate quartz and minor biotite and muscovite; maximum length of the feldspar crystals is several ft. The core of the dike is nearly pure quartz and ranges in thickness from 1 to 3 ft.	The deposit is developed by a semi-circular pit about 40 ft. long which extends about 20 ft. down the dip of the dike. From the size and shape of the workings it is estimated that between 200 and 300 tons of feldspar was mined. Sampson and Tucker (1931) stated that a Mr. Ward and a Mr. Williams of Boulevard "shipped several cars of feldspar in 1929". The material was probably milled at the Standard Sanitary Corporation mill near Campo. Further exploitation of this deposit would necessitate underground development, or removal of a large amount of overburden. (Sampson and Tucker 31:431).
	White Butte deposit				See text under "Quartz and quartzite."
57	White Rose deposit	NE¼NE¼ sec. 17, T17S, R5E, SBM; about 6½ miles north-northwest of Campo and about 300 yards west of the Campo-Buckman Springs road.	Undetermined (1957)	A nearly flat-lying pegmatite dike that ranges in thickness from 2 to 7 ft. crops out irregularly for about 150 ft. on the crest of an east-trending ridge. The pegmatite is composed of a medium to coarse-grained aggregate of potash feldspar, minor quartz, and sparse biotite. The quartz that was removed is stockpiled nearby. About 75 to 100 tons of mineable feldspar are exposed.	The deposit was worked in 1928 by the Globe Tile and Porcelain Co., Hynes, which mined about 150 tons of feldspar. No activity since that date. Developed by 50- and 10-ft. trenches. (Sampson and Tucker 31:431).

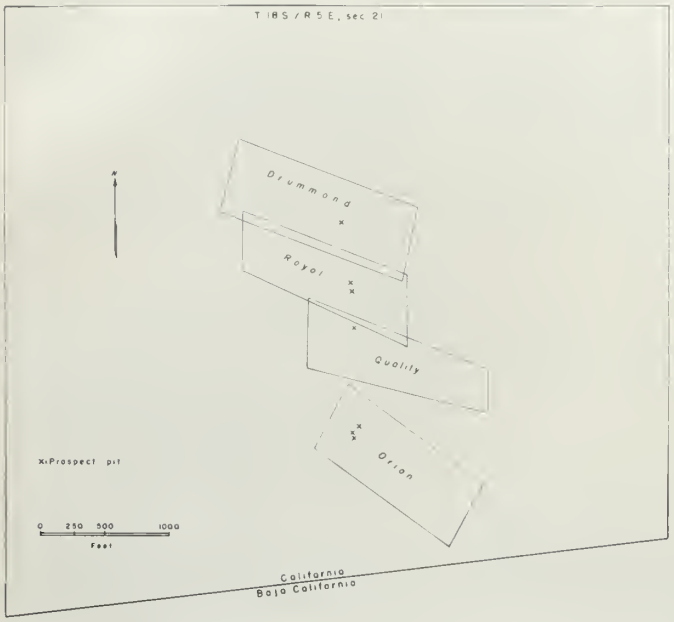


Figure 19. Map showing patented claims on Quality pegmatite deposit, near Campo, San Diego County.

Quality (Orion, Osborne) Deposit

Location: Sec. 21, T. 18 S., R. 5 E., S.B.M.; about 1¼ miles south-southwest of Campo, just north of the international border. *Ownership:* C. B. and Inez Lind, Box 56, Jamul, own three patented claims (Royal, Quality and Orion) and Michael Auer, 4519 Camellia, North Hollywood, owns one patented claim (Drummond) (1958).

The Quality Deposit was discovered and developed for feldspar and quartz, prior to 1925, by Robert C. Osborne and Robert S. Stewart. The property consists of four patented, west-northwest-trending, approximately side-by-side claims which enclose about 65 acres in the south part of the middle of Section 21 (Fig. 19). No work has been done on the property in many years, and no production of feldspar or quartz has been recorded.

The pegmatite dikes that comprise the Quality Deposit crop out on hillocky terrain in a north-trending, crudely elliptical-shaped area about 3,000 feet long and 600 feet in average width. The south edge of the area is nearly contiguous with the international border. The dikes, which are enclosed in partly decomposed tonalite, strike north-northwestward and dip gently. They are several hundred feet in maximum length, but are not well enough exposed to indicate an average thickness. Schorl is very common in dikes in the southern part of the area.

A dike typical of the group ranges in thickness from one to six feet and is composed of a core of quartz which grades abruptly upward and downward into coarse-grained aggregates of pink potash feldspar and minor quartz, and thence into an outer zone of graphic granite.

The dikes have been developed by at least nine shallow pits and cuts, the largest of which is about 50 feet long.

FLUORINE MINERALS

Fluorspar (calcium fluoride) has been reported only from the Mountain Lily Mine, by Merrill (1914, p. 705). Francolite (fluorapatite) has been reported to be abundant in nodules dredged from the sea floor off Southern California (Dietz, Emery, and Shepard, 1942, p. 818). Commercial deposits of these minerals have not been found in the county.

GEM MINERALS

The pegmatite deposits of San Diego and Riverside Counties have constituted one of the most important sources of gem minerals in the United States. These deposits have yielded tourmaline, spodumene, beryl, topaz, garnet, and quartz crystals with a total value of at least $2,000,000. Mining has centered about two principal mining districts in San Diego County—Pala and Mesa Grande. An estimated 90 percent of the total production came from five mines in these districts, which were most active from 1900 to 1912 (Wright, 1957d, p. 209).

The county also contains nonpegmatite deposits of semiprecious gem or ornamental minerals, but these have been worked mainly by amateur collectors and lapidaries. They include deposits of agate and jasper, axinite, dumortierite, epidote, garnet, orbicular gabbro, and rhodonite.

Gem-Bearing Pegmatite Deposits *

Distribution and General Features †

The most productive and most extensively developed of the gem-bearing pegmatite bodies in California are exposed in two areas—at Pala and Mesa Grande—in the north part of San Diego County. The Pala district, which is about three miles south of the boundary between San Diego and Riverside Counties, is 20 miles northwest of the Mesa Grande district. Gem pegmatite areas in San Diego County that are smaller and much less productive than the two noted previously are near Ramona and at Rincon. Individual gem-bearing pegmatite deposits are on Aguanga Mountain, in the Chihuahua Valley area, and near Jacumba.

"Of the gem-quality minerals in these deposits, tourmaline has been mined in by far the greatest quantity, and gem spodumene has proved abundant in certain of the lithium-rich pegmatites. The mining, which was aimed chiefly at the recovery of these two minerals and the nongem lepidolite [(see section on "Lithium Compounds" in this report)], also led to the recovery of gem varieties of quartz, beryl, topaz, and garnet.

"All of the gem-bearing pegmatites of San Diego and Riverside Counties lie within the Peninsular Ranges province, a region underlain mainly by plutonic igneous rocks of the Southern California batholith and by prebatholith metamorphic rocks. The pegmatite bodies were emplaced in late Mesozoic time during the end stages of the consolidation of the batholith. Most of them are within the dark-colored, more basic rocks of the batholith, especially in a unit known as the San Marcos gabbro.

* The sections herein on "Gem-bearing Pegmatite Deposits" and "Markets" were extracted almost wholly, and modified partly, from the sections titled (1) "Gem-bearing Pegmatites of San Diego and Riverside Counties" and (2) "Markets," in "Gem stones" by Wright (1957d, p. 208-214) who acknowledges the following sources of information: Jahns, 1948; Jahns and Wright, 1951; and Hanley, 1951; and from R. H. Jahns in personal communication.

† In parts quoted directly, present author's additions are in brackets.

"Virtually all of the pegmatite bodies of the Peninsular Ranges province are elongate dikes. Although a given dike is generally rather uniform in thickness, some dikes are only a fraction of an inch thick, whereas parts of others are 100 or more feet thick. The thicknesses of those that contain most of the pegmatite, however, lie within the general range of 4 to 25 feet. Many of the dikes are 1,000 to 4,000 feet long. In some areas the dikes occur in swarms that have filled numerous closely spaced parallel to subparallel fractures.

"The percentage of gem material in a given dike bears no obvious relationship to the average thickness of the dike. Indeed the dike at the very productive Himalaya mine at Mesa Grande averages only about four feet in thickness, whereas much larger dikes have yielded no gem material. Virtually all of the gem spodumene and significant amounts of other gem minerals, however, have been found within bulges in the dikes.

"The dikes are granitic in composition. Large numbers of them consist wholly of graphic granite, but others are complex bodies of two or more rock units of contrasting texture or mineralogy or both. The gem and lithium minerals have been found in only a small proportion of the complex dikes and in none of the simple dikes.

"Graphic granite forms the most of the upper part of the typical complex dike, whereas its lower part contains a fine-grained quartz-feldspar (aplitic) rock. Much of this fine-grained rock shows a distinct banding, caused by thin layers rich in minute grains of garnet or tourmaline, and is commonly known as 'line rock' [(fig. 20)].

"Discoidal to pod-like masses of very coarse-grained pegmatite occupy the cores of many of the dikes and form the central parts of most of the bulges. Some of these masses consist of quartz-perthite or quartz-spodumene aggregates; others contain only quartz or perthite. In several of the complex dikes this coarse-grained pegmatite has been worked for feldspar or quartz [(see sections on 'Feldspar' and 'Quartz and Quartzite' in this report)]. Irregularly distributed fracture-fillings and replacement bodies, composed chiefly of quartz, albite, and muscovite, are widespread in the complex dikes.

"All of the gem-quality tourmaline, beryl, topaz, and garnet is contained in a type of pegmatite that is characterized by an abundance of well-formed crystals and lies within or near the cores of the dikes. It ranges from fine-grained to very coarse-grained and consists mostly of quartz, albite, orthoclase, and muscovite. It also contains concentrations of minerals rich in lithium, beryllium, boron, caesium, and other rare elements. This material is popularly known as 'pocket pegmatite' because the crystals commonly are in pockets filled with red clay, but it rarely contains open space and much of it is clay free.

"The gem tourmaline crystals are transparent prisms of the blue, pink, green, and colorless varieties. Nearly all gradations exist between these colors, and individual prisms commonly are bicolored or multicolored in concentric zones or in layers normal to their long axes. Most of the gem tourmaline occurs in prisms that are pencil-like in size and shape, but individuals as much as four feet long and six inches in diameter have been mined. Tourmaline is the most abundant and widespread gem mineral in the pegmatites of southern California, but a single source—the Himalaya mine in the Mesa Grande district—has yielded considerably more tourmaline than all of the other mines combined.

"Spodumene, although locally abundant in the pocket pegmatite, is of gem quality only in the very coarse-grained, quartz-spodumene pegmatite. Here it occurs as unaltered residua in the central parts of some of the spodumene laths. The rest of the spodumene has been altered to a milky material composed partly or wholly of clay. In the pegmatites of the Southern California batholith, the gem spodumene is mostly of the pale-pink to deep bluish-lilac variety known as kunzite. A yellowish to colorless variety of spodumene is somewhat less abundant in these pegmatites and a pale-green variety is rare. The transparent spodumene ordinarily occurs in splintery, striated fragments less than 2 inches long, but locally these residual masses are as much as 4 inches wide

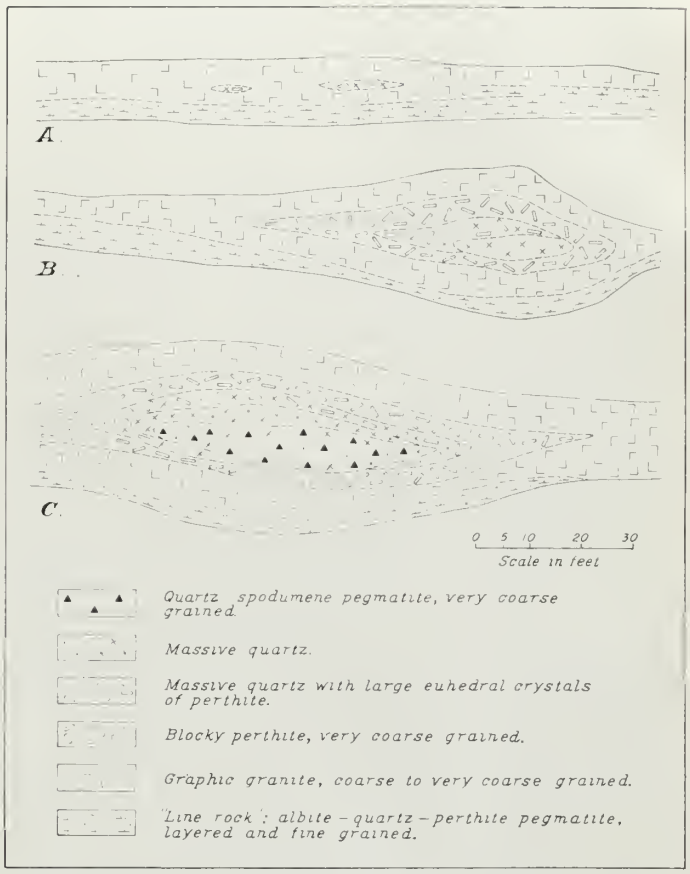


Figure 20. Idealized sections of pegmatite dikes in Pala district, showing typical zonal structure. *A*, Simply zoned dike, lower part fine grained (Tourmaline King, Tourmaline Queen); *B*, Bulging dike with more numerous inner zones (Ocean View, El Molino); *C*, Bulging dike with complex zonal structure (Stewart-Vanderburg-Katerina). *After Jahns 1954a.*

and 15 inches long. Most of the gem spodumene mined in California has been removed from the Pala Chief, Katerina, and Vanderburg mines in the Pala district.

"The most highly prized of the beryl gems in southern California pegmatites is a pale rose to peach-colored variety known as morganite. It is associated, in pocket pegmatite, with a nearly colorless to blue beryl. Both varieties occur in well-faced, equant to tabular crystals as much as six inches in maximum dimension. The gem beryl output has been obtained mostly from the Pala Chief, Anita, El Molino, and San Pedro mines in the Pala district, the Victor and Mack deposits in the Rincon district, and the Himalaya, San Diego, and Esmeralda mines in the Mesa Grande district[; and the A.B.C. mine in the Ramona district].

"Transparent quartz, although less prized than the gem minerals noted above is abundant in many dikes and has been used in the fashioning of cut stones. Colorless to smoky quartz euhedra are abundant in pocket pegmatite, and anhedral masses of rose quartz occur in a few of the dikes. Most of the pocket quartz crystals are smaller than the milky anhedral crystals that are abundant in the cores of the dikes, but locally they are as much as two or three feet long.

"Gem topaz and gem garnet, also constituents of pocket pegmatite, are rarer than the gem stones noted above. The topaz ranges from colorless through pale green to aquamarine, and occurs in well-developed prisms as much as four inches long. The colored

topaz is rare and most of the crystals are less than an inch long. Gem topaz has been recovered most abundantly from the Mountain Lily [(Emeralite No. 2)] mine at Aguanga Mountain and from the Lttle Three and A.B.C. mines near Ramona. The gem garnet, mostly spessartite, ranges in color from golden yellow to cinnamon brown, and occurs as dodecahedrons about an eighth of an inch to three-quarters of an inch in diameter. The Little Three and A.B.C. mines have been the principal sources of gem garnet.

"*History of Mining Operations.* That the gem stones of San Diego and Riverside Counties were gathered and prized by Indians long before they were discovered by white men is shown by the existence of tourmaline crystals in ancient burials. The first recorded discovery, however, was made by Henry Hamilton in 1872 when he noted tourmaline fragments on the slopes of Thomas Mountain in Riverside County and traced them up-slope to a pegmatite dike that was later developed by the Thomas Mountain mine. Subsequently, other minor occurrences of gem stones were noted in this area.

"The next significant tourmaline discovery became known in 1892. This was at a locality near Pala and now occupied by the Stewart mine. Other discoveries of tourmaline in the Pala district soon followed, but were overshadowed in 1898 when the very rich tourmaline deposits at Mesa Grande were first mined.

"In 1902, Fred M. Sickler, while working the Katerina mine near Pala, encountered gem spodumene, a very rare material whose occurrence here attracted the attention of mineralogists the world over. Most of the gem spodumene recovered at Pala proved to be colored various shades of pink and lilac, and soon after its discovery, was named "kunzite" (Kunz, 1903; and Baskerville, 1903) a new gem variety that became popularly known as "California's own gem." Kunzite, however, has since been recovered commercially in both Brazil and Madagascar.

"Intensive mining in the Mesa Grande area was confined mostly to the period 1900-10, and in the Pala area mostly to the period 1903-14. As many as 70 mines and prospects were being worked at one time and at least 95 percent of the gem output of San Diego and Riverside Counties was obtained in the 1900-14 interval. By a coincidence fortunate to the mine operators, the discovery and development of these deposits came at a time of high tourmaline prices which were brought about largely by the popularity of this gem in China. The fall of the Chinese dynasty in 1912, however, caused this market to dwindle to insignificance and the resulting drop in price contributed to the virtual discontinuance of profitable gem mining in this region. Moreover, by 1914 most of the readily detected and easily worked gem occurrences had been well exploited, and the discovery of additional gem-bearing pegmatites at most mines had become, in the opinion of the operators, prohibitively expensive. Nevertheless, the recovery of gem stones from the pegmatites of the Peninsula Ranges province has continued from 1914 to the present, albeit irregularly and on a considerably smaller scale than before. Much of this later mining has been the work of persons as much or perhaps more attracted by the romance of gem mining than by possible montetary gain.

"Operations at the Tourmaline King mine near Pala continued into the 1920's, and in this later development the pegmatite dike was thoroughly explored by 1,000 feet or more of underground workings; but only a very small amount of tourmaline was added to its previous production. A small output of byproduct tourmaline and beryl was obtained in the removal of lepidolite from the Stewart mine which was last worked in 1928. The Himalaya mine has been reopened on several occasions since it was shut down in 1914, but with generally poor rewards. The most productive of these later Himalaya operations began in 1952 and was continuing in 1956. Since 1930, sporadic development in excess of assessment work also has been undertaken at the Katerina, Vanderburg, San Pedro, Fargo, and White Queen mines near Pala, and at the Rose Quartz, Esmeralda, and San Diego mines at Mesa Grande.

"*Production and Mine Workings.* The production records o most of the mines, unfortunately, are incomplete and are incon sistent with respect to the values placed by the operators on th various types and grades of gem stones. Moreover, a large bu undetermined proportion of the total output has been remove surreptitiously by miners, both during and after regular workin hours and from both active and otherwise inactive mines. An other but much smaller fraction of the total gem output has bee removed by amateur mineral collectors whose search has bee confined almost wholly to mine dumps.

"Approximately 90 percent of an estimated 200,000 to 300,00 pounds of gem and near-gem material recovered from the peg matites of southern California has been obtained from only fiv mines—the Himalaya and San Diego in the Mesa Grande distric and the Pala Chief, Tourmaline Queen, and Katerina in the Pal district. All but a very small part of the remainder has been re-moved from 10 other mines—the San Pedro, Tourmaline King, and Vanderburg in the Pala district; the Esmeralda and Mesa Grand in the Mesa Grande district; the A.B.C. and Little Three mine near Ramona; the Mountain Lily at Aguanga Mountain; and the Anita near Red Mountain and the Fano at Coahuila Mountain [i Riverside County]. About 35 small and widely scattered, additional mines also have yielded gem material, and two to thre times as many deposits have been seriously prospected.

"The development of most of the mines began with the discovery of gem crystals in pegmatite outcrops or in the float downslope from them. Some workings were started only on bulges in dikes whose exposures were barren of gem material or nearly so. In their early stages most of the mines consisted of open cuts from which shallow underground workings were developed as the mining advanced. In all but a few of the mines the gem production was obtained from only a single pocket. In each of the five most productive mines, however, numerous pockets were encountered.

"The mine workings are typically very irregular and most of them range from a few feet to several hundred feet in total length. They were driven through the pegmatite rock that was believed to hold the most promise for gem production, principally along the upper margin of the "line rock" or in the lower or central parts of the cores of coarse-grained pegmatite. The Himalaya and Tourmaline King mine workings, each of which extend down-dip for nearly 200 feet, probably are the deepest penetrations.

"The drilling has been done mostly by hand and, in general, care has been taken in blasting so that as little as possible of the gem material is fractured. Some of the workings remain wholly accessible, but entry to others has been made difficult or impossible by caving and backfilling."

Summaries of Districts

Pala District. The Pala district was most active between 1900 and 1922. Its total reported output, which is valued at about three-fourths of a million dollars, consists almost wholly of lepidolite (see under "Lithium compounds") and gem-quality tourmaline and spodumene (Jahns and Wright, 1951). Small quantities of beryl, amblygonite, feldspar and quartz also have been produced. The leading sources of gem minerals in the district have been the Pala Chief, Tourmaline Queen, and Katerina Mines (see descriptions below). The Pala Chief Mine has been the foremost source of gem-quality spodumene in the world. Deposits with a much smaller production than the three mentioned above are the Tourmaline King, Vanderburg and San Pedro. Fourteen additional deposits have yielded small quantities of gem material. During the early 1950's about 450 pounds of gem-spodumene was mined from the San Pedro and Vanderburg Mines, on Hiriart Mountain.

The Pala Deposits comprise more than 400 pegmatite ikes which are exposed in an area of 13 square miles, nd mainly on three hills—Queen, Chief, and Hiriart (or Heriot) Mountains (Pl. 3). Most of the dikes strike orthward and dip gently to moderately southwest. They are enclosed in gabbroic rocks. The dikes are persistent and range in thickness from less than a few inches o about 100 feet. The deposits are described in detail by ahns and Wright (1951).

*Mesa Grande District.** The mines of the Mesa Grande istrict lie within an area of slightly more than two quare miles in the upland region west of Lake Henshaw Pl. 4). The district was most active from 1902 to 1910, hen 99 percent of its total production of gem minerals as mined. This output included nearly 125 tons of gem ourmaline valued at $800,000 and a small quantity of opaz, quartz and other gem minerals valued at about 14,000. Nearly 90 tons of tourmaline has been produced from the Himalaya mine which is the foremost ource of this gem mineral in the world. The mine has een reopened in recent years and from early to mid-958 had yielded about 300 pounds of gem tourmaline. The next most productive mines in the district are the an Diego, Mesa Grande and Esmeralda. Deposits that ave yielded at least a small production are the Rose Quartz, Cota, Green Ledge, Payne, Trask and Trail Mines.

About 90 pegmatite dikes are exposed in the district; nost of these strike northward to northwestward, dip vest to southwest, and are thin. Most of the dikes are nclosed in the largest body of gabbro exposed in the istrict. The Himalaya dike, which averages about four eet in thickness, contains the Himalaya, San Diego, Mesa Grande and Trask Mines (Photo 34). The deposits are lescribed in detail in a report by R. H. Jahns and J. B. Hanley, which is being prepared for publication.

Ramona District. The gem-bearing pegmatite deposits of the Ramona district are restricted to a hilly rea of less than two square miles which lies about four niles east-northeast of Ramona. The deposits were discovered in 1903 and worked intermittently from that late until 1910, and during the 1950's. Total output from he district probably consists only of several hundred ounds of gem and fine specimen material. The most productive mines have been the Little Three and A.B.C., with he Surprise Mine, and Hercules, Lookout and Sunrise Prospects having yielded very small quantities of gem naterial. The district is best known as a source of gem opaz; other gem minerals that have been mined are eryl (including a morganite crystal from the A.B.C. Mine which yielded a 30-carat stone), garnet variety spessartite, and quartz. In addition, specimen-quality tourmaline and other minerals have been mined. From 1955 o mid-1958 (when this description was prepared) a small quantity of gem minerals was mined by L. B. Spaulding from the Little Three Mine and the Black Panther and New ABC Prospects. Included in the output was about 30 pounds of gem quality spessartite from the Little Three Deposit.

The pegmatite deposits of the Ramona district consist of a single swarm of pegmatite dikes exposed in a northwest-trending belt 2½ to 3 miles long and as much as one mile wide. The productive deposits are restricted to Sec. 8 and the SW.¼ Sec. 9, T. 13 S., R. 2 E., S.B.M., (see Pl. 5). The dikes strike northward to northwestward and dip gently to moderately west to southwest in tonalite and diorite. Those dikes that have been prospected range in thickness from 1½ to about 6 feet.

Rincon District. The principal pegmatites of the Rincon district are exposed on Rincon Mountain, about one to two miles southwest of Rincon Springs (see Pl. 6). The deposits were worked mainly during the period 1903 to 1910 by John Mack and others who mined less than $2,000 worth of gem minerals which included beryl (variety aquamarine) and very small quantities of tourmaline and kunzite. The properties, which were developed only by inextensive, superficial workings, include the Mack, Victor, and Clark Mines and the Clark Extension, and Calac prospects.

The deposits consist of dikes that strike northward to northwestward, dip moderately west to southwest, and are enclosed chiefly in tonalite. The dikes are of variable thickness, but those that contain gem minerals are much thinner than the gem-bearing dikes of the Pala district.

Other Areas. Individual pegmatite deposits that have been sources of small amounts of gem minerals are: Emeralite No. 2 and Maple Mines, on Aguanga Mountain; French Pete Mine, north of Warner Springs; Blue Bell Mine, north edge of Chihuahua Valley; Crystal Gem Mine, northwest of Jacumba; and the Royal Mine, south of Banner (see under "Lithium Compounds").

Miscellaneous Gem and Ornamental Minerals and Rocks

Agate and Jasper. Agate and jasper have been reported from Imperial Beach and from beaches near Carlsbad and Cardiff (Dake, 1952, p. 23).

Axinite. An axinite locality in Moosa Canyon has been described by Schaller (1911a, p. 37-41). This is described in the accompanying tabulated list under "Vista Chief".

Dumortierite. A deposit that contains radiating masses of lavender dumortierite is described in the section on "Kyanite, Sillimanite, Andalusite, Dumortierite and Topaz."

Epidote. Epidote was once mined as a gem mineral at the McFall mine, southwest of Ramona.

Garnet. (Non-pegmatite deposits). Many of the scheelite-bearing tactite deposits described under "Tungsten" contain abundant specimen-quality crystals of grossularite.

Feldspar. Feldspar variety adularia variety moonstone has been reported to occur on Moonlight Beach at Encinitas.

* Data in this section were obtained from R. H. Jahns, California Institute of Technology, in personal communication, 1957.

Jade. Jade reported to have been found on beaches near Carlsbad and Cardiff (Dake, 1952, p. 23) may be derived from the San Onofre breccia.

Orbicular Gabbro. Orbicular gabbro has been found at four localities in San Diego County: near Dehesa; on Hiriart Mountain at Pala; near Lawson Peak, in the south-central part of the county; and near Buckman Springs (see descriptions under "Orbicular Gabbro" in tabulated list).

Rhodonite. Rhodonite occurs with manganese oxide and spessartite at the Sherry Ann Deposit northwest of Jacumba. It has also been reported to occur at a locality near the boundary between San Diego and Riverside Counties, in the northwest part of the county (Tucker and Reed, 1939, p. 29).

Markets *

"The crude gem stone material that has been found in California, as elsewhere, command prices that range widely and are determined by: (1) the mineral species and variety, (2) the size and quality of the individual specimens, and (3) popularity of the material at the time of sale. Much of the gem trade is handled on the basis of barter between hobbyists or by part-time lapidaries and is outside of the ordinary commercial channels. A market also is provided by the many professional gem and mineral dealers that are established in California, but such dealers ordinarily are interested only in the highest quality material and trade mostly in gem minerals from out-of-state sources.

"In common practice, the operators of small domestic gem mines have separated newly mined material into three categories: (1) 'gem' material from which unflawed gem stones preferably larger than five carats, can be cut; (2) 'specimen' material not adaptable to cutting, but attractive enough to be valued by serious collectors; and (3) 'pound' material of low commercial value. They then have marketed the three grades to individual collectors, to gem dealers, or to lapidary supply houses at prices consistent with grade and popularity.

"Much of the high-quality material eventually has been sent out of the United States for faceting. The development of a large domestic gem-cutting industry is hindered by the high cost of labor and the existence of an over-supply of most gem stones on the domestic market. The demand for unusually well-cut stones, however, is high. Listed below are the 1956 retail prices for average quality cut stones of the types mined or collected in California."

Tourmaline:
green, 6-10 carat stones, $4-$15 per carat;
pink, 6-10 carat stones, $2-$6 per carat.

Spodumene:
kunzite, 5-15 carat stones, $6-$12 par carat;
pale green variety is priced somewhat lower than kunzite.

Beryl:
yellow to pink, 3-6 carat stones, $2-$8 per carat.

Garnet:
pale yellow grossularite, 5-10 carat stones, $3-$8 per carat.

Topaz:
colorless to very pale colored, 5-10 carat stones, $2-$8 per carat.

Chalcedony (varieties agate, jasper, petrified wood, etc.):
$2-$8 per cabachon stone of average size.

Rhodonite:
$2-$8 per cabachon stone of average size.

* From Wright (1957d, p. 213-214).

As these prices apply to the retail trade, those pa by dealers are considerably lower. These prices we kindly supplied by Mr. James W. Coote of the Gem logical Institute of America, 11940 San Vicente Boul vard, Los Angeles 49, California, and 5 East 47th Stree New York City.

A.B.C. Mine (Daggett Group)

Location: NW.¼ NW.¼ Sec. 8, T. 13 S., R. 2 E S.B.M.; Ramona District, about 3⅔ miles east-northea of Ramona. *Ownership:* Victor L. Baldwin, 3624 Wilco San Diego 6, and A. L. Baldwin, 2045 Pacific Highwa San Diego 1, own three unpatented claims (?) whic cover about 40 acres (1957).

The A.B.C. Deposit, which is noted for its yield o beautiful pink beryl during the early 1900's, was di covered in November 1903 and developed by Henr Daggett, San Diego, and Alexander McIntosh, Ramon (Kunz, 1905, p. 140). The property probably wa worked until the early 1910's and then became idle unt 1922 when it was relocated by L. B. Spaulding, Ra mona. The Baldwins purchased the property from Mr Spaulding in 1937. In recent years activity has bee restricted mainly to work of amateur collectors wh have picked over the old dumps.

The mine was developed in a pegmatite dike which strikes northwestward, dips gently southwest, and range in thickness from three or four to perhaps five feet. The dike is exposed laterally for about 3,500 feet, but the principal workings are limited to the lower part of the eastern slope of a shallow south-trending stream canyon (see Pl. 3). A gem mineral-bearing part of the dike in these workings was described by Kunz (1905, p. 141) as follows:

". . . a stratum varying in width from 1 to 6 inches, composed of a grayish or whitish decomposed orthoclase, with disseminated crystals of muscovite having a pinkish and lavender tinge on the outer edges. It is in this stratum, coated with albite and clay, that the pink beryls are found, generally solitary in a pocket with two or three large blackish-green tourmaline crystals . . ."

Several pounds of pink beryl were mined, including a crystal from which was cut a flawless 30-carat stone. Very small spessartite crystals also occur in the dike, but none probably was mined. Lepidolite also occurs, but is sparse. The workings consists of a series of shallow open cuts and trenches developed along the strike of the dike for about 200 feet. In addition, Kunz (1905, p. 140) stated that the pegmatite was developed by an 18-foot adit from which "a stope following the pay shoot for 45 feet had been run." These underground workings are no longer accessible.

Mining was last done on the property in 1923, when Mr. Spaulding opened a pocket in the probable extension of the A.B.C. dike on the northwest side of the creek, and obtained several "fine" spessartite crystals. The largest stone cut from these was 6¼ carats (L. B. Spaulding, personal communication, 1957).

lue Bell Deposit (Blue Tourmaline Claim, San Diego Group)

Location: NW.¼ Sec. 12 and SW.¼ Sec. 13, T. 9 S., R. 3 E., S.B.M.; about eight miles due north of Warner Springs, at the northeast end of Chihuahua Valley. *Ownership:* Charles V. Fleischer, Box 7, Poway, holds two unpatented lode claims (1957).

The Blue Bell deposit was discovered in 1905 by Bert Simmons, of Oak Grove, who explored the deposit extensively in 1906 for gem-quality blue tourmaline (Schaller, 1916a). The deposit then lay idle until 1915 when a tin-rich pocket was discovered by Roy Carson, E. L. Haney, and D. H. A. Fiske, all of Pasadena. These men located the San Diego group of claims. No additional tin minerals were discovered, however. Since 1915, the deposit has been of interest chiefly to mineral collectors.

The pegmatite dike crops out irregularly, but forms a near dip slope on a part of the southern flank of the mountain range northeast of Chihuahua Valley. The dike is enclosed in biotite-quartz diorite. It strikes northwestward and dips 5° to 15° southwest, steepening up-dip. Its maximum exposed strike length is about 1,500 feet, and its exposed dip length ranges from less than 25 feet to about 150 feet. The thickness ranges from 3 to 7 feet. The dike consists of three layers: (1) The bottom layer is chiefly line rock, and is 1 to 3 feet thick. (2) The middle layer is fine- to coarse-grained quartz-perthite pegmatite which contains minor proportions of botryoidal paragonite (?), book muscovite, biotite, and sparse blue to blue-black tourmaline, pink garnet, and lepidolite. The tourmaline occurs as small pencils which generally are partly altered. No gem-quality material was seen during the writer's visit. Additional minerals reported from this layer are cassiterite and columbite (Schaller, 1916a, p. 353). (3) The upper layer consists of graphic granite, and is 1 to 3 feet thick.

The deposit is developed by numerous cuts, trenches, and pits. An adit, of undetermined length, was inaccessible in 1957.

Esmeralda Mine *

Location: E.½ NE.¼ SW.¼ Sec. 13, T. 11 S., R. 1 E., S.B.M., and W.½ NW.¼ SW.¼ Sec. 18, T. 11 S., R. 2 E., S.B.M.; Mesa Grande district, about four miles northwest of Mesa Grande. *Ownership:* Peter Martin, 1444 36th Street, San Diego 16, owns one claim which was patented in 1908 (Fig. 21), and recently located additional claims which border the patented claim (1960).

The deposit was prospected from 1899 to 1904, and claims first located on it by Gail Lewis and subsequently by Arthur L. Watkins. The first serious development was undertaken in 1904 by Harry Dougherty, who organized and operated the Native Gem Mining Company. The mine was worked intermittently from 1904 until about 1909. The property has had several owners since that time, and was purchased by Mr. Martin in mid-1957.

* The following description of the Esmeralda operation has been extracted and summarized from a detailed description kindly furnished by R. H. Jahns, California Institute of Technology (personal communication, 1957).

The pegmatite dikes in the mine area occur in medium- to coarse-grained gabbroic rocks. The main dike, which is broadly sinuous, ranges in thickness from 2 feet to nearly 40 feet in the mine area, and is locally very irregular in detail. It trends north-northwest and dips steeply west-northwest in the vicinity of the southern group of workings where it splits into several subparallel branches.

The principal rock type in all of the dikes is graphic granite which contains scattered, but locally abundant, albite, muscovite, and quartz. In most places it forms almost the entire thickness of the dikes. Only in the thickest parts of the main dike are other types of pegmatite prominent. The core of this dike is exposed only in the underground workings beneath the main cuts. Most of it has been mined out, but evidently it formed an irregular mass with a 40° to 60° south-southwest plunge. In horizontal section its maximum dimensions were about 3 feet by 25 feet, and it appears to have been about 25 feet long, as measured in a down-plunge direction. The core is fundamentally a coarse- to very-coarse grained quartz-spodumene unit. The spodumene crystals, which are scattered irregularly through the much more abundant quartz, are ⅜ inch by 2 inches in average section and 8 inches in average length.

Gem-quality beryl, tourmaline, and quartz, the principal minerals mined, were taken mostly from one very large pocket that was encountered in the main workings. Quartz was particularly abundant and the output included one 148-pound crystal and several 40-pound crystals. Some of the quartz crystals were studded with partly

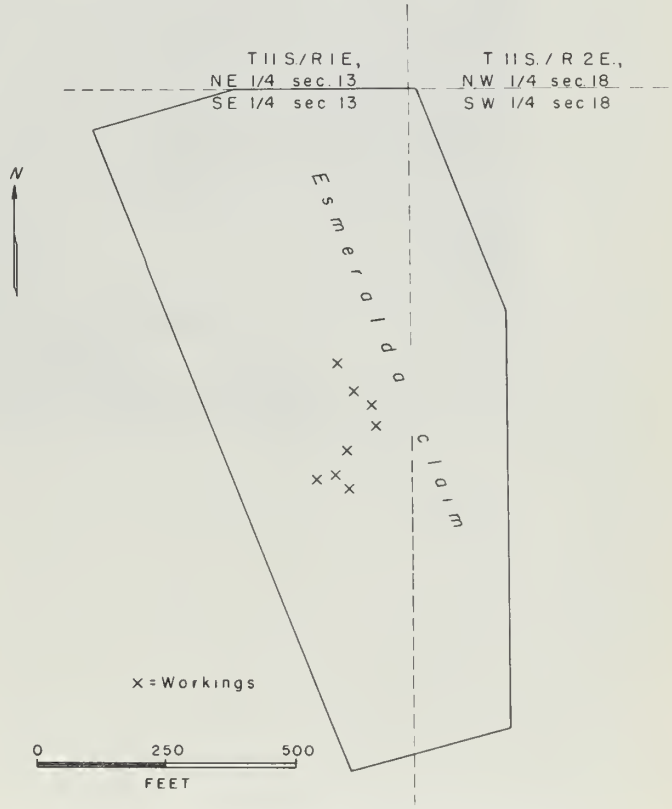


Figure 21. Map of Esmeralda claim, Mesa Grande district.

Photo 34. Mesa Grande gem mining district; aerial view northwestward. Himalaya pegmatite dike, and closely associated dike, strike north-northwest along east side of Gem Hill. Himalaya mine is in north part of dike, on northwest side of Gem Hill.

intergrown tablets and thick prisms of beryl that ranged in color from white to salmon pink and rose pink. Many of these were as much as 1½ inches in diameter. The principal pocket also contained many prisms of gem-quality tourmaline, some pink and some an unusual and beautiful blue-green. Several of these crystals are reported to have been at least six inches long and one-half to one inch in diameter. The core also contains lepidolite, muscovite, light-brown to reddish-brown zinnwaldite (rare), and cookeite.

The mine comprises two groups of workings, each in a relatively thick part of the main pegmatite dike. (1) The south group includes north, middle, and south cuts, which are irregular openings on a west-facing hill slope. The south cut, largest of the three, is about 25 feet by 40 feet in plan and 40 feet in maximum depth. An 18-foot drift extends northeast from its innermost face. (2) The northern, or main group is on the opposite side of the ridge, and comprises three open cuts, a small, irregular stope, and about 200 feet of tunnels. The upper cut was developed downward as a stope when the principal mass of pocket pegmatite was encountered. Entry was later made at three progressively lower levels so that the stope ultimately was extended downward to a depth of at least 25 feet beneath the floor of the upper cut. The deeper part of the stope is an irregular room-like opening from which several short drifts project outward.

Although unusually fine gem material was taken from the Esmeralda deposit, the total production was rather small. Future production of gem-quality tourmaline and beryl plainly is dependent upon the discovery of other masses of pocket pegmatite, probably in the form of additional core segments. Exploration for such deposits might best be aimed at the down-plunge continuation of the main bulge in the dike. Although the coarse feldspar in the dike may be of potential commercial value, the amount is probably too small for future exploitation. The known amount of spodumene in the dike is trivial, and most of it has been so thoroughly altered that it now contains three percent or less of lithium oxide. Beryl is present in many different parts of the dike, but it is too sparse and too fine-grained in the outer units to warrant attempts at recovery. In the quartz-euhedral perthite pegmatite, where it is coarsest and most abundant, it forms less than 0.02 percent of the rock.

Himalaya Mine *

Location: SE.¼ SW.¼ Sec. 17, T. 11 S., R. 2 E., S.B.M.; Mesa Grande district, about three miles northwest of Mesa Grande, and between a quarter and half a mile north of the summit of Gem Hill. *Ownership:* Ralph R. Potter, 7924 Normal, La Mesa, owns two patented claims which cover the N.½ SE.¼ SW.¼ Sec. 17 (Fig. 22) (1960).

The Himalaya mine was opened in 1898 by Gail Lewis of San Diego, who obtained some tourmaline of excellent quality from large float blocks of pegmatite in the vicinity of the present main dump. Later the main pegmatite ledge was opened at several points nearby. In 1902 the property was acquired by J. L. Tannenbaum, who organized the Himalaya Mining Company, under which the principal development was undertaken. During the period 1904-1912, when production reached a maximum, nearly all the mining was done underground, chiefly in low, irregular stopes. A long main tunnel was driven southeastward beneath the shallow workings. Three additional tunnels also were driven. The workings now are only partly accessible.

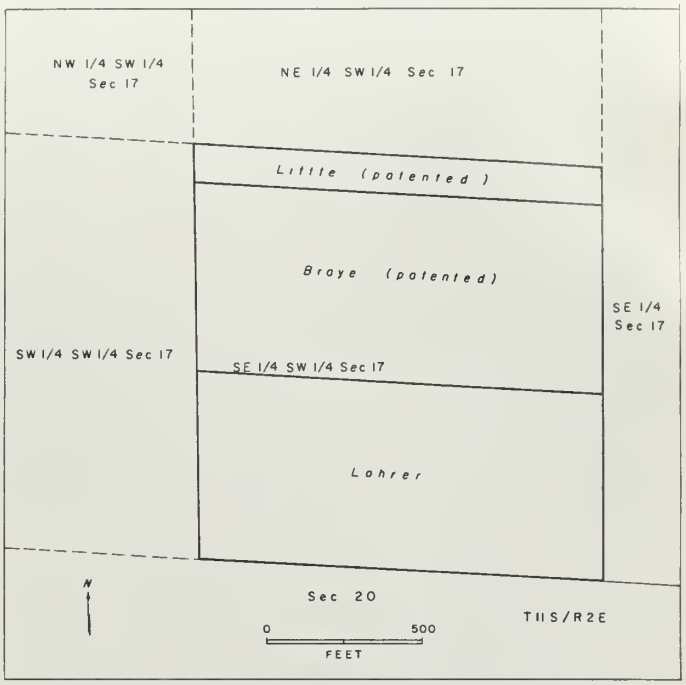


Figure 22. Map showing group of claims comprising Himoloyo mine, Mesa Grande district.

The property was shut down in 1913, when the Himalaya Mining Company was forced into bankruptcy, and until recently nearly all subsequent work in the dike had been sporadic and small in scale. The property was purchased in 1952 by the present owner who until early 1958 had mined only a small amount of tourmaline and other pocket minerals from near-surface workings. In early 1958, however, he uncovered an old working face at the head of an adit which had been filled with muck many years ago. By mid-1958 about 300 pounds of pink and green tourmaline had been mined from this working, including a beautiful bicolored crystal about 7 inches long and 1½ inches in diameter. Total production from the mine may well amount to 90 tons of gem tourmaline and beryl, with a value of at least $600,000.

Most of the output has been obtained from the thin but remarkably continuous Himalaya dike which cuts gabbro. This dike can be traced along the north and east slopes of Gem Hill for a distance of at least 2,000

* Most of the following description has been extracted and summarized from a discussion of the deposit kindly furnished by R. H. Jahns, California Institute of Technology (personal communication, 1957).

feet (Photo 34). It averages about four feet in thickness. The trend of the dike ranges from north-northwestward in the southern part to westward in the northern part. It dips westward to southwestward at an average angle of about 35°. The dike was opened for about 1,600 feet along its curving surface trace, and to a maximum depth of nearly 200 feet beneath the outcrop.

Typically the dike consists of a ⅛-inch to 2-inch border zone of fine-grained perthite-schorl-quartz-muscovite-garnet pegmatite; a somewhat thicker wall zone that is rich in medium- to coarse-grained graphic granite; discontinuous intermediate zones of medium- to coarse-grained quartz-perthite-schorl pegmatite, quartz-euhedral perthite pegmatite, massive quartz, and, very rarely, quartz-spodumene pegmatite; and irregular core segments that contain much coarse-grained quartz, euhedral perthite, and pocket pegmatite. Cavities and typical pocket minerals occur mainly in the pegmatite of the core, and to a lesser extent in the intermediate zones.

The pocket-bearing units, which occupy central positions in the dike, are 1 inch to 22 inches thick. Their maximum dimensions in plan range from a few inches to 150 feet, so that most are very thin lenses or tablets. The pocket-bearing parts of the dike are elongate subparallel lenses whose axes, according to reports, are either nearly parallel or nearly perpendicular to the strike of the dike. Some crystals of the gem minerals are "frozen," or tightly bound within essentially solid pegmatite, whereas others are embedded in clay minerals. The distribution of some masses of pocket pegmatite can be correlated with the gentle, bench-like rolls in the dike.

In addition to tourmaline, lepidolite, beryl, and the other constituents noted above, many other minerals have been observed in the Himalaya dike. Spodumene and topaz were found in greatest abundance in the workings appended to the long tunnel. Large numbers of stibiotantalite crystals were encountered near the portal of this tunnel, and some cassiterite was recognized in pocket pegmatite from underground workings south of the tunnel. Zinnwaldite is rather widespread, especially in the stopes from the North and Middle inclines.

The available information suggests that the gem-bearing parts of the dike have not been worked out, and perhaps the most interesting possibility for future development is in the northwestern part of the mine area, where large masses of pegmatite may be present at shallow depths.

Katerina (Ashley, Caterina, Catherina, Katrina) Mine

Location: Secs. 24 and 25, T. 9 S., R. 2 W., S.B.M.; Pala district, about two miles east-northeast of Pala, very low on the southwestern slope of Hiriart Mountain. *Ownership:* Karl V. Morin, Jr., and J. P. Oddous, 1017 Grevalia Street, South Pasadena, own one west-northwest trending claim which covers the SE.¼ SE.¼ SW.¼ Sec. 24, most of the S.½ SW.¼ SE.¼ Sec. 24, and a small part of the center of the extreme northern part of Sec. 25 (Fig. 23) (1957).

The following description has been mainly extracte from a report by Jahns and Wright (1951, p. 68-70)

"The mine was first opened by M. M. Sickler, and subsequentl was worked for many years by him and his sons. Over a lon period of intermittent operations of both formal and 'high-gradin nature the deposits in the pegmatite have yielded substanti quantities of lepidolite and gem spodumene, quartz, and beryl. I 1947 the mine was purchased by George Ashley of Pala, wh has operated it on a small scale since then. He has obtaine several pounds of gem spodumene from two or three sma pockets, and some of this material is of exceptionally high qualit and attractive color."

The present owners purchased the property in lat 1956 and had done a small amount of exploratory worl by 1957.

"The main mine workings extend along the pegmatite grou for a strike length of 640 feet. They consist of numerous bench like open cuts, from many of which short, irregular tunnels an inclines extend northward and northwestward. The principa workings comprise an open cut 40 feet long, 20 to 25 feet wide and about 30 feet deep at the face; a broad, irregular inclin that extends northwestward from this cut; and more recen workings started from a smaller cut to the southwest.

"The mining has been done in a highly complex series of juxtaposed pegmatite dikes. Only locally do these dikes diverge an become separated by thin screens and projections of country rock.

"Most of the dikes range in thickness from a few inches t about 32 feet, and the average for the major dikes is about 1 feet. They trend north to north-northwest and dip gently westward, so that their traces are essentially west along the steep south slope of the mountain.

"The mass of pegmatite that has been of greatest interest during past operations is a large bulge in the middle dike of the group. This bulge has an internal structure markedly similar in most respects to that of the Stewart pegmatite. A hanging-wall unit rich in graphic granite is underlain successively by units of coarse, blocky perthite, massive quartz and large subhedral to euhedral crystals of perthite, massive quartz, and massive quartz with large laths of spodumene. The quartz-spodumene pegmatite, which forms a discoidal core, is about eight feet in maximum thickness. Its width, as measured in a southwest to northeast direction, is about 70 feet, and its length is at least 85 feet.

"The typical pocket constituents are present in many of the underground workings, and oridnarily appear as fractured and brecciated aggregates along the edges, top, and bottom of the main and other core segments of quartz-spodumene pegmatite. The largest concentrations of these minerals were encountered in the Main incline and in the roomlike openings immediately to the southwest. They are consistently within the quartz-spodumene core, but appear to be in its outer, rather than in its inner parts. The gem spodumene characteristically occurs as unaltered remnants of much larger spodumene crystals, and appears to be a mineral that is indigenous to the core. It is associated in many places with lepidolite, cleavelandite, quartz, fine-grained, felted aggregates of blue tourmaline, and some white to pink gem beryl. Amblygonite is locally abundant in the outer parts of the quartz-spodumene zone, and occurs also here and there in the massive quartz and the quartz-perthite zones."

Little Three Mine

Location: NE.¼ SE.¼ Sec. 8, T. 13 S., R. 2 E., S.B.M.; Ramona district, about 4½ miles east-northeast of Ramona, in Hatfield Creek Valley. *Ownership:* Louis B. Spaulding, P.O. Box 15, Ramona, owns the NE.¼ SE.¼ Sec. 8 (40 acres) which is patented (1959).

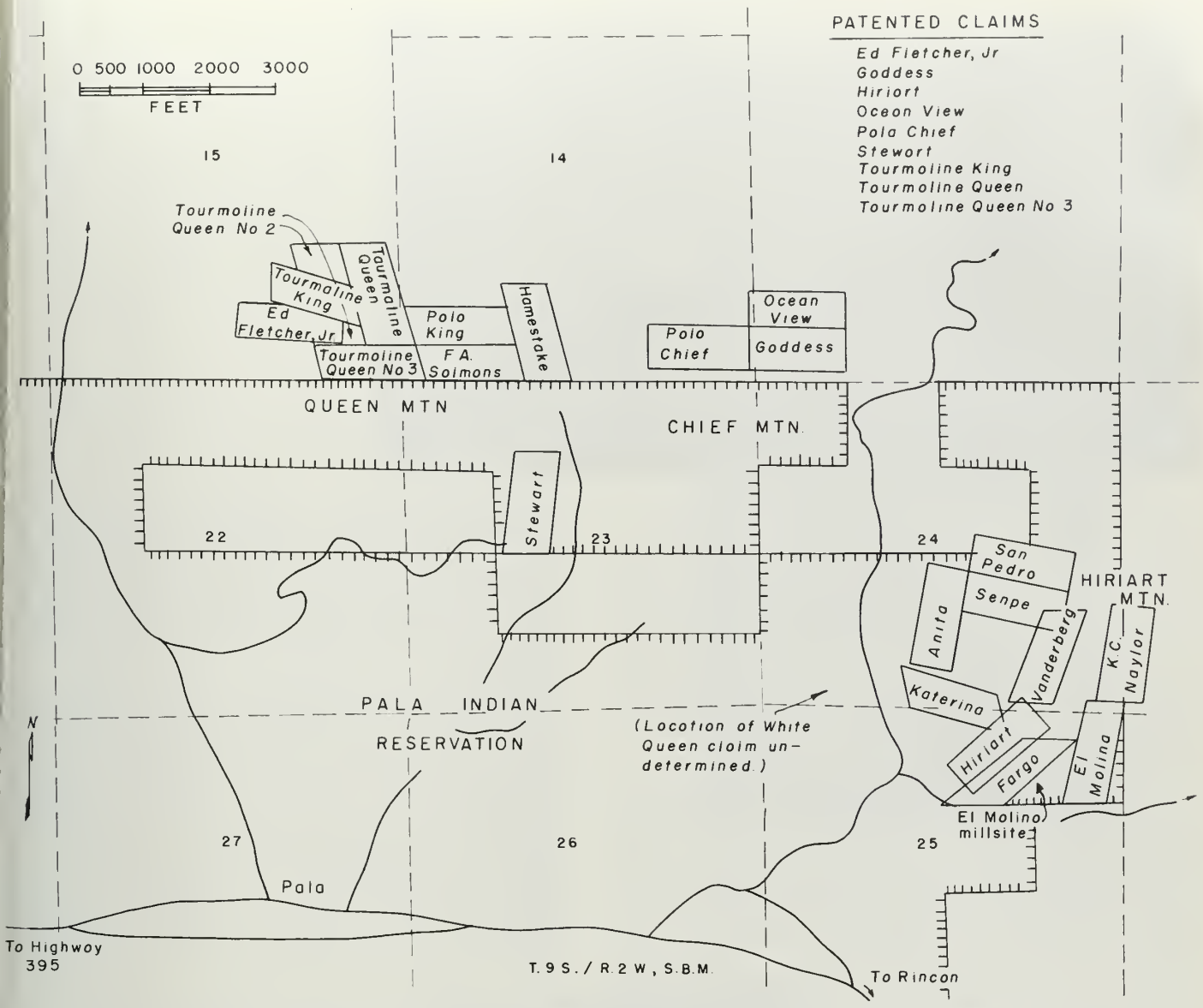


Figure 23. Map showing approximate location of mining claims, Pala district, and limits of Pala Indian Reservation.

The first discovery of gem stones in the Ramona dis-rict was made on this property in May 1903 (Kunz, 905, p. 143). H. W. Robb of Escondido, the discoverer, n partnership with Dan McIntosh of Ramona, and C. F. chnack then purchased the property from its owner, ohn Ferguson, and mined gem-quality topaz and other inerals until nearly 1910 (L. B. Spaulding, personal ommunication, 1957). The deposit then lay idle until 950 when Mr. Spaulding leased it and did a small mount of exploration work. He purchased the prop-rty in 1951 and had worked it continuously from 1955 o mid-1957 (when the property was visited by the vriter).

The Little Three property encloses parts of several ranite pegmatite dikes which range in strike from west-orthwest to northwest and dip gently to the south. The eposits are enclosed in tonalite and diorite (see Pl. 5). The main workings of the mine, which also are the old-est, consist of a small group of overlapping shallow cuts. These workings explore a dike whose productive seg-ment is exposed as a dip slope at the base of the south-facing hill north of Hatfield Creek (Photo 35). This dike dips 30° southwest and ranges in observed thickness from 4½ to perhaps 6 feet. Its upper part, as observed in the north part of the workings, consists mainly of graphic granite and smaller proportions of line rock (Photo 36). The lower part was not observed in detail by the writer in the workings. Gem minerals have been obtained from a pocket-bearing layer, which is approximately in the middle of the dike, and is 1 to 1½ feet thick. The layer is composed chiefly of albite variety cleavelandite, smoky quartz, minor proportions of dark-green to black tourmaline and muscovite, discontinuously and sparsely distributed topaz, spessartite and cookeite, and rare ham-

Photo 35. Romona district. Hotfie Creek is in foreground. Little Three pe motite dike cuts across terroin in cent of photograph to crest of hill ot left. Lit Three mine workings ore at right cente

bergite (which was first identified in 1957). An additional gem mineral that is reported to occur in the deposit is green beryl (Kunz, 1905, p. 144). A pocket being mined at the time of the writer's visit contained numerous vugs whose lower surfaces were lined with groups of beautiful smoky quartz crystals and cleavelandite, many with topaz crystals attached. The larger of these topaz crystals were 1½ to 2 inches long. All of the pocket minerals were coated with cookeite (a lithium, aluminum silicate).

A second productive dike within the property lies about 200 feet south of the dike described above and is parallel to it. This dike was opened in 1955 at a point about 600 feet southeast of the main workings of the mine (see Pl. 5, 103b). At that point the dike is about 2½ feet thick, and its gem-bearing layer, which lies near the middle of the dike, is estimated to range in thickness from four to six inches. This layer is composed chiefl of albite variety cleavelandite, smoky quartz, minor pro portions of black tourmaline and muscovite, sparse spes sartite, and very sparse topaz. The workings consist of trench, cut along the strike of dike, which is about 7 feet long, 15 feet in maximum width, and 15 feet in maxi mum depth.

The total reported output from the Little Three min is small. Output from the main workings, as reported b Kunz (1905, p. 144) for the period from discovery o the deposit in 1903 until the date of his visit to the area consisted of about 30 pounds of topaz, 50 pounds o specimen-quality tourmaline, and a small quantity o spessartite. The topaz was reported to range in colo from white through sky-blue and sea-green to yellow Some of the topaz crystals were reported to be more tha one pound and some of the tourmaline crystals as mucl

Photo 36. Port of workings of Little Three mine, Ramono district. Boulders of "line" rock oppeor in the upper port of photogroph. View east.

; 15 pounds and 5 inches in diameter. From December 955 to mid-1956 the present owner mined gem-quality pessartite from the workings which are 600 feet southast of the main workings. This output included about 0 pounds of crude orange spessartite from which 3,000 arats of cutting material was obtained. The largest stone ut was between four and six carats. In mid-1957, Spauldg mined undetermined quantities of topaz and smoky uartz from the main workings of the mine. He has also ined a small quantity of spessartite from the Hercules ike, at the north edge of the property, and a small quanty of dark-green tourmaline from a point about 200 eet south of the main workings.

ala Chief Mine

Location: E.½ SW.¼ SE.¼ and SE.¼ SE.¼ Sec. 14, . 9 S., R. 2 W., S.B.M.; Pala district, a little more than wo miles northeast of Pala, on the northwest slope f Chief Mountain. *Ownership:* The Pala Chief Mine is nclosed by the east-trending Pala Chief Claim which is art of the Pala Chief Group which also includes the Goddess and Ocean View Claims (Fig. 23). The group owned by Mrs. Margaret S. Moore and Mrs. Mildred . Wear, c/o Star Route, Pauma Valley; and managed y F. D. Fitzsimmons, Pauma Valley (1960).

The Pala Chief Claim was located in May 1903, by ohn Giddens, Pedro Feiletch, Bernardo Hiriart, and rank A. Salmons. The deposit was worked most inensely for several years after its discovery, then interittently until about 1915. Little but assessment work ad been done from 1915 through 1958. A small amount f gem material was obtained from the claim by lessees n 1959 and 1960. The claim was patented in 1956. "The egmatite has yielded gem tourmaline, quartz, beryl, and epidolite but undoubtedly it is best known as the world's oremost source of gem spodumene. Most of the material roduced was kunzite and triphane, but some green and olorless material also were included in the output" (Jahns nd Wright, 1951, p. 62).

The following description of the Pala Chief Mine was xtracted from a report by Jahns and Wright (1951, p. 2-68):

"The main pegmatite mass is a dike 16 feet to at least 33 feet hick. It can be traced southward from the mine area for a disance of nearly 2,000 feet, and extends westward for approximately ,200 feet to the valley of Salmons Creek, where it is buried beeath alluvium. Within this distance the dike joins and diverges rom numerous other dikes. It trends north-northwest to northvest and dips 5° to 55° southwest.

"Coarse-grained graphic granite and subordinate albite and muscovite occur in the upper part of the dike as a unit 6 feet to at east 15 feet thick. The lower part of the dike, of equal or slightly esser thickness, consists of fine-grained quartz-albite-perthitegarnet pegmatite with very poorly to very well-developed layring.

"The pocket pegmatite, which occurs principally within and long the edges of the quartz-spodumene core segments, consists f lepidolite, albite, alkali tourmaline, quartz, spodumene, beryl, oarse potash feldspar and several rare accessory minerals.

"Gem tourmaline is abundant in the pockets of much of the nine area, and particularly in its central and northwestern parts.

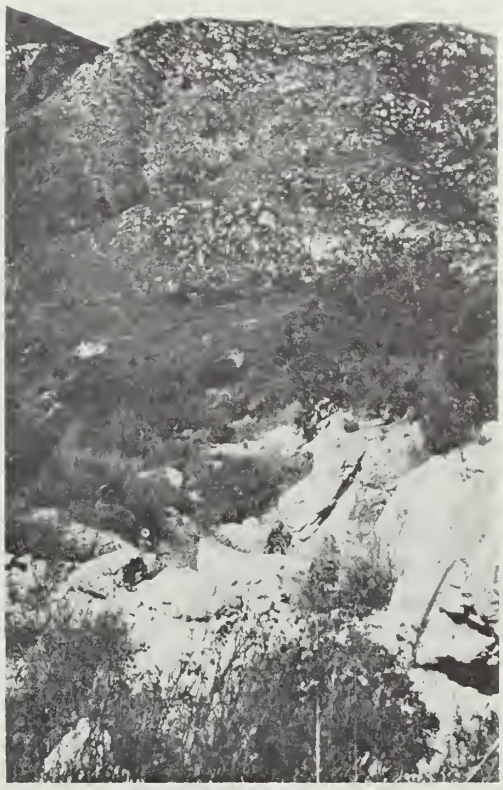


Photo 37. Polo district, view west. Port of workings of Polo Chief mine ore in foreground. High on mountoin ot left is port of pegmotite deposit of Tourmoline Queen mine. Rocks in upper right of photogroph ore gronodiorite.

Farther southeast, however, the most abundant gem material is spodumene, and only in a few places do both these minerals occur in substantial quantities. . . . In some parts of the pegmatite, the kunzite and other clear varieties of spodumene represent unaltered parts of much larger lath-shaped crystals encased in massive quartz. Elsewhere, more isolated crystals project inward into clayfilled pockets, and are associated with abundant quartz crystals and scaly aggregates of lepidolite.

"The principal surface workings form a distinct scar along the southwest face of a nearly flat-topped ridge. . . . The Main open cut, or series of cuts, is 280 feet long and 20 to about 65 feet wide. In places the excavation is 25 feet deep at the face, but in most of the mine area this dimension is not more than 15 feet. The series of cuts faces southwest and is rimmed by a group of extensive dumps. Several irregular, interconnected underground workings extend northeastward from the central and southeastern parts of the cuts. Most of them are drifts or inclines with very gentle slopes, and many irregular rat-hole excavations." (Photo 37.)

As to the possibilities of finding more gem-bearing areas in the deposit, Jahns and Wright (1951, p. 67-68) concluded as follows:

"Recent small-scale mining operations on the knob immediately south of the southeast end of the open cut have demonstrated the existence there not only of the pocket zone, but of excellent gemquality spodumene very near the surface. This block of ground is

approximately 70 feet long as measured in a north-south direction, and may be as much as 6 feet in maximum thickness. It lies immediately west of and slightly higher than the Main tunnel, and could be worked out easily by overhead stoping from this tunnel or by means of a glory-hole. Although at least one large pocket was worked out during the past four years, the likelihood of additional pockets in this block of ground makes the immediate possibilities seem rather attractive. Large crystals of pink beryl also occur in this part of the deposit.

"The down-dip extensions of the pegmatite dike also present interesting possibilities. The pegmatite clearly continues for considerable distances along the surface southwestward from the present workings, and the pocket material that was originally prospected appears to have been exposed at the surface only along the crest of a roll in the dike, rather than along the outer edge of an isolated mass of pegmatite. Additional gem-bearing pegmatite may be farther down the dip, either in the relatively steep-dipping segment of the pegmatite, or, more likely, in some flat, or terracelike part of it. Little gem material is exposed along the present outcrop of the dike immediately northeast of the mine area, and the relatively steep dip of this part of the deposit suggests that the chances for good returns in steeply dipping parts down the dip may not be great. The deposit might well be further explored by means of drill holes."

San Diego Mine *

Location: Near the north edge of the NE.¼ NW.¼ Sec. 20, T. 11 S., R. 2 E., S.B.M.; Mesa Grande district, about 2⅔ miles northwest of Mesa Grande, on the northeast slope of Gem Hill, about 300 yards south-southeast of the Himalaya mine. *Ownership:* E. B. Rynerson, 4088 1st Street, San Diego, owns one patented claim (1958).

The oldest workings in the mine are two open cuts said to have been excavated by Gail Lewis in 1899. For the next three years the deposit was mined by K. C. Naylor and A. L. Ross who began to develop underground workings. From 1904 to 1910 the San Diego Tourmaline Mining Company worked the deposit extensively. Since 1912, when the price of tourmaline dropped, the mine has been active only sporadically. In 1928 the mine was leased to General Electric Company, who made an unsuccessful search for mineable quantities of pollucite. In the late 1940's the present owner mined a small amount of gem tourmaline. The mine has yielded a large amount of gem-quality tourmaline, beryl, and quartz.

Mining has been confined to two pegmatite dikes which converge gradually southward and may connect south of the main workings (Photo 34). The higher of the two dikes is the southerly extension of the Himalaya dike, and has been the source of most of the output. The lower dike is nearly parallel to the Himalaya dike and about 25 to 50 feet vertically below it near the Himalaya workings. The two are progressively closer toward the San Diego workings. The dikes trend north-northwestward and dip gently west-southwest; the thickness of the Himalaya dike ranges from 12 inches to 27 inches, and the lower dike from 4 inches to 7 feet. Both dikes have relatively coarse-grained, graphic granite-rich upper parts and much finer-grained, albite-rich lower parts. Line rock occurs in the lower parts of both dikes. Discontinuous, tabular bodies of pocket pegmatite form core s ments in the central parts of the dikes. They are rich quartz and most contain perthite, cleavelandite, sug albite, muscovite, lepidolite, schorl, elbaite, garnet, one or more clay minerals. Rarer constituents incl apatite, spodumene, cassiterite, tantalum-columbium m erals, and other minerals.

The deposit is developed chiefly by a series of incli and tunnels which were driven west-southwestward fr shallow cuts opened along the north-northwest trendi trace of the Himalaya dike. From these entries, drifts a stopes were developed in the dike and eventually poi were reached 80 feet down dip.

Most of the unmined pegmatite probably lies bene the existing workings, but is of difficult access becau most of the older workings were either backfilled or caved. However, all mining probably would be in ha unweathered rock.

Surprise Mine

Location: W.½ SW.¼ SW.¼ Sec. 9, T. 13 S., R. 2 S.B.M.; Ramona district, about 4½ miles east-northe of Ramona in Hatfield Creek Valley. *Ownership:* J. Bernhardt, Bernhardt Ranch, Ramona (1957).

Garnet, variety spessartite, was discovered on t property in November 1903 by Mrs. J. W. Booth at point slightly north of her residence, which was a stati on the Foster-Julian stage route (Kunz, 1905, p. 146 Mrs. G. M. Stone, who owned the land, Mr. Booth, a A. J. Farley of Ramona worked the deposit for a sho time after its discovery. The deposit has been inacti since the early 1900's, and now is part of the Bernhar turkey ranch.

Gem minerals were mined from a granite pegmati dike which strikes west-northwestward and dips ve gently to the south (see Pl. 5). The dike is exposed f more than 1,000 feet, but the part from which the ge minerals were mined now is enclosed within a turke pen. The dike was not examined in detail by the prese writer. It was reported by Kunz (1905, p. 146-147) t consist of an upper layer composed of graphic granite, middle layer which is the gem-bearing zone, and a low layer composed of line rock. Kunz reported that two o currences of gem minerals were found in this dike. Th first of these occurrences was about 500 feet north of th old stage station. At that point the middle layer of th dike was 18 inches thick and was composed of corrode albite, black tourmaline, muscovite, and deep red t honey-yellow crystals of spessartite. Five pounds of spe sartite crystals were obtained from material remove from a trench 18 feet long, 8 feet wide, and 6 feet dee Gemstones cut from these crystals ranged from 3 to carats. The second of the two occurrences was reporte to be 300 feet east of the first. The core of the dike a that point was 6 to 8 inches thick and composed chiefl of feldspar which contained pockets 2 to 3 inches i diameter filled with "fine grained ferruginous quartz" (Kunz, 1905, p. 146) and white to sky-blue topaz crystal coated with clay (cookeite?). Five pounds of topaz an

* The following has been taken from a detailed description of the San Diego mine kindly furnished by Dr. R. H. Jahns, California Institute of Technology (personal communication, 1957).

2 pounds of pink beryl, including one beryl crystal 6 inches long and 1½ inches in diameter, were reported to have been recovered from this occurrence. The workings consisted of a 20-foot cut.

Tourmaline King (Schuyler, Wilke) Mine

Location: Center SE.¼ Sec. 15, T. 9 S., R. 2 W., S.B.M.; Pala district, about 1¾ miles north of Pala, high on the northwest side of Queen Mountain. *Ownership:* R. M. Wilke (?), Palo Alto, owns one claim which was patented in 1913 (Fig. 23) (1957).

The Tourmaline King Mine was opened by F. B. Schuyler and D. G. Harrington, Oceanside, in March 1903, and "during the early years of operation yielded much gem tourmaline of exceptional quality" (Jahns and Wright, 1951, p. 55). The late Monta Moore, former manager of the adjacent Tourmaline Queen Mine, stated (personal communication, 1957) that he understood that about 16 powder boxes-full of tourmaline were mined in 1904, then operations ceased. The mine was later purchased by Mr. Wilke who "carried on a very thorough program of exploration but obtained only small returns" (Jahns and Wright, 1951, p. 55).

The following description of the geology and workings has been extracted and summarized from a report by Jahns and Wright (1951, p. 55-56).

"The surface workings . . . comprise several small irregular cuts for 450 feet along the trace of a pegmatite dike that trends northwest down the very steep" northwest slope of Queen Mountain. "The dike has been mined extensively underground, and interconnected drifts, inclines, and irregular rooms constitute more than 1,200 feet of tunnel."

The dike is enclosed in gabbro and light-gray quartz-mica shist and is exposed for a strike-distance of about 1,500 feet. It strikes north-northwestward and dips 25° to nearly 40° west and has an average dip of about 32°.

"The pegmatite dike ranges in thickness from a knife edge to about 16 feet, and its average thickness appears to be eight feet or slightly less. . . . The dike consists chiefly of coarse-grained graphic granite with subordinate albite and muscovite, although much of its footwall part is a fine-grained, sugary, albite-rich pegmatite with crudely developed planar structure. . . . In most places, the hanging-wall graphic granite can be traced downward into much coarser-grained graphic granite, and thence locally into thin, lenticular masses of quartz-euhedral perthite pegmatite. In a very few places, segments of a quartz core are exposed."

Red garnet is abundant in the graphic granite and "locally constitutes 15 percent of the rock. Many of these crystals are as much as two inches in diameter . . . Here and there in the graphic granite, especially within a few feet of the hanging wall in the upper part of the mine workings, are concentrations of coarse lepidolite, pink tourmaline, and other typical pocket minerals.

"The pocket-bearing part of the dike is very discontinuous and poorly defined. Most of the characteristic minerals are scattered as irregular bunches or knots through the coarse graphic granite and quartz- or perthite-rich pegmatite of the inner zones.

"The only notable concentration of tourmaline and lepidolite was encountered and subsequently mined out in the workings immediately south of the main cut. It occurred in a discoidal body of typical pocket pegmatite that was several tens of feet long, one foot to six feet thick, and at least 30 feet in maximum downdip extent. It is said that this mass yielded the bulk of saleable tourmaline obtained from the deposit.

"The interior parts of the dike are marked in many places by concentrations of coarse schorl, opaque pink tourmaline, coarse cleavelandite, and irregular masses of fine-grained lepidolite. The dumps contain abundant pocket material, and attractive specimens are still obtainable in several places. Many rosettes of coarse cleavelandite are coated with aggregates of lepidolite flakes and crystals and extending from their surfaces are pencil-like crystals of rubellite. Most of the tourmaline appears to be slightly altered, and is opaque. Some aggregates of prismatic rubellite crystals occur in lepidolite, and resemble the material so abundant in the south part of the Stewart dike.

"The deposit appears to have been thoroughly prospected, and indeed, there is much to suggest that the bulk of the pegmatite has been mined out. In many places, particularly in the inner parts of the upper underground workings, the keel of the dike evidently has been encountered. It fingers out into long, thin, subparallel septa that extend into the gabbroic country rock. Except for the one very large concentration of gem minerals encountered in the workings from the main cut, the dike has yielded little commercial material, and it does not appear to offer great promise for future development."

Tourmaline Queen Mine

Location: Mostly in the E.½ SE.¼ Sec. 15, and a very small part in the SW.¼ SW.¼ Sec. 14, T. 9 S., R. 2 W., S.B.M.; Pala district, about two miles north of Pala, high on the east side of Queen Mountain (Photo 37). *Ownership:* Mrs. Margaret S. Moore and Mrs. Mildred S. Wear, Star Route, Pauma Valley; managed by F. D. Fitzsimmons, Pauma Valley (1960). The mine property consists of the Tourmaline Queen, Tourmaline Queen No. 2, and Tourmaline Queen No. 3 claims, which are part of the Tourmaline Queen Group (Fig. 23). The Tourmaline Queen and Tourmaline Queen No. 3 Claims were patented in 1956.

The Tourmaline Queen property was first located in 1903 by F. A. Salmons, John Giddens, Pedro Feiletch, and Bernardo Hiriart. The property ultimately became the leading source of gem tourmaline in the Pala district. The mine was operated chiefly from 1904 to 1914, and has been worked only intermittently since that time. Jahns and Wright (1951, p. 56) stated that "the total output from the deposit is not known, but a series of sales of gem tourmaline amounting to $48,000 was recorded for one year. Chief consumers were Tiffany and Company, and the American Gem and Pearl Company," both of New York.

The following description of the geology and workings has been extracted and summarized from a report by Jahns and Wright (1951, p. 56-57). The mine is in the north part of a continuous pegmatite dike that is at least 3,000 feet long. The dike strikes northward and dips 10° to 30° west in gabbro. Small faults offset the dike, probably not more than 20 feet. The pegmatite ranges in thickness from about 10 feet to as much as 18 feet, and in most places is less than 15 feet.

"Typical pocket pegmatite is in and immediately beneath the segments of quartz-perthite core. This rock contains abundant quartz, with associated albite, schorl, alkali tourmaline, lepidolite, and other pocket minerals. Such material is exposed for a distance of at least 100 feet along the present trace of the dike, but at no place is it thicker than about three feet.

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Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
58	A. B. C. mine	Ramona district.			See text. (Kunz 05:49, 140-142; Merrill 14:693, 702; Sinkankas 57a:367, 368; Tucker 25:362; Tucker and Reed 39:39).
59	Alvarado prospect	S½S½SW¼NW¼ sec. 23, T9S, R2W, SBM; Pala district, on Queen Mt., about 2/3 of a mile northeast of Pala.	Mrs. Blanche Crane, 405 S. Tremont, Oceanside; managed by Leo J. Mies, 508 Third Street, Oceanside (1957)	A prospect at the south end of the Stewart dike. Source of lepidolite and tourmaline.	On patented property covered by the Stewart claim. Workings consist of shallow open cuts developed before the turn of the century by Don Tomas Alvarado, a local land owner, who considered the lepidolite with rubellite to be a peculiar marble. See also Stewart Mine, in text under "Lithium." (Jahns and Wright 51:14, 59, 61, pl.2; Kunz 05:124; Merrill 14:697).
60	Anita claim	S½ sec. 24, T9S, R2W, SBM; Pala district, about 2 miles east-northeast of Pala, near base of northwest slope of Hiriart Mountain.	W. C. Woynar, 4537 - 42nd St., San Diego; and Harold Noble and William Granzow, San Diego (1958)	A deposit in the Anita pegmatite dike which is exposed over an area of several thousand square feet in the center of the claim. Gem minerals present are spodumene, beryl, and quartz. Petalite also occurs.	A north-northeast trending unpatented claim whose northern end line is only a few hundred feet south of the center of sec. 24 (see claim map in text). Claim was part of Sickler group purchased by George Ashley in 1947. He later sold claim to C. E. Reynolds who sold it to the present owners. Very shallow workings. Production negligible. (Jahns and Wright 51:14, 31, 42, pl.2; Kunz 05:86; Merrill 14:700).
	Ashley				See Sickler group.
	Banner Canyon mine				See Royal deposit in tabulated list under "Lithium compounds". (Wright 57d:206).
	Beryl claim	Ramona district.			Reported by Tucker and Reed (1939) as one of two claims that comprised the Hercules mine. No longer valid. See Hercules prospect. (Tucker and Reed 39:40, pl.1).
	Big Buck				See Victor mine. (Hanley 51:18; Tucker and Reed 39:pl.1).
61	Big Slope prospect	NE¼SE¼ sec. 23, T9S, R2W, SBM; Pala district, west slope Chief Mt., about 1-2/3 miles northeast of Pala.	Undetermined (1957)	A pegmatite deposit.	A prospect mentioned by Jahns and Wright (1951). No additional published information. Now on patented agricultural land. (Jahns and Wright 51:14, pl.2).
62	Black Panther prospect	NW¼SE¼ sec. 8, T13S, R2E, SBM; Ramona district, about 4 miles east-northeast of Ramona, in Hatfield Creek Valley.	L. B. Spaulding, P.O. Box 15, Ramona (1957)	A prospect in a pegmatite dike which strikes northwestward and dips about 20° southwest. The dike is exposed northwestward from Hatfield Creek bed for more than 2000 ft. Where developed, the dike is about 3½ ft. thick; its central layer is about 6 in. thick and is composed of albite crystals as large as 6 in. in diameter, black tourmaline crystals, and quartz. In 1956 Mr. Spaulding mined a small quantity of quartz crystals from this deposit.	A northwest-trending claim located in 1947 by Mr. Spaulding, partly on the site of the old Sunrise claim. Developed by a shallow northwest-trending trench. Adjoins the Fraction claim which lies to the east. Idle.
63	Blanket prospects	NE¼ sec. 23, T9S, R2W, SBM; Pala district, about 1-3/4 miles northeast of Pala, on lower southwest flank of Chief Mt.	Pala Indian Tribe, Pala (1958)	Numerous prospects in a northwest-trending pegmatite dike which is exposed along its strike for about 2000 ft.	Abandoned. Within Pala Indian Reservation. (Jahns and Wright 51:14, pl.2).
64	Blue Bell deposit (Blue Tourmaline claim, San Diego group)	Chihuahua Valley.			See text. (Schaller 16a:351-354; Segerstrom 41:552; Tucker and Reed 39:40, pl.1).
	Blue Tourmaline claim				See Blue Bell deposit. (Schaller 16a:352).

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Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Buster Brown				See White Cloud mine. (Jahns and Wright 51:14, pl.2; Merrill 14:697).
5	Buttercup prospect	Near center SE¼ sec. 24, T9S, R2W, SBM; Pala district, near crest of northern part of Hiriart Mt., nearly 2½ miles northeast of Pala.		A prospect in the Katerina-Vanderburg dike group.	Covered by the eastern part of the Senpe claim or the northwestern part of the Vanderburg claim. No additional published information. (Jahns and Wright 51:15, pl.2).
6	Butterfly prospect	SE¼NE¼ sec. 23, T9S, R2W, SBM; Pala district, on the southwestern slope of Chief Mt., 1-3/4 miles northeast of Pala.	Pala Indian Tribe, Pala (1958)	A prospect in the West Chief dike. Source of a small amount of kunzite.	Claim located in early part of century by T. A. Bakeley, San Bernardino. No longer valid; on Pala Indian Reservation. (Jahns and Wright 51:14, pl.2).
	Cable claim	Ramona district.		A pegmatite deposit.	A northwest-trending claim located in 1903 by a Dr. Cable, Los Angeles, mainly in the SE¼NW¼ sec. 8 and partly in the NW¼NE¼SW¼ sec. 8, T13S, R2E, SBM. It adjoined the Sunrise claim on the northwest. No recorded gem discoveries. Long idle. Parts of this property relocated more recently as the New A.B.C. and Little Three Extension claims, which see. (Merrill 14:702).
7	Calac prospect	Center S½ sec. 19, T10S, R1E, SBM; Rincon district, about 2½ miles east of Rincon, on the La Jolla Indian Reservation.	Undetermined (1957)	Deposit consists of two granite pegmatite dikes which strike about N.40°W., dip about 15° southwest, and are exposed continuously for several thousand ft. The northern dike ranges in thickness from 3 to 4 ft. Quartz-perthite pegmatite pods occur in the central part of the dike where it is thickest. The pods range in thickness from 2 to 12 in. and some contain sparse beryl around their margins. The southern dike averages about 3½ ft. in thickness and contains a quartz-perthite core. Bright blue, greenish blue, and yellowish-green beryl crystals as much as 13 mm. in diameter occur in the core, on its margin, and above it in graphic granite. (Summarized from Hanley, 1951, p. 23-24).	A group of 5 small prospects in 2 pegmatite dikes; four of the prospects are in the northern dike. The largest pit is about 25 ft. long, 15 ft. wide, and about 3 ft. deep. The other pits are 10 to 12 ft. in maximum dimension and all are shallow. Production very small or negligible. (Hanley 51:23-24, pl.1).
8	Canyon King prospect	S½SE¼SE¼ sec. 14, T9S, R2W, SBM; Pala district, on Chief Mt.		A prospect in the West Chief dike.	This prospect probably is just within the southern boundary of the Pala Chief claim. See Pala Chief group. (Jahns and Wright 51:14, pl.2).
	Canyon prospect	Pala district, Hiriart Mt.		A prospect in the northern extremity of the El Molino dike.	Within the boundaries of the K. C. Naylor claim, which see. (Jahns and Wright 51:15, pl.2).
	Carlsbad				Parts of beaches near Carlsbad and Cardiff have yielded cobbles of green nephrite, agate and jasper. The nephrite occurrence is unverified. (Dake 52:23).
	Caterina				See Katerina mine in text. (Kunz 05: 132, 133).
	Catherina				See Katerina mine in text.
9	Center Drive prospect	SW¼SE¼ sec. 24, T9S, R2W, SBM; Pala district, on Hiriart Mt., a little more than 2 miles east-northeast of Pala.		A prospect in a branch of the Katerina-Vanderburg system of dikes. A source of beryl and gem-quality tourmaline.	An abandoned claim on the southwest flank of Hiriart Mt., north of the Katerina claim. Located by F. M. and M. M. Sickler early in the 1900's, but abandoned soon afterward. (Jahns and Wright 51:14, pl.2; Kunz 05:86; Merrill 14:700).

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Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Chapparal prospects	Pala district, Hiriart Mt.		Part of the Anita dike.	Within the area covered by the Anita claim, which see. No additional published information. (Jahns and Wright 51:14, pl.2).
	Chief Extension prospects	Pala district, Chief Mt.		A prospect in the Pala Chief dike.	Within the area covered by the Pala Chief claim. See Pala Chief group. (Jahns and Wright 51:14, pl.2).
	Chief Ridge prospects	Pala district, Chief Mt.		A prospect in the Pala Chief dike.	Within the area covered by the Pala Chief claim. See Pala Chief group. (Jahns and Wright 51:14, pl.2).
70	Clark Extension prospect	SE¼SW¼ sec. 36, T10S, R1W, SBM; Rincon district, about 2½ miles south-southeast of Rincon, low on the slope south of the San Luis Rey River Valley.	Josephine Hall, Rincon (?) (1958)	Deposit consists of a pegmatite dike which strikes N.31°W., dips 65° southwest, is exposed for a length of about 1000 ft. and is about 5 ft. thick. May be a southward extension of the Clark dike which is exposed on the other side of the San Luis River Valley. The hanging wall unit of the dike is 3 ft. thick and is composed of medium- to coarse-grained quartz-perthite-albite—muscovite pegmatite with accessory tourmaline, lepidolite, spodumene, garnet, and beryl. All crystals are "frozen" to adjacent minerals. (summarized from Hanley, 1951, p.23).	Developed by prospect pits about 200 ft apart along the trace of the dike. Production very small or negligible. (Hanley 51:23, pl.1).
71	Clark mine	NE¼SW¼ sec. 36, T10S, R1W, SBM; Rincon district, about 2 miles south-southeast of Rincon, on Mack Ridge, northwest of San Luis Rey River Valley.	Probably on land owned by Vista Irrigation District, Vista, (1958)	The Clark pegmatite dike strikes about N.20°W., dips generally about 40° southwest, and is exposed in open cuts and as small outcrops for a length of 240 ft. It probably extends an additional 150 ft. to the north, and had been traced along sparse outcrops for several hundred feet to the south. Maximum thickness of the dike is 8 ft. and it has not been exposed for more than 8 ft. down dip. In the northern workings the central unit is composed of subhedral white perthite crystals and anhedral milky to colorless quartz crystals, some of which have been mined as electronic-grade material. In the southern workings a pod of quartz-spodumene pegmatite is poorly exposed directly beneath the core. The spodumene is opaque to sub-glassy and forms white to pale pink crystals as large as 1 in. in diameter. Other minerals that occur in the dike are: apatite, helvite, heulandite and petalite. (summarized from Hanley, 1951, p. 20-23).	A prospect explored for gem minerals by J. M. Mack early in the 1900's. During World War II several tens of pounds of electronic-grade quartz was mined by William McGee, Pala. There is no recorded production of gem minerals. The mine workings consist of 2 groups of open cuts: the northern group consists of 6 cuts, and the southern group of 2 cuts. The 2 largest of the cuts are in the north group and have the following dimensions: (1) 47 ft. long, as wide as 23 ft., and 16 ft. deep; and (2) 65 ft. long, 20 ft. wide, and 8 to 11 ft. deep. All the cuts are badly caved and grown over by chaparral. (Hanley 51:20-23, fig. 5, pl.1).
72	Cliff prospects	NW¼SW¼ sec. 24, T9S, R2W, SBM; Pala district, about 1-3/4 miles northeast of Pala, low on east side of Little Chief Mt.	Pala Indian Tribe, Pala (1958)	Shallow prospects in pegmatite dike.	Abandoned, now within Pala Indian Reservation. No additional published information. (Jahns and Wright 51:14, pl.2).
73	Cota mine	Near center SE¼NE¼ sec. 19, T11S, R2E, SBM; Mesa Grande district, nearly 3 miles northwest of Mesa Grande, on west slope of Gem Hill.	Undetermined (1957)	A pegmatite dike which strikes northwest and dips gently southwest. Thickness ranges from 2 to 5 ft. Gem minerals were mined from pockets in pods of quartz-euhedral perthite pegmatite exposed as discontinuous core segments. Pockets now exposed are 2 in. or less in maximum dimension and lined with small crystals of quartz, muscovite, albite, and colorless to pale pink beryl. Coarse cleavelandite and lepidolite are present in the dump.	Deposit opened in 1907 by Juan Mario Cota, and between 1907 and 1910 yielded garnet, beryl and tourmaline of several shades including amber and wine color. Total output of gem minerals may have been as much as 500 pounds. The workings, now largely overgrown, consist chiefly of a cut 50 ft. long, 10 to 25 ft. wide, and 5 to 12 ft. deep. (R. H. Jahns, California Institute of Technology, personal communication, 1957).

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Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
4	Crystal Gem mine	NW¼NW¼ sec. 11, T11S, R7E, SBM; about 7 miles northwest of Jacumba, very low on the northwest slope of Tule Mt.	Undetermined (1957) Kunz (1905) reported that the deposit was owned by "Collier and Smith of San Diego."	Very sparse, pale-green beryl crystals occur with black tourmaline and garnet in the core of a prominent pegmatite dike which strikes north-northeastward and dips steeply west. The core consists principally of crystals of feldspar and quartz whose maximum lengths are 2 ft. The dike is 10-15 ft. thick.	The deposit is developed by a shallow cut which is about 100 ft. north of the road that leads to Sacatone Sprgs. from a ranch house at the end of the Boulevard-McCain Valley county road. See also Ruby deposit in text under "Beryllium." (Kunz 05:152; Merrill 14:693, 703).
5	Crystal King prospects	NE¼NE¼ sec. 23, T9S, R2W, SBM; Pala district, west slope of Chief Mt., about 2 miles northeast of Pala.	Pala Indian Tribe, Pala (1958)	A prospect in the West Chief dike.	Abandoned and within the Pala Indian Reservation. No additional published information. (Jahns and Wright 51:4, pl.2).
	Daggett group	Ramona district.			The original name given to the A.B.C. mine by one of its discovers - Henry Daggett. See A.B.C. mine in text.
	Dos Cabezas mine	Sec. 2(?), T17S, R8E, SBM; southeastern part of county.		Kunz (1905) stated that "fine" grossularite variety hyacinth crystals occur in limestone that was in large enough quantities to use as a building stone.	Reported by Kunz (1905) as "about 8 miles...in a direct line... north and east from Jacumba Hot Springs..in sec. 2, T17S, R8E, SBM." (However, there is no limestone in section 2, and it is assumed that this deposit is associated with the Dos Cabezas limestone deposits which are about 2 miles north of section 2.) See also "Unnamed sec. 33" in this list. (Kunz 05:150; Merrill 14:705).
6	Douglass Extension prospect	About 750 ft. north of center of sec. 23, T9S, R2W, SBM; Pala district, about 1½ miles north-northeast of Pala.	Pala Indian Tribe, Pala (1958)	A prospect located on the Douglass dike which crops out along the base of the southeastern part of Queen Mt.	Abandoned, and within the Pala Indian Reservation. See also Douglass mine. (Jahns and Wright 51:14, pl.2).
7	Douglass mine	About 400 ft. northwest of center of sec.23, T9S, R2W, SBM; Pala district, nearly 1½ miles northeast of Pala.	Pala Indian Tribe, Pala (1958)	A prospect in the Douglass dike which extends for about 4000 ft. along the base of the southeastern part of the Queen Mountain. In addition to the usual common pegmatite minerals, honey-yellow to orange-brown crystals of grossularite, and iridescent stains of marcasite occur in the dike. The output consisted of small quantities of quartz and tourmaline.	An abandoned claim which in the early 1900's joined the Stewart claim on the east. Within the Pala Indian Reservation. No additional published information. (Hubon 02:10; Jahns and Wright 51:14, pl.2; Merrill 14:696; Tucker 25:362; Tucker and Reed 39: pl.1).
	Dulzura deposit	T18S, R2E, SBM; southeast of Dulzura.	Leo Galoski (?), Mason Hotel, 229 F. Street, San Diego 1 (1957)		A deposit of red and white jasper is reported to occur east of the Donahoe gold mining claims. Not verified by present writer. (Merrill 14:674; Tucker 25:369).
8	East Knickerbocker prospect	SW¼SW¼ sec. 13, T9S, R2W, SBM; Pala district, on the crest of Chief Mt., about 2 miles northeast of Pala.		A prospect in the Chief Ridge dike.	Within an area covered many years ago by the Knickerbocker claim, now abandoned. No additional published information. (Jahns and Wright 51:14, pl.2).
	Ed Fletcher				See Ed Fletcher, Jr. mine. (Jahns and Wright 51:14, pl.2).
9	Ed Fletcher, Jr. (Ed Fletcher) mine	S½SE¼ sec. 15, T9S, R2W, SBM; Pala district, about 1-3/4 miles north of Pala, on Queen Mountain. Reached by trail either from the site of Salmons City or from the Stewart mine road.	Ed Fletcher Company, 2340 Fletcher Parkway, El Cajon (1958)	About 200 feet southeast of the Tourmaline King workings and in the Tourmaline King dike which strikes north-northwestward and dips about 30° south-southwest. Source of a small amount of tourmaline and quartz.	An east-trending lode claim which is partly overlapped by the Tourmaline King claim (see claim map in text). The claim was located in March 1900 by Ed Fletcher and patented in Feb. 1914. Workings consist of a 100-foot and a 50-foot adit driven southward into the dike, and a 50-foot cut. Long idle. (Jahns and Wright 51:14, pl.2; Tucker 25:362; Tucker and Reed 39:40, pl.1).

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Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	El Lobo prospects	Pala district, Hiriart Mt.		A prospect in an extension of the Senpe pegmatite dike.	Area covered by Senpe claim, which see. (Jahns and Wright 51:14, pl.2).
80	El Molino mine	Mostly in NE¼NE¼ sec. 25, T9S, R2W, SBM, but a small part overlaps into section 24, and a very small area into sec. 19, T9S, R1W, SBM; Pala district, nearly 2½ miles east-northeast of Pala, on Hiriart Mt.	Norman E. Dawson, Route 1, Box 921, San Marcos (1959)	Mine is low on the southeastern slope of Hiriart Mt., and is in a group of three juxtaposed pegmatite dikes which trend north and dip 15° to 25° west. Nearly all production is from the lowest dike which is 7 feet in average thickness. The gem-bearing variety of pegmatite in this dike is in the central part of the dike and generally at the contact between line rock and overlying graphic granite. This central unit is continuous and ranges in thickness from 3 in. to 2 ft. It consists chiefly of quartz, potash feldspar, albite, and muscovite, with beryl, bismuth minerals and sulfide minerals. Some of the beryl occurs as individual crystals and radiating crystal groups and some as colorless to deep-pink tabular crystals which line cavities. (Description summarized from Jahns and Wright, 1951, p. 70).	Property consists of one unpatented north-trending claim which is bordere on the north by the K. C. Naylor clai and on the west by the El Molino millsite and Fargo claims (see claim map in text). Deposit was opened by F. M. Sickler in 1903 and worked inte mittently by him for about 20 years. The property was acquired by the present owner from George Ashley in 1948 and has been worked intermittent by him. Developed by open cuts. (Jahns and Wright 51:15,44,69,70, fig 34 and 35, pl.2; Kunz 05:86; Merrill 14:700; Sinkankas 57b:82).
81	Elder Canyon deposits	W½ sec. 2, T9S, R4E, SBM; near Riverside County line, in Anza-Borrego Desert State Park.	Undetermined (1958)	Pegmatite deposits. Principal deposit is a tourmaline-bearing dike exposed along east side of Elder Canyon. Dike strikes northward, dips west, and is exposed laterally for about 1500 ft.	Prospected by Charles Clark and Orville Bixley during late 1920's, who reportedly mined and sold a small quantity of gem-quality beryl. Explored only by a few shallow cuts. (C. Durrell in Murdoch and Webb 56:332; R. R. Dye, Warner Springs, personal communication, 1958).
	Elinor				See French Pete deposit. (Tucker and Reed 39:40, pl.1).
	Emerald (Upper Queen) prospect	Pala district, Queen Mt.			In area covered by the Tourmaline Queen group, which see. No additional published information. (Jahns and Wright 51:14, pl.2).
82	Emeralite No. 2 (Gem Mine No. 1, Mountain Lily, Ware) mine	NW¼SW¼ and S½SW¼ sec. 3, T10S, R2E, SBM; a little less than 4 miles south-southeast of Oak Grove, along the east side of the crest of Aguanga Mt.	Alice Wiesendanger, 3660 Puesta del sol, Santa Barbara (1957)	The deposit consists of a thin, very gently dipping pegmatite dike which is exposed discontinuously and is enclosed in gabbroic and dioritic rocks. The following gem minerals were reported by Kunz(1905) and Tucker(1925) to have been recovered from the dike: nile-green and blue tourmaline; white, pink, and light blue beryl; and blue topaz. Merrill (1914) stated that gem stones cut from these minerals averaged only a little more than one carat. In 1958 the dump contained fragments of very thin, pale blue crystals of tourmaline similar to those found at the Maple Lode deposit to the south. The dump also contained lepidolite, albite (including cleavelandite), and black and pink tourmaline.	Original claim named the Gem Mine No. 1 was located in June, 1903 by Bert Simmons of Oak Grove and Charles Gord of San Diego. By 1914 the property ha become known as the Mountain Lily min and had been leased to J. W. Ware of San Diego. Ware eventually purchased the property and patented one northwes trending claim in 1933. The widow of Mr. Ware sold the mine to its present owner in 1947. The deposit is developed by 2 adits and a series of cuts. The adits trend southwestward about 30 ft. apart. The more northwesterly adit is the principal opening; it is about 200 ft. long and contains about 250 ft. of appended workings. Propert long idle. Production probably very small. (Kunz 05:123-124; Merrill 14: 702-703, 705; Sterrett 14:688; Tucker 25:363; Tucker and Reed 39:40, pl.1; Wherry 17:146).
83	Esmeralda mine	Mesa Grande District.			See text. (R. H. Jahns, California Institute of Technology, personal communication, 1957; Kunz 05:49, 136-137; Merrill 14:692, 701).
	Fargo et al.				See Fargo mine. (Tucker and Reed 39: pl.1).
84	Fargo (Fargo et al.) mine	N½NE¼ sec. 25, T9S, R2W, SBM; Pala district, low on the southern slope of Hiriart Mountain, about 2¼ miles east-northeast of Pala.	Norman E. Dawson, Route 1, Box 921, San Marcos (1959)	Workings are in the Fargo dike which strikes northward, dips about 37° west, and crops out for several thousand feet along the southeast slope of Hiriart Mt. Once a source of tourmaline and quartz.	Property consists of one north-northwest trending unpatented claim which is overlapped on the west by the Hiriart claim (see claim map in text). The claim was located by F. M. and M. M. Sickler between 1900 and 1903, as part of the original Sickler group, and worked intermittently by them for several years. The claim was purchased b the present owner from George Ashley. Developed by open cuts. (Jahns and Wright 51:8, 15, 27, fig. 5, pl.2; Kun 05:86; Merrill 14:700; Tucker and Reed 39:pl.1).

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Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
85	Fraction claim	E½NW¼SE¼ and S½SE¼ SW¼NW¼ sec. 8, T13S, R2E, SBM; Ramona district, about 4 miles east-northeast of Ramona, in Hatfield Creek Valley.	Charles H. Davis, 213 Via Cordova, Lido Isle, Newport Beach (1957)	A pegmatite deposit.	A north-trending claim located in the late 1930's and patented in 1949. Adjoins the Little Three property which lies to the east, the Little Three Extension and Black Panther claims which lie to the west, and patented ranch land which lies to the south. Shallow workings only. No record of production. Small house on property. (Tucker and Reed 39:pl.1).
	Francis	Pala district, Chief Mt.			A map location shown by Tucker and Reed (1939, pl.1) in the SE¼ of sec. 14, T9S, R2W, SBM. No additional published information. See Pala Chief group. (Tucker and Reed 39:pl.1).
	Frank A. Salmons claim	South edge SW¼ sec. 14, T9S, R2W, SBM; Pala district, about 1-3/4 miles north-northeast of Pala, low on the east side of Queen Mt.	Mrs. Margaret S. Moore, and Mrs. Mildred S. Wear, Star Route, Pauma Valley; managed by F. D. Fitzsimmons, Pauma Valley (1960)	Includes the north end of the Stewart pegmatite dike.	Part of the Tourmaline Queen group, which was located by Frank A. Salmons and others in the early 1900's. Lies to the south of the Pala King claim (see claim map in text). Very little development work. See also Tourmaline Queen group. For additional information about Frank Salmons, see Pala Chief group.
86	French Pete (Elinor) deposit	NW¼ sec. 35, T9S, R3E, SBM; about 5 miles north of Warner Springs, near the southeast end of the crest of a prominent northwest-trending ridge.	Undetermined (1958)	A pegmatite dike that contains tourmaline and lepidolite.	Reported to have been mined by Peter Labat (or Cabat) in 1900's and/or 1910's (R. R. Dye, Warner Springs, oral communication, 1958). Tucker and Reed (1939) stated that the production is "reputed" to be about $5000 worth of tourmaline. Tucker and Reed (1939) reported that the deposit was developed by 2 shafts and 2 adits, and that the shafts were caved. The dumps from these workings are visible, from below, on the southwest side of the crest of the prominent ridge. (Schaller 17:856; Tucker and Reed 39:40, pl.1).
	Gem Lepidolite				See Gem Star mine. (Merrill 14:697).
	Gem Mine No. 1				See Emeralite No. 2 mine. (Kunz 05:123-124).
87	Gem Star (Gem Lepidolite, Loughbaugh) mine	NE¼NW¼ sec. 23, T9S, R2W, SBM; Pala district, on southeastern flank of Queen Mt., about 1½ miles north-northeast of Pala.	Pala Indian Tribe, Pala (1958)	The mine is in the northern part of the Stewart composite dike mass which consists of 3 distinct dikes. In the mine area the dike mass ranges in surface width from 100 to 150 ft., trends northward, and dips from 20°-42° west. Most mining has been in the thin central unit of the middle dike. This unit consists of quartz-spodumene pegmatite, with accessory lepidolite, albite, and alkalic tourmaline. Where exposed the unit ranges in thickness from 1 in. to 4 ft. Clear fragments of small tourmaline crystals are present in the dump and small gem-quality crystals as large as 4 in. in diameter and 15 in. long have been mined. (Jahns and Wright, 1951, p. 58).	Abandoned. On the Pala Indian Reservation, just north of the Stewart claim. It can be reached from the road that skirts the base of southeastern Queen Mt. The mine was operated by A. M. Loughbaugh (or Labaugh) from about 1905 to 1912 and more recently by Francisco Moreno of Los Angeles. Workings consist of several open cuts and appended inclined adits and drifts which are distributed along the pegmatite outcrop for about 500 ft. (Jahns and Wright, 1951, p. 58). (Aubury and others 06:310; Jahns and Wright 51:14, 17, 31, 57-59, fig. 31, pl.2; Merrill 14:697; Tucker and Reed 39:40, pl.1).
88	Goddess prospect	S½SW¼SW¼ sec. 13, and a very small part of the S½ SE¼SE¼ sec. 14, T9S, R2W, SBM; Pala district, about 2¼ miles northeast of Pala, on the northeast slope of Chief Mt.	Mrs. Margaret S. Moore and Mrs. Mildred S. Wear, c/o Star Route, Pauma Valley; managed by F. D. Fitzsimmons, Pauma Valley (1960)	In a branch of the Ocean View pegmatite dike.	The most southeastern of the 3 east-trending claims which compose the Pala Chief group (see claim map in text). Adjoins the Ocean View claim which lies to the north and the Pala Chief claim which lies to the west. Developed only by shallow cuts. No additional published information. (Jahns and Wright 51:14, pl.2; Merrill 14:698; Tucker and Reed 39:pl.1).
89	Green Cabin mine	S½SW¼SW¼ sec. 14, T9S, R2W, SBM; Pala district, about 1-2/3 miles east-northeast of Pala, low on the east side of Queen Mt.			A claim located by L. H. Doss, Valley Center, in an area now covered by the Frank A. Salmons claim, which see. (Tucker and Reed 39:40, pl.1).

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Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
90	Green Ledge mine	Just east of the center of the N½N½NE¼ sec. 19, T11S, R2E, SBM; Mesa Grande district, about 3 miles northwest of Mesa Grande, on the west slope of Gem Hill.	Undetermined (1957)	A pegmatite dike at least 5 ft. thick which strikes north-northwestward and dips 35°-50° west-southwest. Gem minerals were found in pockets in the central part of the dike which is composed essentially of coarse-grained quartz-perthite-schorl pegmatite.	Deposit opened between 1905 and 1908 has yielded a small amount of "colorless to pale blue beryl, as well as green, pink, and purplish tourmaline." Developed by a series of coalesced cuts which is 50 ft. long and 18 ft. wide. Long idle. (R. H. Jahns, California Institute of Technology, personal communication, 1957).
91	Happy Hooligan prospect	SW¼NE¼ sec. 22, T9S, R2W, SBM; Pala district, a little more than a mile north of Pala, on the southern slope of Queen Mt.	Undetermined (1957)	A prospect within a swarm of pegmatite dikes. Dike in which Hooligan prospect is located strikes north and dips 25° west.	Now on patented non-mining land. No additional published information. (Jahns and Wright 51:14, pl.2; Merrill 14:697).
	Hatfield Creek	Ramona district, Hatfield Creek.			Mr. L. B. Spaulding, Ramona, stated (written communication, 1957) that "many years ago... A. W. Pray... set up a small sluice in the bed of the creek and among the heavy minerals caught in the riffles were two or three tiny (about the size of the head of a pin) clear crystals. Mr. Pray sent these to Dr. W. T. Schaller of the U.S.G.S., who identified them as diamonds."
92	Hazel W. prospect	N½SE¼SE¼ sec. 14, T9S, R2W, SBM; Pala district, a little more than 2 miles north-northeast of Pala, on the northwestern slope of Chief Mt.	Undetermined (1958)	A prospect in a relatively thin dike about 200 feet north of the western part of the Pala Chief dike.	A long idle claim which bordered the Pala Chief claim on the north. One of the claims controlled by the old Pala Chief Mining Company. (Jahns and Wright 51:14, pl.2).
93	Hercules prospect	Mainly in the SE¼ NE¼ sec. 8, with a small part in the S½NE¼NE¼ sec. 8, T13S, R2E, SBM; Ramona district, about 4½ miles east-northeast of Ramona.	Robert B. Winstead, 225 3rd Street, Ramona, and George Converse, Ramona (1957)	About 15 pounds of gem quality spessartite and ½ pound of green beryl were obtained in the early 1900's from a pegmatite dike that strikes northwestward and dips about 45° south. The gems ranged from about 1 to 6 carats. The dike is about 3 ft. thick where it was cut by the workings, and is more than 1,000 ft. long.	Borders the Little Three property on the north. Originally located in August 1903 by A. W. Pray, S. G. Ingle, and Harry Titus as 2 end-to-end north-northwest-trending claims. Most of the development work was done by Pray. In 1954 the present owners relocated a single north-trending claim. Developed by shallow open cuts and a 50-ft. adit driven northwestward from the south border of the claim. (Kunz 05: 49, 147-148; Merrill 14:693, 702; Sinkankas 57a:367-369; Tucker 25:362; Tucker and Reed 39:40, pl.1).
	Heriart				See Hiriart group and mine. (Kunz 05: 86, 132-133).
	Heriot				See Hiriart mine.
94	Himalaya mine	Mesa Grande district.			See text. (Hubon 02:10; R. H. Jahns, California Institute of Technology, personal communication, 1957; Kunz 05: 49, 133-135; Merrill 14:692, 700-701; Tucker and Reed 39:40-41, pl.1).
	Hiriart group	Pala district, Hiriart Mt.			Consisted of three claims (Anita, San Pedro, and Senpe) located by Bernardo Hiriart in early 1900's. Later became part of Sickler group, which see. (Merrill 14:700).
95	Hiriart (Heriart, Heriot, Hiriart prospects) mine	Mostly in the NW¼ NE¼ sec. 25, with small parts in the NW¼NE¼NE¼ sec. 23 and the SE¼SW¼SE¼ sec.24, T9S, R2W, SBM; Pala district, 2¼ miles east-northeast of Pala, near middle of southwest slope of Hiriart Mt.	George A. Ashley, Pala (1958)	A deposit derived by slides from the Vanderburg-Katerina pegmatite dike group which is exposed higher on the slope. A source of spodumene and quartz according to Jahns and Wright (1951, p. 15) and lepidolite, pink and green tourmaline, and amblygonite according to Kunz (1905, p.133).	A northeast-trending patented claim which overlaps part of the Fargo claim which is parallel and to the east (see claim map in text). The north part of the Hiriart claim is partly overlapped by the eastern part of the Katerina claim and the southern part of the Vanderburg claim. Worked by shallow cuts, trenches, and a 40-ft. adit. Located by F.M. and M.M. Sickler, early in the 1900's. Formerly part of the Sickler group which was purchased by owner in 1947. (Jahns and Wright 51:15, pl.2; Kunz 05: 86, 132-133; Merrill 14:700).

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Map No	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Hiriart prospects				See Hiriart mine.
	Home Stake				See Homestake prospect. (Tucker and Reed 39:pl.1).
96	Homestake (Home Stake) prospect	SE¼SW¼ sec. 14, T9N, R2W, SBM; Pala district, about 1½ miles north-northeast of Pala, just north of the site of Salmons City which is at the base of Queen Mt.	Mrs. Margaret S. Moore, and Mrs. Mildred S. Wear, Star Route, Pauma Valley; managed by F. D. Fitzsimmons, Pauma Valley (1960)	A prospect in an exposure of a pegmatite dike which strikes north-northwestward and dips about 30° west. Length of the outcrop is about 250 ft.	Part of Tourmaline Queen group, which see also. A north-trending claim bordered by the Pala King and Frank A. Salmons claims which lie to the west (see claim map in text). One of the claims formerly controlled by old Pala Chief Mining Company. (Jahns and Wright 51:14, pl.2; Merrill 14:697,698).
97	Imperial Beach	T18S, R2W, SBM; Imperial Beach, south of San Diego.			Agate pebbles are reported to have been found once on Imperial Beach. (Roy Kepner, San Diego Div. Nat. Res., personal communication, 1958).
98	Jackpot Tunnel (Butterfly) prospect	Near center of the NW¼NW¼ sec. 24, T9S, R2W, SBM; Pala district, about 2 miles northeast of Pala, low on the east side of Chief Mt.	Pala Indian Tribe, Pala (1958)	A prospect in the southern part of the Ocean View dike.	An abandoned claim. Workings now within the Pala Indian Reservation. (Jahns and Wright 51:14, pl.2).
99	K.C. Naylor mine	E½E½SE¼ sec. 24, T9S, R2W, SBM; and W½W½SW¼ sec. 19, T9S, R1W, SBM; Pala district, about 2½ miles east-northeast of Pala, very low on the eastern slope of Hiriart Mt.	George Ashley, Pala (1957)	In the north part of the El Molino pegmatite dike which strikes north, dips about 20° east, and is the most easterly exposed dike on Hiriart Mt. Dike is exposed for a length of about 2500 ft. In early days a source of tourmaline and quartz. Kunz (1905, p.86) stated that gem-spodumene and lepidolite also were found.	A north-trending claim which is bounded on the south by the El Molino claim (see claim map in text). One of the claims of the original Sickler group. The Canyon prospect is also located within this claim. The mine is developed by minor cuts. Production undetermined. (Jahns and Wright 51:15, 27, 53, pl.2; Kunz 05:86; Merrill 14:700).
100	Katerina (Ashley, Caterina, Catherina, Katrina) mine	Pala district, Hirart Mt.			See text. (Jahns and Wright 51:15, 37, 38, 39, 41, 46, 47, 49, 50, 60, 66, 68-70, pl.2; Kunz 05:132, 133; Merrill 14:692, 700; Sinkankas 57b:82-83).
	Katrina				Original name of claim which encloses Katerina mine, which see. (Merrill 14:700).
101	Knickerbocker (East Knickerbocker, West Knickerbocker) claim	Parts of secs. 13, 14, 23, 24, T9S, R2W, SBM; Pala district, about 2 miles northeast of Pala, on crest of Chief Mt.	Pala Indian Tribe, Pala (1958)		An abandoned claim which was probably located south of the Pala Chief and Goddess claims. Area now partly within Pala Indian Reservation. See also East Knickerbocker and West Knickerbocker prospects. (Jahns and Wright 51:14, pl.2; Merrill 14:698; Tucker and Reed 39:pl.1).
102	Little Chief prospects	NW¼SW¼ sec. 24, T9S, R2W, SBM; Pala district, about 1-3/4 miles northeast of Pala, near crest of Little Chief Mt.	Pala Indian Tribe, Pala (1958)	Shallow prospects in a pegmatite dike.	Abandoned, now within Pala Indian Reservation. No additional published information. (Jahns and Wright 51:14, pl.2).
103a 103b	Little Three mine	Ramona district.			See text. (Kunz 05:46, 142-145; Merrill 14:692, 702; Sinkankas 57a:367-373; Tucker 25:362; Tucker and Reed 39:pl.1).
104	Little Three Extension prospect	E½SE¼NW¼, W½SW¼NE¼, and N½NW¼SE¼ sec. 8, T13S, R2E, SBM; Ramona district, about 4 miles east-northeast of Ramona, in Hatfield Creek Valley.	L. B. Spaulding, P.O. Box 15, Ramona (1957)	A prospect in the Little Three dike, northwest of the Little Three mine workings. Very small output of beryl and spessartite.	A northwest-trending claim located by owner in 1947. Adjacent to the Black Panther claim which lies to the south and the Fraction claim which lies to the east. Idle.

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Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
105	Lookout prospect	Center NE¼ sec. 8, T13S, R3E; Ramona district, about 4½ miles east-northeast of Ramona.	Undetermined (1957)	About 3 pounds of spessartite and 4 ounces of beryl were mined from a pegmatite dike which strikes northwestward and dips gently to the south.	A northwest-trending claim located by S. G. Ingle, H. Titus and A. W. Pray in July 1903. It adjoined the original Hercules claims on the northeast. Developed by shallow open cuts. Long idle. Now partly covered by the new Hercules claim. (Kunz 05:49, 148-149; Merrill 14:693; Sinkankas 57a:368).
106	Lost Valley tourmaline prospects	NE¼NE¼ sec. 28, T9S, R4E, SBM; about 7¼ miles northeast of Warner Springs, slightly north of Lost Valley.	Undetermined (1958)	Several pegmatite dikes crop out along crest and southeastern slope of small hill. Dikes enclosed in granitic rocks. Contain abundant black tourmaline.	Undeveloped. Source of black tourmaline for mineral collectors.
107	Lost Valley Truck Trail prospect	N½ sec. 14, T10S, R3E, SBM; 2 miles north-northwest of Warner Springs, several hundred feet east of Lost Valley Truck Trail.	Undetermined (1958)	Deposit consists of a granite pegmatite dike, enclosed in hybrid rocks, which is exposed just southwest of the crest of a small hill. The dike strikes northward, dips about 30° east, is about 10 ft. thick, and can be traced laterally for at least 200 ft. The dike can be divided into 3 zones: (1) a lower zone, about 4 to 5 ft. thick, which is chiefly graphic granite; (2) a core, about 1 ft. thick, which is composed of quartz, albite (including variety cleavelandite), muscovite, lepidolite, tourmaline, garnet, and allanite; and (3) an upper zone, 4 to 5 ft. thick, which is medium- to coarse-grained graphic granite with muscovite, and black tourmaline crystals as long as 9 in. The tourmaline crystals of the core commonly range in color from solid black to crystals with black cores and grass green exteriors. Also noted were pale blue, pale pink, and colorless crystals. Pale crystals are thin and probably average less than ½ to 1 in. in length. Some of the smallest crystals are gemmy.	Probably worked during 1910's or 1920's, according to R. R. Dye of Warner Springs (oral communication, 1958). Explored by shallow cuts and trenches along outcrop.
	Loughbaugh				See Gem Star mine. (Jahns and Wright 51: 57-59, pl.2).
	Lower Blanket prospects				See Blanket prospects. (Jahns and Wright 51:14, pl.2).
	Lower Salmons View prospect	Pala district.			A prospect within the Pala Chief claim, which see. (Jahns and Wright 51:14, pl.2).
108	Mack mine	SW¼SW¼ sec. 25, T10S, R1W, SBM; Rincon district, about 1½ miles south-southeast of Rincon, low on a hill slope east of San Luis Rey River Valley.	Charles W. Hall, P.O. Box 286, Valley Center (1958)	The Mack pegmatite dike strikes N. 15° W. and dips about 40° southwest. It is exposed continuously along its strike for about 170 ft. and discontinuously to the south-southwest for 120 ft. The dike is about 2 ft. thick for most of its length, and its maximum thickness is 3¾ ft. The pocket pegmatite comprises the lower 4 to 6 in. of the quartz-perthite pegmatite core and the upper 6 in. of the underlying line rock. It contains numerous vugs which are lined with euhedral crystals of muscovite, albite, quartz, beryl, and garnet. The beryl crystals are greenish-blue to blue, and as much as 13 mm. in diameter. Gem-quality crystals are extremely uncommon. The most probable extension of the pocket pegmatite is down the dip of the pegmatite. (summarized from Hanley, 1951, p. 15-18).	Patented ranch property. This deposit was one of the earliest sources of gem-quality beryl of John M. Mack who, with an Indian named J. Calac, discovered the deposit in November 1903. He worked the deposit for several years, but did not disclose the exact quantity of his meager production. The mine is developed by 3 open cuts, the largest of which is 61 ft. long, 32 ft. wide, and 16 ft. deep. The workings are now largely grown over by chaparral. (Hanley 51:15-18, figs. 1, 3, pl.1; Kunz 05:50, 137-139; Merrill 14:692, 693, 700; Tucker and Reed 39:41, pl.1).

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Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Manganese deposits				Kunz (1905) reported that the San Diego Desert Marble Company owned deposits 1½ miles northwest of Jacumba Hot Springs that consisted of a ledge 10 ft. in average width and about 5000 feet long which contained oxides of manganese associated with garnet, beryl, and black tourmaline. The deposit referred to by Kunz probably is a part of either the Jacumba deposits or Sherry Ann deposit described herein under "Manganese". (Kunz 05: 152).
09	Maple Lode mine	S½NW¼ sec. 10, T10S, R2E, SBM; about 4½ miles south-southeast of Oak Grove, about 2,500 ft. southwest of the crest of Aguanga Mountain.	Del Flatz, 3426 Highland Ave., San Diego 5 (1960)	Deposit consists of a granite pegmatite dike which strikes north to northeast and dips 25°-30° east, into the southwest side of Aguanga Mountain. The dike can be traced northward and upward from the mine for at least 600 ft. toward the Emeralite No. 2 mine. The country rocks are mainly gabbroic, but are locally granitic. In the vicinity of the workings the dike is at least 10 ft. thick: (1) its lower part, about 4 ft. thick, consists of medium-grained aggregates of line rock and contains abundant garnet and schorl. This part grades upward into (2) a medium- to coarse-grained aggregate of quartz, albite and muscovite with minor proportions of graphic granite and line rock. This part is about 5 ft. thick; (3) the core of the dike is a coarse-grained aggregate, at least 1 ft. thick, composed mainly of quartz, albite and schorl. Groups of very thin, pale blue tourmaline crystals, no longer than ½ inch, commonly cover faces of quartz and albite crystals. In addition, pale blue topaz crystals as large as 3/4 in. have been recovered from the deposit; (4) the upper part of the dike was not examined in detail.	Deposit probably was first worked about 1903, when Emeralite No. 2 mine, nearby, was discovered and developed. The principal workings consist of two parallel adits driven north-northeastward. The older adit is about 8 ft. south-southeasterly and 5 ft. lower than the younger workings. It is now partly caved, but open for at least 50 ft. The younger adit is an irregular, partly gophered working about 20 ft. long. The two adits are connected by a raise. The present owner purchased the property from a Mr. MacMillan, of Sunshine Summit, late in 1959. MacMillan probably had mined a small quantity of gem material from the younger workings.
10	Margarita mine	Center NE¼NE¼ sec. 23, T9S, R2W, SBM; Pala district, about 2 miles northeast of Pala, near the middle of the west flank of Chief Mt.	Pala Indian Tribe, Pala (1958)	In the West Chief dike, which strikes nearly north and dips 25°-30° west. Once a source of beryl, tourmaline and quartz. Bismuthinite and bismuth also occur.	Abandoned; now within Pala Indian Reservation. Developed by shallow cuts. No additional published information. (Jahns and Wright 51:14, 38, pl.2).
11	Mason Valley Gem claim	Near center W½ sec. 3, T13S, R5E, SBM; on the southwest side of Mason Valley, in a ravine on the east side of a small group of hills.	Undetermined (1958) D. G. Ingraham (1939)	A pegmatite deposit reported to contain lepidolite and tourmaline.	Listed by Tucker and Reed (1939) as a prospect. (Hilton 39:26-28; Tucker and Reed 39:55).
12	Maud prospects	N½SW¼NE¼ sec. 22, T9S, R2W, SBM; Pala district, 1¼ miles north of Pala, on the southern slope of Queen Mt.	Undetermined (1958)	Near the Happy Hooligan prospect, in a swarm of pegmatite dikes.	Now on patented non-mining land. No additional published information. (Jahns and Wright 51:14, pl.2; Merrill 14:697).
3	McFall mine	Near center sec. 5, T14S, R2E, SBM; about 5½ miles southeast of Ramona, and 2 miles east of Barona Road.	Raymond E. Pierce and John K. Underwood (1955)	A small body of tactite in granitic rocks contains garnet, variety essonite, and epidote.	Discovered in 1895, first located wrongly as a zinc deposit, and explored by a 22-ft. shaft (now caved). A few years later the deposit was the source of a small amount of epidote which was cut into gem stones. These stones probably were no larger than one carat each. Pierce and Underwood relocated the deposit in 1955 and worked it very briefly for garnet. (Kunz 05:149, Merrill 14:704).

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Map No	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Meadow prospects	Pala district.			Within the Ocean View claim, which see (Jahns and Wright 51:14, pl.2).
114	Mesa Grande mine	Near center of the N½ sec. 20, T11S, R2E, SBM; Mesa Grande district, nearly 2½ miles northwest of Mesa Grande, on the steep east slope of Gem Hill.	Undetermined (1957)	A pegmatite dike which strikes northward, dips 20°-25° west, and ranges in thickness from perhaps 6 in. to 4½ ft. The dike probably is a southern extension of the Himalaya dike. "Pocket" pegmatite was found in the central part of the dike which is composed mainly of quartz-subhedral perthite pegmatite.	Deposit opened in 1903 or 1904 and worked until 1910 by several people. Yielded a modest amount of pink and purplish tourmaline, white and blue beryl, and quartz. Principal development is a cut 60 ft. long, 15 to 4 ft. wide, and 25 ft. deep, from which was driven an adit, now caved, reported to be 80 ft. long with an appended drift driven north along the dike 80 to 180 ft. Other cuts were driven along the outcrop of the dike. Long idle. (R. H. Jahns, California Institute of Technology, personal communication, 1957).
115	Mission mine	N½NW¼SW¼ sec. 23, T9N, R2W, SBM; Pala district, about one mile north-northeast of Pala, low on the south slope of Queen Mt.	Pala Indian Tribe, Pala (1958)	In a pegmatite dike which strikes north and dips 25°-35° west. Source of small amount of quartz crystals, some lepidolite, and a little gem-quality tourmaline. The dike is 2 to 11 ft. thick, and has an average thickness of less than 6 ft. Only a few concentrations of typical pocket minerals were noted by Jahns and Wright (1951, p. 62) and these were in the main underground workings. No well defined gem-bearing unit was encountered during mining of this deposit.	Abandoned; within Pala Indian Reservation. Deposit was worked intermittently from about 1902 to 1925. Workings consist of an open cut on the Stewart mine road from which a drift was driven 45 ft. to the north, three additional cuts, and an 85 ft. adit driven unsuccessfully to the top of a hidden part of the dike. (Hubon 02:10; Jahns and Wright 51:14, 61-62, 65 Merrill 14:696, 697).
116	Moonlight Beach	T13S, R4W, SBM; at Encinitas.			Moonstones have been found on this beac (Roy Kepner, San Diego Div. Nat. Res. personal communication, 1958).
	Moosa Canyon				See Vista Chief deposit. (Kunz 05:62; Merrill 14:702).
	Mountain Lily				See Emeralite No. 2 mine. (Merrill 14:702-703, 705; Tucker 25:363; Tucker and Reed 39:pl.1).
	Naylor				See K. C. Naylor mine. (Jahns and Wright 51:15, 27, 53, pl.2).
117	New A.B.C. prospect	SE¼NW¼ and N½NE¼SW¼ sec. 8, T13S, R2E, SBM; Ramona district, about 4 miles east-northeast of Ramona, in Hatfield Creek Valley.	L. B. Spaulding, P.O. Box 15, Ramona (1957)	A prospect in the southeastern part of the A.B.C. pegmatite dike. At the point of development, the dike strikes about N.55°W., dips 35° southwest, and is about 3 ft. thick. Mr. Spaulding (written communication, 1957) stated that in 1950 he mined from this deposit "a large quantity" of quartz crystals, many coated with green mica and cookeite; some grass-green tourmaline; several pounds of colorless beryl, plus several pale green crystals; plus minor amounts of topaz, apatite, stibiotantalite, and some "unusual eroded and coated feldspar crystals."	A northwest-trending claim that was located in 1947 by the present owner on land partly covered in the early 1900's by the Cable and Sunrise claim Principal workings are on the site of the extreme northwest part of the sit of the Sunrise claim. Developed by a northwest-trending trench 35 ft. long 10 to 25 ft. wide, and about 10 ft. deep. Idle.
118	North Douglass prospect	N½NE¼NW¼ sec. 23, T9S, R2W, SBM; Pala district, about 1-3/4 miles north-northeast of Pala, at the base of the eastern slope of Queen Mt.	Pala Indian Tribe, Pala (1958)	Prospect in the extreme north end of the Douglass pegmatite dike.	Abandoned; within Pala Indian Reservation. No additional published information. (Jahns and Wright 51:14, pl.2).
	North End prospects	Pala district, Chief Mt.		A prospect in a thin pegmatite dike.	Within the northwest part of the Ocean View claim, which see. No additional published information. (Jahns and Wright 51:14, pl.2).

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Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
19	North Star mine	N½NE¼NW¼ sec. 23, T9S, R2W, SBM; Pala district, about 1-5/8 miles north-northeast of Pala, low on east slope of Queen Mt.	Pala Indian Tribe, Pala (1958)	A prospect at the north end of the Stewart dike, which here strikes north and dips about 20° west. A former source of tourmaline and quartz.	Abandoned; within Pala Indian reservation. Developed by short adits and shallow cuts. (Jahns and Wright 51: 14, 24, pl.2).
20	Ocean View claim	N½SW¼SW¼ sec. 13, and a very small part of the N½ SE¼SE¼ sec. 14, T9S, R2W, SBM; Pala district, about 2¼ miles northeast of Pala, on the northeast slope of Chief Mt.	Mrs. Margaret S. Moore and Mrs. Mildred S. Wear, Star Route, Pauma Valley; managed by F. D. Fitzsimmons, Pauma Valley (1960)	Principal workings are in the Ocean View pegmatite dike, part of which is exposed just within the western limits of the claim. This dike strikes north and dips about 30° west. A former source of beryl and quartz.	Most northerly of the 3 east-trending claims which compose the Pala Chief group. Adjoins the Goddess claim, of the group, which lies to the south (see claim map in the text). Also see North End and Snipe prospects, and Pala Chief group. No additional published information. (Jahns and Wright 51:14, 27, pl.2; Merrill 14:699).
21	Olla prospect	E½NE¼NE¼ sec. 23, T9S, R2W, SBM; Pala district, about 2 miles northeast of Pala, high on the west side of Chief Mt.	Pala Indian Tribe, Pala (1958)	A prospect in the West Chief pegmatite dike.	An abandoned claim whose site is south of the site of the Knickerbocker claim and north of the site of the Butterfly claim. Located early in the century by John Reed and Adolph Shoulders. No additional published information. (Jahns and Wright 51:14, pl.2; Merrill 14:699).
	Pala Chief group	SW¼SW¼ sec. 13, and S½SE¼ sec. 14, T9S, R2W, SBM; Pala district, a little more than 2 miles northeast of Pala, on Chief Mt.	Mrs. Margaret S. Moore, and Mrs. Mildred S. Wear, Star Route, Pauma Valley; managed by F. D. Fitzsimmons, Pauma Valley (1960)		Consists of Pala Chief, Ocean View and Goddess claims, all patented in 1956. Originally the Knickerbocker and Hazel W. claims, which now are abandoned, also were part of the group. The group originally was controlled by the Pala Chief Gem Mining Company which was formed in the early 1900's. The late Frank S. Salmons was president of the company, and the two present owners are his daughters. For descriptions of the geology and operations of the claims of the group see the Goddess prospect, Ocean View claim, and Pala Chief mine. See also the Knickerbocker claim and the Hazel W. prospect. (Merrill 14:698; Tucker 25:362-363; Tucker and Reed 39:41).
22	Pala Chief mine	Pala district, Chief Mt.			See text and Pala Chief group. (Jahns and Wright 51:8, 15, 19, 26, 27, 29, 30, 31, 35, 37, 38, 39, 46, 47, 50, 51, 52, 62-68, pl.2, pl.5; Kunz 05:25, 31, 55, 60-61, 87, 126-127; Merrill 14:691, 693, 697, 698, 699; Tucker 25:362-363; Tucker and Reed 39:41, pl.1).
	Pala Chief Mining Company				See Pala Chief group. (Merrill 14:698).
23	Pala Douglass mine	Near the center of the NE¼SW¼ sec. 23, T9S, R2W, SBM; Pala district, about 1¼ miles north-northeast of Pala, at base of southeastern slope of Queen Mt.	Undetermined (1958)	A prospect in the extreme southern part of the Douglass pegmatite dike.	Abandoned; on patented non-mining land. No additional published information. (Jahns and Wright 51:14, pl.2).
24	Pala King (Spring Bank, Wedge) prospect	S½SW¼ sec. 14, T9S, R2W, SBM; Pala district, about 1-3/4 miles north-northeast of Pala, on the eastern slope of Queen Mt.	Mrs. Margaret S. Moore, and Mrs. Mildred S. Wear, Star Route, Pauma Valley; managed by F. D. Fitzsimmons, Pauma Valley (1960)	A prospect in a pegmatite dike which is exposed laterally for several hundred ft.	Part of the Tourmaline Queen group, which see also. Property consists of an east-trending claim that adjoins the Frank A. Salmons claim, which lies to the south, and the Homestake claim which lies to the east (see claim map in text). No additional published information. (Jahns and Wright 51:14, pl.2; Merrill 14:697, 698; Tucker and Reed 39:pl.1).

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Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
125	Pala View (Sholder-Trotter) mine	NE¼NE¼ sec. 22, T9S, R2W, SBM; Pala district, about 1-1/3 miles north of Pala, on upper part of Queen Mt.	George Ashley(?), Pala (1958)	Prospects located on southern-most extension of the Tourmaline Queen dike, where it strikes north-northwestward and dips about 25° west. A former source of tourmaline and quartz. Pegmatite has garnet-rich layers. Apatite in crystals as long as 1½ in., but averaging less than ¼ in diameter also occurs.	Within Pala Indian Reservation. Most easily reached from the trail on the west side of Queen Mt. (Jahns and Wright 51:14, 25, 41, pl.2).
126	Pasture prospect	N½NE¼SW¼ sec. 23, T9S, R2W, SBM; Pala district, about 1-1/3 miles north-northeast of Pala, very low on the south-eastern slope of Queen Mt.	Undetermined (1958)	A prospect in the southern part of the Douglass pegmatite dike.	South of Douglass mine, on patented non-mining land. No additional published information. (Jahns and Wrigh 51:14, pl.2).
127	Payne mine	Slightly west of the center of the NW¼ sec. 19, T11S, R2E, SBM; Mesa Grande district, 3¼ miles northwest of Mesa Grande, on the west slope of Gem Hill.	William O. Payne, Balboa (1950)	A pegmatite dike 1½ to 3 ft. thick is exposed along the face of a cut. Well crystallized smoky quartz and a little green and pink tourmaline were recovered in the early 1900's from small, very irregular cavities in the euhedral perthite pegmatite core of the dike. Associated minerals are cleavelandite, muscovite, and lepidolite.	Opened in 1905 and worked from 1905 to 1907 by Albert Johnson and Frank Trask. Developed chiefly by a cut 30 ft. long and 20 ft. wide. (R. H. Jahns, California Institute of Technology, personal communication, 1957)
	Pluto prospect	Pala district, Hiriart Mt.		A prospect in the northwestern part of the White King dike.	On the northern limit of the Anita clai and probably covered by this claim. No additional published information. (Jahns and Wright 51:14, pl.2).
	Poison Oak prospect	Pala district, Chief Mt.		A prospect in the Ocean View dike.	On western border of Ocean View claim. No additional published information. See Ocean View claim. (Jahns and Wright 51:14, pl.2).
128	Prospect prospect	W½NW¼SW¼ sec. 5, T13S, R2E, SBM; Ramona district, about 4 miles east-northeast of Ramona, and 200 ft. east of State Highway 78.	Henry Taylor, Julian road, Ramona (1957)	A granite pegmatite dike which strikes northward, dips about 45° west, and is about 4 ft. thick. Distance that dike is exposed was not determined. Dike contains sparse spessartite, not of gem-quality, and black tourmaline crystals as long as 6 inches.	On patented ranch land. Discovered by H. A. Warnock and J. P. Sutherland of Ramona in September 1904 on property owned by Warnock (Kunz, 1905, p. 150) Prospected only, for several years thereafter. Developed by 25-ft. cut. No production. (Kunz 05:53, 150; Merrill 14:693).
	Queen Extension prospects	Pala district, Queen Mt.		A prospect on the Tourmaline Queen dike about 250 ft. south of the principal workings of the Tourmaline Queen mine.	On land covered by the Tourmaline Queen claim. See Tourmaline Queen group. No additional published information. (Jahns and Wright 51:14, pl.2).
129	Redlands King prospect	Near center of the N½N½NE¼ sec. 23, T9S, R2W, SBM; Pala district, a little more than 1-3/4 miles northeast of Pala, very low on the west side of Chief Mt.	Pala Indian Tribe, Pala (1958)	A pegmatite dike which strikes north-northwestward, dips about 25° west, and is exposed for a length of about 400-500 ft.	An abandoned claim whose site now is within the Pala Indian Reservation. Merrill (1914) stated that the claim belonged to "Mascart, of Redlands." (Jahns and Wright 51:14, pl.2; Merril 14:699).
130	Redwing (Redlands, Redwings) prospect	N½NW¼NW¼ sec. 24, T9S, R2W, SBM; Pala district, a little more than 2 miles northeast of Pala, on the east slope of Chief Mt.	Undetermined (1957)	Prospect in the south part of the Ocean View pegmatite dike.	Claim was located south of the Knickerbocker claim. Merrill (1914, p. 699) reported that the deposit was owned by B. T. Cooper, Pala, and that it had yielded aquamarine "of inferior quality." (Jahns and Wright 51:14, pl.2; Merrill 14:699).
	Redwings				See Redwing prospect. (Merrill 14:699)
	Rose Quartz mine	Mesa Grande district.			See text under "Quartz and quartzite".
	Royal [illegible]				See tabulated list under "Lithium compounds". (Merrill 14:704).

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Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
131	San Diego mine	Mesa Grande district.			See text. (R. H. Jahns, California Institute of Technology, personal communication, 1957; Kunz 05:135; Merrill 14:700-701; Tucker and Reed 39:41, pl.1).
132	San Pedro mine	N½SE¼ sec. 24, T9S, R2W, SBM; Pala district, nearly 2-1/3 miles east-northeast of Pala, on north flank of Hiriart Mt.	C. E. Reynolds, Route 4, Box 453, Escondido (1958)	In the northern part of the Vanderburg pegmatite dike where the dike strikes north-northwestward, dips moderately west, and is as much as 20 ft. thick. Gem minerals that occur in the deposit are spodumene (chiefly variety kunzite), pale-green and pink beryl, and pale yellow quartz. Additional minerals are tourmaline, lepidolite, molybdenite, bornite, and large clear crystals of potash feldspar.	The San Pedro claim is the northernmost claim on Hiriart Mountain and the northernmost claim of the old Sickler group (see claim map in text). Unpatented. Adjoins the Senpe claim which lies to the south. The present owner purchased this claim, with the Anita and Senpe claims, from George Ashley in 1948. In 1951 he mined a large pocket which yielded 300 pounds of spodumene which ranged from colorless through pale pink to pale green. The largest crystal from this pocket was 11 in. x 5½ in. x 1½ in. Developed by shallow workings. (Jahns and Wright 51:14, 15, 29, 37, 41, 42, 47, 50, pl.2; Kunz 05:86,133; Merrill 14:700; Sinkankas 57b:82, 86-87).
	Sempe				See Senpe mine. (Kunz 05:86).
	Senpa				See Senpe mine. (Merrill 14:700).
133	Senpe (Sempe, Senpa) mine	N½SE¼ sec. 24, T9S, R2W, SBM; Pala district, about 2¼ miles east-northeast of Pala, on the northwest slope of Hiriart Mt.	Joe Schurer and Herschel Black 4444 - 36th Street, San Diego 16 (1958)	In a thick pegmatite dike which strikes northward and dips 30° west. The only gem mineral known to occur in the deposit is pink beryl. Other minerals are quartz, lepidolite and tourmaline. The White Queen and Vanderburg-Katerina dike groups also cut the property.	A west-northwest trending unpatented claim bounded on the north by the San Pedro claim, on the west by the Anita claim, on the east by the Vanderburg claim, and on the south by the White Queen claim (see claim map in text). Originally part of the Sickler group, which was purchased by George Ashley in 1948. Ashley later sold the claim to C. E. Reynolds who sold it to the present owner. Claim contains El Lobo, White King, Spar Pocket, and Buttercup prospects (Jahns and Wright, 1951, pl.2). Last active mining during World War II when 2 large crystals of quartz were mined and sent to Universal Microphone Company, of Inglewood, which recovered a small amount of electronic grade quartz. Deposit also has yielded a small quantity of pink beryl. (Jahns and Wright 51:14, 15, 31, 37, 47, 49, 50, pl.2; Kunz 05:86; Merrill 14:700; Sinkankas 57b:82, 87).
	Seventeen Palms	Anza-Borrego Desert State Park, about 13 miles east of Borrego Springs.			Kunz (1905) reported a garnet occurrence "in the vicinity" of Seventeen Palms. However, this area is underlain by sedimentary rocks which would only contain minor proportions of garnet-bearing boulders. (Kunz 05:152).
	Sherry Ann prospect				A rhodonite locality. See tabulated list under "Manganese".
	Sickler group (Ashley mines, Sickler mine)	Pala district, Hiriart Mt.			The original Sickler group consisted of 7 claims which were located on Hiriart Mt. by F. M. and M. M. Sickler between 1900 and 1903. These claims were the Center Drive, El Molino, Fargo, Hiriart, K.C. Naylor, Vanderburg, and White Queen. The Katrina(Katerina) claim was located about the same time by M. M. Sickler and Bernardo Hiriart. The Anita, San Pedro and Senpe claims also were located at that time by Hiriart. These 11 claims covered nearly all of Hiriart Mt. Later the Center Drive claim was abandoned and the other 10 claims became known as the Sickler group. The group was purchased by George Ashley from F. M. Sickler during 1947-1948. By 1958 Ashley had sold all but the K.C. Naylor, Hiriart, and Vanderburg claims. For descriptions of the 11 claims see individual names in this list. (Jahns and Wright 51:8; Kunz 05:86; Merrill 14:700; Sinkankas 57b:82; Tucker 25:363; Tucker and Reed 39:41, pl.1).

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Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Sickler mine				See Sickler group. (Tucker 25:363).
	Snake Den prospects	Pala district, Hiriart Mt.		A prospect in a pegmatite dike which is exposed between the Anita and Senpe dikes.	This deposit probably is covered by the Senpe or White Queen claims. No additional published information. (Jahns and Wright 51:14, pl.2).
	Snipe prospect	Pala district, Chief Mt.		A prospect in an isolated pegmatite dike mass.	Within the eastern part of the Ocean View claim. No additional published information. (Jahns and Wright 51:14, pl.2).
134	Sonny Boy claim	Ramona district.			A 600-ft. square claim that was located in the early 1900's, east of the Hercules claim, in the center of the E½E½ sec. 8, T13S, R2E, SBM. It is no longer valid. In 1939 Tucker and Reed reported that Edward Richmond, San Diego, owned the Sonny Boy mine, which was developed by a 50-ft. adit. No evidence of this was found by the present writer. However, one of the workings on the adjacent Hercules claim is a 50-ft. adit. (Tucker and Reed 39:41-42, pl.1).
	Spar Cut prospect	Pala district, Hiriart Mt.		A prospect in the Anita dike.	Within the limits of the Anita claim, and about 250 ft. southwest of the Anita workings. No additional published information. (Jahns and Wright 51:14, pl.2).
	Spar Pocket mine			Prospect on a branch of the Vanderburg pegmatite dike. Has been a source of beryl and quartz.	Within the northeastern part of the Senpe claim, which see. No additional published information. (Jahns and Wright 51:14, pl.2).
135	Stewart Extension prospect	N½NE¼SW¼ sec. 23, T9S, R2W, SBM; Pala district, 1¼ miles north-northeast of Pala, low on the southeastern slope of Queen Mt.	Undetermined (1957)	A prospect in a pegmatite dike which strikes north, dips 25° west, and is exposed for several hundred ft. south of the Stewart mine.	Abandoned, on patented non-mining land. No additional published information. (Jahns and Wright 51:14, pl.2).
	Stewart mine	Pala District, Queen Mt.			Once a source of lepidolite. Also contains pink tourmaline. See text under "Lithium". (Jahns 51:14, 35, 36, 37, 48, 59-61, pl.2; Kunz 05:100, 124-125; Merrill 14:694, 696, 697).
	Sunrise claim	Ramona district.		A pegmatite deposit in which was found one or two fine aquamarine crystals in the early 1900's (L. B. Spaulding, personal communication, 1957).	A northwest-trending claim that was located in 1903 by a Mr. Batchellor of Ramona in the NW¼SE¼ sec. 8 and the E½NE¼SW¼ sec. 8, T13S, R2E, SBM. It adjoined the Cable claim which lay to the northwest. Long idle until 1947 when most of the property was relocated as the Black Panther claim, which see. (Merrill 14:702).
136	Surprise mine	Ramona district.			See text. (Kunz 05:46-47, 49, 146-147; Merrill 14:692, 693, 702; Sinkankas 57a:367, 368; Tucker 25:363).
	Tizmo prospect	Pala district, Hiriart Mt.		A prospect, in the El Molino pegmatite dike, which is about 500 ft. north of the workings of the El Molino mine.	See El Molino mine. (Jahns and Wright 51:15, pl.2).
137	Tourmaline King (Wilke, Schuyler) mine	Pala district, Queen Mt.			See text. (Jahns and Wright 51:7, 8, 14, 15, 16, 25, 31, 35, 38, 46, 47, 48, 50, 52, 55-56, 63; Kunz 05:129; Merrill 14:697; Tucker 25:363; Tucker and Reed 39:42, pl.1).
	Tourmaline Queen group	E½SE¼ sec. 15 and S½SW¼ sec. 14, T9S, R2W, SBM; Pala district, on Queen Mt.	Mrs. Margaret S. Moore, and Mrs. Mildred S. Wear, Star Route, Pauma Valley; managed by F. D. Fitzsimmons, Pauma Valley (1960)		Consists of 6 claims. Of these, the Tourmaline Queen, Tourmaline Queen No. 2, and Tourmaline Queen No. 3 claims enclose the Tourmaline Queen mine which is described in the text. The other 3 claims - the Frank A. Salmons, Homestake, and Pala King, are described individually in this list. Located in the early 1900's. Tourmaline Queen and No. 3 claims were patented in 1956. (Jahns and

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Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Tourmaline Queen group (continued)				Wright 51:14, 52, 56-57, pl.2, pl.3; Kunz 05:127-129; Merrill 14:697; Tucker 25:363; Tucker and Reed 39:42, pl.1).
38	Tourmaline Queen mine				See text. (Jahns and Wright 51:14, 52, 56-57, pl.2, pl.3; Kunz 05:127-129; Merrill 14:697; Tucker 25:363; Tucker and Reed 39:42, pl.1).
	Tourmaline Queen No. 2 claim				Part of the Tourmaline Queen group, which see. (Tucker and Reed 39:pl.1).
39	Trail mine	Near the center of the W½SW¼ sec. 18, T11S, R2E, SBM; Mesa Grande district, about 4 miles northwest of Mesa Grande.	Undetermined (1957)	A pegmatite dike which strikes eastward and dips 35°-50° south. Thickness ranges from 4 to 13 ft. Small cavities in the core of the dike are lined with small crystals of quartz, albite, schorl, dark blue to dark green tourmaline, muscovite, lepidolite, and beryl.	Adjacent to the south border of the Esmeralda claim. Opened by William Rorack in 1903; source of a small amount of colorless to moderately deep-pink beryl and some dark tourmaline. Developed by open cut 60 ft. long and 6 to 20 ft. wide. Long idle. (R. H. Jahns, California Institute of Technology, personal communication, 1957).
40	Trask mine	Just south of the center of the SE¼SW¼ sec. 17, T11S, R2E, SBM; Mesa Grande district, about 2-3/4 miles northwest of Mesa Grande, high on the east side of Gem Hill. (see photograph of part of Mesa Grande district in text)	Undetermined (1957)	A southerly extension of the north-trending Himalaya pegmatite dike. Here the dike dips about 35° west and ranges in thickness from 16 to 25 in. Pocket pegmatite is widepread in the central part of the dike which is composed mainly of coarse-grained quartz-euhedral perthite pegmatite. The pocket pegmatite forms thin, lenticular masses.	Active from 1909 to 1912, then property merged with San Diego mine. Yielded "nodules" and pencils of tourmaline, many of which showed distinct color variation. Developed chiefly by an incline which is about 100 ft. long and from which stopes were worked northward and southward. (R. H. Jahns, California Institute of Technology, personal communication, 1957).
	Unnamed	"9 to 10 miles northeast of Jacumba" (Merrill, 1914, p. 693).		Kunz (1905) and Merrill (1914) reported that garnet variety essonite was found in limestone at several localities in this area.	Early in the century Kunz (1905) reported that the deposits were being worked by the San Diego Gem Company. These deposits are believed to be in Imperial County, as no garnet-bearing limestone could be found by the writer in this area in San Diego County. (Kunz 05:150-151; Merrill 14:693, 703).
41	Unnamed	Center of the E½E½ sec. 33, T16S, R8E, SBM; in Anza-Borrego Desert State Park, about one mile southwest of Dos Cabezas siding.		A small, undeveloped pendant of tactite in granitic rocks. The tactite is composed of epidote, wollastonite, and crystals of grossularite as large as 1 inch on a face.	Undeveloped.
	Unnamed	Northeast corner of sec. 20, T16S, R8E, SBM; a little more than 2½ miles northwest of Dos Cabezas siding of the San Diego and Arizona Eastern railroad, and about ¼ mile north of the railroad tracks.	Undetermined (1960)	Grossularite garnet occurs in a pendant of crystalline limestone.	(Roy Kepner, San Diego Div. Nat. Res., personal communication, 1960).
	Upper Blanket prospects				See Blanket prospects. (Jahns and Wright 51:14, pl.2).
	Upper Katerina prospect			In a pegmatite dike which also contains the Center Drive prospect.	In the north-central part of the Katerina claim. See Katerina mine in text. No additional published information. (Jahns and Wright 51:14, pl.2).
	Upper Salmons View prospect	Pala district, Chief Mt.		A prospect in a thin pegmatite dike which is exposed south of the Pala Chief dike.	In the western part of the Pala Chief claim. See Pala Chief group. (Jahns and Wright 51:14, pl.2).

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Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
142	Vanderburg (Naylor-Vanderburg) mine	SE¼ sec. 24, T9S, R2W, SBM; Pala district, about 2-1/3 miles east-northeast of Pala, on crest of southern part of Hiriart Mt.	George Ashley, Pala (1957)	The Vanderburg workings are in about the center of the Vanderburg dike, which strikes northward and dips about 40° west. The dike is exposed along the crest of Hiriart Mt. for more than 3000 ft. The deposit has been a source of spodumene, beryl, quartz, and tourmaline.	A north-northeast trending unpatented claim which is bordered on the west by the White Queen and Senpe claims, and on the south by the Hiriart claim. (see claim map in text). Located in February 1903 as one of the claims of the original Sickler group, which also see. Developed by open cuts and inextensive underground workings. Kunz (1905) reported that "about 5 pounds of kunzite has been mined." In 1949 the present owner mined about 2,000 pounds of quartz crystals, half of which were smoky and half colorless. One crystal was greater than 100 pounds. In 1952 he discovered a pocket in the dike from which he removed about 130 pounds of beautiful gem quality spodumene which ranged in color from pink, through green, to blue. See also under "Orbicular gabbro". (Jahns and Wright 51:8, 29, 37, 50, pl.2; Kunz 05:86, 129-132; Merrill 14:700; Sinkankas 57b:83-86).
143	Verdant View (Anita) prospect	Near center of the W½W½NW¼ sec. 24, T9S, R2W, SBM; Pala district, about 2 miles northeast of Pala, near the crest of the southern part of Chief Mt.	Pala Indian Tribe, Pala (1958)	In the extreme south end of the Pala Chief dike.	Abandoned. Nearly on boundary between Pala Indian Reservation and public domain. No additional published information. (Jahns and Wright 51:14 pl.2).
144	Victor (Big Buck) mine	SE¼NW¼ sec. 36, T10S, R1W, SBM; Rincon district, about 2 miles south-southeast of Rincon, on Mack ridge.	Jesse J. Cain, Los Molinos (1958)	Deposit consists of a granite pegmatite dike that is exposed only in the workings. The dike strikes about N.10°W. and dips about 55° southwest. Its exposed strike-length is 84 ft. and its dip-length is at least 35 ft. The maximum exposed thickness before mining was 12 ft., and now is about 8 ft. The gem-bearing unit, cleavelandite-lepidolite-pegmatite, is exposed as 5 small isolated patches, the largest of which is 4 ft. long, 3 ft. wide, and not more than 6 in. thick. This unit may have occurred as pods or as a continuous layer beneath the quartz-perthite core of the dike. The exact yield of gems from the deposit is not known; however, the following minerals do occur or have been found: green and red tourmaline, garnet, and beryl. In addition, Rogers (1910) reported the occurrences of kunzite, bismite, bismuth, spinel variety pleonaste, cookeite, amblygonite, and other minerals. (summarized from Hanley, 1951, p. 18-20).	On patented ranch land. This deposit probably was discovered and developed very early in the 1900's by J. M. Mack who also developed the Mack mine. Hanley(1951) stated that a Mr. Eric Hindorf probably mined the deposit as the "Big Buck" mine sometime after Mack's activity, and obtained a small quantity of gems. The mine was developed by (1) an open cut about 60 ft. long, 45 ft. wide, and 25 ft. in maximum depth; and (2) a series of underground workings whose total length is about 30 ft., which were driven from the cut to explore the pegmatite. The workings and dumps now are largely grown over with chapparal. Hanley (1951) reported that the deposit is mined out. (Fischer 43:125; Hanley 51:18-20, fig. 4, pl.1; Rogers 10:202-218; Tucker and Reed 39:54, pl.1).
145	Vista Chief (Moosa Canyon) deposit	NW¼ sec. 26 and NE¼ sec. 27, T10S, R3W, SBM; nearly 3 miles east of Bonsall, on the north side of Moosa Canyon, and on the southwest slope of Mt. Ararat.	Guy C. Earl ranch, P.O. Box 1, Bonsall (1957)	A prominent pegmatite dike, which is enclosed in granitic rocks, strikes N. 45° W., dips 65° southwest. It extends southeast from the NE¼NE¼ sec. 26 into the E½ sec. 26 for several thousand feet. The upper part of the dike is composed of graphic granite, the lower part of line rock. Only the common pegmatite minerals were noted in the dike by the writer. An occurrence of axinite in the Moosa Canyon area was described by Schaller (1911a). He reported that the axinite occurs as crystals which are smoky colored, and range in size from minute to nearly 5 cm. They are associated with "quartz, epidote, and a little laumontite in a much decomposed granite, and its true mode of occurrence is not determined, for all the rock in the vicinity is greatly altered."	Colored tourmaline, kunzite, quartz crystals, and topaz were reported by Kunz (1905) to have been found near Moosa Falls, in sec. 26. The reported discoverers were Thomas Freeman and Joe Meyers, of Oceanside, who located the Vista Chief and Mountain Belle claims in the area in 1904 or 1905. Later information was reported by Merrill (1914) to place the discovery in the E½ sec. 27. The present writer could not find any workings or signs of gem minerals in the dike that cuts the area. As the reported deposits were not examined personally and described by any of the early investigators, and have not been described since that time, it is surmised that the gem minerals shown to Kunz were from the Pala area. The axinite locality, which was shown to Dr. Schaller by Freeman, is assumed to be in the Mt. Ararat-Moosa Falls area also, although it could not be located by the present writer. (Kunz 05:62; Merrill 14:702; Schaller 11a:37-41).

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Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Ware mine				See Emeralite No. 2 mine.
146	West Canyon (Freak) prospect	SE¼SW¼ sec. 15, T9S, R2W, SBM; Pala district, about 1-2/3 miles north of Pala, on the west ridge of Queen Mt.	Undetermined (1957)	In a north-striking pegmatite dike less than 500 ft. long.	Probably abandoned. No additional published information. (Jahns and Wright 51:14, pl.2).
147	West Knickerbocker prospect	N½NE¼NE¼ sec. 23, T9S, R2W, SBM; Pala district, 2 miles northeast of Pala, high on the western slope of Chief Mt.	Pala Indian Tribe, Pala (1958)	In the West Chief dike.	An abandoned prospect south of the Pala Chief claim. On Pala Indian Reservation. No additional published information. (Jahns and Wright 51: 14, pl.2).
148	White Cloud (Buster Brown) mine	Near center of the S½S½SE¼ sec. 15, T9S, R2W, SBM; Pala district, a little more than 1½ miles north of Pala, high on the south slope of Queen Mt.	Undetermined (1957)	In a north-striking pegmatite dike which crops out very high along the east and west flanks of Queen Mt. The pegmatite dips about 25° west. Principal output from the mine was tourmaline and quartz. Sparse lithiophilite and triphylite also occur.	Long idle. Merrill (1914, p. 697) reported that the mine was owned by John Reed, Fallbrook, and Adolph Shoulders, Pala. The workings probably are just west of the western boundary of the southernmost claim in the Tourmaline Queen group. The Ed Fletcher, Jr. claim lies to the north. (Jahns and Wright 51:14, 17, 25, 27, 40, pl.2; Merrill 14:697).
	White King prospect	Pala district, Hiriart Mt.			An abandoned prospect within the Senpe claim, which see. (Jahns and Wright 51:14, pl.2).
149	White Queen prospect	Center of the W½ SE¼ sec. 24, T9S, R2W, SBM; Pala district, about 2¼ miles east-northeast of Pala, high on the west slope of Hiriart Mt.	Norman E. Dawson, Route 1, Box 921, San Marcos (1959)	A prospect in the pegmatite dike in which was discovered the pink variety of spodumene later to be named kunzite. Also source of a small quantity of beryl and quartz.	One of claims that constituted the original Sickler group. Unpatented. Purchased by owner with Fargo and El Molino claims from George Ashley in 1948. No recent activity. Bounded on north by Senpe claim, on west by Anita claim, and on east by Vanderburg claim. See also Sickler group. No additional published information. (Jahns and Wright 51:8, 14, pl.2; Merrill 14: 700).

"Within the pocket-bearing parts of the dike, some of the coarser crystals of green muscovite are rimmed by pink to lilac lepidolite. Such muscovite also contains abundant inclusions of clear green tourmaline. Some crystals of schorl above the pocket horizon extend downward into this unit, and most of them grade along their lengths into green, and some into pink tourmaline.

"The principal mine openings comprise two bench-like cuts along the trace of the pegmatite and extensive underground workings that were driven from the north, or upper cut. These workings consist of inclines, irregular drifts, and numerous low rooms, many of which are interconnected. In general they occupy an area 150 feet long, as measured along the strike of the pegmatite, and 80 to 100 feet wide. Not all are accessible as some of them have been backfilled and others are blocked by caved ground. In particular, the main adit or incline is completely filled at its portal by large blocks that have slumped from the face of the open cut. At least one incline or irregular sloping room extends down the dip of the dike from the southern, or smaller cut, but it is no longer accessible. It appears to have been filled in part by caved material and in part by debris washed in during periods of heavy rain.

"The main, or upper cut is about 130 feet long, 40 to 50 feet wide, and nearly 40 feet in maximum depth.

"It seems likely that additional pocket-bearing ground is present in the pegmatite, not only in unmined areas that are surrounded by existing workings, but in parts of the dike down dip from the limits of the present underground workings. The gem-bearing part of the dike appears to extend almost directly down the dip, with possibly a slight component to the south. Most of the pockets appear to have been concentrated along the terracelike features in the pegmatite, and if additional flattenings of dip are encountered, the possibilities for further substantial returns of gem material appear to be fairly good. The pegmatite exposed in the south cut probably does not warrant much attention, as it is reported to become barren down the dip and to pinch out locally."

GOLD

Gold was first mined formally in San Diego County in 1870, and from that year until the early part of the twentieth century it constituted one of the principal mineral commodities of the county. During the 1930's and early 1940's gold mining was renewed, first because of the depression, and secondly because of the increase in the price of gold from $20.67 to $35 per ounce. However, the scale of mining during this period was much smaller than before. The total recorded value of gold produced in the county is estimated by the writer to be about 5½ to 6 million dollars. Of this output only about $150,000 worth has been mined since the early 1900's.

The principal source of gold in the county has been the Julian district, which is slightly northeast of the center of the county. The district was active from 1870 to 1876, from the late 1880's to the early 1900's, and, on

a very small scale during the 1930's. The value of the total production for the district is estimated to be about $5 million. The district lies near the northwest end of a northwest-trending belt of schist and hybrid rocks which is about 20 miles long and one to six miles wide. The Stonewall Mine, which has the largest gold production of any mine in the county, lies a few miles to the south of the district. To the south-southeast of the Stonewall Mine, and in the same belt of schist and hybrid rocks, are the gold mines of the Laguna Mountains region and the Deer Park district (see descriptions below). The output of gold from these mines, however, is only slightly more than $50,000.

Gold mines of the Escondido area rank third behind the Julian district and the Stonewall Mine as a source of gold in San Diego County. The total value of output of gold from these mines, however, is only about $150,000. Additional districts that have yielded very small to small amounts of gold are the Boulder Creek, Dulzura, and Montezuma districts, and the area south of Pine Valley. Small quantities of placer gold were once obtained from the Ballena area, southeast of Ramona.

About 225 deposits, from which gold has been sought, are described in the text and tabulated list of this report. Of these only one has yielded more than $1,000,000 worth of gold. This is the Stonewall, whose total production is estimated at about $2,000,000. Production from six deposits is estimated to be between $100,000 and $1,000,000. Five of these deposits are in the Julian district, and include the Ready Relief Group ($750,000 to $800,000), Golden Chariot Mine ($600,000 to $700,000) Helvetia Mine ($500,000 to $600,000), Owens Mine (estimated $400,000 to $500,000), and Golden Gem Group (estimated $200,000). Production from the Cleveland-Pacific Mine, near Escondido, is estimated to be about $100,000 in gold and silver. Production of gold from 16 additional deposits is estimated to be between $25,000 and $100,000, and from 35 deposits between 0 and $25,000.

Most of the gold deposits in the county have been worked from rather shallow underground workings. The deepest workings were those of the Stonewall Mine whose main shaft was slightly more than 600 feet deep. The ore obtained from most of the mines was processed mainly in stamp mills, of 1 to 30 stamps capacity, which were on the mine properties. Arrastres were used at some of the very small operations.

District Summaries

Julian District. The Julian district is in east-central San Diego County, about 40 airline miles northeast of San Diego, and in the central part of the Peninsular Range province. The town of Julian is on a gently rolling upland, known as Julian Mesa, which ranges in elevation from 4,200 to 4,500 feet (Photo 20). The mines of the Julian district have been worked principally for gold. Most of them lie in an irregular and discontinuous belt which is about six miles long and extends southeasterly from a locality one-half mile northwest of Julian along the western slope of Banner Canyon and into Chariot Canyon (see map, Pl. 7). The Banner Canyon-Chari Canyon area formerly was designated separately as tl Banner district. The Stonewall Mine, which is about thr miles south of the southernmost limit of the accompan ing map, is discussed here because its history and geolog setting are similar to those of the mines of Julian distri proper.

The annual precipitation on Julian Mesa averages abo 30-35 inches and the slopes are forested with conifer oak, and poplar. The flatter areas of the mesa are largel grassland. East of Julian Mesa, on the western slopes c Banner and Chariot Canyons, precipitation is lower, an the forest of the mesa gives way to a dense growth c scrub oak and manzanita. This in turn grades into th sparse desert cover of sage, yucca, and other plants o the lower canyon slopes. The lowest elevation in the are mapped is 2,750 feet—at Banner. Temperatures range fro below 32° F. in the winter to the 90's F. in summe Snow is not uncommon at Julian during winter.

The most complete description of the geological fea tures of the Julian district has been provided by Donnell (1934). Additional geological data have been furnishe by Creasey (1946), Hudson (1922), and Merriam (1959) Mine descriptions have been provided by: Hanks (1886) Goodyear (1888, 1890), Preston (1890), Storms (1893) Crawford (1894, 1896), Hubon (1902), Merrill (1914) Tucker (1921b, 1925), Tucker and Reed (1939), an Stewart (1959).

HISTORICAL SKETCH. In November 1869, Mike an Webb Julian, and James and Drury Bailey—ex-Confed erate soldiers who were driven from the South by th economic collapse that followed the Civil War—dis covered placer gold near Julian and subsequently or ganized the Julian mining district. On February 20, 1870 the first lode gold was discovered, north of Julian, and or February 22 the George Washington and Van Wir Claims were located; by August, 54 others, including th Owens, Eagle and High Peak, were located. In March the Stonewall Deposit was discovered south of the district. In August 1870, gold was discovered in Chariot Canyon and subsequently the Ready Relief, Madden and other claims were located in the area, and the Banner district was formed. In February 1871, the Golden Chariot deposits were discovered in Chariot Canyon. From 1870 to 1875 the Julian and Banner districts boomed. The Golden Chariot, Ready Relief, Helvetia, Owens, and many other mines were active and yielded gold with a total value estimated at between $1,000,000 and $2,000,000. By 1876, however, the easily recovered ore had been mined; interest waned, and the mines lay nearly dormant for the next decade. In 1881, the Julian, Banner, and several lesser districts were combined and since have been known collectively as the Julian district.

In 1886, Robert W. Waterman, Governor of California from 1887 to 1891, purchased the Stonewall Mine south of the Julian district, and from 1888 to 1891, this mine yielded gold valued at nearly $1,000,000. In 1888, the Gold King and Gold Queen Deposits were discovered 4

iles south of Julian (Photo 38). The success of the tonewall Mine and the discovery of the latter two deosits rejuvenated general interest in the Julian district. 1 1887, the Helvetia Mine was reopened; during the eriod 1889-1890 the Owens Shaft was dewatered and eepened; and in 1889 the Golden Gem Deposits were repened. In addition, several of the mines that had been ctive on a small scale during the 1880's were worked on larger scale during the 1890's. These included the Ready Relief and Eagle Mines. In 1895 the Ranchito and Clevada-and-Aquajito Deposits were discovered and put nto production. These were the last significant disoveries in the district. Also late in the 19th cenury, tailings dumps of several old mines were treated in yanide plants for gold not recovered by former less efcient recovery methods. This later period of relative rosperity lasted through the 1890's and into the early 900's. However, by 1910 the district was inactive again. lining since that time has been limited mainly to unsucessful redevelopment of old mines. During the late 920's and 1930's, several deposits may have been worked rofitably for short to moderate periods. These include he Eagle, High Peak, Madden, Ranchito and Ready Ref Deposits. The status of claims in the district, as of 957, is shown on Plate 9.

Production. As production statistics were not comiled officially prior to 1880, the total value of gold proiced in the district cannot be reported accurately. This alue was estimated at $7,500,000 by the *Julian Sentinel* 1 1880, and as "between $4,000,000 and $5,000,000" by Donnelly (1934, p. 352). A total of about $5,000,000 is stimated by the writer who employed: (1) production igures of the U.S. Bureau of Mines, collected from San Diego County producers since 1890; (2) an interpretation f the extent and nature of workings; and (3) an evaluaion of previously published figures (chiefly those of Donnelly, 1934, p. 352-353).

Photo 38. Gold King mill, Julion district, about 1900. View probably outhwest. Gold King and Gold Queen deposits are believed to be to northvest, or right, of oreo photogrophed. *From Union Title Insurance and rust Company Historical Collection, courtesy Mrs. Ida Wellington, San Diego.*

Geologic Setting. The gold-bearing deposits of the Julian district occur mainly in an elongate, northwest-trending body of Julian schist which is Cretaceous, or older in age (see Pl. 7). This body tapers downward steeply, is about 1½ miles in maximum width, and is bordered on the east and west by hybrid and younger intrusive rocks (Photo 20). The central one-fourth to one-third of the body consists mostly of mildly metamorphosed, thinly bedded siltstone in alternating buff and medium-gray strata. Lenses and beds of mildly metamorphosed, light-gray sandstone that range in thickness from a fraction of an inch to several feet are irregularly distributed in the siltstone. These rocks strike northwestward and dip generally from 70° to 80° northeast. An indistinct grading observed by the writer in the Chieftain Mine indicates that the section probably is upright (Fig. 24). The meta-siltstone locally contains irregularly distributed knots of biotite and quartz, as well as certain strata that are especially biotite-rich. The outer portions of the body consist of interlayered medium- to dark-gray quartz-mica schist and dark-gray quartzite. In the southwest part of the area mapped the unit is gneissose. Foliation generally is parallel to the bedding.

Intermediate to basic plutonic rocks of probable Cretaceous age border the Julian schist on the east and west. These have been subdivided into three mappable units: Stonewall quartz diorite (Hudson, 1922), San Marcos gabbro (Miller, 1937), and Bonsall tonalite (Hurlbut, 1935). The Stonewall quartz diorite is the oldest and most widespread of the three units. In its surface exposures the rock is medium-gray, medium-grained and generally moderately weathered. It commonly contains inclusions of Julian schist, and this association of schist and plutonic rocks has been termed "mixed" rocks (Miller, 1935; Everhardt, 1951) or hybrid rocks (Jahns, 1954b). San Marcos gabbro and Bonsall tonalite are exposed in the southern part of the area mapped. The gabbro is a dark greenish-gray, fresh-appearing rock which contains abundant schorl-rich pegmatite dikes.

Granite pegmatite dikes and other intrusive bodies are common but not abundant in the Julian schist, and abundant in the Bonsall tonalite.

The northwest-trending Elsinore Fault Zone cuts the eastern part of the area mapped, in Banner and Rodriguez Canyons (Photos 9, 20, 21). In the southeastern part of the area, horizontal separation of the contact between Stonewall quartz diorite and Bonsall tonalite along this fault suggests an apparent right lateral movement of about 2,000 feet. Strike faults, including bedding plane faults, within the Julian schist may be more common than is indicated by mapping, but are difficult to detect.

Gold-bearing Deposits. The gold-bearing quartz of the Julian district occurs in northwest-trending, nearly *en echelon* shear zones as: (1) lenses, (2) lenticular veins, and (3) elongate veins. These bodies generally range from lenticular veinlets less than one-eighth inch in width to bodies four or five feet in width and as much as several hundred feet long. The maximum known width of

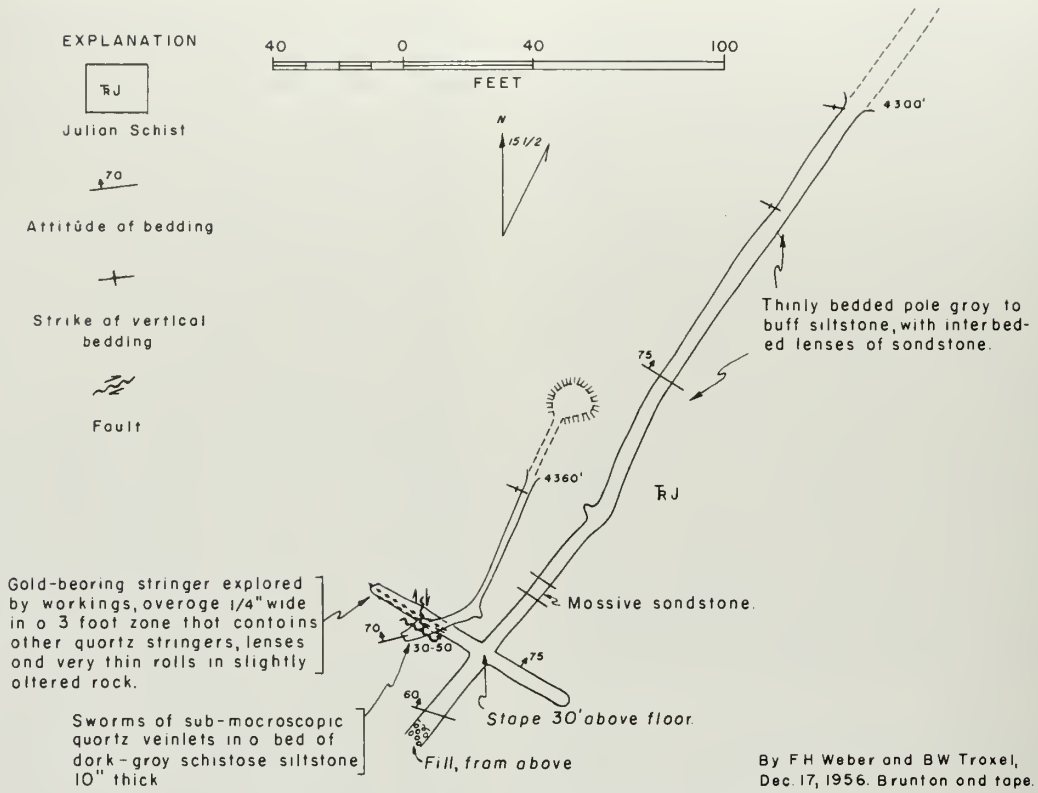


Figure 24. Geologic map of Chieftain mine, Julian district.

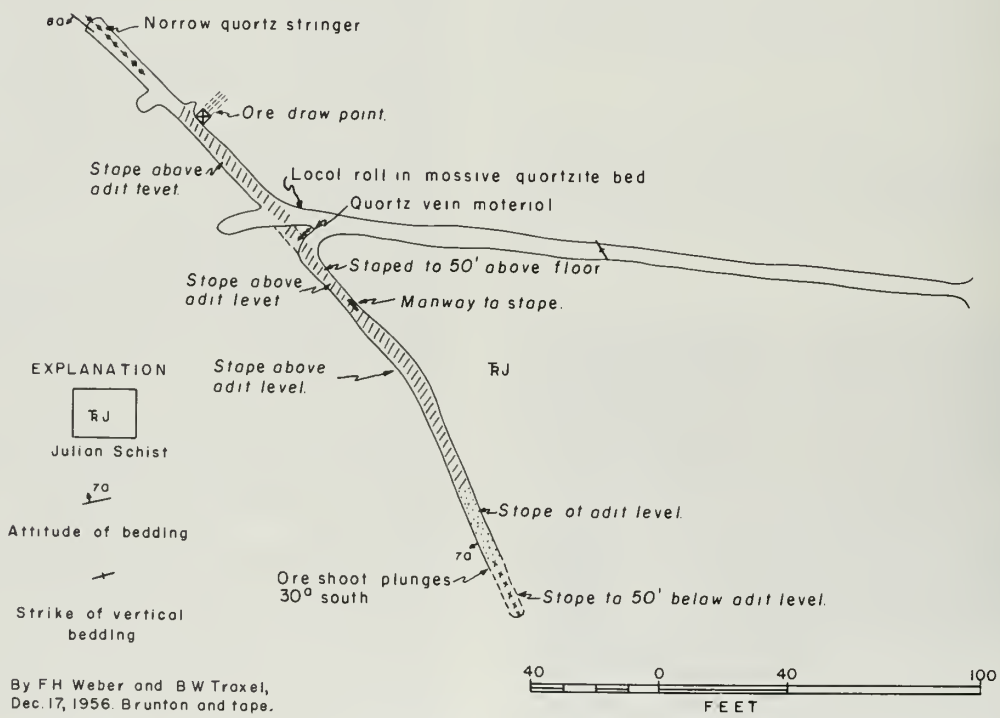
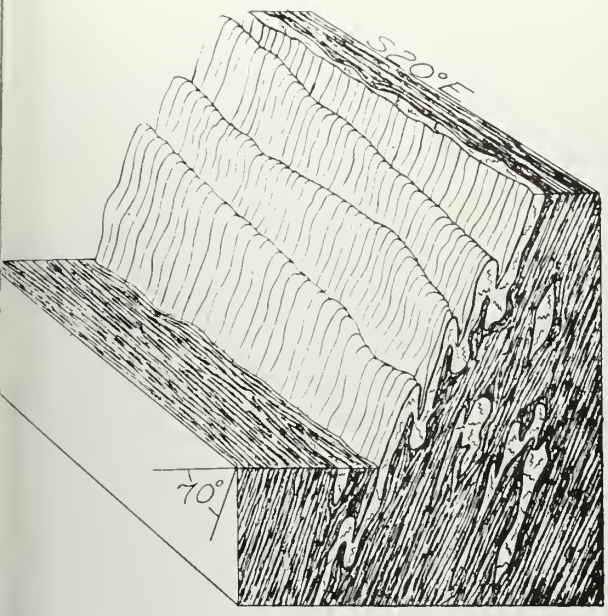


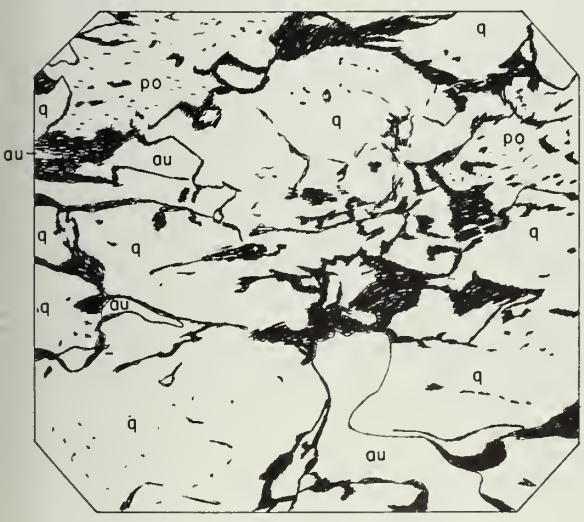
Figure 25. Geologic map of Hidden Treasure mine, Julian district.



igure 26. Idealized diagram of rall structure af quartz-bearing veins Julian district. General dips af rall structures are abaut 60° NE., and s af ralls plunge narthwest, taward the face af the diagram. Drawing ot ta scale. *After Dannelly 1934.*

ore body was 20 feet (in the Stonewall Mine). The ear zones and associated quartz bodies are essentially rallel to the bedding of the Julian schist, and thus dip eply and generally to the northeast. As the workings most of the mines are now inaccessible, only a few of e ore shoots were observed by the writer. Published scriptions of the mines indicate that most of the shoots ere quite irregular in strike length, although the rich

igure 27. Pyrrhatite (pa) and gald (au) in banded quartz (q). Gald urs as stringers and blebs, usually parallel ar at high angles with the nding, which is parallel ta the battam af the sketch. Galden Chariat e, magnificatian 20 diam. *After Dannelly 1934.*



shoot worked in the Stonewall Mine plunged steeply southeast (Fig. 37) and the shoot worked in the Hidden Treasure Deposit plunged 30° southeast, in the plane of the vein (Fig. 25). The maximum known vertical range of ore bodies in the district is 600 feet, as the Stonewall orebody was worked to that depth. Donnelly (1934, p. 364) concluded that gold-bearing quartz persists to a "considerable depth" because the difference in elevation between the highest and lowest surface points in the gold-bearing belt is about 1,800 feet, and because there is "no change in the general character of the ore" between the highest and lowest deposits.

Some of the vein material, which filled zones in schist contorted by transverse fracturing and drag folding, occurs as "rolls" (Fig. 26). These have formed mineable zones as wide as 20 feet. Dilated and *boudinage* (pull-apart) veins also occur. Some very narrow quartz veinlets proved rich in gold and, conversely, most veins several feet wide proved low-grade or barren. The Eagle and High Peak Mines were mapped by the writer to show a vein system typical of the Julian district (Pl. 8).

The ore of the Julian district is generally free-milling; auriferous pyrite, pyrrhotite, and arsenopyrite are common, but not abundant. Donnelly (1934, p. 360) noted that a gold telluride, probably petzite also occurred, but in very minor proportions. Silver was produced from several deposits after 1900 as a byproduct. The ore probably ranged in grade from less than $5 (¼ ounce, at $20 per ounce) to about $300 (15 ounces) in gold per ton, and probably averaged between $5 (¼ ounce) and $30 (1½ ounces). Biotite and sericite are common alteration minerals adjacent to quartz bodies in Julian schist.

All but three of the deposits that have been productive are in Julian schist. The exceptions are the Ranchito and Elevada-and-Aguajito deposits which are in hybrid rocks, and the Gold King Deposit which is in Stonewall quartz diorite, but within a few tens of feet of a Julian schist contact.

The deposits of the Julian district were considered to be hypothermal by Donnelly (1934, p. 367) who cited as evidence ". . . the coarseness of the grain of the gangue quartz, the mineralogic composition, and the general geologic relations." By "mineralogic composition" it is assumed that Donnelly was referring principally to his observations (p. 361) of tourmaline in the Owens, Madden and North Hubbard Deposits. However, the present investigator did not observe tourmaline in vein quartz in the mines of the district; it was observed only in layers of quartzite in schist and in pegmatite dikes. As filling is the principal means of emplacement of the quartz, and wall-rock alteration is only moderate, the deposits probably are mesothermal.

Possible guides to ore in areas of known hydrothermal mineralization are: (1) concentration of yellow-brown hydrous iron oxides in wall rocks near mineralized shear zones, and (2) barren northwest-trending quartz-bearing shear zones which might lead along their strikes to gold-bearing shoots.

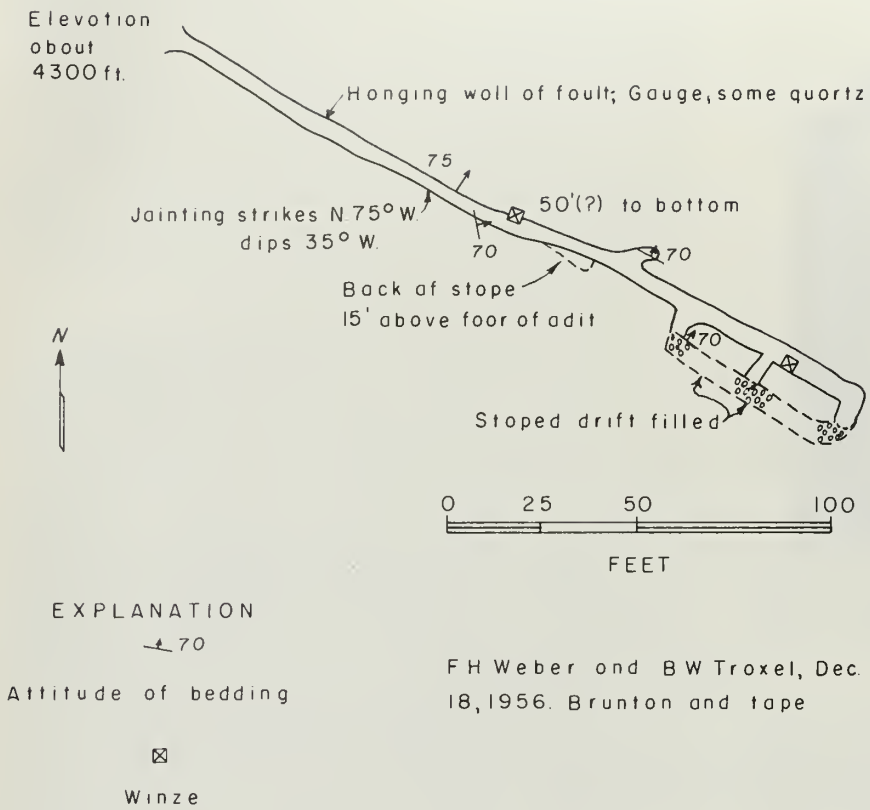


Figure 28. Geologic map of Jumper mine, Julian district.

Escondido Region. The two productive gold mines in the Escondido region—the Cleveland-Pacific and Oro Fino Mines—are on a single, northeast-trending, quartz-bearing shear zone in granitic rocks. The zone is exposed for a length of about three-quarters of a mile in an area which is about two miles southeast of Escondido city hall (Fig. 29). The geology of the zone is described below in the description of the Cleveland-Pacific Mine. The deposits may have been worked as early as 1868, or before, by Indians and early Spanish and Mexican inhabitants. The largest output from the deposits was during the 1890's and early 1900's. They have been idle since the 1920's, and the area now is covered with avocado and citrus groves. The total value of gold and silver produced from the district is about $150,000.

During the mid-1890's many additional claims were located near Escondido and prospected very briefly and unsuccessfully. These have been described only by Crawford (1896, p. 331-346) and Merrill (1914, p. 649, 651). Claims that were located at that time between three and seven miles southwest of Escondido included the Able, Crescent, Golden Crescent, Jolly Boy, Mountain Lion,

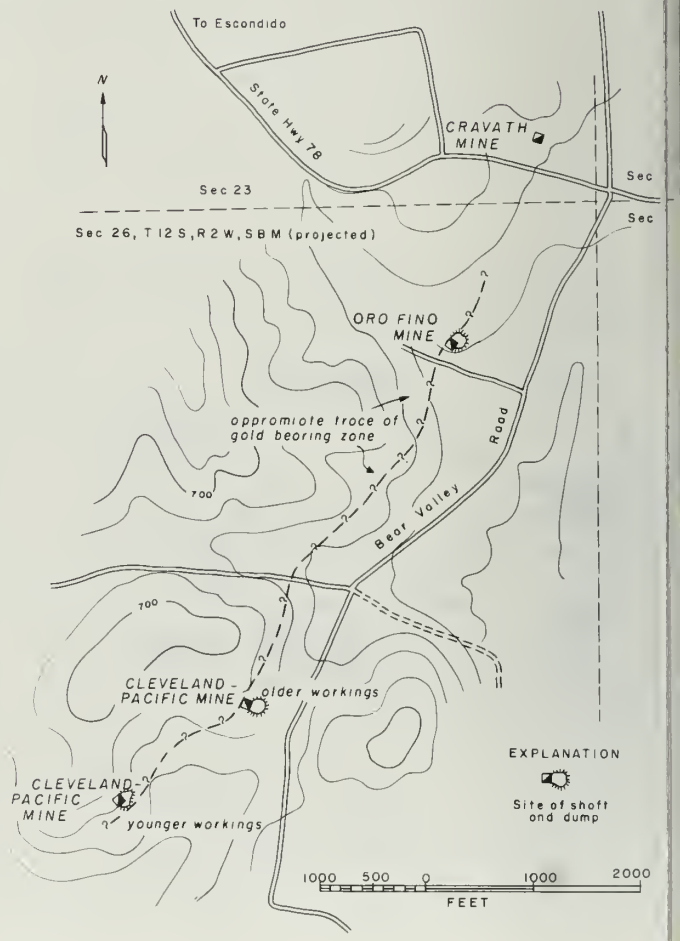


Figure 29 (right). Map showing sites of Cleveland-Pacific, Oro Fino, and Cravath gold mines, about 2 miles southeast of Escondido. Area is now largely covered over by citrus and avocado groves.

xide, and Redrock Group; those described as between ½ and six miles north, northeast, or east of Escondido cluded the Bloodstone, Bottle Peak, Geneva, La Condo, Moe, Monarch, and White Oak Claims. The Clifn property was described as nine miles southwest of condido, probably in the same area as the present Pioer and Harris Pyrophyllite Deposits.

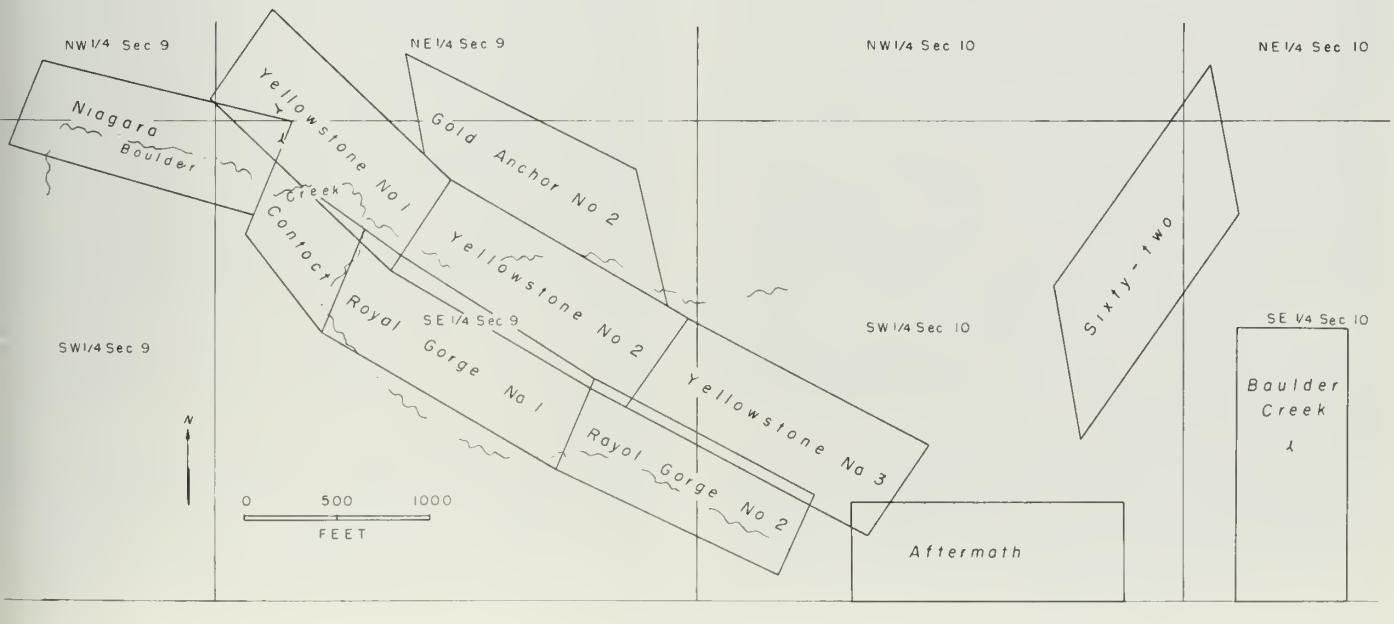
Mesa Grande District. The mines of the Mesa Grande ld mining district lie in a small area along the base of e southeast slope of Angel Mountain, about two miles rtheast of Mesa Grande. The most important of these the Shenandoah Mine; other properties are the Black gle Mine, the Mesa Grande Mine (whose location was t determined by the writer), and the Ida Mae Prospect. he deposits were discovered in the late 1880's and orked from then until about 1896, and briefly in the rly 1930's. The Shenandoah Mine yielded about $50,000 orth of gold (at $20 per ounce) and total production r the district is probably only a little more than this gure. The deposits consist of narrow, northeast-trending artz veins in schist and/or hybrid rocks which are mposed of schist and quartz diorite. Some of the ore as reported by Storms (1893, p. 382) to be "quite ch."

Area South of Pine Valley. Two productive gold eposits exist in the area that lies between two and five iles south and southeast of Pine Valley and west of uckman Springs. These are the Eagle Nest Mine and ose Quartz Group. In addition, very small amounts f gold were obtained from the Tres Amigos Mine and ong Valley placer deposits. The area was first prosected in the mid-1930's and most of the output was ained between 1939 and 1942. The value of the total roduction is estimated at a little more than $30,000 in gold (at $35 per ounce) and a small amount of silver. The deposits consist of narrow quartz veins in tonalite and in schist and gneiss inclusions in tonalite.

El Cajon District. El Cajon district encloses a small area about two miles south and southeast of El Cajon. It once contained several small operations, including the Parsons (Orange Blossom) and Phillips (Chase Ranch) Mines, and the Coe Prospect. All but the Phillips property were subdivided as residence sites by 1958. One prospect in the district was worked in 1896, but most of the activity was in the 1930's. The value of the total production from the district is estimated to be between $12,000 and $15,000 worth of gold (valued at $35 per ounce) and a small amount of silver. The deposits consist of narrow quartz veins in tonalite.

Laguna Mountains Region. A very large number of claims have been located in the region east of Cuyamaca Rancho State Park and west of the Sunrise Highway. They remain little explored, however, except at the Noble Deposit where more than $60,000 worth of gold (at $20 per ounce) was produced between 1888 and 1914 (see description below). Claims, or groups of claims, that were located mainly during the 1910's and 1920's and prospected on a very small scale, are the Abbie, Anchor, Barbara Worth, Brown, Cimarron, Ester, Frances, Golden Harp, Melba, Mercedes, Victoria and Willhite. The deposits consist of narrow northwest to north-northwest-trending, gold-bearing quartz veins. These occur in shear zones in Julian schist and in hybrid rocks composed of schist and quartz diorite. The schist and hybrid rocks constitute a north-northwest-trending belt that ranges in width from one to three miles and is a south-southwestward extension of the schist belt that embraces the Julian District (see Pl. 1).

Figure 30 (below). Map of part of Boulder Creek district: Boulder Creek gold mine comprises the eight westernmost claims. Mineral Hill group comprises Sixty-two and Boulder Creek claims.



Boulder Creek (Mineral Hill) District. The Boulder Creek district is in the central part of the county, between four and six miles west of Cuyamaca Reservoir. The principal gold-bearing deposits consist of several northwest-trending mineralized shear zones which are exposed for at least 1½ miles along the north side of Boulder Creek Canyon. The deposits lie within hybrid rocks composed of schist and quartz diorite. The Boulder Creek, Mineral Hill, and Pioneer groups, and Aftermath Claim are located along these zones (Fig. 30). Other deposits in the area consist of narrow quartz veins and veinlets in hybrid rocks. Of these, the Last Chance Mine, which is about 1½ miles north of the area described above, has yielded a small amount of gold. As the deposits in this district are of very low grade, the production is very small. Gold was discovered in the district about 1885 and the deposits worked sporadically and on a small scale from then until the 1920's.

Deer Park District. The Deer Park district covers a small and irregular area between four and six miles north-northwest of Pine Valley Lodge, in the upper part of Pine Valley. The deposits consist of narrow, north- to northwest-trending quartz veins in schist, hybrid rocks, and diorite. They have been prospected sporadically and on a very small scale for gold since the early 1900's, and for tungsten during the 1940's. The total production of gold from the district is estimated to be very small. Properties described in the accompanying tabulated list are: Expansion, Gold Standard, Lucky Baldwin, Lucky Chuck, North Star, Schley, and Telluride groups, Oak Canyon Mine, Good Luck Prospect, and Deer Park Deposit (see under "Limestone-Dolomite").

Dulzura District. The Dulzura district is in the eastern part of the San Ysidro Mountains, about two miles south to southwest of Dulzura, near the border between California and Baja California. Gold occurs in a northwest-trending mineralized fault zone, and in subordinate, parallel shear zones, in metavolcanic rocks. From southeast to northwest along this zone are the Donahoe Mine, Doolittle Group, and Johnston's Mine.

Placer gold was discovered near Dulzura in 1877 by a Mexican boy (McCain, 1955, p. 18-19), but nearby lode deposits were not worked until the 1890's. The Donahoe Mine was worked sporadically and on a small scale from about 1890 to 1915; the Johnston's Mine was worked briefly in the 1890's; and the Doolittle group probably was located in the 1930's. Placer deposits in Mine Canyon, which drains to the south most of the area covered by the Donahoe and Johnston's properties, were worked briefly in the 1890's and early 1900's. The total production for the district is not known, but is probably very small. Most of it came from the Donahoe Mine which is described below.

Montezuma (Rice) District. The Montezuma district is between six and eight miles southeast of Warner Springs, on the south slope of San Ysidro Mountain, north of Montezuma Valley. Gold-bearing deposits in the district consist of northeast-trending quartz veins in metamorphic rocks which consist mainly of schist, hybrid rocks composed of schist and quartz diorite. deposits probably were prospected first in the 1890's, the Rice Brothers of Warner Springs, and others. Du that period the following properties were located (Cr ford, 1896, p. 331-346): Bertha, Bonnie Bell, Hills Little Granite, Morning Star, Pine Ridge, Sundown Valley View. By about 1910 these had been reloca chiefly as three groups (Merrill, 1914, p. 648): Mo zuma Mine (13 claims), Buckeye Group (seven clai and Maid of Erin Group (four claims). Most of t claims probably were in Sections 10 and 11, T. 11 S., 4 E., and the principal workings of the district—cove by the Montezuma property—are near the center of S tion 10. The Grubstake and Lucky Strike proper were located and prospected in the 1930's (Tucker Reed, 1939, p. 54 and 55). The value of the total p duction from the district is not known. As the worki of the Montezuma Mine are caved and have not b described fully, even an estimate is not possible.

This district also contains the Verruga (includ White Peak property) and Sentenac limestone depo and Payoff tungsten mine, which are described elsewh in this report.

Ballena Placer Deposits. The Ballena placer gold posits lie in a northeast-trending area, about four m long, which lies two miles southeast to four miles of Ramona. The deposits were worked at least as ea as 1890, and probably before that time. The first recor production from the area, however, was by C. F. Willa Ramona, from 1906 to 1914. In the 1920's the depo were worked by J. C. Hopkins of Escondido (Fairban 1893a, p. 91-92; Merrill, 1914, p. 652; Tucker, 1925, 332-334).

These operators worked the deposits sporadically a on a small scale, and the value of their total output v probably very small. The deposits consist of grav which occur in creeks adjacent to elongate northeast-east-trending ridges which are capped by Poway co glomerate of Eocene age (described in "Geologic F tures" section, herein). These occurrences of conglo erate are part of a northeast-trending, early Tertia drainage channel, remnants of which extend southwe ward from Whale Mountain, north of Ballena Valley, a point just northwest of Foster. The gold in the Pow conglomerate, in turn, probably was derived from go bearing lode deposits now exposed to the east, especia in the Julian district and in the Laguna Mountains regi The gravels were reported by Tucker (1925, p. 333) average $0.30 in gold per yard. One of the chief facto that prevented the operations from being successful w a lack of water with which to wash the gold from t gravel.

Additional Gold Mines. Additional mines in San Die County that have yielded at least small quantities of go are: Descanso Mine, about 1½ miles northwest of De canso; Granite Mountain Mine, on Granite Mountain, the east-central part of the county; Grapevine Star mi

bout 2½ miles south of Ranchita, in the east-central part f the county; Harper Ranch Mine, about 11 miles south-outheast of Julian; Kuhnis (Whaley) Mine, about 5½ iles north-northwest of Fallbrook; and the Oriflamme line, about eight miles south-southeast of Julian (for escriptions of these properties, see accompanying tabu-ted list).

oulder-Creek Group (Boulder Creek Mines, Mineral Hill Mine)

Location: Secs. 9 and 10, T. 14 S., R. 3 E., S.B.M.; oulder Creek district, about nine miles south-southwest f Julian, on the north side of Boulder Creek. *Ownership:* odney S. Sprigg, 2044 First Street, San Diego, owns ight patented claims (1957).

Gold was discovered in the Boulder Creek area in 1885, nd in 1890 the Boulder Creek Deposit was acquired y the Boulder Creek Gold Mining and Milling Com-any, which installed a 10-ton roller-type mill on the roperty. This company produced very little gold, even hough the mine contains several thousand feet of work-ngs. The Sprigg family gained control of the property rom George H. Moyer who patented 8 of the original 0 claims in 1928 (Fig. 30). The property now is called Sprigg Rancho."

The Boulder Creek Deposit consists of at least four ineralized shear zones which are poorly exposed along he hill slope north of Boulder Creek, and are enclosed n hybrid rocks which consist of schist and quartz diorite. The shear zones trend northwestward, dip steeply south-vest, and range in length from 1,350 feet to at least 4,500 eet. They enclose quartz veins, of undetermined extent, n which occur ore shoots which ranged in length from 0 to 30 feet, as described by Tucker (1925, p. 334). The ore mined ranged in value from $6 to $12 per ton n gold, which occurred with sparse pyrite and arseno-yrite (gold was then valued at $20 per ounce).

The deposit was worked from three adits, whose ortals are low on the slope north of the creek: (1) The owest adit is a crosscut which trends N. 25° E. for about 0 feet, from where a drift trends N. 30° W. for about 60 feet (Tucker, 1925, p. 334). A winze at the inter-ection of the crosscut and drift is 30 feet deep. (2) The iddle adit is 40 to 50 feet above the lowest one, and s portal is adjacent to the main, canyon road. This adit a drift which trends irregularly north-northwestward or about 360 feet. (3) The highest adit is about 60 feet bove the middle one, and is a drift which trends N. 30° V. for 150 feet (Tucker, 1925, p. 334).

eveland-Pacific (Escondido) Mine

Location: Near center of Sec. 26, T. 12 S., R. 2 W., .B.M. (projected); in Lots 2 and 4, Block 257, Rincon el Diablo grant; about two miles southeast of Escon-ido city hall (Fig. 29). *Ownership:* On ranch land wned by George C. Paros, Route 1, Box 61, Escondido, nd Donald Belding, Route 1, Box 59, Escondido; now overed by citrus and avocado groves (1957).

The Cleveland-Pacific Mine was the southeasternmost of three former mines which lay on a northeast-trending gold-bearing zone about three-quarters of a mile long. This zone extends from a point near the center of Section 26 (projected) to at least several hundred feet north-west of the intersection of Bear Valley road and State Highway 78 (Fig. 29). It is enclosed in quartz diorite. The other two mines on the zone—the Cravath and Oro Fino—are described in the accompanying tabulated list. The workings of all three mines now are totally inac-cessible and only their dumps are visible in the citrus and avocado groves. The following information about the character of the Cleveland-Pacific Deposit was compiled mainly from descriptions by Merrill (1914, p. 651-652) and Tucker (1925, p. 335).

The workings of the Cleveland-Pacific Mine explored a single quartz vein in the gold-bearing zone. This vein strikes N. 40° E., dips 40° to 50° northwest, and ranges in width from a few inches to six feet. The grade of the ore mined ranged from one-quarter to one-half ounce of gold, and less than one-quarter ounce to as much as four ounces of silver, per ton. The ore also was reported to contain abundant pyrite.

The Cleveland-Pacific, with other deposits of the area, probably was worked informally prior to 1868 by early Mexican and Spanish inhabitants. It was first worked commercially, but on a very small scale, between 1868 and 1896. In 1896 the deposit was developed on a mod-erate scale by the Cleveland-Pacific Company which op-erated the mine until 1911. This company sunk a 350-foot inclined shaft on the vein (at a site now on the Paros property) and drove about 500 feet of drifts from the shaft. Ore was processed on the property, utilizing a five-stamp mill, amalgamation plates, a Wilfley concen-trating table, and two 10-foot cyanide tanks. During its operation the company produced between $50,000 and $75,000 worth of gold and more than 3,500 ounces of silver.

The mine was idle from 1911 to 1924. Starting in 1924, B. F. Brough and Associates, Toledo, Ohio, operated the mine for several years. This company sunk a vertical shaft (about 750 feet southwest of the old shaft and on the Belding property) to a depth of 160 feet. At 150 feet a crosscut was driven to the vein which was then followed 450 feet to the northeast, or toward the old workings. No activity has taken place since that time. It is estimated that during the entire period of activity, the deposit yielded gold and silver worth approximately $100,000 (gold worth $20 per ounce).

Donohoe (Artery Consolidated, Comet, Donohue, Golden Artery) Mine

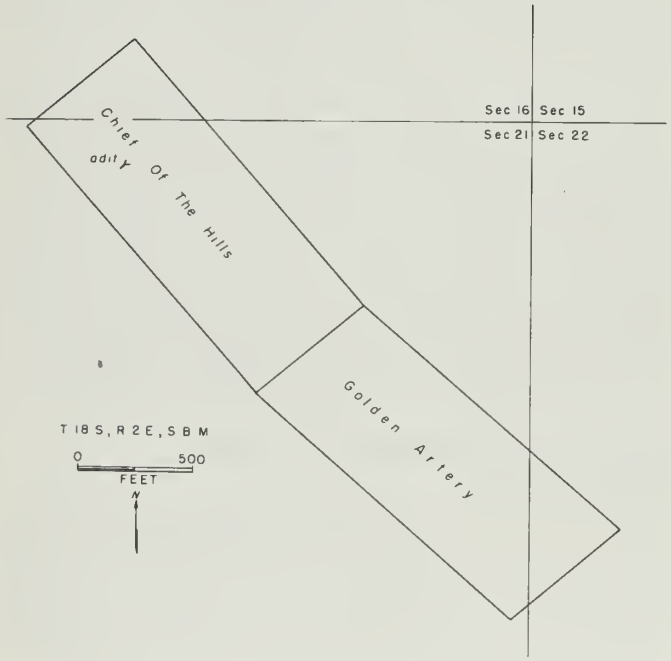
Location: SW.¼ SW.¼ Sec. 16, E.½ Sec. 21, and W.½ Sec. 27, T. 18 S., R. 2 E., S.B.M.; Dulzura district about 2½ miles south of Engineer Springs, in the eastern part of the San Ysidro Mountains (1957). *Ownership:* Walter Thing, 518 Second Street, Calexico, Lennie L. Thing, and Mary J. Donahue, own two patented and five unpatented lode claims (1957).

Alonzo and Stuart Donohoe discovered gold in this area in the early 1890's and worked the deposits intermittently and on a small scale until about 1915. By 1915 the Donohoes had located at least 24 lode claims and two placer claims. The principal workings are covered by two northwest-trending, end-to-end claims which transect the NE.¼ Section 21 (Fig. 31). From northwest to southeast these are the Chief of the Hills (or Gold Chief) and Golden Artery Claims which were located in 1894 and patented in 1897.

Most of the gold-bearing mineralization in the area is within a northwest-trending fault zone which cuts Sections 8, 16, 21, and 22 (see Pl. 1). The fault zone traverses chiefly dark grayish-blue metavolcanic rocks which, within the zone, have been brecciated and subsequently silicified. The silicification was accompanied by the deposition of sparsely disseminated fine-grained pyrite, less common arsenopyrite, and gold. At the surface, the silicified rocks are crusted with yellow-brown to brick-red iron oxides. As the workings of the mine are now mainly inaccessible, it is not possible to describe the characteristics of the ore shoots. The ore was reported by Storms (1893, p. 383) to average about $8 in gold per ton (gold then valued at $20 per ounce). Other, less extensive mineralized zones are reported to occur within several hundred feet of the main zone, and parallel to it (Merrill, 1914, p. 664).

The Golden Artery Claim is developed principally by a 185-foot crosscut adit which extends northeastward into a north- to northwest-trending ridge, near its crest. Appended to this adit are a 125-foot drift, which extends northwestward, and several adits and drifts, each less than 25 feet in length. Two raises, one about 50 feet long, connect the workings with the surface. The principal workings covered by the Chief of the Hills Claim are nearly 2,000 feet northwest of those covered by the Golden Artery Claim and consist chiefly of a 260-foot adit, as reported by Tucker and Reed (1939, p. 17). The Sulfide Claim, which lies in the NW.¼ of Section 22, is developed principally by a 200-foot stoped adit which extends eastward from a point near the bottom of southeast-flowing Donohoe Creek Canyon. Additional workings in the mine area consist of numerous shallow pits and cuts. A two-stamp mill was used originally to process the ore, but later an arrastre proved more successful (Merrill, 1914, p. 664-665). The value of the total production is not known, but probably is small.

Figure 31. Map showing patented claims of the Donohoe gold mine, south of Dulzura, San Diego County.



Golden Chariot Mine

Location: Sec. 14, T. 13 S., R. 4 E., S.B.M.; Julian district, about two miles south of Banner, in Chariot Canyon (Fig. 20). *Ownership:* C. C. Pease and Associates, Bank of America Bldg., San Diego, own two north-northwest trending, end-to-end, patented claims: the Golden Chariot and Chariot North; and three adjoining unpatented claims: Ida Clair, Elizabeth, and Hilldale (1958).

The Golden Chariot Deposit was discovered in February 1871, about one year after gold was first discovered in the Julian district. It was then worked very profitably from 1871 until about 1877 by the Chariot Milling and Mining Corporation, of which James and Alex MacDonald were the only stockholders. The mine remained idle from 1877 until 1913, when the Working Shaft was sunk to its initial depth of 100 feet, but no ore mined. During 1923-1924, this shaft was deepened to 200 feet and some mining done, but the returns were small. In 1945 a lessee dewatered the Working Shaft, but did no mining. The present owner purchased the property in 1946 and since that year has done minor exploratory work on the surface near the south end of the property. Goodyear (1890, p. 147) estimated that the mine yielded gold worth between 600,000 and 700,000 dollars (gold then valued at $20 per ounce). Thus it probably ranks second in the district in total production, behind the Ready Relief Group.

The workings of the Golden Chariot Mine explored a north-northwest trending, quartz-bearing shear zone which occurs along the contact between Julian schist, to the west, and Stonewall quartz diorite, to the east. The zone dips 60° to 70° east-northeast. It was explored laterally for about 650 feet and down dip for about 350 feet, as shown in Fig. 32. As the workings are now inaccessible, veins and ore shoots were unobserved by the writer. However, descriptions from previous reports indicate that the shoot developed by the Main stope was worked down dip from the surface to a depth of about 150 feet, and laterally for about 165 feet. It ranged in width from about 2 to 15 feet, and in grade from $75 to at least $250 in gold per ton (gold then valued at $20 per

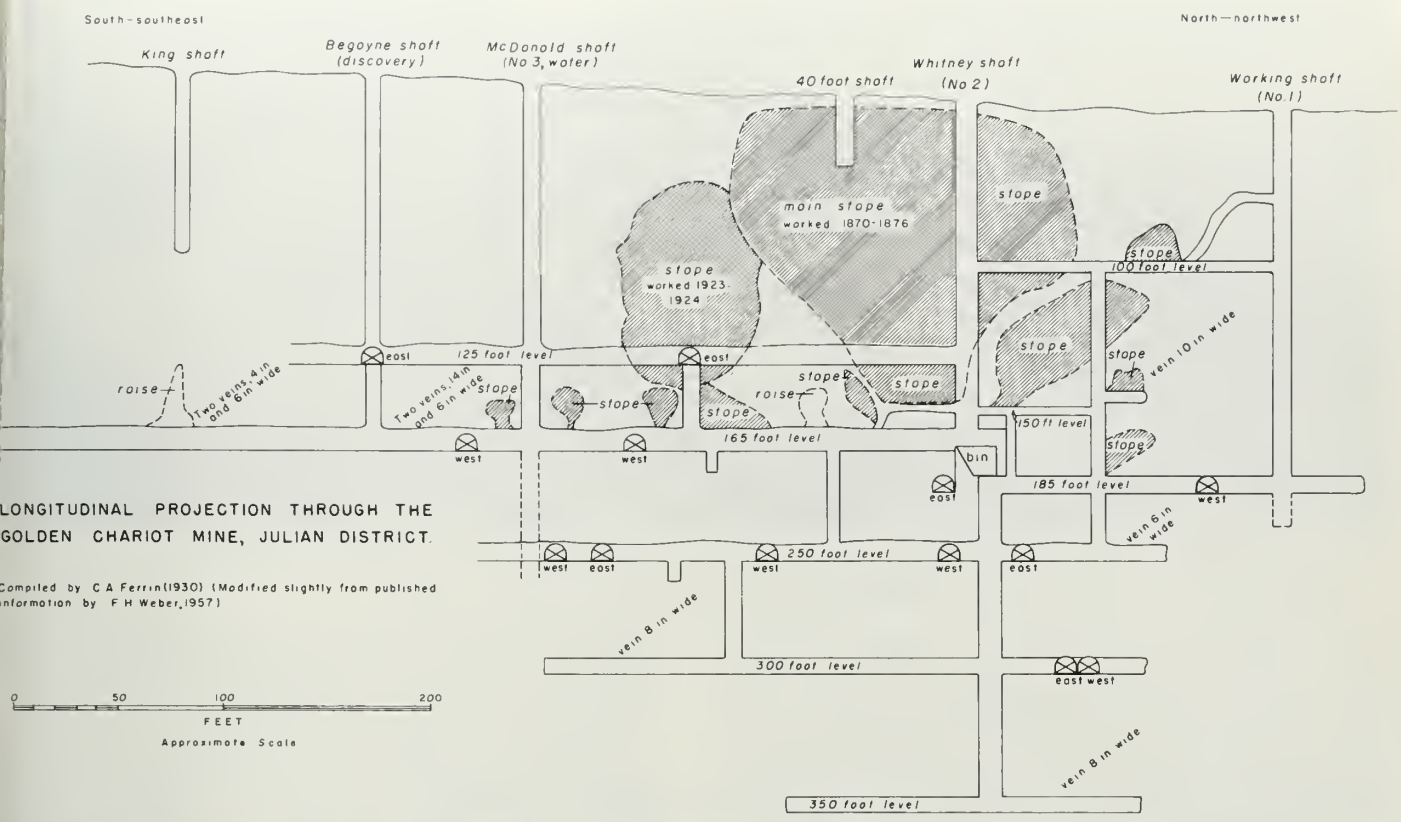


Figure 32.

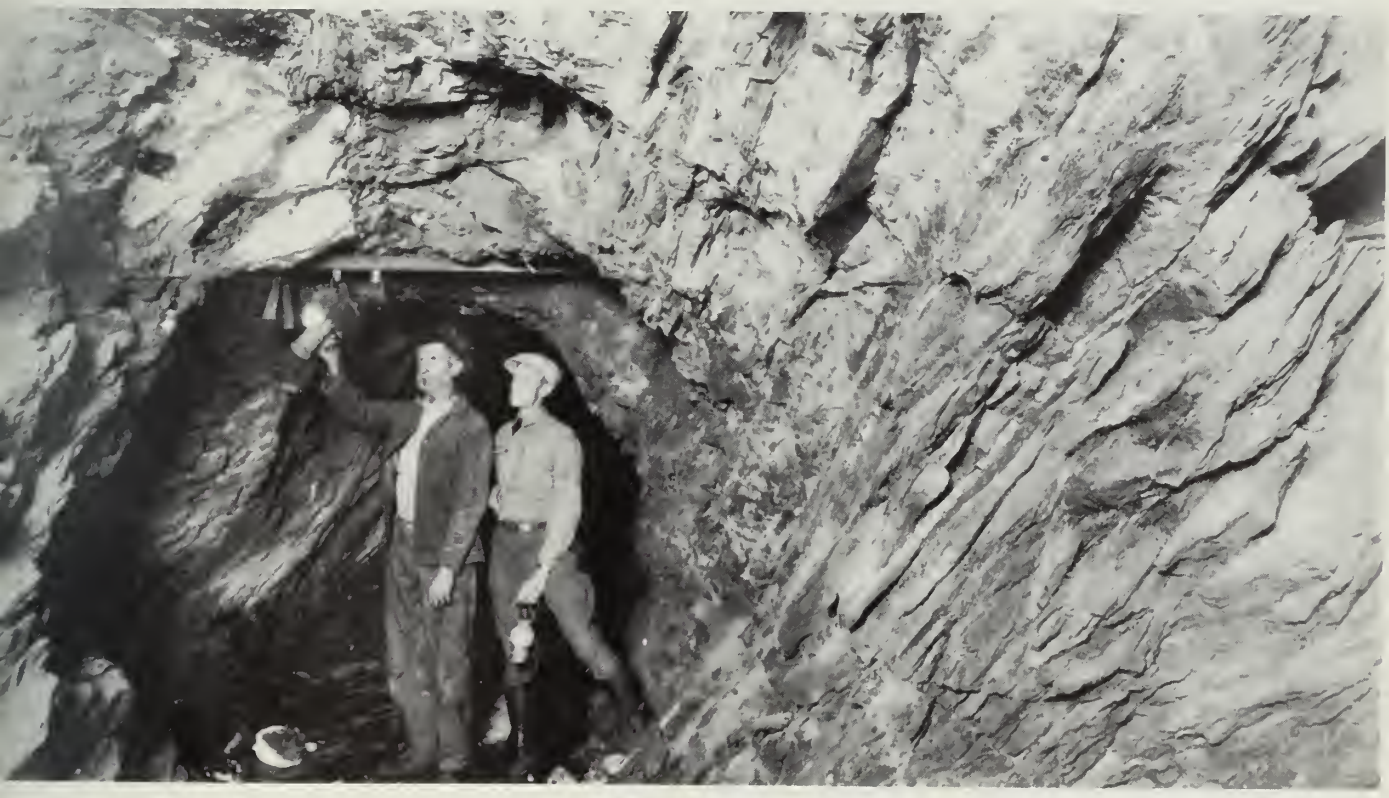


Photo 39. Golden Chariot mine, Julian district, about 1900. Narrow quartz veins, which in one ore shoot were very rich, dip to the east-northeast. *From Union Title Insurance and Trust Company Historical Collection, courtesy Mrs. Ida Wellington, San Diego.*

Photo 40. Golden Chariot mine, Julian district, about 1900; view northeast. Whitney shaft in middle left, 10-stamp mill lower left. *From Union Title Insurance and Trust Company Historical Collection, courtesy Mrs. Ida Wellington, San Diego.*

ounce). Apparently, the "ore zone" consisted of several to many very rich, parallel quartz veins and veinlets which were separated by barren silicified gouge and wall-rock (Photo 39). The ore was free milling except for very small proportions of a gold telluride, probably petzite (Donnelly, 1934, p. 360). The gangue minerals, in addition to quartz, are pyrite, pyrrhotite, calcite and biotite.

The following data on the now inaccessible workings were assembled from published and unpublished descriptions. The mine is developed by four inclined shafts, from which level and stope workings are appended, and two exploratory shafts which do not intersect the level workings (Fig. 32). The shafts were sunk at points that lie within a 500-foot segment of the quartz-bearing shear zone. From north-northwest to south-southeast these are the Working (No. 1) Shaft, 200 feet deep; Whitney Shaft (No. 2), 350 feet; Exploratory Shaft, 40 feet; McDonald (No. 3, Water) Shaft, 260 feet; Begoyne (Discovery) Shaft, 165 feet; and King Shaft, 100 feet. The original and main entry was the Whitney Shaft, from which all level workings of the mine were driven, and from which the main stope was developed between the surface and the 185-foot level. In early 1957 the water level in the Working Shaft was within 30 feet of the top.

During the early 1870's ore from the mine was milled in San Felipe Valley, to the northeast. Later, a five-stamp mill was installed on the property at a site west of the Whitney Shaft (Fig. 32). In 1957 the mill shown at the extreme right of Photo 40 was in poor condition.

Golden Gem Group (Big Blue, Blue Hill, Gardiner, Gardner, Gem Mine)

Location: SW.¼ Sec. 33, T. 12 S., R. 4 E., and N.½ Sec. 4, T. 13 S., R. 4 E., S.B.M.; Julian district, 1½ miles east of Julian, high on the southwest slope of Banner Canyon. The workings are on both sides of old Banner grade. *Ownership:* Estate of D. F. Lane, Box 404, Julian and T. M. Jacobs, 320 San Diego Trust and Saving Building, 350 Broadway, San Diego (1957).

The Golden Gem Group comprises four northwest trending, contiguous claims (Fig. 33). Of these, the Gardner Claim was patented before 1900, the Golden Gem Numbers 1 and 2 Claims in 1936, and the Golden Gem Number 3 Claim in 1957.

The deposit consists of thin quartz veins which are enclosed in schist, and which are poorly exposed at the surface. The veins are mainly parallel to the layering of the schist: they strike northwestward and dip very steeply. As the workings in the productive part of the deposit are now caved, the character of the ore shoots cannot be determined.

Gold worth about $200,000 is estimated to have been produced from this deposit (Donnelly, 1934, p. 352). Most of it probably was extracted by a Mr. Stratton and Robert Gardiner who worked the deposit individually prior to 1900. Stratton is credited with first working the deposit, and reportedly struck a rich pocket of ore in workings whose exact location is now unknown, but which were within a few hundred yards southwest of old Banner grade (D. F. Lane, personal communication 1957). In 1889, Gardiner drove an adit south-southwestward about 140 feet from a point about 250 feet southwest of old Banner grade (Fig. 33). At the face of this adit, he reportedly intersected a vein that was at least two feet thick and rich in "specimen" gold (Goodyear 1890, p. 146). In 1890 the adit was extended 50 feet, another vein intersected, and a 35-foot winze sunk to open another shoot of rich ore (Preston, 1890, p. 545). A raise was driven 135 feet to the surface from this adit. Gardiner worked the deposit until 1898.

Very late in the 19th century, or early in the 20th, the Waterman Tunnel was driven 800 feet south-southwest

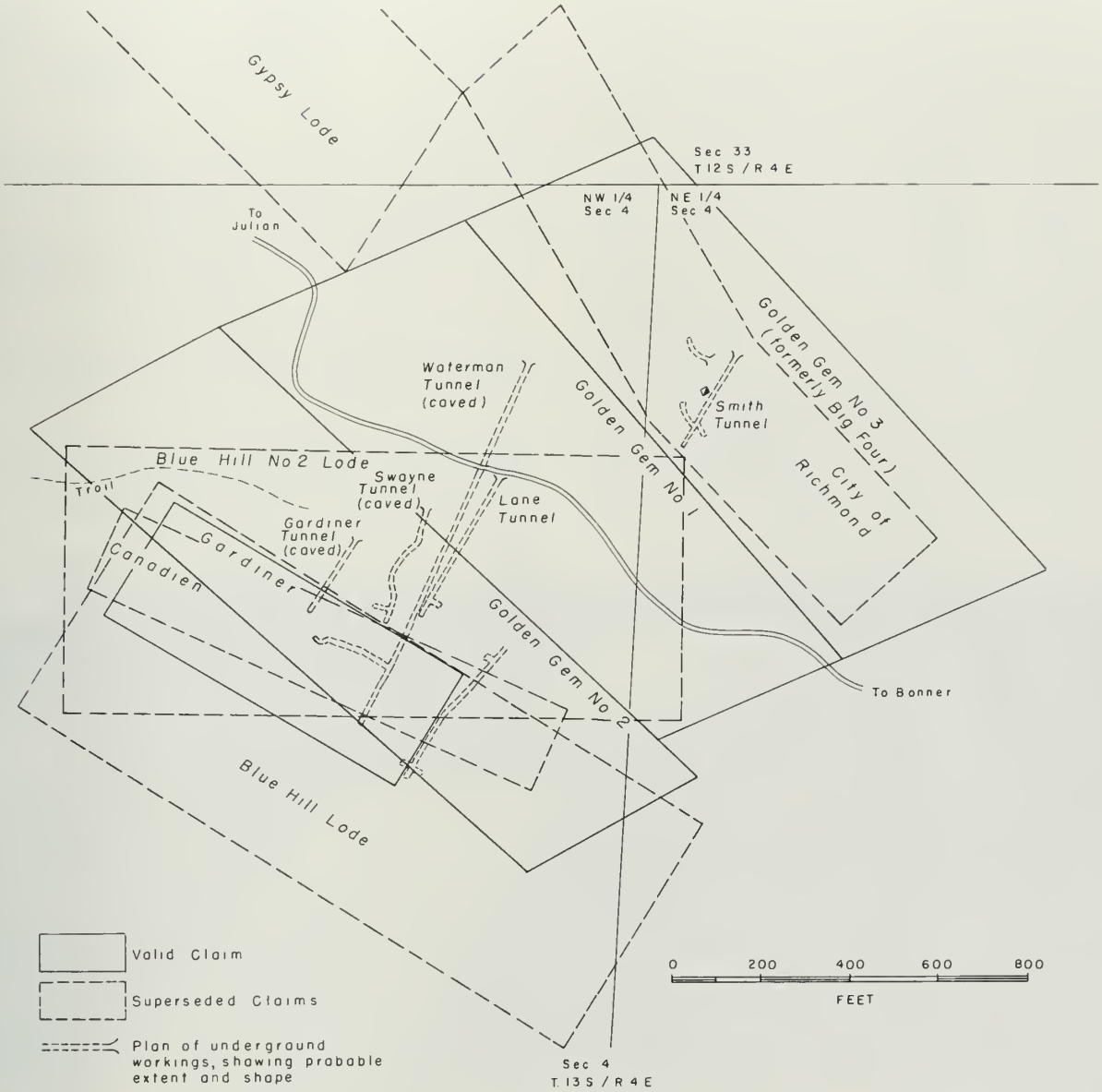


Figure 33. Map of Golden Gem group of claims, Julian district, San Diego County.

rd from a point about 550 feet north-northeast of the rtal of the Gardiner Tunnel, and about 300 feet lower. is adit was driven beneath the Gardiner and Stratton rkings to intersect possible downward extensions of ore shoots mined in those workings. Apparently it ed to intersect ore. This adit was extended to its sent length of 975 feet early in the 20th century, and w is caved 50 feet from the portal.

Additional workings of the group consist of four thwest-trending adits, with appended drifts, that were ened mainly in the 20th century. The portal of the Lane Tunnel (360 feet long) is adjacent to old Banner grade (Fig. 34). The Smith Tunnel (240 feet long) is in the extreme northeastern part of the property on the Golden Gem Number 3 Claim. The portal of the Swayne Tunnel (about 375 feet long) is midway between the portals of the Lane and Gardiner Tunnels, and now is caved. The fourth adit (360 feet long), which is unnamed, is at the southeast edge of the property. The Smith Tunnel workings yielded a small amount of gold and silver ore in 1940.

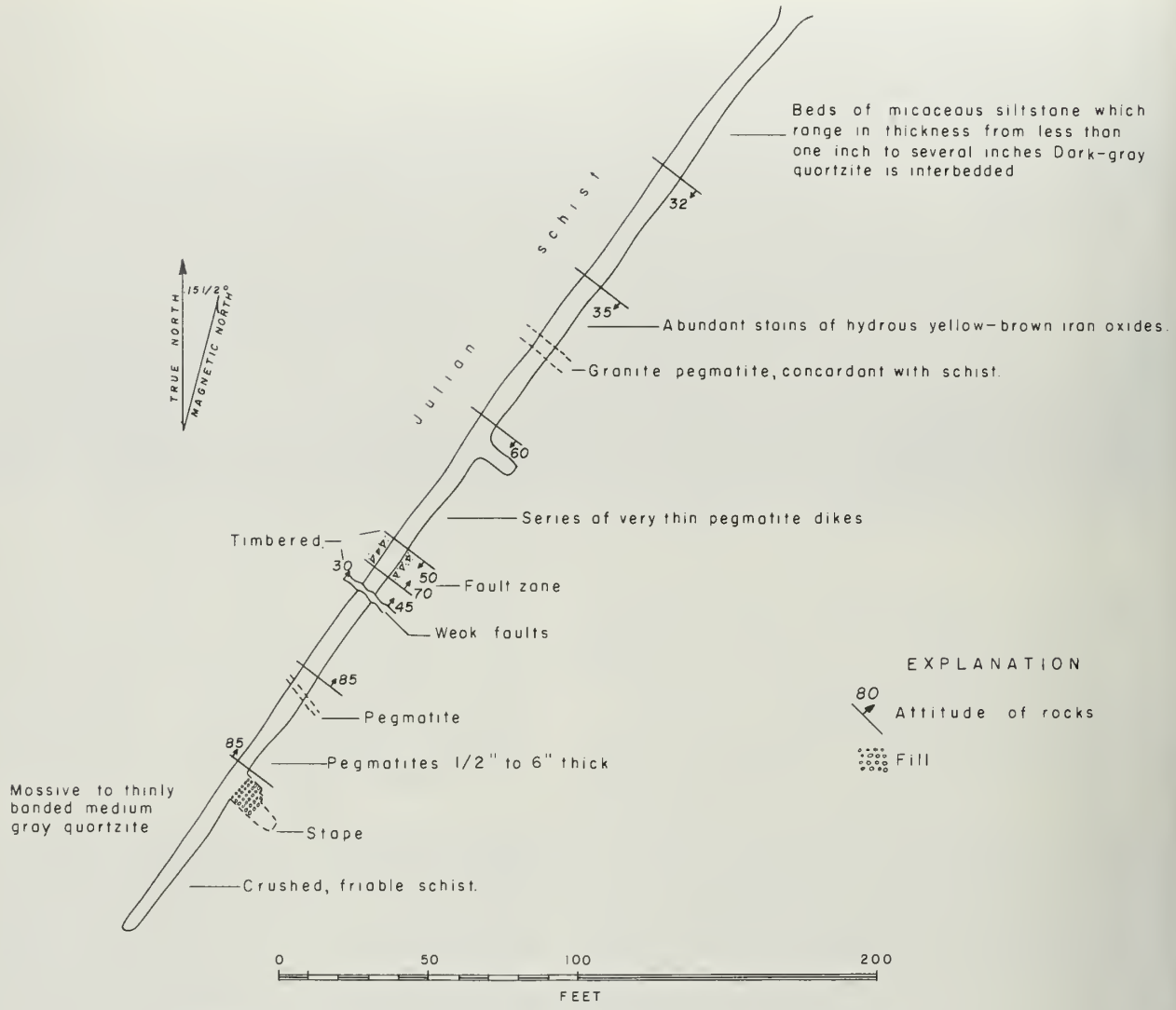


Figure 34. Geologic plan of Lone tunnel, Golden Gem group, Julian district, San Diego County.

Helvetia Mine

Location: NW.¼ Sec. 4 and NE.¼ Sec. 5, T. 13 S., R. 4 E., S.B.M.; Julian district, about one mile east of Julian, on the southwest side of old Banner grade. *Ownership:* Estate of D. F. Lane, Box 404, Julian; and T. M. Jacobs, 320 San Diego Trust and Savings Building, 350 Broadway, San Diego, own one northwest-trending claim which was patented in 1882 (1957).

The Helvetia Deposit was discovered in August 1870, and worked continuously from that date until 1875 or 1876. Then the mine lay idle until about 1887, when it was reopened and worked by several operators until 1904. It has not been operated since that time. The output from 1870 to 1890 was said to have been about $480,000 worth of gold, according to Goodyear (1890, p. 146); and from 1890 to 1904 it was about $100,000, according to statistics of the United States Bureau of Mines (gold was valued then at $20 per ounce).

The gold-bearing quartz of the Helvetia Deposit occurs as lenses, thin lenticular veins, and stringers, which are enclosed in a northwest-trending shear zone several tho sand feet long. The zone is enclosed concordantly Julian schist and is nearly vertical. As the workings the mine now are mainly caved, it is not possible to dete mine the characteristics of the ore shoots. The grade the ore mined was reported to be as high as $75 per t in narrow quartz bodies, and only $12 to $15 in bodi four to five feet wide (Goodyear, 1890, p. 146). T average grade of the ore probably ranged from one-ha ounce to between two and three ounces of gold per to The San Diego Mine is on the northwest extension of t quartz-bearing zone, and the Jumper Deposit is on i southeast extension (see descriptions in the accompanyin tabulated list).

During its early years of mining the Helvetia Depos was developed by a 310-foot shaft, with appended stope and a drift that extended northwestward from the botto of the shaft for about 100 feet and southeastward f about 200 feet (Fig. 35). The site of the collar of th

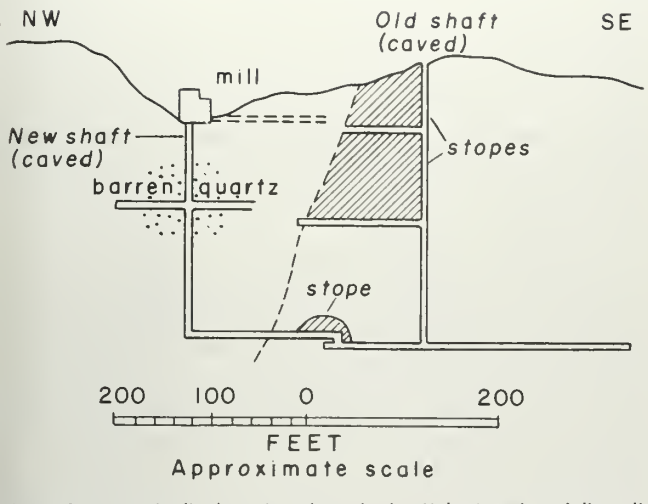
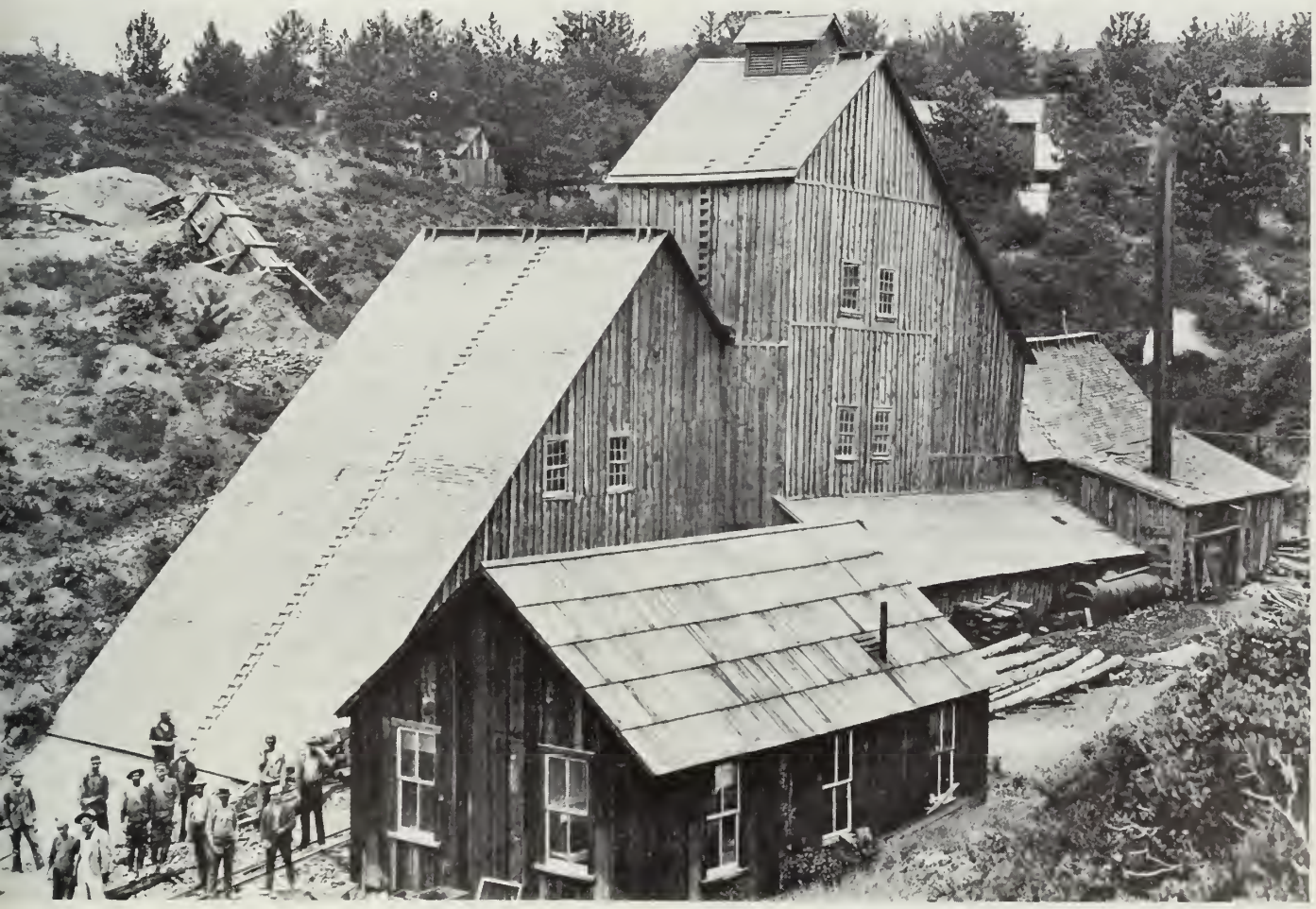


Figure 35. Longitudinal section through the Helvetio mine, Julion dis-ct. *After Storms 1893.*

Photo 41 (below). Helvetia mine, Julion district, about 1900; view uth. Site of Old shaft is at upper left. Shaft sunk in 1887 is beneath llest port of mill building. *From Union Title and Trust Company His-rical Collection, courtesy Mrs. Ida Wellington, San Diego.*

shaft is a few feet south of a dirt road that skirts the side of a hill which slopes north and northeast, toward old Banner grade. A sharp bend in old Banner grade is about 250 feet to the northeast of, and 75 feet lower than, the site of the old shaft. These workings followed a vein reported to be two to five feet wide and to average $18 per ton in gold (Goodyear, 1890, p. 146).

In the late 1870's, or early 1880's a drift adit was driven southeastward for 210 feet, from a point on the southeast side of a ravine near the sharp bend in old Banner grade. This adit intersected the old workings about 75 feet below the top of the shaft. In 1887 a new shaft was started in the ravine, near the portal of this drift adit. It was inclined 75° northeastward for about 50 feet, then sunk vertically to its ultimate depth of 225 feet. It reportedly followed a stringer of quartz 10 inches wide which averaged $20 per ton in gold (Goodyear, 1890, p. 146). A drift was driven southeastward from the bottom of the shaft for about 150 feet, where it intersected workings appended to the old shaft, which by then was caved. A 10-stamp mill and steam hoist were erected under one roof to treat ore from the new workings (Photo 41). In 1957 the workings were inaccessible except the 210-foot drift adit, which was open for at least 50 feet. No equipment remained on the property.



Madden Group (Antelope Mine)

Location: Secs. 3 and 4, T. 13 S., R. 4 E., S.B.M.; Julian district, 2 to 2½ miles east-southeast of Julian, along old Banner grade. *Ownership:* Mrs. C. Wilson, Julian (1956).

The Madden Deposit lies to the southeast of the Warlock Deposit and to the northwest of the Kentuck S and Hidden Treasure Deposits. It was discovered and first worked in the early 1870's. The mine was active on a small scale as late as the 1890's, and yielded a small amount of ore in 1928 and 1936. The Madden Group comprises three northwest-trending, partly end-to-end lode claims (Curry, Gopher, Old Madden), and one millsite claim, all of which were patented in 1936 (see Pl. 9). They cover about 50 acres. The Curry and Gopher (formerly Antelope) Claims were owned independently of the Old Madden Claims until sometime during the period 1914-1925, when the late Charles Curry of Julian purchased the latter group. The value of gold produced from the mine was estimated by Donnelly (1934, p. 352) to be between $50,000 and $100,000.

The deposit consists of at least two northwest-striking quartz-bearing zones enclosed concordantly in Julian schist. The quartz occurs chiefly as veins which dip 70° to 80° southwest. The bodies that were mined ranged in width from one to three feet, and in grade from $10 to $75 in gold per ton (gold valued at $20 per ounce at time of mining) (Hanks, 1886, p. 86; Preston, 1890, p. 544).

The principal development on the property is a crosscut adit, with appended drifts, which was driven S. 45° W. for 550 feet from a point several hundred feet east of old Banner Grade, on the Curry Claim. The adit intersected a vein at a point within the Gopher Claim, which lies west of the Curry Claim. Drifts were driven on this vein 150 feet to the northwest and 100 feet to the southeast. In December 1956, this adit was caved 375 feet from its portal.

The accessible workings on the Old Madden Claim are about 1,000 feet southeast of the portal of the adit on the Curry Claim, and a few tens of feet southwest of old Banner Grade. They consist of a 60-foot drift adit which trends S. 45° E., and a shaft, near the portal of the adit, which is inclined concordantly with the schist. This shaft is reported to be 100 feet deep (Tucker, 1925, p. 341). The site of an old shaft, reported by Tucker (1925, p. 345) to have been 200 feet deep with 500 feet of appended drifts, could not be located in 1957.

Noble Group (Noble Mines, Noble's Mines, Pine Valley Mines)

Location: Secs. 7, 8 and 17, T. 15 S., R. 5 E., S.B.M.; in the Laguna Mountains, about 4½ miles north-northeast of Pine Valley. *Ownership:* Fred W. Schaefer, P.O. Box 16, Pine Valley, is reported to own the Treasury, Eureka, Bay View and Oxide Claims of the original group which consisted of eight claims (1962) (Fig. 36). Ownership of the additional claims (Millsite, South End, Spring and Spring No. 2) is undetermined. The claims of the group may have been patented November 12, 1908.

The Noble Deposit was discovered in 1888 by Joh Noble, who with his brother Thomas, worked the deposi intermittently until about 1914. Most of their output wa gained during a short period near the turn of the century when more than $60,000 worth of gold (at $20 pe ounce) was produced. Since 1914, lessees have show sporadic interest in the property, and very small ship ments of gold were made from it in 1938, 1940, and 1944 The total value of the gold recovered from the depos is not known.

The geologic setting of the Noble Deposit is simila to that of the deposits at Julian, described elsewhere i this section of the report. The deposit occurs in a north trending belt of schist, about one mile in average width which is enclosed mainly in granitic rocks. The deposi consists of several north-northwest trending mineralize shear zones, as much as several thousand feet long, whicl enclose lenticular quartz veins. The veins contain fre gold, silver, and pyrite, and were reported by Tucke (1925, p. 344) also to contain galena and tellurium. Mos of the output was obtained from the Bay View-Eurek and Treasury shear zones, which are covered by claim of the same names. These zones are poorly exposed, abou 300 feet apart, high along the west side of a long ridge The Bay View-Eureka zone strikes N. 35° W. and dip about 60° east-northeast; the extent of its ore shoots i not known, but the quartz veins within the zone are a much as three feet wide. The Treasury shear zone strike northwestward and dips 75° northeast; and the quart veins within it are as much as two feet wide.

A mineralized shear zone also is exposed along the cres of the ridge, north of the Eureka Claim; this zone strike north-northwestward and dips 70° to 75° north-north-east.

Workings on the Eureka Claim consist of a 40-foo trench, at the end of which is a 120-foot shaft, now caved; and two adits, 150 feet and 350 feet long, and 100-foot winze near the portal of the 150-foot adi (Tucker, 1925, p. 344). The Bay View Claim is developed by a 50-foot drift adit and a 75-foot open cut which is above the adit. The Treasury Claim was worked by a 330-foot drift adit, and a 225-foot crosscut adi which is about 200 feet below the drift adit. A stope in the drift adit extends 125 feet to the surface. The Spring Claim, at the north end of the deposit, was worked from a shaft 200 feet deep, with drifts opened on several levels. In 1957 this shaft was open, but inaccessible. Unpatented claims on the crest of the ridge north of the Eureka Claim were developed by several shafts, now only partly open, which are at least 50 feet deep each. Other, shallower workings are common in the area.

Ore was hand-sorted at the workings, then packed by mule to the five-stamp mill in Noble Canyon, about one-half airline mile to the southeast. The ore milled was reported by Tucker (1925, pp. 343-345) to have yielded ½ to 1½ ounces of gold per ton. A 3,500-foot flume that carried the water for the mill from a spring on the east side of Noble Creek still partly exists.

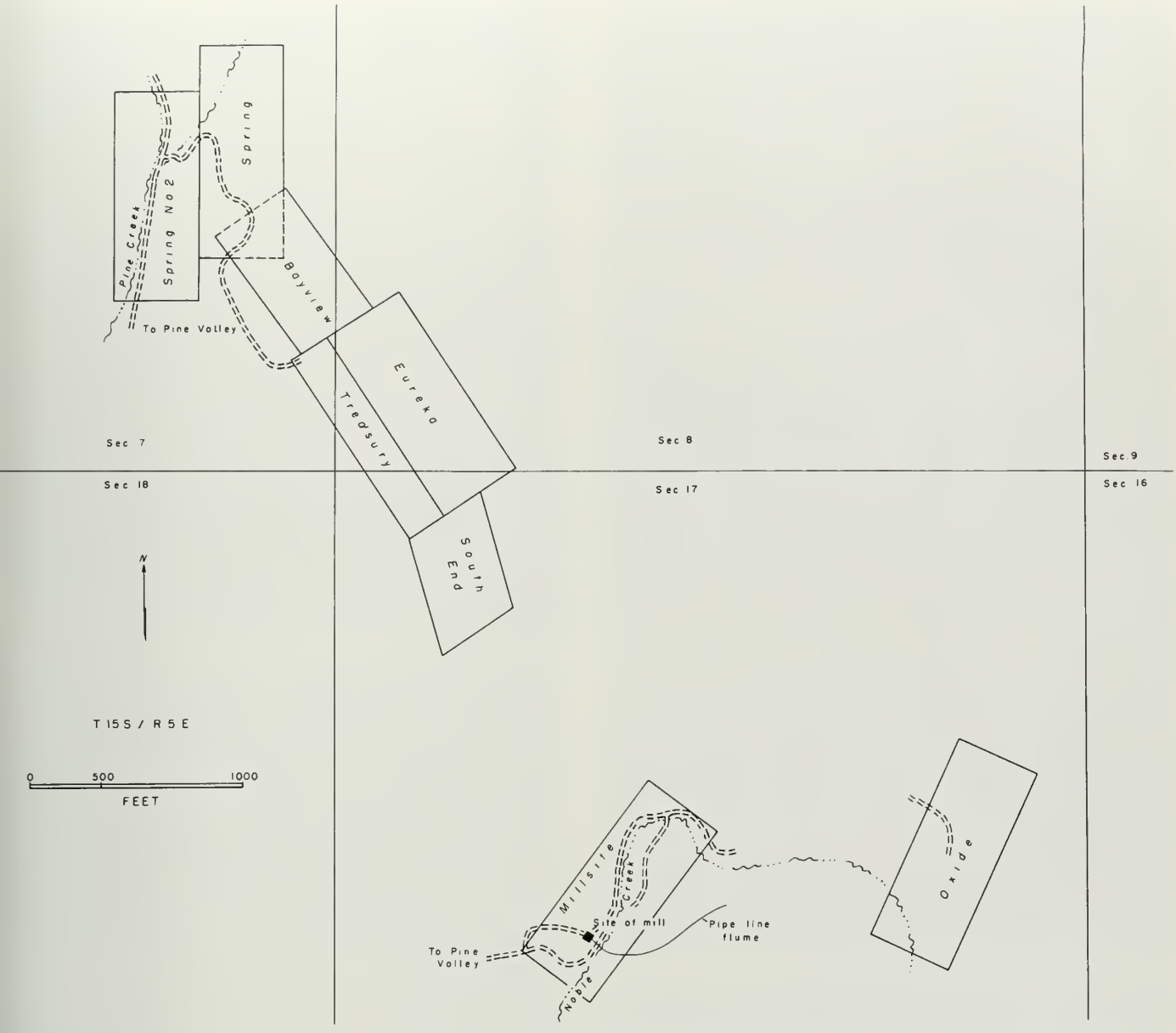


Figure 36. Map showing Noble group of claims, Laguna Mountains, San Diego County.

vens (Old Owens, New Owens) Mine

Location: SE.¼ Sec. 31, T. 12 S., R. 4 E., S.B.M.; ılian district, about two-fifths of a mile north of Julian. he property can be reached from Julian by a dirt road hich extends northward from the end of C Street. *wnership:* Howard A. Williams, 1626 Seventh St., San iego. The property comprises two partly overlapng west-northwest-trending claims which are patented 956).

The Owens Deposit is on the east edge of Julian Mesa, ear the head of an east-flowing tributary to Banner anyon. It was discovered in March 1870 and worked ntinuously from that date until 1873 by James Kelley d associates, who also constructed and operated a 10-amp mill on the property. The mine then lay idle from 1873 to 1884, when it was reopened and worked until 1887. During the period 1889-1890 the workings were dewatered and deepened, but the subsequent mining effort failed, and not until a few years later was gold-bearing quartz again mined. During the period 1890-1910 the mine was worked only intermittently, but custom milling operations enabled the operators to ship about $90,000 worth of gold, and during one year—1904—13,000 ounces of silver and 104,000 pounds of copper. The deposit has been idle since 1910. The value of the total production has been estimated as follows: Goodyear (1890, p. 145), $300,000; Tucker (1925, p. 346), $500,000.

Two productive quartz veins were worked in the Owens Mine: the Owens Ledge and the Red Ledge

(Goodyear, 1890, p. 144-145). These veins strike west-northwestward, dip steeply to the north-northeast, and are enclosed concordantly in Julian schist. The Owens Ledge was reported to crop out 20 feet south-southwest of the Red Ledge (Goodyear, 1890, p. 144). Where the veins were worked, they averaged 2½ feet in width and 2¼ to 3¼ ounces of gold per ton (as inferred from published production figures). Goodyear (1888, p. 519) stated that "a thin streak in"—the Red Ledge—"has been extremely rich in handsome specimens." He also stated that pyrite was common in the wall rocks. The ore was free milling.

The original workings consisted of a 275-foot shaft and appended drifts which were developed on the Owens Ledge. The drifts extended west-northwest and east-southeast from the shaft, on the 100-, 200-, and 275-foot levels, and ranged in length from 300 to 460 feet. When the mine was reopened in the mid-1880's, the Red Ledge was discovered and worked on the 200-foot level. During the period from 1889 to 1890 the shaft was extended to a depth of about 325 feet. Total length of the level workings is about 1,500 feet. The workings are now caved and inaccessible. The mill site is a slight depression, nearly covered by vegetation, at the head of a relatively large dump.

Ranchito Mine

Location: NE.¼ Sec. 11, T. 13 S., R. 4 E., S.B.M.; Julian district, about one mile southeast of Banner, on the northeast side of a small valley (see Photo 42). *Ownership:* Heirs to the estate of Cave Couts, c/o Mrs. Cave Couts, Jr., 3587½ 1st St., San Diego. Leased to William Mushet, Banner Queen Ranch (1957). The property consists of a 140-acre patented homestead.

The Ranchito Deposit was discovered in 1895, and was the last important gold-bearing deposit to be developed in the Julian district. The deposit was worked continuously for about three years after its discovery, and intermittently during the periods 1934 to 1940 and 1946 to 1948. Most of the output obtained was produced during the earliest period of mining and from 1939 to 1940. The value of the total production of gold is estimated to be between $60,000 and $75,000 (at $20 per ounce during the earliest period, and $35 per ounce during the later periods). Slightly less than 100 ounces of silver also was produced.

Photo 42 (below). Ranchito mine, Julian district, about 1895. View north toward mill. *From Union Title Insurance and Trust Company Historical Collection, courtesy Mrs. Ida Wellington, San Diego.*

The Ranchito Deposit crops out low on a southwest facing ridge slope which partially opens into a small valley (see Pl. 4). The deposit is enclosed in hybrid ("mixed") rocks which are composed of quartz diorite and schist. As the deposit lies on the northeast side of the Elsinore Fault, which extends along the base of the ridge slope, the hybrid rocks are highly sheared. The deposit consists of quartz bodies in shear zones which strike west-northwest along the fault. As the workings of the mine are no longer accessible, the exact nature of the deposit was not determined during this investigation. The gold-bearing quartz bodies were reported by Storms (1896, p. 344) to be lenticular, to range in width from one to three feet, and to be four or five feet apart. They probably dip steeply northeast. Storms also stated that the bodies are sheared by minor northwest-trending faults.

The workings of the mine consist primarily of two shafts, which are now inaccessible, but which were reported to contain appended drifts and stopes (Storms, 1896, p. 344; Hubon, 1902, p. 8; Tucker and Reed, 1939, p. 25). One of these shafts extends downward vertically about 330 feet from a point low on the slope northeast of the small valley. In 1957 the shaft was open, but inaccessible. At a point about 200 feet northwest of this working, at the base of the slope, is the collar of a caved shaft inclined 40° to the northeast. A five-stamp mill, adjacent to the vertical shaft, is still nearly intact, but unusable (Photo 42).

Ready Relief Group (Bailey Brothers Mine)

Location: S½ Sec. 3, Sec. 10, W½ Sec. 11, T. 13 S., R. 4 E., S.B.M.; Julian district, within one mile west and southwest of Banner. *Ownership:* Frank Herron, Banner Grade, Julian and 468 Acheson, Pasadena 6, owners 10 contiguous, northwest-trending, unpatented lode claims—Belmont, Carp, Fountain, North Hubbard, North (Northwest) Redman, Raindrop, Ready Relief, Redman, South Hubbard, and Tom Paine (see Pl. 9) (1957).

The principal workings of the Ready Relief group explored a northwest-trending, gold-bearing zone which cuts Chariot Canyon about one-quarter mile south of the intersection of the canyon with State Highway 78. This zone is covered by five end-to-end claims, which from northwest to southeast are the North (Northwest), Redman, Redman, Ready Relief, North Hubbard and South Hubbard. Until 1932, the North Hubbard Claim was owned and operated independently of the other claims, which together were known before that year as the Ready Relief or Bailey Brothers Mine.

*Gold-bearing deposits were discovered in the area overed by the present day Ready Relief property in ugust, 1870 by Louis Redman, who was grubstaked by mes and Drury Bailey of Julian. The deposits probly were worked continuously from the date of their iscovery until about 1875, when the district became enerally inactive. They then lay mainly idle until repened in the late 1880's. From the late 1880's until 1910 e veins covered by the Ready Relief Claim were orked nearly continuously, principally by William tewart, Chester Gunn, and the Bailey Brothers. The eposits covered by the North Hubbard Claim were orked from the late 1880's until 1902, from 1922 to 924, from 1930 to 1937, and briefly in 1940. Most of e veins covered by the other claims have not been orked since 1900. Parts of the property were leased termittently during the 1950's.

The total production of the mine was estimated by onnelly (1934, p. 352-353) as follows: Ready Relief laim, $500,000; North Hubbard, $200,000; Redman, 25,000 to $50,000; and South Hubbard, less than $25,-00. Thus the Ready Relief Group ranks first in total old output in the district. The greatest part of the outut was produced before 1875, and since that time only bout $200,000 worth of gold and 1800 ounces of silver ave been produced. The silver was produced between 900 and 1910.

The northwest-trending, gold-bearing zone developed y the group is nearly one mile long, and is enclosed in ulian schist. It dips 55° to 65° northeast, steepening own dip. Gold-bearing quartz in the zone occurs as enses, lenticular veins and spectacular "roll" structures Fig. 26), for which the Ready Relief Mine was locally mous. The lenses and veins generally range in width rom a few inches to several feet, but mineable zones ncountered which followed "rolls" were as wide as 20 eet. The grade of the ore averaged about $15-$20 in old per ton (gold then valued at about $20 per ounce), ut was much higher where the workings followed rolls". The gold is both free and associated with pyrite.

The workings opened in the gold-bearing zone extend outheastward from a point about one-eighth of a mile outh-southwest of the highway, low on the west side f Chariot Canyon, to a point high on the east side of Chariot Canyon. From northwest to southeast these are s follows: (1) The Redman Claim was developed chiefly y a 115-foot shaft to which was driven a 120-foot adit vith 300 feet of drifts. These workings are now caved. 2) The principal workings on the Ready Relief Claim re low on the east side of Chariot Canyon and consist f three southeast-trending stoped drift adits, each about 0 to 100 feet apart vertically, which from bottom to top re 450, 475, and 530 feet long. Additional workings on his claim are a 160- and a 200-foot shaft. The drift adits vere partly accessible in 1957. (3) The North Hubbard Claim is developed chiefly by a 200-foot crosscut adit which was driven northeastward at the level of the canyon floor. Stoped drifts extend from the end of the crosscut for 500 feet to the northwest and 200 feet to the southeast. A 100-foot winze was sunk in its northwestern drift. The workings were accessible in 1957. (4) The South Hubbard Claim was developed by a 300-foot crosscut with appended drifts 90 and 100 feet long, and a 275-foot shaft.

In 1957, a mill on the Ready Relief Claim, about ½ mile south of the highway in Chariot Canyon, was in operable condition, but idle. The site of an old five-stamp mill, formerly on the North Hubbard Claim, is about one-eighth mile south-southeast of the Ready Relief Mill.

A large part of the information in the following paragraph was compiled from references listed under "Ready Relief" in the accompanying tabulated list.

Stonewall (Stonewall Jackson) Mine

Location: SW¼ Sec. 3 and SE¼ Sec. 4, T. 14 S., R. 4 E., S.B.M. (projected); near the southeastern shore of Cuyamaca Reservoir, about seven miles south of Julian. The mine was formerly in Cuyamaca Rancho, and now is within the northern limit of Cuyamaca Rancho State Park. *Ownership:* Administrated by the California Division of Beaches and Parks, Sacramento (1958).

The Stonewall Mine, the most productive gold property in San Diego County, has yielded ore with an estimated value of $2,000,000 (Donnelly, 1934, p. 352). The property was active periodically from 1870 to 1908. The site of the workings and mill, with some of the mining implements, are now preserved for public view.

The Stonewall Deposit consists of a large gold-bearing quartz body enclosed in hybrid rocks composed of quartz diorite and schist. As the workings of the mine now are completely inaccessible, it is not possible to observe the character of the ore. Merrill (1914, p. 661-662) and others showed that the body strikes northwestward, dips steeply southwest, and pitches steeply to the southeast. It is tabular, and irregular in vertical section (Fig.

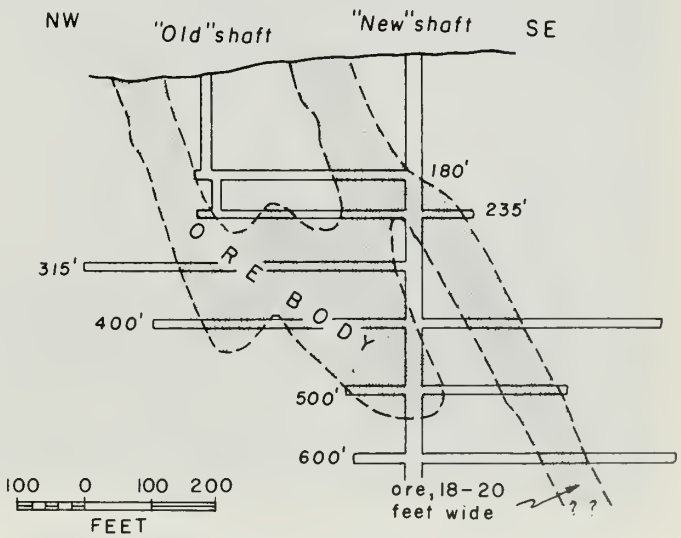


Figure 37. Longitudinal section through the Stonewall mine, San Diego County. *Modified from Merrill 1914.*

Photo 43. Stonewall mine and mill, about 1900; view southeast. *From Union Title Insurance and Trust Company Historical Collection.*

Photo 44. Stonewall mine and mill, about 1900; view southwest. During a short period beginning in 1898, tailings left from prior mining operations were processed to recover gold not previously recovered. Tailings were scooped up with scrapers attached to horses and transported to mill in background. *From Union Title Insurance and Trust Company Historical Collection.*

7). It is at least 800 feet in pitch length, and as much s 20 feet in width. The ore mined was free milling.

According to unpublished accounts, gold was discovred in the area in March 1870 by a farmer who was hasing a stray mule (Moore, 1959). This man was Wilam Skidmore, an emigrant from Texas. With his three ons and Doc R. M. Thompson, Skidmore located one laim which he named the Stonewall Jackson. Soon after, wo adjacent claims were located on the deposit, probbly by George B. and Charles Hensley. The Hensley istrict was then formed to enclose the Hensley Claims nd the Stonewall Jackson Claim, whose name was hortened about that time to "Stonewall." In May 1870 lmon P. Frary purchased the Hensley Claims and durng the latter part of the same year acquired title to the tonewall Claim from Skidmore and his partners. By 1871 he Stonewall Mining Company, under the supervision f Frary, had sunk a 100-foot shaft with a drift on the 0-foot level driven 180 feet to the northwest and 100 eet to the southeast. A small stamp mill also was contructed. At this time the mine was said to have yielded re with $12 to $20 worth of gold per ton (gold then alued at $20 per fine ounce). Mining continued from 871 to about 1874 or 1875, when gold mines in the egion became generally inactive. In January 1876 the roperty was sold at public auction to Wallace Leach, hose property later was reduced to seven acres when e north boundary of Cuyamaca Rancho was deterined to cut through the mine area (Moore, 1959). This roperty was known thereafter as Lot A.

Lot A changed hands several times until it was purhased for $75,000 in September 1886 by Robert W. Vaterman, Governor of California. As Waterman also urchased the Cuyamaca Rancho he gained control of e entire mine and mill area. By the time that Waterman urchased the mine its shaft had been deepened to 155 eet, and several levels established. In addition, a 10-stamp ill with a capacity of about 20 tons per 24-hour period as on the property. The initial step of the new manageent—which was headed by the Governor's son, Waldo Waterman—was to sink a second shaft at a point about 00 feet southeast of the first one. By May 1888, this aft was 230 feet deep, and by October 1889, 400 feet. eventually reached a depth slightly greater than 600 et, with levels at 180, 235, 315, 400, 500, and 600 feet Fig. 37) (Merrill, 1914, p. 661). The total length of rifts on these levels was about 2,700 feet. From 1888 to 891, the production assumed bonanza proportions, and e value of gold, as compiled by the U.S. Mint and ther Bank of San Francisco, totaled $909,442 (Merrill 914, p. 661). During the boom period, about 65 men ere employed underground and eight in the mill. A 20amp mill was put into operation in 1890 to give the ine a capacity of 30 stamps (Photos 43, 44). By 1893, owever, the accessible ore had been mined and operaons ceased.

The remaining efforts to operate the mine did not rove successful. In 1898, a cyanide reduction plant was installed to process the mill tailings which were reported to average $4 to $6 in gold per ton (Photo 44). Thirty-five thousand tons were processed. During the period 1907-1908, an attempt was made to reactivate the property, but, by then water in the newly formed Cuyamaca Reservoir had risen to a level that prevented holding down the water level in the mine. The last attempt to operate the mine ended in 1926, when the main shaft caved. In 1933, the Cuyamaca Rancho and Lot A were purchased for one-half value by the State of California.

Warlock Group

Location: S.½ S.½ Sec. 33, T. 12 S., R. 4 E., and NE.¼ Sec. 4, T. 13 S., R. 4 E., S.B.M.; Julian district, about two miles east of Julian, on the west slope of Banner Canyon. *Ownership:* Fred and Cecil Creese, Julian. Leased to Knelly Norwood, 803 W. 17th Street, Santa Ana, in 1957.

The Warlock property consists of five northwest-trending claims, four of which are *en echelon* and partly contiguous. From northeast to southwest these four are the Bedrock, Warlock (formerly Chaparral), Neptune, and Shamrock Claims (see Pl. 9). The fifth claim is the East California, which partly overlaps the northwest end of the Bedrock. The deposit probably was discovered in 1870 and worked from that year until the mid-1870's, then again in the 1890's, and briefly during the period 1908-1909. Recent work has been restricted to exploration. The value of the total production from this mine was estimated by Donnelly (1934, p. 352) as follows: Shamrock Claim, $25,000 to $50,000; Warlock Claim, $25,000 to $50,000; and Neptune, less than $25,000.

The Warlock Deposit lies to the southwest of the Golden Gem Deposit and northeast of the Madden. The workings have explored a series of northwest-trending quartz veins which dip steeply west, range in width from one to seven feet, and are enclosed in Julian schist. The gold is free except for minor proportions associated with pyrite and arsenopyrite.

The principal working on the property is a 1,660-foot crosscut adit which extends S. 20° W. from a locality on the Warlock Claim, several hundred feet east of old Banner Grade. The adit intersected seven veins, including the Warlock, Kentuck, Cincinnati Belle (or Neptune), and Shamrock (Fred Creese, personal communication, 1957). Mr. Creese stated that all veins cut by the adit were low-grade or barren except the Shamrock vein which was cut at 1,400 feet. During periods of previous ownership, drifts had been driven on this vein from the adit 100 feet to the northwest and 200 feet to the southeast. In mid-1957 the Creese brothers were extending along the strike of the vein a stoped raise which sometime in the past had been driven upward about 120 feet from a point in the southeastern drift. Ore in the face and sides of the upper part of this raise was reported by the owners to average about $40 in gold per ton. Additional workings on the property have been described by Hubon (1902, p. 6, 8), but are now caved.

Gold

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Able mine	"In Crescent Valley 7 miles S.W. of Escondido" (Crawford).	Undetermined (1958) S. P. Able, Escondido (1896)	"Vein in--diorite".	A prospect. Explored in 1890's by two shafts, 25 and 35 ft. deep. (Crawfor 96:331; Merrill 14:651).
150	Abbie group	Along common boundary between NE¼ sec. 8 and NW¼ sec. 9, T15S, R5E, SBM; Laguna Mountains, 4 miles west-northwest of Mount Laguna, on the east side of Noble Canyon.	Undetermined (1958) P. C. Barney (1929)	North-trending quartz veins in schist. Southward extension of Melba deposit.	A prospect. Two claims located south c Melba group and east of Frances grou Plotted by Tucker and Reed (1939) as "Abbie and Louis". (Tucker and Reed 39:pl.1).
151	Aftermath claim	S½S½ sec. 10, T14S, R5E, SBM; Mineral Hill district, on southwest side of Mineral Hill.	Max and Catherine Heimburge, 939 5th Ave., San Diego 1, and J. D. Blosser, c/o C. S. Young, 1420 Valley View, Glendale (1956)	Narrow quartz veins in "hybrid" rocks composed of schist and quartz diorite.	One patented claim. Adjoins Boulder Creek group which lies to northwest. Prospected by several shallow cuts ar short adits. Remnants of a one-stamp mill are on property. Production neg ligible.
152	Anchor prospect	NE¼ sec. 20 or SE¼ sec. 17, T15S, R5E, SBM; Laguna Mountains, about 4½ miles west-southwest of Mount Laguna, just west of the west edge of Crouch Valley plateau.	C. F. and Anna Paull, 515 E. Avenue National City (1955)	Narrow quartz veins in schist.	Listed by Tucker and Reed (1939) as a prospect. No additional published in formation. Explored only by shallow cuts. No production. (Tucker and Reed 39:54).
153	Andes prospect	Secs. 12 and 13, T18S, R5E, SBM; about 2½ miles east of Campo.	Scott F. Edwards, Box 148A, Campo (1958)	An undescribed deposit.	Property consists of 13 claims. Explored by 4 adits - 20 to 60 ft. in length, and 2 shafts - 12 and 30 ft. deep. No production. (Scott F. Edwards, personal communication, 1958
	Antelope claim	Julian district, west of Banner.			Same as Gopher, which see. (Crawford 94:238; 96:331; Donnelly 34:350, 352, pl. 4; Hubon 02:6; Merrill 14:656, 657; Preston 90:544; Storms 93:380; Tucker 25:341).
	Anthony Ranch Placer	Sec. 35 or 36, T12S, R3E, SBM; Julian district.	Undetermined (1957)	A placer deposit.	In 1939 operated by Dan Lomax and Giles Taylor, Julian. See also Coleman Creek placer. (Tucker and Reed 39:16
	Apex claim				Earlier name for Empire claim, which see. (Donnelly 34:pl.4; Merrill 14: 656, 659; Tucker 21:377; Tucker and Reed 39:pl.1).
	April Fool	Sec. 14, T13S, R4E, SBM; Julian district, south of Banner.	E. R. Rousseau (1939)		Listed as prospect by Tucker and Reed (1939). No additional information. (Tucker and Reed 39:54).
	Aguajita (Aguajito)				See Elevada and Aguajito. (Donnelly 34:pl.4; Hubon 02:6; Merrill 14:656, 659; Tucker and Reed 39:18).
	Aguajito				See Elevada and Aguajito. (Donnelly 34:pl.4; Tucker and Reed 39:pl.1).
	Artery Consolidated				One time name for Donahoe mine, which see. (Crawford 96:331; Hubon 02:9).
	Asper	Sec. 2, T13S, R4E, SBM; Julian district, east of Banner.	Undetermined (1957)		Listed by Tucker and Reed (1939) as a prospect. Since sold to non-mining interests. (Tucker and Reed 39:54).
	Bailey Brothers mine				Local name for Ready Relief group prior to 1932. (Hanks 86:87).

Gold

ap No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
54	Ballena Placer deposits	Secs. 17, 18, 19, 20 and 21, T13S, R2E, SBM; within 4 miles east and southeast of Ramona.	Undetermined (1957) John Johnson, Escondido (1925)	Deposits consist of gold-bearing gravels derived from the Eocene Poway conglomerate which occurs as erosional remnants capping hills and ridges (also see text). Of principal interest in the Ballena area were gravels in the bed of the creek that originates in the N½SW¼ sec. 16 and extends westward across the SE¼SE¼ sec. 17, the N½N½ sec. 20, the S½ of sec. 18, and into Hatfield Creek. These gravels were derived from Poway conglomerate which caps ridges along both sides of the creek.	Deposits first worked by Indians prior to 1900, and by settlers in early 1900's. For descriptions of individual operations in this list see: Hopkins, San Vicente, Sawday Ranch, and Willard. Apparently, none of these operations was profitable; one reason was that there was very little water available for washing the gold. (Donnelly 34:369; Fairbanks 93a:91-92; Haley 23:156; Jenkins 46:157; Merrill 14:647, 652; Tucker 25:332-334; Tucker and Reed 39:16, pl. 1).
	Banner Creek placer deposits	Julian district, east of Banner, along Banner Creek.	Undetermined (1957)	Stream gravels.	Stream bed prospected in early days of the district. Drill hole samples taken prior to 1925 by J. L. Hill on San Felipe ranch said to have shown values from $0.30 to $1.50 per yard. (Tucker 25:332).
	Banner Gold claim				See Poor Man's group. (Tucker and Reed 39:25, pl. 1).
55	Banner Horseshoe prospect	Sec. 10, T13S, R4E, SBM; Julian district, northwest of Banner.	B. H. Sage, 5216 N. Mount Curve Ave., Altadena (1956)	Narrow quartz veins in zone between Julian schist and Stonewall quartz diorite.	A fraction between the Treasure Hill and Ready Relief claims. Reported by Frank Herron (personal communication, 1957) to be developed by a 30-ft. and an 85-ft. adit. No production. (Donnelly 34: pl. 1; Tucker and Reed 39:54, pl.1).
	Banner Placer claim	Sec. 3, T13S, R4E, SBM; Julian district, north of Banner.	Alex Anderson and Julia Seamster, Borrego Star Route, Julian (1956)		An undeveloped placer claim along Banner Creek.
56	Banner Queen prospect	Sec. 7 or 12(?), T13S, R5E, SBM; Julian district, east of Banner	William Mushet, Banner Queen Ranch, Borrego Star Route, Julian (1956)		No published information. Abandoned workings consist of a 300-foot adit and a 100-foot shaft. Property now part of Banner Queen ranch.
57	Barbara Worth (Bengal) group	Sec. 18 and NW¼ sec. 19, T15S, R5E, SBM; about 3 miles north-northeast of Pine Valley.	P. M. Reidy, 4063 Ingraham St., Los Angeles (1939)	Tucker and Reed (1939) reported that there is "a 6-ft. vein of quartz showing values in gold".	Group composed of 5 claims. Four of these are contiguous northwest-trending lode claims which transect Noble Canyon near its confluence with Pine Valley Creek. Also part of the group is a patented millsite claim in the center of the NW¼ of sec. 19. Workings consist of a 70-ft. shaft and a 50-ft. adit. Long idle. (Tucker and Reed 39:16,pl.1).
58	Barber Mountain (Gold Star, Hetty Green) mine	Sec. 19, T17S, R3E, SBM (proj.); about 5 miles northeast of Dulzura, on the southwest slope of Barber Mt.	L. G. Walker, Box 155, Jamul (1955)	Quartz veins in gabbroic and gneissic rocks. Workings explored two veins: one ranges in width from ½ to 2 in. and contains chalcopyrite and pyrite; the other is about 3 ft. wide but contains no apparent sulfide mineralization. It is heavily iron-stained, however. It strikes N35°E. and dips 70° northwest.	Patented, non-mining land. Discovered prior to 1900; explored by Barber Mountain Mining and Development Company from about 1907 to 1910. No production. Vein number one explored by adit driven N65°E for about 200 ft., then turned east for 100 ft.; now caved. Vein number two was explored by a 40-ft. shaft at a point 150-200 ft. southeast of, and 100 ft. higher than, portal of adit described previously. Between shaft and main adit, an adit was driven N55°E. for 75 to 100 ft.; now caved. (Merrill 14:665; Walker, L. G., oral communication, 1955). (R.M.S.)
	Bay View claim				One of claims in Noble group, which see. (Crawford 94:238; 96:332; Goodyear 90: 142; Merrill 14:663).
	Bedrock (Belrock, Lucky Ben, Nip and Tuck) claim				See Warlock group. Warlock mill on this claim. (Donnelly 34: pl. 4; Merrill 14:658; Tucker and Reed 39:28).
	Belmont claim	Julian district, south of Banner.			A claim that is part of the Ready Relief group, which see also. Prospected by shallow pits and trenches. (Donnelly 34: pl. 4; Merrill 14:656, 657; Tucker and Reed 39:26).
	Belrock				Incorrect spelling for Bedrock, which see. (Tucker and Reed 39:28).

Gold

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Ben Johnson claim (Gold Ray)				See C. B. mine.
	Bengal No. 1 and No. 2 claims	Sec. 18, T15S, R5E, SBM; Laguna Mts.			Reported by Tucker and Reed (1939) as a prospect. Bengal No. 2 claim is part of Barbara Worth group. Bengal No. 1 claim was adjacent to Bengal No. 2 on north (NW¼ sec. 18). See Barbara Worth group. (Tucker and Reed 39:54, pl. 1).
	Bertha mine	Montezuma (Rice) district.	Undetermined (1958) Rice Brothers, Warner Springs (1896)		Described by Crawford (1896). Probably relocated later as part of Montezuma mine, which see. (Crawford 96:332).
	Beyers group	Sec. 31, T14S, R5E, SBM; Deer Park district, about 6 miles north-northeast of Pine Valley.		Narrow quartz veins in diorite and schist.	Property now covered by Expansion group and Oak Canyon mine. The Beyers group originally consisted of 6 claims located about 1890 by John Beyers, of Descanso. During the 1890's Beyers worked the deposits intermittently from shallow workings, eventually constructed a 2-stamp mill, and probably produced a small amount of gold. About 1900, one of the 6 claims (the Cascade) was relocated by Messrs. Saybold and Sunnocks, of San Diego, who combined it with their own newly located claim, the Independence. By 1914, these two claims were known as the You Bet group and were owned by J. H. Schook, of Descanso, and J. L. Burns, of San Diego. (The You Bet group now is covered by the Oak Canyon mine, which see.) Beyers retained interest in the area, and early in the 1900's relocated 2 of his earlier claims as the Lone Jack and Expansion claims, to form the Expansion group, which see. (Crawford 96:332; Hubon 02:9; Merrill 14:662).
	Big Blue Claim				A name used prior to 1890 for a claim now covered by the Golden Gem group, which see. (Goodyear 90:146; Preston 90:542, 544).
	Big Four				See Golden Gem No. 3. (Donnelly 34: pl. 4; Tucker and Reed 39:pl.1).
159	Bill Hills prospect	Along south edge SW¼SW¼ sec. 9, T18S, R5E, SBM; about 3/4 mile northwest of Campo.	Hugh B. Martin, Merryline Ranch, Campo (1952)	Tucker and Reed (1939) stated that gold "occurs in quartz and porphyry".	On patented ranch land. Explored by a shaft, now caved, and an east-trending 25-ft. adit. (Tucker and Reed 39:17, pl.1).
160	Black Eagle mine	Near center(?) sec. 22, T11S, R2E, SBM; Mesa Grande district, about 1-3/4 miles north-northeast of Mesa Grande.	Undetermined (1957) Dela Angel, Mesa Grande (1939)	Quartz vein in "hybrid" (?) rocks composed of schist and quartz diorite. Vein strikes northeastward, dips northwest, and ranges in width from 1 to 2 ft. (F.J.H. Merrill, 1913, unpublished field report).	Discovered probably about 1889 and worked for a short period into the 1890's. Property then consisted of one unpatented claim and contained a 5-stamp mill. During the 1890's the deposit was bonded to the Shenandoah Mining Company which presumably processed a small amount of ore from this deposit in the Shenandoah mill. Shallow workings consisted of a 25-ft. shaft, an open cut 25 ft. long, and a 75-ft. adit (F.J.H. Merrill, 1913, unpublished field report). Production probably very small. In 1939 owner also held Red Hill claim in same area. See also Shenandoah mine. (Crawford 94:238; 96:332; Hubon 02:6, 9; Merrill 14:649; Tucker and Reed 39: 54, pl.1).
	Black Hawk group	Sec. 24 or 25 (?), T10S, R3E, SBM; 3/4 mile east of Warner Springs.	Undetermined (1958) T. E. Wilson (1939)		Four claims; listed by Tucker and Reed (1939) as a prospect. No additional information. (Tucker and Reed 39:54).
	Black Mountain				See text under "Arsenic".
	Bloodstone mine	"4½ miles east of Escondido" (Crawford, 1896).	Undetermined (1958) H. C. Brown, Escondido (1896)		25-ft. shaft. No additional published information. (Crawford 96:332; Merrill 14:649).

Gold

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Blue Bird	Sec. 11, T13S, R4E, SBM; Julian district, south of Banner.	Undetermined (1957) Earl J. Lusk (1939)		Listed by Tucker and Reed (1939) as a prospect. No additional published information. (Tucker and Reed 39:54, pl. 1).
	Blue Hill				See Gardner. (Donnelly 34:352, 355; Hubon 02:6).
	Bonnie Bell mine	Montezuma (Rice) district.	Undetermined (1958) Chatam Helm, Warner Springs (1896)	"Vein is from 2' to 10' wide--- strikes E., and dips 80° N."	A 15-ft. shaft and several superficial cuts. Same area as Montezuma mine, which see. (Crawford 96:332).
	Bottle Peak mine	"4 miles E. of Escondido".	Undetermined (1958) W. P. Bevington, Escondido		Described by Crawford (1896) as an extension of the "Escondido" mine, now known as the Cleveland-Pacific, which see. (Crawford 96:332).
61	Boulder Creek group	Boulder Creek district.			See text. (Everhardt 51:109, pl.3; Merrill 14:662; Tucker 25:334; Tucker and Reed 39:17).
	Boulder Creek mines				See Boulder Creek group. (Tucker 25: 334).
	Boulder Creek Mining and Milling Co.				See Boulder Creek group. (Merrill 14: 662).
62	Brier claim	NE¼ sec. 21(?), T15S, R5E, SBM; Laguna Mts.	J. B. McConnell, 8320 Truxton Ave., Los Angeles 45	Narrow quartz vein along contact between schist and granitic rocks.	Claim transects Laguna Mt. road just east of Crouch Valley.
63	Brown group	Sec. 8, T15S, R5E, SBM; Laguna Mts., about 4½ miles west-northwest of Mt. Laguna.	J. J. Brown, 3627 Bancroft, San Diego (1955)	Two veins in schist. Veins strike N30°W., dip 50°-60° northeast, and range in width from 4 to 8 ft.	Group of 4 claims located west of Frances group and south of Melba group prior to 1925. Long idle. Shallow workings. No production. (Tucker 25: 334; Tucker and Reed 39:pl.1).
	Buckeye group	T11S, R4E, SBM; Montezuma district, about 2½ miles west-northwest of Ranchita.	Undetermined (1957) H. Galbraith, Warner Spgs. (1914)		An undescribed deposit on which 7 claims were located. One of the claims was reported to be on the Montezuma vein. See also Montezuma mine. (Merrill 14: 648).
	Butte No. 2 prospect	Sec. 5, T15S, R5E, SBM; about 9 miles southeast of Julian, west of Mason Valley.	Undetermined (1958) H. L. Neild (1939)		A claim listed by Tucker and Reed (1939) as a prospect. No additional published information. See also Two Bills, under "Tungsten". (Tucker and Reed 39:54).
	Butte prospect	"5 miles southeast of Julian".	Undetermined (1957) Tony Floersch et al. (1939)		Listed by Tucker and Reed (1939) as a prospect. No additional published information. (Tucker and Reed 39:54).
64	C. B. mine (consists of Ben Johnson claim, formerly Gold Ray; and Cold Beef claim, formerly Gold Reef)	Secs. 14 and 23, T13S, R4E, SBM; Julian district, south of Banner, in Chariot Canyon.	Ed Faris and Ben F. Johnson, Box 43, Julian (1955)	Southward extension of Golden Chariot deposit. Vein strikes N14°W. and dips about 76° east.	Adjoins Golden Chariot on south. Developed by 115-ft. shaft on vein, plus open cut and shallow shafts. A 25-ton mill on property never used except for small amount of custom work. No recorded production, but property at one time was part of Golden Chariot operation. (Donnelly 34: pl. 4; Stewart 58:26; Tucker 25:337; Tucker and Reed 39:20, pl. 1).
	Cable claim				See Gold Cross No. 2 claim. (Crawford 96:332-333; Donnelly 34:352; Goodyear 90:146-147; Hubon 02:6; Merrill 14:656, 660; Preston 90:543).
	California claim	Julian district.			Adjacent on southeast to El Dorado claim. Workings of Ella mine, which see, are within probable boundaries of this claim, as shown by Donnelly (1934, pl. 4). (Donnelly 34: pl. 4; Hubon 02:6; Merrill 14:656, 658).

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Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Canadian claim	Sec. 4, T13S, R4E, SBM; Julian district, southeast of Julian.			A small fraction which formerly overlapped the Gardner claim. Now part of the Golden Gem group, which see in text. (Tucker and Reed 39:pl.1).
	Carp claim	Julian district, southwest of Banner.			A claim in the Ready Relief group. Prospected by shallow pits and trenches. See Ready Relief group in text. (Donnelly 34:pl.4; Merrill 14:656, 657; Tucker and Reed 39:26).
	Carson Ranch placer claim	NW¼ sec. 10, T18S, R8E, SBM; about 1½ miles east of Jacumba.	J. L. Shea Carson (1939) (now deceased) Undetermined (1958)		No additional published information. Claim no longer valid. (Tucker and Reed 39:54).
	Cascade claim	Deer Park district.			See Beyers group and Oak Canyon mine. (Crawford 96:332; Everhardt 51:111, pl 3; Merrill 14:662).
165	Cash Entry group	SW¼ sec. 30 and NW¼ sec. 31, Deer Park district, about 6½ miles north-northeast of Pine Valley.	Undetermined (1957) W. R. Biggs (1939)		Inextensive workings in a shallow northwest-trending canyon. Listed by Tucker and Reed as a prospect. Seven claims in group. No additional published information. (Tucker and Reed 39:54, pl.1).
166	Challenger prospect	Sec. 2, T13S, R4E, SBM; Julian district, north of Banner.	Undetermined		An undescribed deposit. (Donnelly 34: pl. 4; Hanks 86:83).
	Chaparral claim				Now called Warlock claim. See Warlock group in text. (Crawford 94:239; 96: 334; Donnelly 34:350, 352; Hubon 02: 6; Merrill 14:656, 659; Preston 90: 544).
	Chariot				See Golden Chariot mine in text. (Merrill 14:654; Newman 23:106).
	Chariot No. 4 and No. 5 claims				See Poor Man's group. (Tucker and Reed 39:25, pl. 1).
	Chariot North claim				See Golden Chariot mine in text. (Donnelly 34:pl.4); Merrill 14:656, 658; Tucker and Reed 39:19, pl.1).
	Charley K prospect	T15S, R5E, SBM; "west of Noble Canyon."	Undetermined (1958) Charles Keiser (1939)		No additional published information. (Tucker and Reed 39:54).
	Chase Ranch				See Phillips mine.
167	Chieftain mine	Sec. 31, T12S, R4E, SBM; Julian district, north of Julian.	Ray and Thelma Jacobs, P.O. Box 207, Julian (1956)	Narrow quartz vein which strikes northwestward and dips 75° east.	Property consists of one northwest-trending claim which adjoins northeast side of Owens property (see claim map in text). Developed by two adits. Lower adit is a 230-ft. crosscut with an appended 70-foot drift and stope on the vein. Upper adit is about 50 feet above lower one and is about 70 feet long (see composite map in text). Output estimated by Donnelly (1934) to be less than $25,000. (Donnelly 34: 352,pl.4; Goodyear 90:145; Merrill 14:656, 658; Stewart 58:27; Tucker and Reed 39:pl.1).
168	Cimarron (Cimmeron) prospect	Sec. 20, T15S, R5E, SBM; Laguna Mts.	E. V. and L. E. Twyman, 6522 Kelley, San Diego 11 (1955)		Listed by Tucker and Reed (1939) as a prospect. (Tucker and Reed 39:54, pl.1).
	Cimmeron				See Cimarron prospect. (Tucker and Reed 39:pl.1).

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Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Cincinnati				See Cincinnati Belle mine. (Tucker and 39:21, pl.1).
59	Cincinnati Belle (Cincinnati) mine	Sec. 3, T13S, R4E, SBM; Julian district, west of Banner.	Fred H. Farmer, Star Route, Santa Ysabel (1957)	Quartz lenses in schist; strike northwest, dip steeply southwest.	Formerly part of Kentuck group. Developed by 200-ft. adit, and a 230-ft. shaft with levels at 50-ft. intervals. Level workings total less than 700 ft. in length. The long crosscut adit of the Kentuck group extends under the Cincinnati Belle claim, but no exploration there. During 1890's yielded about $30,000 worth of gold at ($20 per ounce). Total production estimated to be at least $50,000. Idle since about 1900. (Crawford 94:239; 96:334; Donnelly 34:352, pl.4; Goodyear 90:147; Hubon 02:6; Merrill 14: 656, 659; Preston 90:542; Stewart 58:27; Storms 93:380-381; Tucker 25: 340-341; Tucker and Reed 39:19, 21, pl.1).
	City of Richmond				See Golden Gem No. 3 claim. (Tucker and Reed 39:pl.1).
	Clark mine	"9 miles N.E. of Descanso" (Crawford, 1896).	Undetermined (1958) Clark, Descanso (1896)		In Laguna Mountains region, which see in text. Described only by Crawford. (Crawford 96:334).
70	Cleveland-Pacific (Escondido) mine	Southeast of Escondido.			See text. (Crawford 94:240; 96:336; Goodyear 88:524-525; Merrill 14:649, 650-651; Storms 93:382; Tucker 25:335; Tucker and Reed 39:pl.1).
	Clifton mine	"9 miles S.W. of Escondido" (Crawford, 1896)	Undetermined (1958) Q. R. Smith, et al, Santa Ana (1896)	Crawford (1896) stated: "..deposits occur in the broad zones of crushed felsite. It is heavily mineralized and stained with iron oxides. ..Ore shoots strike N. 15° W., and dip 80° N.E."	Deposits were explored in the mid-1890's by several open cuts and short adits. They probably are in same area as Pioneer and Harris pyrophyllite deposits which were first mined in 1946. (Crawford 96:334; Merrill 14: 651).
71	Coarse Gold prospect	Sec. 2(?), T14S, R3E, SBM; Boulder Creek district, about 6½ miles south of Julian.	Undetermined (1957) Donald Wallace (1939)	Tucker and Reed (1939) reported an "8-ft. stringer vein in schist".	Composed of 3 claims; explored by a shaft 80 ft. deep and an adit 25 ft. long. Idle since prior to 1939. (Tucker and Reed 39:17, pl.1).
	Coe prospect				About 100 yards east of the Phillips mine. Now subdivided. Worked from 1932 to 1935 by D. H. Coe and E. T. Moriarity, and as late as 1940 by a Mr. Frank. Ore milled at Parsons mine. Output included with total for Phillips mine, which see. (Tucker and Reed 39:17, pl. 1).
	Coinage				See Lucky Chuck mine. (Tucker and Reed 39:pl.1).
	Cold Beef (Gold Reef)				See C. B. mine.
72	Coleman Creek (Anthony Ranch) placer deposits	Secs. 35 and 36, T12S, R3E, SBM; Julian district, west of Julian, along Coleman Creek.	Undetermined (1957)	Placer gravels.	The earliest prospecting and recovery of gold in the Julian area occurred along Coleman Creek, near Wynola, late in 1869. This activity preceded the first discovery of lode gold on the present-day George Washington and Van Wert claims. Placer mining said to have continued until 1880. Some gold recovered during the late 1930's. (Donnelly 34:349; Haley 23:156; Tucker and Reed 39:16).
	Comet mine				See Donahoe mine in text. (Crawford 96:334).

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Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
210a	Contact claim				See Kentuck group. Portal of long exploratory adit for Kentuck group on this claim. (Donnelly 34:pl.4; Merrill 14: 656, 658; Tucker and Reed 39:21).
	Coyote				See Redrock group. (Crawford 96:334; Merrill 14:651).
173	Cravath mine	SE¼SE¼ sec. 23, T12S, R2W, SBM (proj.); nearly 2 miles east-southeast of Escondido city hall, in an area covered by a citrus grove, northwest of intersection of San Pasqual highway and Bear Valley road (see map in text).	Claire Houghtelin, Escondido (1957)	Deposit probably part of northeast extension of zone explored to southwest by Oro Fino and Cleveland-Pacific mines.	Patented ranch land; in Lot 2, Block 32 Rincon del Diablo grant. By 1957 the workings were inaccessible and almost completely obliterated. The property was described by Merrill (1914, p.651 as follows: "The depth of the shaft is 100 feet. Only a short drift has been carried along the vein. But little work has been done and no production has been yet attained. No mill". (Crawford 94:239; 96:334; Goodyear 88:524-525; Merrill 14:649, 651; Storms 93:382).
	Crescent mine	"in Crescent Valley, 3 miles S.W. of Escondido" (Crawford, 1896).	Undetermined (1958) Ranford Worthing, Escondido (1896)		65-ft. vertical shaft. No additional published information. (Crawford 96: 334).
221a	Curry claim				See Madden group in text. (Donnelly 34:pl.4).
	Dark Horse group	Sec. 14, T13S, R4E, SBM; south of Banner.	Undetermined (1957) L. Bittner (1939)		Listed by Tucker and Reed (1939) as a prospect. No additional published information. (Tucker and Reed 39:54)
174	Decker prospect	SW¼ sec. 16, T15S, R4E, SBM; about one mile northwest of Pine Valley.	Undetermined (1957)	Swarm of quartz stringers in Bonsall tonalite contain sparse gold.	Developed by a 180-ft. prospect adit an an 80-ft. shaft. Shaft full of water in 1946. (Everhardt 51:112, pl.3).
	Deer Park group	Sec. 31, T14S, R5E, SBM; Deer Park district, about 6 miles north-northeast of Pine Valley.	Undetermined (1958) Dr. Frank Kaentz (1939)		Listed by Tucker and Reed (1939) as a prospect. No additional published information. (Tucker and Reed 39:54)
175	Descanso (Descanso Mining Company, Ellis, Magdalena) mine	Sec. 24, T15S, R3E, SBM; about 1½ miles northwest of Descanso Junction, just northwest of Descanso Guard Station.	Wilbur A. Martin, 1516 Kettner Blvd, San Diego (1955)	Several parallel, east-trending quartz veins in Bonsall tonalite. Quartz contains gold-bearing pyrite, galena and other sulphides; free gold very sparse. Grade reported to range from $10 to $50 per ton (at $20 per ounce).	Two patented lode claims of 40 acres. Principal exploration was from 230-ft inclined shaft, now caved near surface. Shaft was sunk on Magdalena vein which dips 70° to 80° north; vein is 1 ft. wide near surface, increasing to 3 ft. in lower levels. Drifts on 4 levels (at intervals of 26, 40, 60 and 80 ft.) explored vein for 80 ft. west of shaft. Several raises from 1st level to surface, and 60 ft. stope above 1st level. Area first prospected at least as early as 1880's. Descanso deposit discovered in 1900 and explored sporadically through mid-1920's. Several thousand dollars of gold and small amount of silver produced during period from 1932 to 1936. Workings inaccessible in 1957. (Eric 48:320; Everhart 51: 112, pl.3; Merrill 14:664; Miller 35: 137; Tucker 24b:371; 25:335; Tucker and Reed 39:pl.1). (R.M.S.)
	Descanso Mining Company				See Descanso mine. (Tucker and Reed 39:pl.1).
	Dewey				See Grapevine Star mine. (Merrill 14: 648-649).
176	Donohoe (Artery Consolidated, Comet, Donahue, Golden Artery) mine	Dulzura district, south of Engineer Springs, near Mexican border.			See text. (Crawford 96:331, 335; Hubon 02:9; Merrill 14:664-665; Storms 93: 382-383; Tucker and Reed 39:17, pl.1)

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Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Donahue				See Donahoe mine in text. (Tucker and Reed 39:17, pl.1).
77	Doolittle group	Sec. 16, T18S, R2E, SBM; Dulzura district, about 2½ miles south of Engineer Springs, in eastern San Ysidro Mts.	Undetermined (1957) A. R. Majors (1939)		Undeveloped claims probably located in Mine Canyon between Johnston and Donahoe groups. (Tucker and Reed 39: 54, pl.1).
	Dulzura district	Southeast part of San Ysidro Mountains.			See Donahoe mine, Doolittle group, and Johnston's mine. (Crawford 96:335; Merrill 14:665; Storms 93:382-383).
	Duplex and Apex. North Star Annex				See North Star group. (Tucker and Reed 39:pl.1).
	E. A. Harper Ranch				See Harper Ranch mine. (Tucker and Reed 39:21, pl.1).
78	Eagle mine	Secs. 31 and 32, T12S, R4E, SBM; Julian district, north of Julian.	Ida Wellington, 3511 Pershing Ave., San Diego (1956)	Deposit consists of quartz veins enclosed concordantly with layering of mildly metamorphosed siltstone (Julian schist). Three narrow veins worked from main crosscut adit strike N. 70°-80°W. and dip 50°-80° northeast (see composite map in text). These veins range in width from ½ to 12 in. The gold occurs free in the quartz.	One west-northwest trending claim that adjoins the south-southwest side of the High Peak claim. The claim was located in 1870; it is unpatented. Principal working is a north-northeast trending crosscut adit 358 ft. long (see composite map). This working intersects the northwest-trending drift adit of the High Peak mine. Appended to the crosscut adit are 3 west-northwest trending drifts which from south-southwest to north-northeast are 143, 37, and 157 ft. long. About 170 ft. west of the portal of the crosscut adit, a 260-ft. drift adit extends northwestward on the same vein explored by the 37-ft. drift. Ore was mined from narrow stopes in the drifts and drift adit. Total value of production was estimated by Donnelly (1934) to be between $25,000 and $50,000. Mine operated during early 1870's, then mine and/or mill operated nearly continuously on a small scale from late 1880's to 1939. Operated from 1925 to 1939 by Sid Dodge of Julian. (Crawford 96:335; Donnelly 34:350, 352, 362, pl.4; Eric 48:320; Goodyear 90:145; Hanks 86: 83, 85; Hubon 02:6; Merrill 14:656, 658; Tucker 25:335, 336; Tucker and Reed 39:17-18, pl.1).
79	Eagle Nest (Fargo) mine	Sec. 25, T16S, R4E, SBM (proj.); about 5 miles south of Pine Valley, on the south side of the Long Valley Truck Trail.	Fred A. Storey, 307 N. Broadway, Santa Ana (1955)	Workings are on a mineralized shear zone which strikes N. 80°-85° W. and dips 55°-75° south in Bonsall tonalite. The zone contains quartz veins which range in width from 1 in. to at least 6 in. and contain free gold, silver, pyrite, and arsenopyrite (Everhardt, 1951). Ore averaged about ½ ounce of gold and ¼ ounce of silver per ton.	The zone is developed laterally for about 300 ft. Principal working is a two-compartment inclined shaft which was probably about 200 feet deep, but is now partly caved. Other workings include a 75-ft. shaft, a 50-ft. shaft, and stopes which have been glory-holed to the surface. A large dump is adjacent to the collar of the two-compartment shaft. Operated intermittently from 1939 to 1950, and yielded about $20,000 worth of gold (at $35 per ounce) and 300 ounces of silver. See also Long Valley mine. (Everhardt 51:112, pl. 3).
	East California claim	Julian district.			A claim that is part of the Warlock group, which see in text. (Donnelly 34:pl.4).
	El Diablo				See Oro Fino mine. (Tucker and Reed 39: pl.1).
80	El Dorado claim	Secs. 32 and 33, T12S, R4E, SBM; Julian district, about 1½ miles east of Julian.	John H. Mahon, Box 237, Julian (about 1955)	Narrow quartz vein in schist.	Adjacent on northwest to California claim. Donnelly (1934) estimated value of production to be "less than $25,000." Long idle. (Donnelly 34: 352, pl.4; Hubon 02:7; Merrill 14: 656, 658).

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Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
181	Elevada and Aguajito group	Secs. 1, 2, 11, and 12, T13S, R4E, SBM; Julian district, southeast of Banner.	Michael Mushet, Banner Queen Ranch, Borrego Star Route, Banner (1956)	Gold-bearing lenses of quartz in zone that strikes northwestward and dips 60° southwest in quartz diorite. Zone ranges in width from 2 to 10 ft.	Three side by side, north-northwest trending claims (Elevada, Aguajito, and Millsite) patented in 1903. Elevada claim mined from 160-ft. inclined shaft having levels at 50 and 100 ft., and from 685-ft. crosscut adit driven southwest from Aguajito claim. Drift from crosscut adit extends 170 ft. to southeast on vein. Deposit worked during the late 1890's and yielded at least $15,000 worth of gold (at $20 per ounce). Donnelly (1934, p. 352) estimated the value of the total output to be between $25,000 and $50,000. (Crawford 96:335; Donnelly 34:350, 351, 352, 353, pl.4; Hubon 02:6, 7; Merrill 14:656, 659; Tucker and Reed 39:18, pl.1).
	Elevado and Aguajito group				See Elevada and Aguajito group. (Tucker and Reed 39:18).
182	Elk and Landslide deposit	W½NW¼NE¼ sec. 3, T14S, R3E, SBM; Boulder Creek district, about 7 miles south-southwest of Julian.	Ella Kelly, 1538 Granada St., San Diego (1957)	Two quartz veins in "mixed rocks". The quartz contains pyrite, pyrrhotite, and gold.	Two claims were located many years ago by R. D. and B. F. Moore. Long idle and nearly inaccessible. (Everhardt 51:110; Tucker 25:336; Tucker and Reed 39:18, pl.1).
183	Ella (Old Ella) mine	Sec. 33, T12S, R4E, SBM; Julian district, on west slope of Banner Canyon.	John M. Collins, Borrego Star Route, Julian (1957)	Narrow gold-bearing quartz veins in Julian schist.	One unpatented claim. In January 1957, owner was driving an exploratory crosscut adit westward. At that time an aerial tram extended from workings on slope to small stamp mill (recently reconstructed) adjacent to owners residence on west side of highway. Operated chiefly before 1900 and intermittently since 1939 on a very small scale by present owner. Total production probably between $30,000 and $35,000 in gold ($20 per ounce). See also California claim. (Crawford 94: 239-240; 96:339; Donnelly 34:352; Hanks 86:85; Hubon 02:6, 7; Merrill 14:656, 658; Tucker and Reed 39:55, pl.1).
	Ellis				See Descanso mine. (Tucker 24b:371; 25:335).
	Empire claim	Sec. 3, T13S, R4E, SBM; Julian district, near Banner.	Frank Herron, Banner grade, Julian; or 468 Acheson, Pasadena 6 (1957)	Quartz vein in Julian schist.	Formerly part of Melrose group, now part of Kentuck group, which see. Prospected by adit and short drift. (Donnelly 34:pl.4; Merrill 14:656, 659; Tucker 21:377; Tucker and Reed 39:pl.1).
	Encino				See Golden Duke group. (Tucker and Reed 39:pl.1).
	Escondido				See Cleveland-Pacific mine, in text. (Crawford 94:240; 96:336; Goodyear 88 524-525; Merrill 14:649, 650-651; Storms 93:382; Tucker 25:335).
184	Ester group	S½ sec. 32, T14S, R5E, and N½ sec. 5, T15S, R5E, SBM; Laguna Mts., about 5 miles northwest of Mt. Laguna.	Undetermined (1957) James Fox, Guatay (1925)	Tucker (1925) reported that quartz "veins occur in schist and strike N.20° W." Northward extension of Melba deposit.	A prospect. Group originally comprised three claims. No workings could be located in the area in 1957. (Tucker 25:336; Tucker and Reed 39: pl.1).
	Eureka claim				One of claims in Noble group, which see in text. (Crawford 94:240; 96: 336; Goodyear 90: 141-142; Hubon 02:9 Merrill 14:663).
185	Eureka group	SE¼ sec. 14 and NE¼ sec. 23, T13S, R4E, SBM; Julian district, south of Banner.	Charles W. Carey, Julian (1955)	Partly a southward extension of the Golden Chariot deposit.	A prospect; 5 north-trending claims. (Tucker and Reed 39:54).

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Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Expansion claim				See Expansion group. (Merrill 14:662).
36	Expansion group	NW¼ sec. 31, T14S, R5E, SBM; Deer Park District, about 6½ miles north-northeast of Pine Valley.	C. E. Ducret, Box 44, Guatay (1955)	Narrow quartz veins in diorite and schist.	Group originally located in early 1900's by John Beyers, of Descanso. It then consisted of Lone Jack and Expansion claims which Beyers located in the area formerly covered by his Beyers group (which also see). In 1955 the group consisted of 6 claims. The workings are shallow and inextensive. Production negligible. (Crawford 96;332; Merrill 14:663; Tucker 25:336; Tucker and Reed 39: pl.1).
	Fargo				See Eagle Nest mine. (Everhardt 51:112).
	Fee claim	"½ mile southeast of shiners camp, Laguna Mountains." (Probably Shriners Lodge, sec. 3, T15S, R5E, SBM).	Undetermined (1958) Harry Fee (1939)		Listed as a prospect by Tucker and Reed (1939). No additional published information. (Tucker and Reed 39:54).
	Fountain	Julian district, southwest of Banner.			Part of Ready Relief group, which also see in text. Prospected by shallow pits and trenches. (Donnelly 34: pl.4; Merrill 14:656, 657; Tucker and Reed 39:26).
	Fraction				See Gold Cross No. 1. (Crawford 96: 332-333, 336; Donnelly 34:352, 360-361; Goodyear 90:146-147; Hubon 02:6; Merrill 14:656, 660; Preston 90:543; Tucker and Reed 39:pl.1).
87	Frances group	Sec. 8, T15S, R5E, SBM; Laguna Mts., about 4½ miles west-northwest of Mt. Laguna, west of Noble Canyon.	Undetermined (1957) Randcliff Heineman, et al, San Diego (1925)	Several parallel quartz veins in schist strike N. 20°W. and dip northeast. The veins range in width from 8 to 10 ft.	Group of 5 claims located prior to 1925 east of Brown group and south of Melba group. Explored by short adits. In 1957 claims probably no longer valid. Long idle. Production negligible. (Tucker 25:336; Tucker and Reed 39:19, pl.1).
	Francis group				See Frances group. (Tucker and Reed 39: pl.1).
	Free Coinage (Coinage)				See Lucky Chuck mine. (Everhardt 51: 111; Hubon 02:7; Merrill 14:663; Tucker 25:336-337; Tucker and Reed 39:19, pl.1).
	Gardiner mine				Former name for the Golden Gem group, which see. (Donnelly 34:352, 355, pl.4; Goodyear 90:146; Hubon 02:6; Merrill 14:656, 659; Preston 90:542, 544; Tucker 40:12; Tucker and Reed 39:19, pl.1).
	Gardner claim				Part of the Golden Gem group, which see in text. (Donnelly 34:352, 355, pl.4; Goodyear 90: 146; Hubon 02:6; Merrill 14:656, 659; Preston 90:542, 544; Tucker and Reed 39:19, pl.1; Tucker and Sampson 40:12).
	Garnet Canyon placer deposit	Undetermined.	W. J. Flynne, San Diego (1932)		A one-sentence reference only. Slightly less than $1,000 production 1932 to 1933. (Tucker and Reed 39:16).
	Gem				An abbreviation of Golden Gem. See Golden Gem group in text. (Tucker and Reed 39:pl.1).
	Geneva mine	"3 miles E. of Escondido" (Crawford, 1896).	Undetermined (1958) Geneva Mining Co. Santa Ana; H. C. Brown, Escondido, Mgr. (1896)	"A dike of felsitic rock about 100' thick, which strikes N.E..." stained with iron oxides.	Described only by Crawford (1896) who reported the mine to contain 3 shafts including one 75 and one 30 ft. deep. Location not determined during this investigation. (Crawford 96:336-337).

Gold

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	George Washington				See Washington mine. (Donnelly 34:349, 350; Hanks 86:82, 83).
	Gold Cliff claim	Mesa Grande district.			A prospect. Location undetermined. (Merrill 14:649).
210b	Gold Cross No. 1 (Fraction) claim	Secs. 3 and 10, T13S, R4E, SBM; Julian district, west of Banner.		Two parallel, narrow veins, named Knelly and Cable, in schist; width ranges from 1 in. to 2 ft., strike northwest, dip nearly vertical. Gold in quartz, and in places associated with rather large concentrations of arsenopyrite. Average grade of ore was reported to be in excess of 5 oz. of gold per ton.	Now part of Kentuck group which see also. Mined from 3 adit levels, whose aggregate length is more than 700 ft., and from 65-ft. shaft. Donnelly (1954) estimated production to be less than $25,000. (Crawford 96:332-333, 336; Donnelly 34:352, 36 361, pl.4; Goodyear 90:146-147; Hubo 02:6; Merrill 14:656, 660; Preston 9 542-543; Stewart 58:29; Tucker and Reed 39:19, pl.1).
188	Gold Cross No. 2 (Cable) claim	Sec. 10, T13S, R4E, SBM; Julian district, southwest of Banner.	F. H. Farmer, Star Route, Santa Ysabel (1957)	Quartz vein in schist, parallel to vein covered by Gold Cross No. 1 claim.	Northwest of Ready Relief claim. Explored by 80-ft. shaft and adit. Donnelly (1934) estimated production to be less than $25,000. (Crawford 96:332-333; Donnelly 34:352, pl.4; Goodyear 90:146, 147; Hubon 02:6; Merrill 14:656, 660; Preston 90:543; Tucker and Reed 39:pl.1).
189	Gold Crown group	Secs. 1 and 12, T14S, R3E, SBM; Boulder Creek district, about 7½ miles south of Julian, on a ridge just north of Boulder Creek.	Undetermined (1957) R. D. and B. F. Moore, Julian (1925)	North-trending quartz vein nearly ¼ mile long in quartz diorite. Vein is reported to be one ft. wide and to contain $2 in gold per ton where intersected by workings.	Workings consist of an east-driven crosscut adit. No production. Long idle. (Everhardt 51:110, pl.3; Tucker 25:337; Tucker and Reed 39: pl.1).
	Gold Dollar Nos. 1 and 4 claims	Pine Valley district.	Undetermined (1957) Ignatz Rottman, 985 National Ave., Chula Vista (1939)	Reported by Tucker and Reed (1939) to consist of a "vein of mineralized schist".	Workings consist of a 100-ft. and a 25-ft. shaft. No additional published information. (Tucker and Reed 39:20)
	Gold King deposit	Southwest corner sec. 1, T18S, R2E, SBM; about 2½ miles northwest of Barrett Junction.	Undetermined (1957) Coppin and Loud, 743 6th Street, San Diego (1888)		A supposed rich find reported by Goodyear as hearsay. Location unconfirmed. (Goodyear 88:522).
190a 190b	Gold King group	Sec. 15, T13S, R4E, SBM; Julian district, about 4 miles southeast of Julian.	O. F. Heckelman, 638 Gravilla St., La Jolla (1957)	High grade gold ore in thin quartz stringers in zones in Julian schist and Stonewall quartz diorite. Zones strike about N.30°W., and dip 50°-80° northeast. Early reports state that ore was extremely rich.	Includes Gold King, Gold King Nos. 2 an 3, and Gold Queen claims. Patented. Discovered in 1888, nearly 20 years after first discoveries in Julian district. Gold King is explored by 134-ft. shaft and appended 100-ft. drift. Gold Queen shaft, which is about 600 ft. to southeast of Gold Queen workings, on parallel zone, is 200 ft. deep with a 400-ft. appended drift. Mine worked until about 1900. Ore was processed in small mill, as shown in photograph in text. Value of production for Gold Queen and Gold King claims combined was estimated by Donnelly (1934, p. 352) to be less than $50,000. (Crawford 94:241; 96:337; Donnelly 34:350, 351, 352, 35 369, pl.4; Goodyear 88:520; 90:143-144; Hubon 02:7; Irelan 88:513; Merrill 14:656, 658; Preston 90:543; Storms 93:381; Tucker and Reed 39:20)
	Gold Leaf claim				See Kentuck group. (Donnelly 34:pl.4; Tucker and Reed 39:21).
	Gold Luck prospect	Sec. 11, T13S, R4E, SBM; Julian district, south of Banner.	Undetermined (1957) formerly owned by R. G. Melrose, now deceased.		No additional published information. (Tucker and Reed 39:54, pl.1).
	Gold Queen claim				See Gold King group. (Crawford 94:241; 96:337; Donnelly 34:352, 353, 369, pl.4; Hubon 02:7; Merrill 14:656, 658, Tucker and Reed 39:20).

Gold

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Gold Ray				See C. B. mine. (Donnelly 34:pl.4).
	Gold Reef				See C. B. mine. (Donnelly 34:pl.4; Tucker 25:337; Tucker and Reed 39:20, pl.1).
	Gold Standard and North Star mines				See Gold Standard group. (Everhardt 51:111; Tucker 24a:371-372; 25:337, 353; Tucker and Reed 39:pl.1).
91b	Gold Standard group (Gold Standard and North Star mines)	NE¼ sec. 12, T15S, R4E, SBM; on the east side of upper Pine Valley, about 4-1/3 miles north of Pine Valley Lodge.	Undetermined (1957) J. F. Gage, San Diego (1925)	North-trending quartz veins in "mixed" rocks which consist of schist and quartz diorite. Quartz contains pyrite, marcasite, free gold, and scheelite. Two parallel veins on Gold Standard claims dip 45° west: principal development is on east vein which is 4 ft. wide. On North Star claims North Star vein dips 35° west and ranges in width from 4 to 8 in. (Tucker, 1924, p. 371).	Discovered in 1886. Tucker (1924, 1925) reported that Gold Standard mine consisted of 6 claims and adjoining North Star mine consisted of 4 claims. Principal workings of the Gold Standard claims consist of 2 north-trending drift adits on east vein: the upper adit is 150 ft. long and the lower adit, 50 ft. below, is 190 ft. long. Workings of the North Star claims consist of an inclined shaft 50 ft. deep on North Star vein and a 190-ft. east-trending crosscut adit which intersects the vein. In 1925 a 20-ton ball mill, with amalgamation plates was on the property. Deposit was prospected for tungsten in early 1940's. Production of gold and tungsten probably very small. (Everhardt 51:111; Kerr 46:165; Jenkins 42:353; Partridge 41:317; Tucker 24a:371-372; 25:337, 353; Tucker and Reed 39:pl.1).
91a	Gold Standard prospect	Sec. 10, T13S, R4E, SBM; Julian district, south of Banner.	Undetermined (1957) formerly owned by Mike Morani, now deceased.		Adjoined Fountain claim on southeast. No additional published information. Tucker and Reed 39:54, pl.1).
	Gold Star				See Barber Mountain mine. (Merrill 14: 665).
	Golden Artery claim				One of two patented claims of the Donahoe mine, which see. (Merrill 14:665; Tucker and Reed 39:pl.1).
92	Golden Chariot mine (includes Chariot North and Golden Chariot claims)	Julian district, south of Banner.			See text. (Crawford 94:240; 96:337; Donnelly 34:345-346, 349, 350, 351, 352, 353, 355, 359-360, 361, 363, 365, 367, 368, pl.4; Goodyear 90:147; Hanks 86:86; Merrill 14:654, 656, 658; Newman 23:106; Stewart 58:29; Tucker 21:377; 24a:372; 25:337-339; Tucker and Reed 39:19-20, pl.1).
	Golden Crescent mine	"3 miles S.W. of Escondido" (Crawford, 1896).	Undetermined (1958) J. B. Carrol, et al Escondido (1896)		A prospect described only by Crawford. (Crawford 96:337).
	Golden Crown claim	"5 miles SE of Oak Grove."	Undetermined (1958) Mrs. T. E. Wilson		Listed by Tucker and Reed as a prospect. See also Black Hawk group. (Tucker and Reed 39:54).
93	Golden Duke (Encino?) group	At common corner of sections 4, 5, 8, and 9, T9S, R3E, SBM; north of Chihuahua Valley, near Riverside County line.	Roscoe P. Tompkins, 559 Encinitas St., San Diego (1951)	Quartz vein 1 ft. to 2½ ft. wide strikes N.80°W., dips 70° south, in schist.	Probably the same Golden Duke described by Tucker and Reed (1939) as being in SW¼ sec. 5. Probably synonymous with Encino which was plotted in S½ sec. 4 by Tucker and Reed. Developed by shaft at least 100 ft. deep, but inaccessible. Additional, shallow workings lie 1,500 ft. to west-northwest of shaft. (Tucker and Reed 39: pl.1).
94	Golden Ella prospect	Sec. 14, T13S, R4E, SBM; Julian district, south of Banner.	George L. Herrington, 1805 S. 43rd St., San Diego (1957)	Narrow quartz vein in quartz diorite strikes N.10°E., dips 50° southeast.	Joins east side of Chariot North claim. Explored by 130 ft. shaft, inclined on vein. (Tucker and Reed 39:20, pl.1).
95	Golden Gem group (Big Blue, Blue Hill, Gardiner, Gardner, Gem mine)	Julian district.			See text. (Donnelly 34:352, 355, pl. 4; Goodyear 90:146; Hubon 02:6; Merrill 14:656, 659; Preston 90:542, 544; Tucker 40:12; Tucker and Reed 39:19, pl.1).

Gold

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Golden Gem Nos. 1 and 2 claims				See Golden Gem group in text. (Donnell 34:pl.4; Merrill 14:656, 659; Tucker and Reed 39: pl.1).
	Golden Harp prospect	Sec. 20, T15S, R5E, SBM; Laguna Mts.	Undetermined (1957) Chas. Keiser (1939)		No additional published information. (Tucker and Reed 39:54, pl.1).
	Golden Lola prospect	Sec. 11, T13S, R4E, SBM; Julian district, southeast of Banner.	Charles Carey and Assoc., Julian (1939)		Two claims. No additional published information. (Tucker and Reed 39:54
196	Golden Rule prospect	Sec. 4, T13S, R4E, SBM; Julian district, east of Julian.	Cecil J. and Fred J. Creese, Julian (1957)	Southward extension of Helvetia ore zone.	Unpatented claim which adjoins Jumper claim on southeast. Explored by adit driven S.15°W. at least 200 feet. No reported production. (Donnelly 34: pl.4).
	Golden Star No. 1 claim	Sec. 21, T17S, R5E, SBM; about 5 miles north of Campo.	Undetermined (1958) R. E. Clark (1939)		Listed by Tucker and Reed (1939) as a prospect. No additional published information. (Tucker and Reed 39:54).
	Golden Stump claim	"Recreation area, Laguna Mountains"	Undetermined (1958) B. H. Fischer, et al (1939)		Listed as a prospect by Tucker and Reed (1939). No additional published information. (Tucker and Reed 39:54)
197	Good Hope prospect	Sec. 15, T13S, R4E, SBM; Julian district, south of Banner.	Undetermined (1957) S. W. Swan, Julian (1939)	A prospect in quartz diorite.	Adjoined Gold King group on the north. Shallow exploration only. (Donnelly 34:pl.4; Tucker and Reed 39:20, pl.1)
	Good Luck prospect	NW¼ sec. 31, T14S, R5E, SBM; Deer Park district, about 6½ airline miles north-northeast of Pine Valley.	Marguerite F. Burns, Box 223, Alpine (about 1955)	Deposit consists of a quartz vein which strikes N.30°E. and dips 50° southeast.	One northwest-trending claim which was located so that it adjoins the south end of the Telluride group. A 50-ft. shaft was sunk on vein. No productic (Everhardt 51:111; Tucker 25:339; Tucker and Reed 39:pl.1).
	Good Shepard prospect	Sec. 14, T13S, R4E, SBM; Julian district, south of Banner.	Undetermined (1957) J. D. Cotman (1939)		No additional published information. (Tucker and Reed 39:54).
221c	Gopher (Antelope) claim	Julian district.			Part of Madden group, which see in text (Crawford 94:238; 96:331; Donnelly 34 350, 352, pl.4; Hubon 02:6; Merrill 14:656, 657; Preston 90:544; Storms 93:380; Tucker 25:341).
	Grand Central claim	Sec. 4, T13S, R4E, SBM; Julian district, east of Julian.	L. A. Smith Estate, Julian (1955)	Quartz stringers in schist strike northwest, dip northeast.	Inextensive workings. Probably no production. (Hubon 02:6, 7; Merrill 14:656, 659).
	Grand Central Quarry mine				See Grand Central Quartz mine. (Tucker and Reed 39:pl.1).
198	Grand Central Quartz (Grand Central Quarry) mine	NW¼ sec. 23, T15S, R3E, SBM; about 2 miles northwest of Descanso Junction.	Undetermined (1957)		One unpatented claim that was located in 1886 and probably has been long abandoned. Developed by 10-, 25-, and 50-ft. shafts. Claim is cut by Chiquito Truck trail. No additional published information. (Tucker and Reed 39:pl.1).
	Grand Strike group				See Lucky Strike mine.
	Grand View No. 1 claim	Sec. 3, T17S, R7E, SBM; about 4 miles north of Boulevard.	Undetermined (1958) Asa Freeman (1939)		Listed by Tucker and Reed (1939) as a prospect. No additional published information. (Tucker and Reed 39:54).

Gold

Map no.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Granite Mountain mine	SW¼ sec. 21, T13S, R5E, SBM; about 8½ miles east-southeast of Julian, on the south slope of the Oriflamme Mts.	W. A. Spillars, 3270 Polk St., San Diego 4 (1955)	Gold occurs in quartz veins which trend northwestward and dip steeply west and east in schist. One vein was reported to be 8 ft. wide, another was reported to range in width from 6 in. to 2 ft. (Tucker, 1925).	Seven claims were located by W. K. Maull of San Diego. Mine was worked in 1910 from 3 adits driven northwestward from points along the upper part of the northwest side of a steep southeast-trending canyon. Each of the adits was about 75 ft. long. In the mid-1920's a 200-ft. drift was driven from one of the adits and about $1500 worth of gold mined from it. This work probably was done by Gus Redman of Julian. Later, some work was done by Fred and Cecil Creese of Julian. A small mill contained a crusher, a pulverizer, and cyanide tanks. All water used was carried up the mountain from Potter Springs, 3½ miles to the west. This trail is still useable. Value of total production is small. Long idle. The area is now part of Anza-Borrego Desert State Park. (Donnelly 34:351, 352; Merrill 14:660; Tucker 25:339, Tucker and Reed 39:20-21, pl.1).
	Grapevine prospect	Sec. 23, T13S, R4E, SBM; Julian district, south of Banner, in Chariot Canyon.	Undetermined (1957) H. Sharpless (1939)		No additional published information. (Tucker and Reed 39:54).
0	Grapevine Star (Dewey group, Ready Relief) mine	Sec. 36, T11S, R4E, SBM; in Grapevine Canyon, south of Montezuma Valley.	Mrs. Moyne Williams, Ranchita (1955)	Quartz vein, 3 to 4 ft. wide, strikes N. 70°W., dips 35°-40° north; contains gold associated with concentrations of pyrite, chalcopyrite and pyrrhotite. Vein cuts hybrid rocks composed of schist and quartz diorite.	Originally opened in 1903. Early work included a 975-ft. crosscut adit, a 100-ft. shaft and other workings. A mill was erected but never used. Leased in 1950-51 by Art Rys who deepened an inclined shaft on the vein to 150-ft., but did not mine any ore. Total production not determined but probably very small. (Merrill 14:648-649; Stewart 58:30).
	Green Money prospect	Sec. 35, T12S, R4E, SBM; and sec. 2, T13S, R4E, SBM; northeast of Banner.	Clytie Bowles, 1439 Essex Street, San Diego (1939)	Quartz vein in granodiorite.	Explored by adits and 280 ft. of drifts on vein. (Tucker and Reed 39:21).
1	Group Mining claims	Sec. 13(?), T15S, R4E, SBM; about 3 miles north of Pine Valley.	Undetermined (1957) Ben Record, Pine Valley (1939)	No published information.	Tucker and Reed (1939) reported 3 claims in group. Developed by an 85-ft. shaft, an 85-ft. adit, and 2 short drifts. Long idle. (Tucker and Reed 39:21).
	Grubstake prospect	Sec. 10, T11S, R4E, SBM; south slope San Ysidro Mts., north of Montezuma Valley.	James Fox (1939)		No additional published information. (Tucker and Reed 39:54, pl.1).
	Happy Jack mine	"7 miles N.E. of Descanso" (Crawford, 1896).	Undetermined (1958) G. Collier Robbins, San Diego (1896)		A prospect described only by Crawford. See Deer Park district in text. (Crawford 96:339).
2	Harper Ranch (E. A. Harper, Harper's) mine	SW¼ sec. 24(?), T14S, R4E, SBM (proj.); about 11 miles southeast of Julian, in Lot H of Rancho Cuyamaca.	Daley Enterprises, San Diego (1958)	A 12-in. quartz vein, according to Tucker (1939).	Patented land. Worked in the 1890's and perhaps before, by J. D. Harper who sank two 50-ft. shafts. In 1937 one of the shafts was deepened to 165 ft. and 55 ft. of drifts driven from it. Very small output. (Crawford 96:339; Merrill 14:662; Tucker 40:12; Tucker and Reed 39:21, pl.1).
	Harper's				See Harper Ranch. (Crawford 96:339; Merrill 14:664).
	Hassayhampa				Old name for Jumper mine, which see. (Hubon 02:7; Merrill 14:656, 659).
	Hawkes' mine				See Lucky Chuck mine. (Crawford 96:339).

Gold

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
203	Helvetia mine	Julian district.			See text. (Crawford 94:241; 96:339; Donnelly 34:348, 350, 352, 354, 355, 363, 365, pl.4; Goodyear 90:145-146; Hubon 02:6, 7, 9; Merrill 14:656, '65 Preston 90:542; Storms 93:376-378; Tucker and Reed 39:pl.1).
	Herma prospect	Sec. 4, T13S, R4E, SBM; Julian district east of Julian.	Undetermined (1957) Herman Meyer (1939)		No additional published information. (Tucker and Reed 39:54).
	Herman claim	Sec. 9, T13S, R4E, SBM; Julian district, southwest of Banner.	Undetermined (1957)		North of Ora group. No published description. Now on patented homestead and adjudicated out as mining claim. (Donnelly 34:pl.4).
	Hetty Green				See Barber Mountain mine.
	Hickory Jim mine	"13 miles NE of Descanso" (Crawford, 1896).	Undetermined (1958) J. F. Neeley, San Diego (1896)		A prospect described only by Crawford. See Laguna Mountains region in text. (Crawford 96:339).
210c	Hidden Treasure claim	Sec. 3, T13S, R4E, SBM; Julian district, west of Banner.	Frank Herron, Banner Creek, Julian or 468 Acheson, Pasadena 6 (1957)	Narrow vein in schist; strikes northwest, dips 70°-80° southwest. Shows remarkable "roll" formation described by Donnelly (1934). Ore shoot that plunges 30° southeast was worked for about 190 ft. along drift (see map in text). Ore reported to have averaged $65 per ton (Goodyear, 1890).	Formerly part of Ready Relief group, now included in Kentuck group, which also see. Claim developed by 235-ft. crosscut adit driven N.85°W. Drifts driven 80 ft. northwestward, and 140 feet southeastward on vein from poin near end of adit. Shaft also report Last worked in 1899 by Bailey Bros. Donnelly (1934, p. 352) estimated value of total production at about $25,000. (Crawford 94:241; 96:339; Donnelly 34:352, 358, pl.4; Goodyear 90:147, Hubon 02:7, Merrill 14:656, 657).
204	High Peak mine	Secs. 31 and 32, T12S, R4E, SBM; Julian district, north of Julian.	L. A. Smith Estate and Marks Sisters, 2441 Pamo Ave., San Diego (1956)	A mineralized shear zone which strikes N.65°W. and dips 75° to 85° northeast is enclosed concordantly in mildly metamorphosed siltstone (Julian schist). Two very narrow, en enchelon gold-bearing quartz veins are enclosed in the zone. These were explored, and partly stoped, for 180 ft. along the northwest part of a 462-ft. drift adit (see map in text). In addition, a northwest-trending quartz vein 2 to 15 in. wide was exposed by workings about 25 ft. northeast of the drift adit. Ten tons of ore milled in 1886 averaged $42 per ton in gold (Hanks, 1886, p. 85) (at $20 per ounce).	Located March 1870. Unpatented. Adjoins Eagle claim which lies to south west. Formerly included High Peak South and Rossland claims reported by local resident (1957) to have been adjudicated out as mining claims. Developed by a 462-ft. partly stoped drift adit driven N. 65°W. along the mineralized shear zone. Adit intersected north-northeast trending cross cut adit driven from Eagle property. Vertical winze was sunk at end of Eagle crosscut on quartz vein 25 ft. northeast of main mineralized zone. A drift on this vein extends southeas from the winze for 60 ft. In 1957 the winze was caved 50 ft. below its collar. Additional caved workings li to the southeast of the portal of the main adit along the main mineralized zone. The mine was worked sporadically from 1870 to 1902 and from 1928 to 1932. Value of total production estimated by Donnelly (1934, p. 352) to be between $25,000 and $50,000. (Crawford 94:241; 96:339; Donnelly 34 350, 352, pl.4; Hanks 86:83, 85; Hubon 02: 7; Merrill 14:656, 659; Preston 90:542; Tucker 25:339-340; Tucker and Reed 39:14, 21, pl.1).
	High Peak South claim	Julian district.	Undetermined (1957)		Formerly part of High Peak group. Loca resident stated (1957 that claim was adjudicated out as a mining claim and is now patented homestead land. Developed by several cuts and trenche (Donnelly 34:pl.4).
	Hillside mine	Montezuma (Rice) district.	Undetermined (1958) Charles McGeary, Warner Springs (1896)		Described only by Crawford, and mention ed briefly by Merrill. Prospected by 150-ft. adit and 2 shorter adits. See Montezuma mine. (Crawford 96:339 Merrill 14:648).
	Hoar group of mines				See Rose Quartz group. (Tucker and Reed 39:pl.1).

Gold

Map no.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
5	Home Builders prospect	SE¼SE¼ sec. 11, T13S, R4E, SBM; Julian district, south of Banner.	Undetermined (1957) Julia Loock (1939)		No additional published information. (Tucker and Reed 39:54, pl.1).
2a	Homestake (Wilcox) claim	Secs. 10 and 11, T13S, R4E, SBM; Julian district, about ½ mile south of Banner.	See Reed group.	Two, narrow quartz veins between schist and quartz diorite. Veins strike northwest and dip southwest.	Part of Reed group which see also. Formerly part of Melrose group, now dissolved. Claim was explored by adit and open cut. Total estimated production less than $25,000 (Donnelly, 1934). (Crawford 94:243; 96:345; Donnelly 34:352, pl.4; Hubon 02:8; Merrill 14:656, 659; Tucker 25:342; Tucker and Reed 39:25, pl.1).
	Hopkins Placer Mining Company	Parts of secs. 17, 18, 19, 20 and 21, T13S, R2E, SBM; about 3 to 4 miles east of Ramona.	Undetermined (1957)		J. C. Hopkins, Escondido, operated a placer deposit in the mid-1920's on land that belonged to John Johnson, Escondido. Tucker (1925) reported that gold averaged 30 cents a cubic yard and ran as high as $1.50. Even then, however, the lack of water was a problem. For general description of deposits, see "Ballena placer deposits." (Tucker 25:333-334).
	Hubbard claim				Same as North Hubbard. See Ready Relief group in text. (Crawford 94:241; 96:342; Donnelly 34:350; Hanks 86:87; Newman 23:49; Storms 93:380).
	Ida Claire claim	Sec. 14, T13S, R4E, SBM; Julian district, south of Banner.			Adjoins Golden Chariot claim on west. Now part of Golden Chariot group, which see in text. (Donnelly 34: pl.4).
	Ida Mae (Ida May) prospect	Probably in sec. 22 or 23, T11S, R2E, SBM; Mesa Grande district, "about 3 miles northeast of Mesa Grande".	Undetermined (1957) Louis A. Scholders (1939)		Probably near Shenandoah mine, which see also. Worked briefly in 1933 and yielded small amount of gold. (Tucker and Reed 39:54, pl.1).
	Independence claim	Deer Park district			See Beyers group and Oak Canyon mine. (Hubon 02:7; Merrill 14:662).
	Jacques prospect	Sec. 14, T13S, R4E, SBM; Julian district, south of Banner.	Undetermined (1957) Earl J. Lusk (1939)		No additional published information. (Tucker and Reed 39:55, pl.1).
6	Janet mine	Sec. 31, T12S, R4E, SBM; Julian district, northwest of Julian.	Undetermined (1957) At one time belonged to Julian Mining and Milling Co., Julian	Quartz vein in schist is probably the northwest extension of the Owens deposit. Vein strikes northwestward and dips steeply northeast.	One claim, patented in 1932. Developed by 125-ft. shaft, 100-ft. adit, and a 125-ft. crosscut adit which intersected the probable extension of the Owens vein. Drifts were driven on this vein from the crosscut adit. (Donnelly 34:pl.4; Hubon 02:7; Merrill 14:656, 660; Tucker 25:346; Tucker and Reed 39:pl.1).
	Jatina claim	Sec. 20, T15S, R5E, SBM; Laguna Mountains, nearly 5 miles west-southwest of Mt. Laguna.	Undetermined (1958) J. and T. Rasmusson (1939)		Listed by Tucker and Reed (1939) as a prospect. No additional published information. (Tucker and Reed 39:55).
7	Johnston's mine	NW¼ sec. 16, T18S, R2E, SBM (proj.) Dulzura district, about 2 miles southwest of Engineer Springs.	Undetermined (1957)	A northwest extension of the northwest-trending mineralized fault zone developed one mile to southeast by the Donohoe mine. Zone contains free gold with pyrite and arsenopyrite in brecciated and silicified metavolcanic rocks.	Charles Johnston of San Diego located the Johnston and Oneida claims in the early 1890's. Johnston claim explored by 80-ft. shaft, a "long" crosscut tunnel (Crawford, 1896, p. 340), and a drift adit with appended crosscuts and a winze. Oneida claim explored by several cuts and a 20-ft. shaft with a 30-ft. drift connected. A 5-stamp mill could not recover sufficient gold from the low grade deposits to make the operation successful. (Crawford 96:340; Storms 93: 382-383; 94:241).

Gold

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
208	Jolly Boy mine	Sec. 7, T13S, R3W, SBM; about 6 miles southwest of Escondido, less than one mile southwest of Del Dios.	Undetermined (1958) A. W. Pray and others, Escondido (1914)		Prospected briefly in 1896 by 100-ft. adit and shallow shaft. Exact location not determined. (Crawford 96: 340; Merrill 14:651).
209	Jumper mine	Sec. 4, T13S, R4E, SBM; Julian district, 1½ miles east of Julian.	Eldridge McGovern (or Elbridge McGowan), Los Angeles and Manuel E. Woodward, Box 286, Julian (1957)	Workings along fault zone which is probably a southeast extension of the Helvetia ore zone. Zone strikes northwestward and dips 70°-75° east (see map of workings in text).	Adjoins the southeast end of the Helvetia claim, and the northwest end of the Golden Rule claim. Developed by 200-ft. drift adit driven S.60°E. along fault zone. Two winzes of undetermined depth sunk from drift. In addition, a 50-ft. drift was driven parallel to main drift about 10-ft. to southwest. About $1,500 worth of gold (at $20 per ounce) mined from 1895 to 1900. (Donnelly 34:pl.4).
210a -d	Kentuck group	Secs. 3 and 10, T13S, R4E, SBM; Julian district, east of Banner.	Frank Herron, Banner Grade, Julian or 468 Acheson, Pasadena (1957)	Narrow quartz veins in schist.	Group consists of 7 claims: Contact (210a), Gold Cross No. 1 (210b), Empire, Gold Leaf, Hidden Treasure (210c), Kentuck $ (210d), and Wedge. Each claim is described individually in this list. Most extensive working on group is a 1540-ft. crosscut adit driven southwestward from the Contact claim to a point under the Cincinnati Belle claim. Adit did not intersect workings developed from the surface of the other claims, nor were any workings driven from it. It was intended to provide drainage. Some work was done on group by lessee in 1947; small amount of ore mined. (Crawford 94:241; 96:340; Donnelly 34:350, 352, pl.4; Hanks 86:86; Hubon 02:7; Merrill 14:656,658,659; Preston 90:542-543; Stewart 58:32; Storms 93:380; Tucker 25:340-341; Tucker and Reed 39:21, pl.1).
210d	Kentuck S claim	Julian district.		Two parallel veins in schist, strike N30°W, dip 70° northeast, and range in width from 6 in. to 4 ft. Early reports indicate that ore contained between 2 and 3 oz. gold per ton.	Part of Kentuck group, which see also. Ore mined from 2 shafts: (1) a 97-ft. shaft with stopes to surface is caved; (2) a 100-ft. shaft was intersected at a depth of 50 ft. by a 350 ft. crosscut adit that was driven southwestward. The adit intersected the shaft 100 ft. from the portal. Donnelly (1934) estimated the total value of production at between $25,000 and $50,000. (Crawford 94:241; 96:34 Donnelly 34:352, pl.4; Hubon 02:7; Merrill 14:656, 659; Stewart 58:32; Storms 93:380; Tucker 25:340-341; Tucker and Reed 39:21).
	Keystone Pilot	Sec. 31, T12S, R4E, SBM; Julian district, northwest of Julian.	Undetermined (1957)	Northwest-trending quartz veins in Julian schist.	A former claim between Janet and Van Wert claims. Has been adjudicated out as mining claim; now on patented homestead land. Developed by inextensive surface workings. (Donnelly 34:pl.4).
211	Kitty Kay group	Secs. 17 and 18, T16S, R5E, SBM; about one mile north of Buckman Springs.	Charles R. Keen, P.O. Box 11, Pine Valley (1956)		Located before 1939 by Guy Hogan, Pine Valley. Listed by Tucker and Reed (1939) as a prospect. No additional published information. In same area as Red Rooster claim. (Tucker and Reed 39:55).
	Klondike claim	Sec. 1, T14S, R1E, SBM; on San Vicente grant, about 5 miles south-southwest of Ramona.	Undetermined (1957) T. P. Converse, Ramona (1925)	Quartz veins in schist.	Patented land. No trace of previous activity could be located in 1957. Hubon (1902) reported only very shallow workings. (Hubon 02:7).
212	Kuhnis (Whaley) mine	E½SE¼NE¼ sec. 28, T8S, R4W, SBM; nearly 5½ miles north-northwest of Fallbrook, and about 750 ft. south of Deluz-Murrieta road.	John A. Kuhnis, Route 2, De Luz, Fallbrook (1958)	A north-trending quartz-bearing zone in granitic rocks; zone several hundred ft. long and 3 to at least 5 ft. wide. Dip undetermined. Zone contains sericite and crusts of yellow-brown hydrous iron oxides.	On patented land. Vincent Rabboni discovered deposit about 1896. Principal development is a shallow 100-ft. cut along the vein. Additional workings are short shallow cuts, trenches and adits. Mill consisting of ore bin, 20-ton ball mill, and concentrating table is in poor condition. Idle. Very small production of gold and silver between 1936 and 1938. (Tucker and Reed 39:28, pl.1).

Gold

ip	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	La Condado mine	"6 miles NE of Escondido" (Crawford, 1896).	Undetermined (1958) D. W. McKay, Escondido (1896)		A prospect on the La Condado ranch. No additional published information. (Crawford 96:341; Merrill 14:649).
	Last Chance claim	Secs. 14 and 23, T18S, R4E, SBM; about 1½ miles west of Canyon City.	John Dubois (1939)		A north-trending claim that overlapped State Highway 94. Patent application rejected in 1933. No published description. (Tucker and Reed 34: pl.1).
3	Last Chance mine	Near center of the E½NE¼ sec. 4, T14S, R3E, SBM; Boulder Creek district, about 7-2/3 miles south of Julian.	In dispute (August, 1957)	Tucker (1925) reported that the workings explored a vertical quartz vein which strikes N.20°W. and ranges in width from 1 to 4 ft. Pyrite and marcasite occur with sparse gold in the quartz.	Five unpatented claims. Prior to 1924 a two-compartment, 110-ft. shaft was sunk on the vein; from the shaft, drifts were driven on the 40-, 70-, and 100-ft. levels. The shaft is now caved. Remnants of a 5-stamp mill that was constructed prior to 1912 are on the property. Twenty tons of ore that were milled were reported to average $18 per ton in gold (at $20 per ounce). Small production. (Everhardt 51:110, pl.3; Tucker 24a: 372-373; 25:341; Tucker and Reed 39: 22, pl.1).
	Ledge Lode prospect	Sec. 31, T12S, R4E, SBM; Julian district, northwest of Julian.	Undetermined (1957) Charles E. Sexton (1939)	A prospect in Julian schist.	Adjudicated out as a mining claim since 1939; now patented homestead land. (Tucker and Reed 39:55, pl.1).
	Little Granite mine	Montezuma (Rice) district.	Undetermined (1958) Rice Brothers, Warner Springs (1896)		A prospect. (Crawford 96:341).
	Lone Jack				See Expansion group. (Merrill 14:662).
4	Long Valley placer deposits	Sec. 25, T16S, R4E, SBM; about 5 miles south of Pine Valley, in the Long Valley area.	Undetermined (1957) Walter R. Horr, Campo (1939)	Both placer and lode deposits. Tucker and Reed (1939) stated that the principal vein "had been exposed by a few superficial cuts for a length of 350 feet."	Six claims were located shortly prior to 1939. May have been the original name for the Eagle Nest mine, which see. (Tucker and Reed 39:22).
5	Lookout group	Sec. 10, T14S, R3E, SBM; Boulder Creek district, on Mineral Hill.	Undetermined (1957) George H. Moyer, William Acheson, et al., San Diego (1925)	A series of gold-bearing quartz veins in "mixed rocks."	Adjoined the Aftermath group on the north. A group of 6 claims that was located prior to 1925. Long idle. (Tucker 25:341; Tucker and Reed 39: pl.1).
6	Lost Peg Leg claim	Sec. 34, T16S, R1E, SBM; about 2 miles north-northeast of Jamul, high on the east side of a south-southeast trending spur of McGinty Mountain.	Undetermined (1958) John Trusheim, Minnie Schaffnet, Address undetermined (about 1914)	Undetermined.	Two lode claims - Lost Peg Leg and Cosmos- located about 1900. Lost Peg Leg patented in 1914. Explored by adit driven west-northwest about 500 ft. No production.
7	Lucky Baldwin (Margaret, Margurite, Margaret and Lucky Baldwin) group	S½ sec. 31, T14S, R5E, SBM; Deer Park district, about 5½ miles north-northeast of Pine Valley.	J. S. and Marguerite Burns, Box 233, Alpine (about 1955)	Tucker and Reed (1939, p. 23) stated that "four parallel veins varying in width from 1 to 2 ft., have a northerly strike, dipping 50° E. ...The quartz contains free gold and pyrite." Country rock is diorite.	Property comprises two adjacent, north-trending patented claims whose southern endlines are contiguous with the southern end-line of section 31. Property cut by Pine Valley Creek road. Claims located in 1915, patented in 1924. Tucker and Reed (1939) stated that workings consisted of a shaft 80 ft. deep on the Marguerite claim. Workings inaccessible in 1957. Long inactive. Production negligible. (Tucker 25:341-342; Tucker and Reed 39:22-23, pl.1).
	Lucky Ben	Julian district.			See Bedrock claim, as now known. (Donnelly 34:pl.4; Merrill 14:658).

Gold

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
218	Lucky Chuck (Free Coinage, Hawkes') mine	N½ sec. 12, T15S, R4E, SBM; Deer Park district, on east side of Pine Creek road, about 4½ airline miles north of Pine Valley.	Mr. and Mrs. James H. Diehl, 3048 C Street, San Diego, and others (1957)	Steeply dipping quartz vein, 12 to 18 in. in width strikes N.30°W. in "mixed rocks."	First prospected in 1890's and known then as Hawkes' mines and later as Free Coinage mine. Explored by 96-f vertical shaft and 200-ft. crosscut adit, driven N.80°E., to connect with shaft at bottom. Additional working consist of several shallow cuts alor strike of vein. Small production of ore having grade as high as $18 wort of gold and silver per ton. Foundation of small mill and a few tons o tailings on property. Inactive for many years. (Crawford 96:339; Everhardt 51:111; Tucker 25:336-337; Tucker and Reed 39:19, pl.1). (R.M.
	Lucky Gene prospect	Sec. 9, T13S, R4E, SBM; Julian district, southwest of Banner.	Undetermined (1957)		No additional published information. (Tucker and Reed 39:pl.1).
	Lucky Strike claim	Sec. 19, T9S, R4E, SBM; about 8 miles northwest of Warner Springs, along Chihuahua Valley road.	Undetermined (1958) W. D. Tungate (1939)		Listed by Tucker and Reed (1939) as a prospect. (Tucker and Reed 39:55).
219	Lucky Strike group (includes Lucky Strike, Dam Fino, Pocket, and Long-Time-No-See prospects)	Sec. 14 (proj.), T14S, R3E, SBM; Boulder Creek district, about 9 miles south-southwest of Julian.	A. E. Goeppinger, Oceanside (1946)	A series of short, narrow quartz veins in "mixed rocks". The quartz contains arsenopyrite and gold.	No evidence of recent activity in 1957 Explored by shallow cuts. (Everhard 51:110).
220	Lucky Strike mine (Grand Strike group)	Sec. 14, T13S, R4E, SBM; Julian district, south of Banner in Chariot Canyon.	G. L. Herrington and C. L. Powers, 1805 S. 43rd St., San Diego (1956)	Gold-bearing quartz vein in schist; vein strikes N. 25°W., dips 70° northeast.	Group consists of four unpatented clai Principal working is a 130-ft. incli shaft sunk on vein from point in bottom of southeast-trending canyon. Additional workings consist of 2 crosscut adits driven S.10°W. in southwestern slope of canyon. Upper adit is at least 100 ft. long; lower adit is 50 ft. below upper adit, is undetermined length, and in 1957 was issuing water. Value of production undetermined.
	Lucky Strike prospect	Sec. 10, T11S, R4E, SBM; south slope of San Ysidro Mts., north of Montezuma Valley.	Ralph J. Wagor, Rt. 2, Box 345, Escondido (1939)		No additional published information. (Tucker and Reed 39:55, pl.1).
	Macaboy claim	Plotted by Tucker and Reed (1939) in NW¼ sec. 5, T9S, R3E, SBM; north of Chihuahua Valley, near the Riverside County line.	Undetermined (1958) Mrs. Margaret Langley (1939)		No published description. Deposit coul not be located during present investi gation. In same area as Pawnee deposit which see in text under "Tungsten". (Tucker and Reed 39:55, pl.1).
221a -c	Madden group (Antelope mine)	Julian district.			See text. (Crawford 94:238, 242; 96: 331, 341; Donnelly 34:350, 352, 354, 361, pl.4; Hanks 86:86; Hubon 02:6,7; Merrill 14:656, 657; Preston 90:544; Storms 93:380; Tucker 25:341; Tucker and Reed 39:22, pl.1).
	Magdalena				Name of principal vein explored by workings of Descanso mine, which see. (Eric 48: 320; Merrill 14:664).
	Mahood prospect				See Rose Quartz group. (Everhardt 51: 112, pl.3).
	Maid of Erin group	T11S, R4E, SBM; Montezuma district, about 2½ miles west-northwest of Ranchita.	Undetermined (1957) Frank Burton, Ramona (1914)		A group of 4 claims on "2 ledges". No additional published information. See also Montezuma mine. (Merrill 14:648).

Gold

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
2	Majestic group	Secs. 32 and 33, T12S, R4E, SBM; Julian district, one mile east of Julian.	A. M. Andreason, Julian (1956)	Very narrow quartz veins in Julian schist contain very sparse gold.	Consists of 2 claims patented in 1935. Developed by (1) a vertical shaft, now caved, (2) a 50-ft. crosscut adit driven northwestward, and (3) a 50-ft. crosscut adit driven N.50°W. which exposed a narrow vein. In October 1956, owner was sinking a winze on this vein. Perhaps very small output from old caved shaft. (Donnelly 34: pl.4; Tucker and Reed 39:pl.1).
	Margaret				See Lucky Baldwin group. (Tucker and Reed 39:22-23).
	Margaret and Lucky Baldwin				See Lucky Baldwin group. (Tucker 25: 341-342).
	Margurite				See Lucky Baldwin group. (Tucker and Reed 39:pl.1).
	Mascot	Sec. 14, T13S, R4E, SBM; Julian district, south of Banner.	Undetermined (1957)		Adjoins east side of Golden Chariot property. No published description. (Donnelly 34:pl.4).
3	Maude E. claim	SE¼ sec. 13, T13S, R3E, SBM; within one mile south of Pine Hills.	Undetermined (1957) Maude E. and L.L. Bosworth (1931).		A prospect. Patent application rejected in 1931. No additional published information. (Tucker and Reed 39: pl.1).
4	Melba group	Secs. 4, 5, 8 and 9, T15S, R5E, SBM; Laguna Mountains, about 4½ miles west-northwest of Mt. Laguna.	Allen Crane, 8115 El Paseo Grande, La Jolla (Grace and Rosa claims) and Elizabeth K. Peterson, 7241 Carrizo, La Jolla (Elizabeth claim) (1957)	Tucker (1925) reported that 5 north-northwest trending quartz veins are enclosed in schist. The veins dip steeply to the east and range in width from 4 to 12 ft. Quartz contains pyrite and marcasite. The value of the ore was reported to range from $6 to $14 in gold per ton (gold then worth $20 per ounce).	Twenty-three lode claims patented by W. A. Keys and J. A. Morrison in 1929. Only 3 of these apparently were valid in 1958 (see ownership). Workings mainly on Elizabeth and Rosa claims and consist of short adits and shafts. Longest adit, on Rosa claim, is about 275 ft. long. Production negligible. See also Victoria group. (Tucker 25: 342; Tucker and Reed 39:23, 55, pl.1).
	Melrose group	Secs. 3, 10, and 11, T13S, R43, SBM; Julian district, south of Banner.	Formerly R. M. Melrose, deceased.		Dissolved. Formerly included Apex, Homestake, North Star, and Stanley claims. All but Stanley described individually. No published information on Stanley. (Crawford 94:243; 96:342, 345; Donnelly 34:352, 353, pl. 4; Hubon 02:8; Merrill 14;656, 657, 659; Tucker 21:377; 25:342; Tucker and Reed 39:pl.1).
5	Mercedes group	W½ sec. 4, T15S, R5E, SBM; Laguna Mts., about 4 miles west-northwest of Mt. Laguna.	R. J. Sevick, P.O. Box 247, Spring Valley (1957)	Narrow quartz veins in schist.	East of Melba group. Originally consisted of Mercedes, Thelma and Millsite claims. The Mercedes claim is patented. Workings consist of a 75-ft. adit. Long idle. No production. (Tucker and Reed 39:55, pl. 1).
	Mesa Grande mine	Mesa Grande district (exact location undetermined).	Undetermined (1939) Milton Edgar, Los Angeles (1954)	"A vein 2 to 8 in. in width occurs in granite; strike NW and SE; dip vertical. ...Ore reported to carry from $20 to $100 in gold per ton" (Tucker, 1934).	Tucker reported that property consisted of group of 6 claims. Developed by shaft 100 ft. deep. This may be the Shenandoah mine, which see. (Tucker 34:326).
6	Mine Canyon	Secs. 16, 21, and 18, T18S, R2E, SBM; Dulzura district, south of Engineer Springs.			A long time local resident reported in June 1957 that during the 1890's and early 1900's attempts were made to recover placer gold in Mine Canyon. These ventures, however, were not profitable. (Fred Mellor, Dulzura, personal communication, 1957).
7	Mineral Hill group	Sec. 10, T14S, R3E, SBM; Mineral Hill district, on southside of Mineral Hill.	C. S. Young, 1420 Valley View Rd., Glendale (1957)	Narrow quartz veins in "mixed" rocks composed of quartz diorite and schist. Veins contain very small proportions of gold.	Two unconnected, patented claims: Sixty Two and Boulder Creek (see map in text). Patented in 1932. Boulder Creek claim was prospected by a north-trending 300-ft. adit. Production negligible.
	Mineral Hill mine				See Boulder Creek mine in text. (Everhardt 51:109, pl.3).

Gold

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Moe mines	"2½ miles N.E. of Escondido" (Crawford, 1896)	Undetermined (1958) E. A. Moe, Escondido (1896)		Two claims were located on "siliceou felstone, much mineralized." Shal cuts. (Crawford 96:341; Merrill 1 649).
	Monarch mine	"4 miles N.E. of Escondido" (Crawford, 1896)	Undetermined (1958) A. H. Beach, Escondido (1896)		A prospect. No additional published information. (Crawford 96:341; Merrill 14:649).
228	Montana group	Secs. 7, 8, and 17, T14S, R4E, SBM; nearly 8 miles southeast of Julian, in the Laguna Mts.	Undetermined (1957) Walton Bros., 30th and F Sts., San Diego (1939)	South of Oriflamme mine and probably in same geologic environment.	Tucker and Reed (1939) stated that tl group consisted of 8 claims. Deve oped by a 260-ft. inclined shaft or "a porphyry dike in granite that carries gold." On another of the claims a 178-ft. adit was driven ea to crosscut a "56-ft. porphyry dike at 126 ft." No additional publishe information. Production negligible Long idle. (Tucker and Reed 39:23)
229	Montezuma mine	Sec. 10, T11S, R4E, SBM; Montezuma (Rice) district, on south slope of San Ysidro Mt., north of Montezuma Valley.	Mrs. I. F. Gunner, Ocean Beach (1959) R. J. Stauch, 4029 Spencer, Torrance (1939)	Quartz veins cut schist, quartz diorite and "mixed rocks". Principal vein strikes N.65°E., dips 70° northwest (Tucker and Reed, 1939), and is 4 ft. wide at surface.	Deposits in secs. 10 and 11 first prc pected for gold in mid-1890's by Ri Bros. and others, and many claims located. Montezuma mine was formed by relocation of older claims in ab 1910 by Montezuma Gold Mining Compa of San Diego. Mine then comprised claims. It was worked mainly from 230-ft. vertical shaft with about 2000 ft. of appended level workings Workings long inaccessible. Value production undetermined. (Merrill 14:658; Stewart 58:33; Tucker 25: 342-343; 34:326-327; Tucker and Ree 39:23, pl.1).
	Morgan mines	Mesa Grande district.	Undetermined (1958) A. C. Morgan, Mesa Grande (1896)		"Discovered in May 1896... have only superficial workings." (Crawford 96:341).
	Morning Glory claim				See Winatoma and Morning Glory claims (Tucker and Reed 39:55).
	Morning Star mine	Montezuma (Rice) district.	Undetermined (1958) Haight and White, Riverside (1896)	Quartz vein 1 to 2 ft. wide in metamorphic rocks.	Explored by a 70-ft. shaft. (Crawfor 96:341).
	Mother Lode and Princess claims	Secs. 17 and 20, T15S, R5E, SBM; Laguna Mountains, nearly 5 miles west-southwest of Mount Laguna.	Undetermined (1958) Keuahe J. McLauchlan (1939)		Listed by Tucker and Reed (1939) as a prospect. No additional published information. (Tucker and Reed 39:5
	Mountain Lion mine	"6 miles S.W. of Escondido" (Crawford, 1896)	Undetermined (1958) H. C. Brown, et al, Escondido (1896)		Crawford (1896) stated "vertical shaft has been sunk 65' on a mass of minei alized felsite." No additional published information. (Crawford 96:3 Merrill 14:651).
230	Narrows mine	Center W½ sec. 13, T12S, R6E, SBM; just south of State Highway 78, at the southwest end of The Narrows.	Undetermined (1957) H. W. Maddox (1939)		Reported by Tucker (1939) as a prospec No evidence of former workings seen i 1957. (Tucker and Reed 39:55, pl.1).
	Neptune claim	Julian district.			Part of Warlock group, which see in text. (Crawford 94:242; 96:342; Donnelly 34:352, pl.4; Hubon 02:8; Tucker and Reed 39:pl.1).
	New Owens				See Owens mine in text. (Donnelly 34: pl.4; Hubon 02:8; Merrill 14:656, 66 Preston 90:541, 542; Tucker 25:345-346).
	Nip and Tuck (Lucky Ben)				See Bedrock claim. (Merrill 14:658).

Gold

Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
Noble group (Noble Mines, Noble's Mines, Pine Valley Mines)	Laguna Mts.			See text. (Crawford 94:238, 240, 242, 243; 96:332, 336, 342, 343, 345; Goodyear 90:141-143; Merrill 14:663-664; Preston 90:544; Storms 93:382; Tucker 25:343-345; Tucker and Reed 39:23-24, pl. 1).
Nona and Coarse Gold prospects				See Nona group. (Everhardt 51:110, pl.3).
Nona group (Nona and Coarse Gold prospects)	Center N½N½ sec.5, T14S, R3E, SBM; Boulder Creek district, 8-1/3 miles southwest of Julian.	Ben E. Santessen, P.O. Box 256, Julian (1957)	Very sparse gold occurs in thin stringers and segregated masses of quartz in "mixed rocks". The "mixed rocks" strike N.35°W. and dip 75° south.	Three unpatented claims. Developed by short adits and shallow cuts. No production. (Everhardt 51:110, pl.3).
North Hubbard (Hubbard) claim	Julian district.			Part of Ready Relief group, which see in text. (Crawford 96:342; Donnelly 34:346, 350, 352, 354, 355, 360, 361, pl.4; Hamilton 20:35; Hubon 02:8,9; Merrill 14:656, 658; Storms 93:380; Tucker 21:377; 24a:373; Tucker and Reed 39:15; 26-27).
North Redman				Same as Northwest Redman claim. See Ready Relief group in text. (Donnelly 34:pl.4.; Merrill 14:657).
North Star (Duplex and Apex. North Star) group	Sec. 31, T14S, R5E, SBM; Deer Park district, about 5½ miles north-northeast of Pine Valley.	F. R. Lee, 4385 New Jersey, San Diego (about 1955)	Narrow quartz veins in schist.	Property consists of 2 unpatented, northwest-trending claims which lie to the east of the Lucky Baldwin group. The more northwesterly claim is developed by a northeast-trending 200-ft. adit. Long idle. (Tucker 24:50; Tucker and Reed 39:55,pl.1).
North Star mine	Sec. 12, T13S, R4E, SBM; Julian district, southeast of Banner.	H. S. Cozens, 675 F Street, Chula Vista, and E. A. Buck (1956)	Two parallel quartz veins in schist strike northwest, dip northeast, and are each about 3 ft. wide. Early reports indicate that ore contained ¼ oz. gold per ton.	Formerly part of Melrose group. Two unpatented claims. Shafts were sunk on each of the veins: one to depth of 115 ft., other to depth of 50 ft. with 70-ft. appended drift. Last active in 1898. Donnelly (1934) estimated value of production at less than $25,000 (Crawford 96:342; Donnelly 34:353, pl.4; Hanks 86:85, Hubon 02:8; Merrill 14:656, 659; Stewart 58:33; Tucker 25:342; Tucker and Reed 39:pl.1).
Northwest Redman				See Redman claim in description of Ready Relief group in text. (Tucker and Reed 39:26).
Oak Canyon (Cascade, You Bet group) mine	Sec. 31, T14S, R5E, SBM; Deer Park district, about 6 miles north-northeast of Pine Valley.	Andrew T. Knight, 9322 Vista Drive, Spring Valley (1957)	Narrow, north- to northwest-trending quartz veins which dip westward. Veins range in width from 1 in. to 2 or 3 ft. and contain moderate proportions of arsenopyrite. Workings also have intersected bodies of tactite which contain as much as 1.28 percent tungsten trioxide. No tungsten produced, however.	Part of this property originally was covered by the Cascade claim of the Beyers group. That claim was relocated about 1900 by Messrs. Saybold and Sunnocks, of San Diego, who combined it with their own newly located claim, the Independence. By 1914, these two claims were known as the You Bet group and then were owned by J. H. Schook, of Descanso, and J. L. Burns, of San Diego. By 1945 the property had become the Oak Canyon mine, which in 1947 was being worked by a Mr. Knight. The workings consist of several short, northwest-trending adits along the northwest side of a northeast-trending canyon in the SE¼NW¼ sec. 31. Production is undetermined, but probably negligible. (Crawford 96:332; Everhardt 51:111, pl.3; Hubon 02:7; Merrill 14:662; Tucker 25:353).
Old Ella				See Ella mine. (Tucker and Reed 39:55, pl.1).
Old Madden (Madden) claim	Julian district.			Part of Madden group, which see in text. (Crawford 94:242; 96:341; Donnelly 34:350, 352, 354, 361, pl.4; Hanks 86:86; Hubon 02:7; Merrill 14:656, 657; Tucker 25:341; Tucker and Reed 39:22, pl.1).

Gold

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Old Owens				See Owens mine in text. (Hubon 02:8 Merrill 14:656, 660; Preston 90:54 542; Tucker 25:345-346).
236	Ora (Ord) group	Sec. 9, T13S, R4E, SBM; Julian district, southeast of Julian.	Schuyler C. Kelly, 4112 Randolph, San Diego (1957)		A prospect. Adjudicated out as a mi claim; now on patented homestead 1 (Donnelly 34:pl.4; Tucker and Reed 39:pl.1).
	Ord group				A misspelling of Ora group, which se (Tucker and Reed 39:pl.1).
237	Oriflamme (Oroflamme) mine	Mostly in extreme western part of sec. 6, T14S, R4E, SBM; a small part overlaps into sec. 1, T14S, R5E, SBM; about 8 miles south-southeast of Julian, on the west side of Oriflamme Creek Canyon.	B. W. Wood Estate, San Diego (1957)	The geologic setting is the same as that of the Golden Chariot mine in the Julian district. Quartz veins in schist at contact with "hybrid" rocks which lie to east. Schistosity strikes northwest and dips steeply northeast. Donnelly (1934) stated that the quartz contains pyrite and is "reported to carry tellurides".	Very little is known of this propert It was located in the mid-1870's a patented in 1882 by E. W. Morse. claims, including the millsite on Oriflamme Creek, are accessible fr Sunrise highway only with great di ficulty. Donnelly (1934, p. 353) estimated that less than $25,000 w of gold was produced from the mine The length of the workings is estimated to be about 1,000 feet. A t stamp mill on the property has not been operated since 1905. (Crawfo 96:342; Donnelly 34:340, 350, 353, pl.4; Everhardt 51:112, pl.3; Hank 86:84, 89; Hubon 02:8; Merrill 14: Tucker 25:345; Tucker and Reed 39:
238	Oro Fino (El Diablo) mine	Center N½NE¼ sec. 26, T12S, R2W, SBM (proj.); about 1-3/4 miles southeast of Escondido city hall and about 1,000 ft. southwest of intersection of San Pasqual highway and Bear Valley road.	Frank O. Stough, San Pasqual highway, Escondido (1957)	In same northeast-trending ore zone as Cleveland-Pacific deposit which is about 2000 ft. to the southwest (see map in text). Country rock is Green Valley tonalite.	Patented ranch land; Lots 5 and 7, Block 188, Rincon del Diablo grant Crawford (1894) reported that "an inclined shaft was sunk on the vei to a depth of 40 feet, and a drift cut south along the vein. The qua vein varies from 2 in. to 10 in. i width." Merrill (1914, p. 651) reported that the property "has a m of 5 stamps... was a small produce owner Mrs. O. J. Stough... depth o shaft 330 ft... drifts on vein abo 1000 ft." The mine dumps remain a only evidence of the operation. Deposit worked between 1894 and 19 and yielded nearly $50,000 worth o gold (at $20 per ounce) and more t 1500 ounces of silver. (Crawford 94:242;96:343; Hubon 02:8; Merrill 649, 651; Storms 93:382; Tucker an Reed 39:pl.1).
	Oroflamme				See Oriflamme mine. (Hubon 02:8).
	Osage prospect	Secs. 31 and 32, T12S, R4E, SBM; Julian district, north of Julian.	Undetermined (1957)		Adjudicated out as a mining claim; n on patented homestead land. (Donnelly 34:pl.4; Tucker and Reed 39:pl.1).
	Overlook prospect	Sec. 21, T17S, R8E, SBM; about 4 miles north-northwest of Jacumba.	Undetermined (1957) Stephen Bistram (1939)		Reported by Tucker and Reed (1939) a undeveloped gold prospect. An "Ove look" in the same section was also reported as a feldspar deposit. S also under "Feldspar". (Tucker an Reed 39:55, pl.1).
239	Owens (Old Owens, New Owens) mine	Julian district.			See text. (Crawford 94:242, 96:343; Donnelly 34:348, 350, 352, 354, 35 361, 363, pl.4; Eric 48:320; Goodye 88:519; 90:144-145; Hanks 86:83, 8 87; Hubon 02:8, 9; Merrill 14:656, 660; Preston 90:541-542; Storms 93: 378; Tucker 21:377-378; 25:345-346; Tucker and Reed 39:14, 24, pl.1).
240	O.X. group	Sec. 6, T14S, R5E, SBM; Laguna Mts., about 8 miles southeast of Julian.	L. B. Spaulding, P.O. Box 15, Ramona (1957)	An extension of the Oriflamme deposit.	Two unpatented claims. Explored only by shallow cuts. (L. B. Spaulding, personal communication 1957).
	Oxide claim				One of claims in Noble group, which s in text. (Crawford 94:242; 96:343; Merrill 14:663-664; Tucker and Reed 39:pl.1).

Gold

Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
Oxide mine	"near Crescent Valley, 3 miles S.W. of Escondido" (Crawford, 1896).	Undetermined (1958) D. Crise, Escondido (1896)		A prospect. No additional published information. (Crawford 96:343).
Padlock claim	Secs. 3 and 4 T13S, R4E, SBM; Julian district, east of Julian.	Cecil J. and Fred J. Creese, Julian (1957)	Two veins strike northwestward, dip steeply southwest.	South of Warlock group and formerly part of that group. Explored by inextensive workings. Donnelly (1934) estimated value of production at less than $25,000. (Donnelly 34:353, pl.4; Hubon 02:8; Merrill 14:656, 658; Tucker and Reed 39:28).
Parsons (Orange Blossom) mine	Sec. 23(?), T16S, R1W, SBM; about 2 miles south of El Cajon.	Undetermined (1958) E. F. Parsons, El Cajon (1939)	"Gold and a little silver occur in a vein of white quartz, with hematite, 2 in. to 2 ft. wide". (Tucker and Reed, 1939).	Area now subdivided. Workings consisted of a vertical shaft with appended drifts driven northward and southward. Worked during the 1930's by Parsons. Total production, as compiled from data of U. S. Bur. of Mines, about $2,500 worth of gold and small amount of silver. A 2-stamp mill once on property. See also Coe prospect. (Tucker and Reed 39:24, pl.1).
Penny prospect	Center sec. 11 (proj.), T14S, R3E, SBM; Boulder Creek district, in Boulder Creek Canyon.	Undetermined (1957)	Everhardt (1951) reported northwest-trending quartz stringers in "mixed rocks". The quartz contains free gold and pyrrhotite.	A prospect. One short adit, caved in 1941. (Everhardt 51:111, pl.3).
Phillips (Chase Ranch) mine	SW¼SW¼ sec. 13, T16S, R1W, SBM; about 1-3/4 miles southeast of El Cajon.	H. J. Phillips, 1361 Chase Ave. El Cajon (1958)	A nearly vertical quartz vein, as much as 5 ft. wide, trends north-northwestward in granitic rocks; contains auriferous pyrite and chalcopyrite. Ore mined as late as 1950 averaged less than 1 ounce gold per ton.	On patented land at address of owner. Deposit developed by a 120-ft. shaft, inclined 35° to north-northwest. On the 30-ft. level a drift was driven north-northwestward and intersected ore shoot which yielded most of the ore mined. A short drift driven beneath the ore shoot from the bottom of the shaft (80-ft. level) did not encounter ore. The mine was worked individually from 1932 to 1935 by Arthur Dusenberry, T. F. Young, and H. J. Phillips, and intermittently from 1947 to 1950 by Phillips. A prospect about 1/3 mile east of the Phillips mine was worked by D. D. Bailey of Julian in 1896; and the Coe prospect (which see), 100 yards east of the Phillips mine, was worked in the 1930's. The value of the total production for these three properties, as compiled from records of the U. S. Bureau of Mines, is about $9,000 worth of gold (at $35 per ounce) and a small amount of silver. A one-stamp mill was on the Phillips property in 1958. (Phillips, H. J., personal communication, 1958; Tucker and Reed 39:17, pl.1). (R.M.S. and F.H.W.)
Pine Ridge mine	Montezuma (Rice) district.	Undetermined (1958) C. Helm, Warner Springs (1896)		A prospect. No additional published information. (Crawford 96:343).
Pine Tree prospect	Sec. 4, T13S, R4E, SBM; Julian district, east of Julian.	Undetermined (1957)	Narrow quartz veins in schist.	One claim, south of Helvetia mine. Adjudicated out as mining claim, now on patented homestead land. (Tucker and Reed 39:pl.1).
Pine Valley mines				An old name for Noble group, which see in text. (Goodyear 90:141-143; Preston 90:544; Storms 93:382).
Pioneer group	Secs. 9 and 10, T14S, R3E, SBM; Boulder Creek district.	Undetermined (1957) C. S. Young, 2417 S. Hope St., Los Angeles (1939)	Narrow quartz veins in hybrid rocks composed of quartz diorite and schist. Tucker (1939) reported that workings developed a 12-in. vein of gold-bearing quartz.	Group consists of 2 unpatented claims. It lies to the northwest of the Aftermath claim and adjoins the southeast end of the Boulder Creek group. Workings consist of a 100-ft. adit with 200 ft. of drifts, plus a stope driven 175 ft. from the adit to the surface. There are also two other stopes in the adit; also a 50-ft. shaft. Remnants of a stamp mill on Boulder Creek road. Small production. (Tucker and Reed 39:25, pl.1).

Gold

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
252c	Poor Man claim	Sec. 11, T13S, R4E, SBM; Julian district, south of Banner.	See Reed group.	Quartz vein 3 ft. wide along contact between schist and hybrid rocks that consist of quartz diorite and schist.	Part of Reed group, which see also. E: plored by a 50-ft. and a 100-ft. sh plus open cuts. (Donnelly 34:pl.4; Tucker and Reed 39:25, pl.1).
	Poor Man's group	Secs. 3, 10, and 11, T13S, R4E, SBM; Julian district, south of Banner.	Undetermined (1957) Quayle Bros., et al., Spreckels Bldg., San Diego (1939)		At one time comprised 6 claims. Now consists of only 3 claims: Banner Gold, Chariot No. 4, and Chariot No. No published information on working or output from these claims. The other 3 claims, of the former 6-clai group, are the Homestake, Poor Man, and Treasure Hill claims which were relocated as the Reed group, which see. (Crawford 94:243; 96:345; Donnelly 34:352, pl.4; Merrill 14:656, 657; Tucker 25:342; Tucker and Reed 39:25, pl.1).
	Pride of Julian				See Pride of the West mine. (Hubon 02 8).
247	Pride of the West (Pride of Julian) mine	West edge NW¼SW¼ sec. 36, T12S, R3E, SBM; Julian district, between 1 and 1½ miles northwest of Julian.	Cauzza Bros., Julian (1955)	Quartz vein, 1 to 3 ft. wide, strikes N15°W, dips 65° east. Cuts hybrid rocks which consist of quartz diorite and schist. Early mining produced ore having a grade of about 1-3/4 oz. gold per ton.	On patented ranch land. Developed by 340-ft. crosscut adit and 255 ft. of drifts on vein. In 1901 W. H. Holc mined about $2,000 worth of gold (at $20 per ounce); and during 1934-35, Fred H. Sawday mined about $2,000 worth (at $35 per ounce). (Hanks 86:85; Hubon 02:8; Merrill 14:656, 658; Stewart 58:34; Tucker and Reed 3 25, pl.1).
	Princess claim				See Mother Lode. (Tucker and Reed 39: 55).
248	Prosperity prospect	NW¼NW¼ sec. 3, T14S, R3E, SBM; Boulder Creek district, about 7½ miles south-southwest of Julian.	Richard A. McCubbin, P.O. Box 205, Julian (1957)		Very small production of gold. (Everhardt 51:111, pl.3).
	Raindrop claim	Julian district, southwest of Banner.			Part of Ready Relief group, which see text. Prospected by shallow pits an trenches. (Donnelly 34:pl.4; Merril 14:656, 657; Tucker and Reed 39:26).
249	Ranchito mine	Julian district.			See text. (Crawford 96:344; Donnelly 34:346, 350, 351, 352, 353, 369, pl. Hubon 02:8, 9; Merrill 14:656, 658; Tucker 25:346; Tucker and Reed 39:25 26, pl.1).
	Ready Relief claim	South of Montezuma Valley.			A claim that constitutes part of the Grapevine Star mine, which see. (Merrill 14:648-649).
250b	Ready Relief claim	Julian district			See Ready Relief group in text.
250a -d	Ready Relief group (Bailey Brothers mine)	Julian district, near Banner.			See text. (Crawford 94:241, 242, 243; 96:339, 342, 344, 345; Donnelly 34: 338, 346, 350, 351, 352, 354, 355-35 362, 365, 368, pl.4; Fairbanks 94: 321-322; Goodyear 88:520; 90:147-148 Hamilton 20:35; Hanks 86:86, 87-89; Hubon 02:8, 9; Irelan 88:513-515; Merrill 14:656, 657, 658; Newman 23: 49; Preston 90:543-544; Storms 93: 378-380; Tucker 21:377; 24a:373; 25:346-347; 34:327; 40:12; Tucker an Reed 39:15, 26-27, pl.1).
	Red Hill and Hillside claims	Mesa Grande district.			Probably located before 1900. In 1939 Red Hill claim held by Dela Angel of Mesa Grande (See Black Eagle mine). Hillside claim probably no longer valid by that time. (Merrill 14:649 Tucker and Reed 39:55).

Gold

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Red Rooster claim	Sec. 17, T16S, R5E, SBM; about one mile north of Buckman Springs.	Edith M. Connery, Box 14, Pine Valley (1956)		Located before 1939 by Guy Hogan, Pine Valley. Listed by Tucker and Reed (1939) as a prospect. In same area as Kitty Kay group. (Tucker and Reed 39:55).
	Red Wing claim	Sec. 31, T12S, R4E, SBM; Julian district, northwest of Julian.	Undetermined (1957)		Adjudicated out as a mining claim; now patented homestead land. (Donnelly 34: pl.4; Tucker and Reed 39:pl.1).
0c	Redman claim				See Ready Relief group in text. (Crawford 94:242; 96:344; Donnelly 34:350, 352, pl.4; Hanks 86:86, 87; Hubon 02: 8; Merrill 14:657; Storms 93:380; Tucker 24a:373; 40:12; Tucker and Reed 39:26-27).
1	Redrock group (Coyote)	Sec. 1, T13S, R3W, SBM; about 7 miles southwest of Escondido, and 1¼ to 2 miles south-southwest of Harmony Grove.	Undetermined (1957)	Not determined.	A group of 4 claims first located in 1896, abandoned, then relocated in 1913 by Peter Schnack, Escondido. Merrill (1914) stated that the claims extended northwest across the section. Explored by a 225-ft. inclined shaft. Production negligible. Long abandoned. (Crawford 96:334; Merrill 14: 651).
2a	Reed group	Secs. 3, 10, and 11, T13S, R4E, SBM; Julian district, south of Banner.	Frank Herron, Banner Grade, Julian or 468 Acheson, Pasadena 6 (1957)		Contains Homestake, Poor Man, and Treasure Hill claims which are described individually in this list. These claims were formerly part of the Poor Man's group which see also. (Crawford 94:243; 96:345; Donnelly 34: 352, pl.4; Hubon 02:8; Merrill 14: 656, 657; Tucker 25:342; Tucker and Reed 39:25, pl.1).
	Rice district				Synonymous with Montezuma district which is described in text. (Merrill 14: 648).
	Rocky Genes				See Ora group. (Donnelly 34:pl.4).
	Roosevelt Lode	Sec. 31, T12S, R4E, SBM; Julian district, north of Julian.	Undetermined (1957)	Narrow quartz veins in schist.	A fraction that was formerly part of the High Peak group. Adjudicated out as mining claim and now patented homestead land. Developed only by shallow cuts. (Donnelly 34:pl.4; Hubon 02:8; Tucker and Reed 39:pl.1).
3a 3b	Rose Quartz group (Hoar group of mines, Mahood prospect)	S½ sec. 7, T16S, R5E, SBM; about 2½ miles southeast of Pine Valley, on both sides of Bear Valley Loop Road.	Fred A. Storey, 307 N. Broadway, Santa Ana (1955)	Two deposits: Mahood prospect (253a), about 600 ft. west of loop road, consists of gold-bearing quartz veinlets in gneiss; deposit about 250 ft. east of loop road (253b) consists of north-northwest trending quartz vein 2 to 5 in. wide in schist.	Area was first prospected in mid-1930's by Walter Horr. In 1955 the group consisted of 5 unpatented claims. Main workings of Mahood prospect (253a) consist of a 25-ft. shaft at the north end of a shallow 50-ft. trench and a short adit at the south end of the trench. About 50 ft. northwest of the trench is a shaft between 50 and 75 ft. deep. Workings east of road (253b) consist of shaft inclined 40° west and a 25-ft. trench 100 ft. to south of shaft. Nearly $10,000 worth of gold (at $35 per ounce) and small amounts of silver were mined from 1939 to 1942; in 1939 worked by Walter Horr and Assoc., and from 1940 to 1942 by J. S. Mahood of Pine Valley. Last active about 1946. (Everhardt 51:112, pl.3; Tucker and Reed 39:pl.1).
	Rosalyn				See Rossland claim. (Tucker 25:339).
	Roseland				See Rossland claim.. (Hubon 02:8).
	Roselyn				See Rossland claim. (Tucker and Reed 39:21).
	Rossland (Rosalyn, Roseland, Roselyn) claim	Sec. 32, T12S, R4E, SBM; Julian district, northeast of Julian	Undetermined (1957)	Narrow quartz veins in schist.	Formerly part of High Peak group. Now adjudicated out as a mining claim and part of a patented homestead. Developed only by shallow cuts. (Donnelly 34:pl.4; Merrill 14:657, 659).

Gold

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
254	Ruby claim	Secs. 3 and 4, T13S, R4E, SBM; Julian district, east of Julian.	H. S. Cozens, 675 F. St., Chula Vista (1956)	Narrow quartz veins in schist.	Southeast of Warlock group, and at on time part of that operation. No pu lished information on workings. Donnelly (1934) estimated total val of production at less than $25,000. (Donnelly 34:353, pl.4; Merrill 14: 657, 658; Tucker and Reed 39:28).
	Ruby mine	T13S, R4E, SBM; Julian district.	Undetermined (1955)		"At Banner". Not related to Ruby cl tabulated above. Storms (1893)re- ported this mine was east of the Ready Relief group. At one time supported a 5-stamp mill. (Crawfor 94:242; 96:345; Storms 93:380).
255	San Diego mine	Sec. 32, T12S, R4E, and sec. 5, T13S, R4E, SBM; Julian district, east of Julian.	In dispute (1956)	Two quartz veins in schist strike northwestward, dip steeply to northeast, and are 2 to 4 ft. wide. Ore mined in early days averaged about 1 oz. gold per ton.	Claim was developed by 125-ft. inclin shaft, 2 other shallow shafts, 3 adits 100 to 300 feet in length, an shallow trenches. Workings now lar ly caved, inaccessible, and partly grown over by vegetation. Inactive after 1898. Donnelly (1934) estima total value of production at betwee $25,000 and $50,000. (Crawford 96: 345; Donnelly 34:350, 352, pl.4; Gc year 90:146; Hanks 86:83, 85; Hubon 02:8; Merrill 14:658, 660; Preston 542; Stewart 58:36; Tucker and Reed 39:14, 27, pl.1).
256	San Felipe mine	Center S½ sec. 2, T13S, R4E, SBM; Julian district, about ½ mile east of Banner, on crest of ridge.	Undetermined (1958) Bailey Brothers, Banner (1896)	North-trending, nearly vertical vein 1 to 1½ ft. wide (Crawford, 1896).	Prospected in 1890's by 30-ft. shaft, short adits, and shallow trenches. (Crawford 96:345).
257	San Vicente Valley placer deposits	Sec. 25, T13S, R1E, SBM; and secs. 30 and 31, T13S, R2E, SBM (proj. in part); about 4 miles southeast of Ramona.	Action Ranch, Ramona (1957)	Gold-bearing gravels lying in foot- hill land, and in gulches in low hills between San Vicente and Santa Maria Valleys.	Patented ranch land. A southwestern tension of Ballena placer deposits, which see also. Very small product (Fairbanks 93a:91-92; Tucker 25:33 334; Tucker and Reed 39:16).
258	Saratoga pros- pect	Secs. 4 and 5, T13S, R4E, SBM; Julian district, east of Julian.	C. W. Carey, Julian (1956)	Narrow veins in schist.	A prospect developed by numerous shal open cuts and pits. One unpatented claim adjoins southeast end of San Diego claim and northwest end of Helvetia claim.
259	Sawday Ranch placer deposit	Sec. 16, T13S, R2E, SBM; be- tween 4 and 5 miles east of Ramona.	Phillip Traverso, Ye Olde Stone Ranch, Ramona (1957).	Tucker (1925) stated, "pay gravels also occur in sec. 16, on the F. R. Sawday Ranch, and extend south into the San Vicente grant".	Patented ranch land. See also Baller placer gold deposits. (Tucker 25: 333).
260	Schley group	Secs. 1 and 12, T15S, R4E, SBM; Deer Park dis- trict, about 5 miles north of Pine Valley.	Undetermined (1957) C. M. Walker, Descanso (1925)	The deposit was reported by Tucker (1925) to consist of "a vein of quartz 4 ft. wide, having a strike of N.30°W., and a dip of 80°E." The vein cuts hybrid rocks which consist of quartz diorite and schist. The vein was reported to contain $4 of gold (at $20 per ounce) per ton and arsenopyrite and pyrite.	In 1925 the property comprised 5 clai Explored by shallow shafts and shor adits. Long inactive. Not investi gated by writer. (Everhardt 51:111 Tucker 25:348; Tucker and Reed 39: pl.1).
	Sentenac claim				See Sentenac deposit in section on "Limestone-dolomite". (Tucker and Reed 39:pl.1).
	Seventy-six claim	Sec. 10, T13S, R4E, SBM; Julian district, south of Banner.	Undetermined (1957) J. Hervey Johnson (1939)		Listed by Tucker and Reed (1939) as a prospect. (Tucker and Reed 39:55, pl.1).
	Shamrock claim	Julian district.			Part of Warlock group, which see in text. (Donnelly 34:350, 352, pl.4; Hanks 86:83, 85; Tucker and Reed 3 28).

Gold

p	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Shenandoah mine	SW¼NW¼ sec. 23, T11S, R2E, SBM; Mesa Grande district, about 2 miles northeast of Mesa Grande. Workings are on north side of Lake Henshaw-Mesa Grande road.	Undetermined (1958) Arthur Stone (1939)	Quartz vein, 1 to 2½ ft. wide, in "mixed" rocks or schist. Vein strikes northeastward and dips northwest. Grade and character of ore not determined.	One north-northeast trending patented claim. Discovered in the late 1880's and worked until 1896, and in 1932. Total production probably about $50,000 worth of gold (at $20 per ounce). During the period of activity the property contained a 5-stamp mill. Deposit was worked from a 175-ft. shaft, now caved, which had about 250 ft. of drifts appended. See also Black Eagle and Mesa Grande mines and Ida Mae prospect. (Crawford 94: 238, 242; 96:345; Hubon 02:8, 9; Merrill, 1913, unpublished field report; 14:649; Storms 93:382; Tucker and Reed 39:55, pl.1).
	Silent King prospect	Sec. 26(?), T15S, R4E, SBM; about one mile northwest of Pine Valley.	Albert F. Schneider, Box 92, Pine Valley (about 1955) or H. B. Minnick, San Diego and Jack Wisins, San Diego (about 1955)		No additional published information. (Tucker and Reed 39:55, pl.1).
	Silver Cloud prospect	Sec. 20, T15S, R5E, SBM; about 4½ miles west-southwest of Mt. Laguna.	Blair W. Tilley, 111 Kenton Ave., National City (about 1956)		Two claims. No additional published information. (Tucker and Reed 39: 55).
3	Silver King group	Secs. 2 and 3 (?), T14S, R3E, SBM; Boulder Creek district, about 7½ miles south-southwest of Julian.	George Moyer, Box 8, El Cajon (1955)	Deposit consists of a northwest-striking quartz vein, about 4 ft. wide, which dips 45° northeast in "mixed" rocks. The quartz was reported by Tucker (1925) to contain galena with gold and silver.	Reported by Tucker (1925) as a group of 5 claims on "ridge north of Kelly Creek." At that time the main workings consisted of three crosscut adits which had been driven toward the vein. One of these was 130 ft. long and did not reach the vein; the second adit was driven from a point 150 ft. above the first for 110 ft. to the vein, and 70 ft. of drifts were driven from it; the third adit was about 50 ft. long. An additional working consisted of a shaft about ¼ mile west of the adits. Long idle. Production negligible. Location could not be determined during present investigation. (Tucker 25:348; Tucker and Reed 39:27, pl.1).
	South California claim	Sec. 33, T12S, R4E, and sec. 4, T13S, R4E, SBM; Julian district, east of Julian.	Undetermined (1957)	Quartz veins in schist.	No published description. (Donnelly 34:pl.4).
1	South Hubbard claim	Julian district.			Part of Ready Relief group, which see in text. (Crawford 94:243; 96:345; Donnelly 34:352, 357, pl.4; Hanks 86: 87; Hubon 02:8; Merrill 14:656, 657; Tucker 24a:373; Tucker and Reed 39: 26).
	Spring claim				One of claims in Noble group, which see in text. (Crawford 94:243; 96:345; Merrill 14:663).
	Stanley claim				See Melrose group. (Merrill 14:657, 659; Tucker 25:342).
4	Stoner prospect	SW¼SW¼NW¼ sec. 28, T8S, R4W, SBM; slightly more than 5½ miles north-northwest of Fallbrook, and 200 feet north of DeLuz Murrieta road.	Mr. Levack, Route 2, Box 25A Fallbrook (1958)	A vein quartz-bearing zone which strikes N.70°E. and dips 70° north across the top of a small hill. Zone is 300 to 400 ft. long and ranges in width from 5 to 10 ft. Quartz is brecciated and contains arsenopyrite and yellow-brown hydrous iron oxides.	Patented land. Workings are on southwest side of the hill and consist of two shafts sunk on the zone: one is inclined 20° and is at least 75 ft. deep; the other is inclined 40° and is at least 100 ft. deep. According to present owners of property work was probably done by Frank Stoner, of DeLuz, prior to 1940.

Gold

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Stonewall Jackson				See Stonewall mine in text.
265	Stonewall (Stonewall Jackson) mine	Cuyamaca Rancho State Park.			See text. (Crawford 96:345; Donnelly 348, 350, 352, 353, 355, 365, 366, pl.4; Everhardt 51:112-113, pl.3; Goodyear 90:143; Hanks 86:89-90; Hubon 02:8; Irelan 88:515-516; Merr 14:660-662; Moore 59:1-24; Preston 540-541; San Diego County Div. Nat. Res. 53:8-9; Storms 93:382; 94:243; Tucker 24a:374; 25:348; Tucker and Reed 39:pl.1).
	Sulphur Springs claim	Sec. 2, T13S, R4E, SBM; Julian district, at Banner.	Undetermined (1957)		Map reference only. (Tucker and Reed 39:pl.1).
	Summit and Summit Extension claims	Sec. 11 (proj.), T14S, R3E, SBM; Boulder Creek district.	Undetermined (1957) More and Feiler, Julian (1939)	Deposit reported by Tucker and Reed (1939) to consist of a quartz vein about 18 in. wide which contains gold.	Workings consist of an adit 100 ft. l and 2 shafts. One of the shafts wa 45 ft. deep and the other about 15 deep. Long idle. Production very small or negligible. (Tucker and Reed 39:27, pl.1).
	Sundown mine	Montezuma (Rice) district.	Undetermined (1958) Mrs. C. Helm, Warner Springs (1896)		A prospect. No additional published information. (Crawford 96:345).
	Telluride claim				An unpatented claim which was formerl part of Noble group, which see in text. (Merrill 14:664).
266	Telluride (Triluride) group	NW¼ sec. 31, T14S, R5E, SBM; Deer Park district, about 6½ miles north-northeast of Pine Valley.	Marguerite F. Burns, Box 223, Alpine (about 1955)	Tucker (1925) reported that several northwest-trending quartz veins are enclosed in Julian schist. The veins dip steeply southwest and range in width from 2 to 12 in. In addition to gold the quartz contains pyrite and galena.	Two unpatented claims. Long idle. T claims were prospected by a crosscu adit driven N.40°E. for 100 ft. wit a 30-ft. winze sunk in the adit 30 from its portal. Production neglig ible. See also Good Luck prospect. (Everhardt 51:111-112; Tucker 25:34 349; Tucker and Reed 39:pl.1).
	Thelma claim				See Mercedes group. (Tucker and Reed 39:55, pl.1).
	Tom Paine claim	Sec. 10, T13S, R4E, SBM; Julian district, south of Banner.			Part of the Ready Relief group, which see in text. Prospected by shallow pits and trenches. (Donnelly 34:pl Merrill 14:657; Tucker and Reed 39: 16).
267	Tom Scott mine	Sec. 31, T12S, R4E, SBM; Julian district, north of Julian.	Mrs. C. Wilson, Julian (1955)	Two narrow, parallel veins in schist strike northwestward, dip northeast.	One claim, patented in 1932. Develop by a 225-ft. shaft and a 300-ft. ad with appended drifts and stopes. I active after 1902. Workings caved and inaccessible in 1957. Donnelly (1934) estimated value of total pro duction at less than $25,000. (Donnelly 34:353, pl.4; Hubon 02:8; Merrill 14:657, 659; Tucker 25:349; Tucker and Reed 39:27, pl.1).
	Townsite claim	Sec. 31, T12S, R4E, SBM; Julian district, north of Julian.	H. R. Koob, 943 - 10th St., San Diego 1 (about 1955)	Narrow quartz veins in schist.	No published information on deposit o workings. Developed only by shallo cuts and trenches. Has been adjudi cated out as a mining claim and now part of a patented homestead. (Donnelly 34:pl.4; Merrill 14:657, 660).
252b	Treasure Hill claim	Secs. 3, 10, and 11, T13S, R4E, SBM; Julian district, south of Banner.		Quartz vein 3 ft. wide along contact between schist and granodiorite.	Formerly part of Poor Man's group, no part of Reed group, which see also. Explored by 200-ft. drift adit driv southeastward on vein. (Donnelly 3 pl.4; Tucker and Reed 39:25, pl.1).
	Treasury claim				One of the claims in the Noble group, which see in text. (Crawford 94:24 96:345; Merrill 14:663).

Gold

Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
Tres Amigos mine	Slightly north of center sec. 7, T16S, R5E, SBM; 2 miles southeast of Pine Valley, about 1000 ft. east of Bear Valley Loop road.	Undetermined (1957) Guy Hogan, Pine Valley (1941)	Sparse gold occurs in northwest-trending veinlets of quartz in Bonsall tonalite (quartz diorite).	Developed by a shallow inclined shaft and two connected adits. Last reported activity 1946. Very small output during 1940-41. (Everhardt 51:114, pl.3).
Triluride				See Telluride group. (Tucker and Reed 39:pl.1).
Truelsen's prospect	Sec. 31, T12S, R4E, SBM; Julian district, north of Julian.	Undetermined (1957)		Has been adjudicated out as a mining claim, and now part of a patented homestead. No additional published information. (Tucker 39:55).
Undetermined	Center sec. 29, T13S, R6E, SBM; in Anza-Borrego Desert State Park, about 13 miles east-southeast of Julian, in southeastern Blair Valley.	Undetermined (1957)		Prospect. A 25-ft. shaft is inclined steeply east in biotite quartz diorite. Probably no production.
Undetermined	SW¼SW¼ sec. 24, T13S, R5E, SBM; Anza-Borrego Desert State Park, about 11 miles east-southeast of Julian, at base of southeast flank of Oriflamme Mts.	Undetermined (1957)	Narrow quartz veins in schist strike north-northeastward and are nearly vertical.	Explored by 3 short adits. No published information. Production probably negligible.
Valentine mine	"2 miles S. of Julian" (Crawford, 1896).	Undetermined (1958) E. A. Stanley, Banner (1896)		A prospect. No additional published information. (Crawford 96:345).
Valley View mine	Montezuma (Rice) district.			A prospect. No additional published information. (Crawford 96:345).
Van Wert (Van Wirt) mine	Sec. 31, T12S, R4E, SBM; Julian district, north of Julian.	Marks Sisters, 2441 Pamo Avenue, San Diego (1955)	Narrow quartz veins in schist, strike northwestward, dip steeply northeast.	Patented (?). One of the first deposits discovered in district. Tucker (1939) reported that the mine was developed by "2 crosscut tunnels 200 ft. in length to vein, with a drift of about 150 ft. along the vein in the north tunnel; stoped to the surface". In 1956 the only workings that were evident were a southeast-trending adit at least 300 ft. long, which was caved by slumping from the surface, and several short trenches and shallow cuts. Donnelly (1934) estimated value of total production to be between $25,000 and $50,000. (Donnelly 34:349, 350, 352, pl.4; Hanks 86:82, 83; Merrill 14:657; Tucker 25:349; Tucker and Reed 39:27-28, pl.1).
Van Wirt				See Van Wert mine. (Hanks 86:82, 83).
Vault of Ages prospect	Sec. 26, T15S, R4E, SBM; about 1 mile north-northwest of Pine Valley.	Selman P. Stone, 593 Glendale Blvd. Los Angeles 26 (1957)	Quartz vein deposit reported by owner to contain gold, silver and tungsten.	Explored only by shallow shafts and pits. No production.
Vernon group	Secs. 30 and 31, T14S, R5E, SBM; Deer Park district, north of Pine Valley.	Undetermined (1958) Zoe Vernon (1939)		Five claims. Listed by Tucker and Reed (1939) as a prospect. No additional published information. (Tucker and Reed 39:55).

Gold

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
272	Victoria group	Sec. 5, T15S, R5E, SBM; Laguna Mts. about 4 miles west-northwest of Mt. Laguna.	Undetermined (1957)		Group of 3 claims which was located b T. Blair and J. McKie of San Diego the E½ of sec. 5. This area later was covered by the Melba group of claims which now are patented. Shallow workings. Negligible produ tion. See also Melba group. (Tuck 25:349; Tucker and Reed 39:pl.1).
273	Viejas Mt. prospect	NW¼ sec. 19, T15S, R3E, SBM; about 3½ miles east-northeast of Alpine, on east slope of Viejas Mt.			In 1940 an adit was driven westward 1 ft. into Viejas Mt. by Indians from Viejas Reservation. One miner reported "very small amounts of gol (Everhardt 51:14, pl.3).
274	Warlock group	Julian district.			See text. (Crawford 94:239, 242, 243 96:334, 342, 345; Donnelly 34:350, 352, 357, pl.4; Hubon 02:6, 8; Merr 14:656, 657, 658, 659; Preston 90:5 Tucker and Reed 39:28, pl.1).
	Warrior's Ledge	Julian district.			Located February 20, 1870 by D. D. Bailey and others. First claim to filed in Julian record book "A". (Tucker and Reed 39:14).
275	Washington (George Washington) mine	Sec. 31, T12S, R4E, SBM; Julian district, north of Julian.	W. C. Barker & Assoc., 610 San Diego Trust and Savings Bank, San Diego (1939)	Narrow quartz vein in schist, strikes northwestward, dips steeply southeast.	First important discovery of gold in San Diego County was made here on February 22, 1870. This led to rap development of Julian district. Mi workings, now caved and grown over vegetation, once consisted of 100-f adit, and 100-ft. shaft with 300-ft drift on vein at bottom. After 190 active only in 1931. Donnelly (193 estimated value of total production be between $25,000 and $50,000. (Crawford 94:243; 96:345; Donnelly 349, 350, 352, pl.4; Goodyear 90:14 Hanks 86:82, 83; Hubon 02:8; Merril 14:657, 658; Tucker and Reed 39:14, pl.1).
	Wedge claim				Part of Kentuck group, which see. (Donnelly 34:pl.4; Tucker and Reed 39:21).
276	West California claim	Secs. 32 and 33, T12S, R4E, SBM; Julian district, east of Julian.	Undetermined (1957) W. K. Robinson, Julian (1935)		No published description. Prospected only by shallow cuts and trenches. (Donnelly 34:pl.4).
277	Wettleson prospect	Center E½E½ sec. 14, T16S, R2E, SBM; about 4½ miles south-southeast of Alpine, just north of the Glenn Lonely Truck Trail.	Undetermined (1957)		A 200-ft. adit was driven to intersec a quartz vein. No production. (Everhardt 51:114, pl.3).
	Whaley				See Kuhnis mine. (Tucker and Reed 39:28, pl.1).
	White Oak mine	"4 miles N. of Escondido" (Crawford, 1896)	Undetermined (1958) J. N. Turrentine, et al, Escondido (1896)		Prospected by 25-ft. shaft. (Crawfor 96:346; Merrill 14:649).
	Wilcox				See Homestake claim. (Crawford 94:24 96:345; Hubon 02:8; Tucker 25:342).
	Wild Cat claim	Mesa Grande district.	Undetermined (1958) Fred Scholder, Mesa Grande (1914)		A prospect first reported by Crawford (1896). No additional published information. (Crawford 96:345; Merri 14:649).

Gold

p	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Willard	Secs. 7, 18, 19, 20 and 21, T13S, R2E, SBM; between 3 and 4 miles east of Ramona.	Undetermined (1957)		C. F. Willard, Ramona, intermittently operated placer deposits in the Ballena area from 1906 to 1914. See also Ballena and Hopkins placer deposits. (Tucker 25:333-334).
3	Willhite group	Sec. 17, T17S, R5E, SBM; in the Laguna Mts., about 4 miles west of Mt. Laguna.	Jack A. Fuller, P.O. Box 42, Pine Valley (1957)	Very narrow quartz veins in schist. Tucker (1925) reported that the quartz is "heavily mineralized with pyrite and arsenopyrite, with gold and silver values."	Group comprises 4 claims. Explored principally by shallow shafts and trenches in north-trending canyon in E½ sec. 17. Production negligible. Long idle. (Several claims also were located immediately to the south, in section 20, but were only prospected). (Tucker 25:349; Tucker and Reed 39:pl.1).
9	Winatoma and Morning Glory claims	S½ sec. 16, T16S, R6E, SBM (proj.); Metal Mountain district, about 6 miles north-northwest of Live Oak Springs, in the southwest part of the In-Ko-Pah Mts.	State Lands Commission, State of California, Los Angeles (1958)	Veins of gold-bearing quartz strike approximately northward, dip steeply. Similar to deposits developed to north by Metal Mountain tungsten mine.	Two claims located on state-owned land were invalid. In 1921, L. B. Spaulding of Ramona sunk a 45-ft. shaft on the Winatoma claim, in the SW¼ sec. 16. (Tucker and Reed 39:28, pl.1).
	Yellow Bar prospect	Sec. 26, T10S, R5E, SBM; Anza-Borrego Desert State Park.	Undetermined (1957)		No additional published information. (Tucker and Reed 39:55, pl.1).
	You Bet group	Deer Park district			Property now covered by Oak Canyon mine, which see. For early history of property ownership, also see Beyers group. (Crawford 96:332; Merrill 14:662).

In 1957, the Creese brothers were planning installation a mill, with 50 or 100 tons per day capacity, to replace mill that was being used for pilot testing of ore from Shamrock vein. The pilot mill has a capacity of three-urths of a ton of ore per hour, and contains a ball mill, algamating plates, and five Wilfley-type concentrating les.

ANITE

See herein under "Stone, Dimension" and "Sand and avel, and Crushed and Broken Stone."

APHITE

There are three known graphite-bearing deposits in n Diego County. These are the Mary Jane and Seyer posits and a deposit which is unnamed. They are in Mason Valley area, in the east-central part of the unty, and consist of graphite-rich zones in fine-grained ist which is composed chiefly of quartz and potash dspar (see descriptions of deposits in tabulated list). one has been worked commercially. The Mary Jane the largest deposit: it is 250 feet long, 50 feet wide, d was reported to contain about 11 percent graphite ucker, 1925, p. 369).

Graphite has not been mined in California since 1935, t is brought into the State from deposits in Mexico and Madagascar (Oakeshott, 1957, p. 227). Fine-grained graphite from deposits such as those in San Diego County is suitable only for use in paints and foundry facings. The deposits in the county are too low-grade and too small to be mined at this time in competition with imported graphite.

GYPSUM

The only deposits of gypsum in San Diego County lie along its eastern edge, in the north part of the Fish Creek Mountains region, and are westward extensions of very large deposits in Imperial County (Ver Planck, 1952, Pl. 20; Photo 46). The mine of the United States Gypsum Company, in Imperial County, is the largest mine of gypsum in California (Ver Planck, 1956b, p. 233). Unmined, as of 1960, is the National Gypsum Company Deposit which lies both in Imperial and San Diego Counties (see description in tabulated list).

The gypsum of the Fish Creek Mountain area occurs as strata in a section of folded sedimentary rocks of Tertiary age. The most northerly deposit in the area consists of gypsum partly overlain by celestite, the mineral for which it has been worked (see Roberts and Peeler Deposit in text under "Strontium").

Gypsum is a very low cost commodity which is used mainly in the plaster and portland cement industries, and in agriculture.

Graphite

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Bullard prospect	Near Campo.	Undetermined (1957) C. H. Bullard, Campo (1918)		No additional published information. (Boalich and Castello 18:16).
	Kane Graphite (Leebrick) mine				See Mary Jane deposit. (Tucker 25:369 Tucker and Reed 39:pl.1).
	Liebuck				See Mary Jane deposit. (Tucker 21b:37
280	Mary Jane (Kane, Leebrick, Liebuck) deposit	Near the center of the W½E½ sec. 10, T14S, R5E, SBM; west of Mason Valley, low on the southeast tip of a long northwest-trending ridge which separates tributaries flowing southeast into Cottonwood Creek.	Guy Urquhart, 1041 Columbia St., San Diego (1958)	A zone of graphite-bearing schist, which strikes northwestward and dips 60°-75° northeast, is exposed on a southeast-facing ridge slope. Zone is about 250 ft. long and 50 ft. wide. Schist is fine-grained and composed chiefly of quartz, potash feldspar, and graphite. Tucker (1925) stated that the schist contains about 11 percent graphite.	Patented ranch land. Deposit first explored before 1915 by Frank Stephe of Julian and T. L. Works of San Diego. Principal development, at southeast end of zone, consists of two adits driven west-northwestward and northwestward from a common port The adits are about 60, and at least 75 ft. long respectively. A 50-ft. shaft near the portal is now partly caved. About 150 ft. north-northwes of these workings is an irregular northwest-trending cut which is abou 15 ft. long and 5 to 10 ft. wide. (Boalich and Castello 18:16; Merrill 14:713; Tucker 21b:378; 25:369; Tuck and Reed 39:44, pl.1).
281	Seyer deposit	Sec. 3(?), T14S, R5E, SBM; Mason Valley area. (Tucker, 1921b and 1925, reported deposit to be in sec. 34, T13S, R5E. Could not be located there by present investigator. Hilton, 1939 shows a deposit which is probably in NW¼ sec. 3 and may be the Seyer deposit).	Undetermined (1958) W. B. Seyer, Julian (1925)	"Two graphite bands of schist 4 to 12 feet wide." "..According to reports showed 16.2% graphite". (Tucker, 1921b).	Development not reported. (Hilton 39: 26-28; Tucker 21b:378; 25:369).
282	Unnamed	NW¼NE¼ sec. 10, T14S, R5E, SBM; west of Mason Valley, low on the southwest side of a southeast-trending ridge.	Undetermined (1958)	Graphite-bearing schist. Similar to Mary Jane deposit.	A prospect.

Gypsum

Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
Blanc deposit (Blanc placer claims)	Secs. 30 and 31, T13S, R9E and sec. 6, T14S, R9E, SBM (Imperial Co.); Fish Creek Mts. area.	National Gypsum Co., New York, N.Y. (1957)		Within Imperial County. Claims were sold to National Gypsum Co. in mid-1950's. (Tucker and Reed 39:44; Ver Planck 52:27-35, pl.20).
Consolidated Placer Mining claim	SE¼ sec. 25, T13S, R8E, SBM; Fish Creek Mts. area.			A map locality of Tucker and Reed (1939, pl. 1). Locality is slightly north of National Gypsum Co. deposit, which see. (Tucker and Reed 39:pl.1).
Kipp placer claims	South edge SE¼ sec. 25 and N½ NE¼ sec. 36, T13S, R8E, SBM; in the Fish Creek Mts. area.	National Gypsum Co., New York, N.Y. (1957)		Patented placer claims which comprise about 80 acres. Sold in mid-1950's by Sylvester Kipp to National Gypsum Company. (Tucker and Reed 39:44; Ver Planck 58:28, pl.20).
National Gypsum Company deposit (Blanc and Kipp claims)	South edge SE¼ sec. 25 and N½ NE¼ sec. 36, T13S, R8E, SBM (San Diego Co.); and sec. 31, T13S, R9E, and sec. 6, T14S, R9E, SBM (Imperial Co.); in the north part of the Fish Creek Mts. area, partly in Anza-Borrego Desert State Park.	National Gypsum Co., New York, N.Y. (1957)	Deposit consists of a northwest-trending deposit of gypsum which is exposed irregularly, high on the southwest slope of a northwest-trending ridge. Thickness undetermined. Of several hundred acres underlain by gypsum only about 80-85 are in San Diego County.	Property holdings consist of the Kipp claims, which comprise 80 acres in the SE¼ sec. 25 and the NE¼ sec. 36 (San Diego Co.); and the Blanc claims, which are in secs. 30, 31 and 6 (Imperial Co.) These claims were purchased by the company in the mid-1950's. The company had drilled the property extensively by early 1957. (Tucker and Reed 39:44; Ver Planck 52:27-35, pl.20; 57b:233).
Peler (W. F.) and Roberts, (D. R.)				See Roberts and Peeler deposit in text, under "Strontium". (Tucker 21a:271-272).
Roberts and Peeler deposit	Fish Creek Mts. area.		Gypsum overlain partly by celestite.	See text under "Strontium". (Hewett 36:154-155, 161; Sampson and Tucker 42:136; Tucker 21a:271-272; Ver Planck 52:27-35, pl.20).
Undetermined	Middle E½SE¼ sec. 24, T13S, R8E, SBM (San Diego Co.); and secs. 19 and 30, T13S, R9E, SBM (Imperial Co.); Fish Creek Mts. area.	Undetermined (1957)	A deposit, wedge-shaped in plan, which lies in both Imperial and San Diego Counties. It is an exposed part of the southwest limb of a syncline in whose east limb the U. S. Gypsum deposit is exposed in Imperial Co. Underlies 10-15 acres in San Diego County and several times that area in Imperial Co. Thickness undetermined.	Undeveloped. (Ver Planck 52:27-35, pl.20; 57b:233).

Iron

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Campo				See Companion No. 1 deposit. (Egenho 48:289; Tucker 25:350).
285	Companion No. 1 (Campo) deposit	Sec. 22(?), T18S, R4E, SBM; west of Campo.	William Stulsen homestead, Campo (1956)	Deposit in granitic rocks contains small amount of magnetite. Deposit of little significance.	Original claim invalid; land homestea Deposit explored by 2 shallow shaft (Egenhoff 48:289; Tucker 25:350; Tucker and Reed 39:29).
	Cornelius				See Iron Master deposit.
	El Cajon				See Iron Master deposit.
286	Iron Master (Cornelius, El Cajon) deposit	Along boundary between the SW¼ sec. 25 and the SE¼ sec. 26, T15S, R1E, SBM (proj.); nearly 8 miles northeast of El Cajon, at south edge of McClain truck trail.	B. A. Cornelius, La Cresta (1956)	A small, northeast-trending pod of fine-grained magnetite which is associated with epidote and silicified granitic rocks. In 1940's best showing was drilled to a depth of between 40 and 100(?) ft. Core and sludge contained finely disseminated magnetite in siliceous gangue.	Patented non-mining land. Explored b small, shallow pit. Several hundre pounds of magnetite on dump. (Egenhoff 48:292; Tucker 24:374; 25: 350; Tucker and Reed 39:29, pl.1). (R.M.S.)
	Juch	Secs. 34 and 35, T13S, R2E, SBM, and sec. 23, T14S, R2E, SBM; about 7½ miles southeast of Ramona, in the Cleveland National Forest.		Unexplored "exposure of gossan" (Tucker, 1925, p. 349); also reported as "vein of hematite 12 to 15 feet thick" (Goodyear, 1890, p. 144). Deposit could not be located by present investigators. Possibly red soil resulting from weathering of Green Valley tonalite was mistaken for an outcrop of iron ore.	Adjacent to Gower truck trail. (Aubur 06:300; Boalich 23:112; Egenhoff 48: 293; Goodyear 90:144, 154; Merrill 14:668; Tucker 25:349-350). (R.M.S.
287	Lakeview deposit	N½ sec. 1, T15S, R1E, SBM; about 6 miles northeast of Lakeside, on south side of El Cajon Mt.	A. C. Harbough and Mr. Shears, San Pedro (1944)	Several very large boulders composed of coarse-grained schistose magnetite. Source of boulders undetermined.	Nearly inaccessible. Explored by shal low open cuts. (Egenhoff 48:293; Tucker 24:374; 25:350; Tucker and Re 39:29, pl.1). (R.M.S.)
288	Mammoth deposit	Sec. 31, T7S, R5W, (proj.), and sec. 36, T7S, R6W, SBM (Riverside County); and sec. 6, T8S, R5W, SBM (proj.) (San Diego County); Defiance district, about 12-13 miles northeast of San Clemente.	Howard V. Harrison, Thomas Dunston, Paul Harris, and Beth Harris French, Box 502, Fallbrook (1955)	Bodies of iron oxide minerals in two northwest-trending shear zones in meta-andesite of the Santiago Peak volcanics. Principal zone intersects San Mateo canyon slightly less than 1,500 ft. northeast of its junction with Nickel Canyon. Zone is perhaps one mile long. Siliceous magnetite bodies are exposed discontinuously in zone for about 1,500 ft. on the southeast side of San Mateo Canyon. The bodies range in width from 5 to 20 ft.; the largest is 30 ft. long and 18 ft. wide. A second zone intersects San Mateo Canyon slightly less than 1,000(?) ft. south of its junction with Nickel Canyon. This zone contains hematite-bearing bodies.	Deposit explored only by shallow trenches and a 12-ft. adit. About 1 tons of magnetite produced for testi in early 1950's. District of interest earlier because of copper minera ization. Also see Defiance district in tabulated list under "Copper". (Engel, Gay, and Rogers 59:70, 71, 1 pl.2). (R.M.S.)
	Unnamed	Sec. 10(?), T13S, R4E, SBM; southeast of Julian.	Undetermined	"Scattered boulders and fragments of iron ore, some of which are rich enough to be of value in a country where it would pay to smelt iron" (Goodyear, 1890, p. 140). Probably refers to alteration products of gabbro or to a gossan similar to occurrence at Friday nickel deposit in same area.	(Aubury 06:300; Boalich 23:112; Goodyear 90:144). (R.M.S.)

ON *

The only known iron deposits in San Diego County e too small to be mined for the principal use of iron e—as blast furnace feed in the manufacture of steel. he deposits include the Companion, Iron Master, Lake-ew, and the Mammoth Deposit, which is partly in verside County. They are described in the accompany-g tabulated list. Additional, minor uses of iron ore e described by Gay (1957a, p. 253-258).

Iron is contained also in small nodules that compose rt of the Linda Vista terrace deposits which lie be-een Mission and San Dieguito River Valleys. The dules contain as much as 15 percent iron (Emery, 1950, 213-221; Hanna, 1926a, p. 218-219) (see more com-ete description under "Phosphates").

ANITE, ANDALUSITE, SILLIMANITE, DUMORTIERITE, AND TOPAZ

The basic principle of utilization of kyanite and related inerals is based upon their conversion when heated to mperatures in the range of 2,000° F. to 3,000° F., to a ixture of mullite ($3Al_2O_3.2SiO_3$) and free silica. As ullite is stable to 3,290° F., has a low thermal expansion, chemically inert, and has high strength, it is valued as constituent of refractories.

Sillimanite (aluminum silicate) occurs at several locali-es in San Diego County. Near Dehesa it is associated ith *dumortierite* (hydrous silicate of aluminum and ron) in a dike-like body composed chiefly of quartz ee description below). The mineral is also reported as constituent of quartz-muscovite-sillimanite schist at calities south and east of Ramona and near Mesa Grande Merriam, 1946, p. 228). It has been reported to occur gneiss at the entrance to Palm Canyon, west of Borrego alley, and in blocks of breccia in Split Mountain Can-on, south of Ocotillo Wells (Cordell Durrell *in* Mur-ch and Webb, 1956, p. 299). The mineral was noted Waring (1905, p. 359) at a locality four miles south-st of Fallbrook. Deposits of *kyanite* (aluminum silicate) e not known in San Diego County. *Andalusite* (alumi-m silicate) occurs in several pegmatite dikes which e exposed on the north sides of Queen and Chief Moun-ins in the Pala district (Jahns and Wright, 1951, p. 42) d at a locality about three miles northeast of Pala (W. Schaller *in* Murdoch and Webb, 1956, p. 50). *Topaz* ydrous silicate of aluminum and fluorine) has been ined in the county as a gem mineral (see herein under Gem Minerals").

hesa Dumortierite Deposit

Location: N.½ NW.¼ NE.¼ Sec. 9, T. 16 S., R. 2 E., B.M.; about 2⅓ miles south-southwest of Alpine, and 0 feet south of the Alpine-Dehesa Road (Photo 45, g. 38). *Ownership:* On patented land owned by W. W. nny, 401 St. Cloud Road, Los Angeles 24 (1955).

The Dehesa Deposit was first mentioned in technical erature in 1902 when W. E. Ford (1902, p. 426) blished an analysis of the dumortierite. In 1905 W. T.

By R. M. Stewart and F. H. Weber.

Photo 45. Dehesa dumortierite deposit. View north showing outcrop of dumortierite-bearing body. (See also fig. 38.)

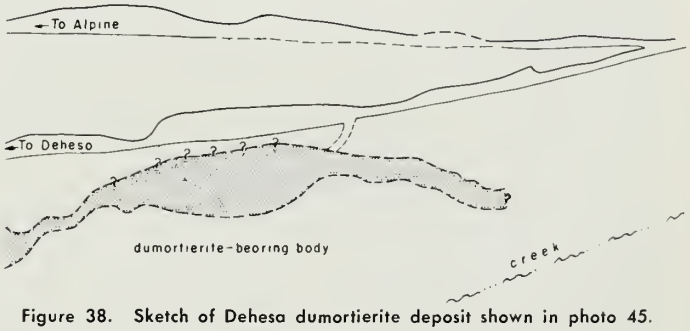


Figure 38. Sketch of Dehesa dumortierite deposit shown in photo 45.

Schaller (1905a, p. 91-120) published a thorough description of the mineralogy and geology of the deposit. The deposit is presently of interest only to mineral collectors, principally as a source of dumortierite-bearing specimens.

Dumortierite occurs in a crudely tabular, dike-like body, composed chiefly of quartz, which strikes N. 70° W., and dips 40° to 55° northeast. The body is bordered by tonalite and is exposed for a strike-length of about 750 feet. It pinches abruptly to the east-southeast and gradually to the west-northwest, and attains a maximum thickness of nearly 90 feet, about 200 feet from its east-southeastern end. The body can be divided into upper and lower zones on the basis of differences in mineralogy and structure. Dumortierite is restricted to the lower zone. (1) The lower zone, which constitutes about one-third of the body, has a schistose structure and is composed chiefly of fine- to coarse-grained anhedral quartz. Lavender dumortierite occurs as radiating masses as much as several inches in diameter, and as single isolated blades oriented in parallel arrangement. This mineral constitutes from less than 5 percent to perhaps 10 percent of the rock. Muscovite is also common, and sillimanite, rutile, and pyrite are sparse. Schaller (1905a, p. 99) also noted the occurrence of magnetite, titanite (sphene), apatite, and zircon in this part of the body. Schaller also reported that the dumortierite contains 1½ percent titanium oxide. (2) The upper zone, which constitutes the remaining two-thirds of the body, is also schistose and composed chiefly of quartz. In this zone

Kyanite, etc.

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
289	Dehesa dumortierite deposit	South of Alpine.		Deposit contains both dumortierite and sillimanite.	See text. (Ford 02:426; Kunz 05:71; Merrill 14:703; Sampson and Tucker 452; Schaller 05a:91-92, 96-102; Tucker and Reed 39:52, pl.1).
	MacCullough deposit	Secs. 4 and 5, T11S, R2E, SBM; south of Alpine.	John A. MacCullough, Chicago, Ill. (1939)	Sillimanite in quartz. Possibly related to Dehesa deposit, in sec. 9, which is described in text.	(Tucker and Reed 39:52).
	Unnamed	Sec. 12, T9S, R2W, SBM; Pala district, about 3 miles northeast of Pala.	Undetermined (1958)	Pink radiating masses of andalusite occur in a quartz vein.	Undeveloped. (W. T. Schaller in Murdoch and Webb 56:50).

Lead

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
290	Bradbury (Surprise) prospect	SE¼NW¼ sec. 1, T11S, R2W, SBM; about 2¼ miles north-northwest of Valley Center, along a north-east-trending creek.	Undetermined (1958) W. M. Bradbury, 116 S. Broadway, Escondido (1939)	The more northeasterly of two groups of workings explores a northwest-trending quartz vein enclosed concordantly in metamorphic rocks. The vein is reported by Tucker (1925) to be 3 ft. wide, to dip 60° southwest, and to contain silver-bearing galena and sphalerite. Grade undetermined. The more southwesterly workings explored rocks that do not contain apparent lead mineralization.	Two claims located before 1910. Explored by 2 groups of workings about 250 ft. apart. The more northeasterly group consists mainly of a shaft, now caved, with a rather large dump. Lower, more southwesterly, workings consist of a shaft caved within 30 ft of the surface. Probably no production. (Goodwin 57:681; Merrill 14:667-668; Tucker 25:350; Tucker and Reed 39:29, pl.1). (R.M.S.)
291	Cedar Creek (Lost Spanish) mine	Secs. 12 and 13, T18S, R1E, SBM, (proj.); in the San Ysidro Mts., about 4 miles west-southwest of Engineer Springs, and on the east side of Cedar Creek.	Paul Weber, Rt. 1, Box 145, Campo (1957)	Deposit consists of at least 2 north-northwest trending zones which contain galena-bearing quartz veins. The zones are 50 to 100 ft. apart and are several thousand feet long. They are about vertical and are enclosed in metamorphosed silicic volcanic rocks which are chiefly rhyolite in composition. The zones cut Cedar Creek about at the point where it is crossed by the east-trending line between secs. 12 and 13. Principal vein developed is in the more westerly zone and ranges in width from less than one in. to about 3 ft. The principal vein minerals, in addition to quartz, are galena, arsenopyrite, and pyrite. Additional minerals, as reported by R. W. Rowland, of the Natural History Museum, Balboa Park, San Diego (unpublished manuscript, 1956) are chalcopyrite, sphalerite, scorodite, silver and gold.	The deposit can be reached from State Highway 94 via a series of dirt road which originates at a point on the highway in the NE¼NE¼ sec. 31, T17S, R2E. Original claims located many years ago. In 1956 property consist of seven contiguous north-northwest trending unpatented claims. Leased and prospected briefly by Paul Henderson and associates, of La Mesa, in 1956. Zones have been prospected laterally for about one mile by shallow shafts and open cuts. Principal development is a 25-ft. open cut, driven eastward, from which was sunk a 45-ft. vertical shaft with drifts about 20 ft. long driven north and south from the bottom. Production negligible.
	Descanso mine	Near Descanso Jct.			Galena associated with gold ore. See tabulated list under "Gold". (Goodwin 57:681; Tucker 25:335, 353; Tucker and Reed 39:29).
	Lost Spanish				See Cedar Creek mine.
	Metal Mountain deposit	North of Live Oak Springs.			Deposit originally prospected in 1890' for lead and silver; now of interest for tungsten minerals. See text und "Tungsten". (Hubon 02:4; Merrill 14 668).
	Silver King group	Boulder Creek district.			Quartz veins contain gold and galena. See tabulated list under "Gold". (Tucker 25:348).
	Surprise				See Bradbury deposit. (Goodwin 57:681 Merrill 14:667-668).
	Telluride group	Deer Park district.			Quartz veins that contain gold and galena. See tabulated list under "Gold". (Goodwin 57:681; Tucker 25:350).

: anhedral quartz is fine- to medium-grained and du-
rtierite is absent. Sillimanite, as fine- to medium-
ined prisms and prismatic aggregates, is the second
st common mineral. Tiny ruby-red to yellow-brown
ins of rutile are very sparse. In addition, Schaller
905a, p. 96-97) reported the presence of pyrite, mus-
vite, titanite (sphene), apatite, zircon, and corundum
this part of the body.

The deposit has not been mined commercially. Devel-
ment consists only of surface scalpings and a north-
nding adit of undetermined length whose portal is
w nearly covered over by debris.

D

The Cedar Creek Deposit in the San Ysidro Mountains
d the Bradbury Deposit near Valley Center are the
ly properties in San Diego County that have been
spected chiefly for lead. The Cedar Creek Deposit
s being developed as late as the mid-1950's. Neither
posit has a record of production. These deposits con-
n galena with sphalerite, native silver (or silver-bearing
ena) and other minerals sparsely distributed in quartz
ns which occur in metamorphic rocks. Additional
d-bearing deposits include the Metal Mountain Tung-
n Deposit, which once was prospected for lead and
er (see herein under "Tungsten"), and the Encinitas
pper Mine. Several gold deposits in the county con-
n traces of galena; these include the Descanso Mine,
ver King Prospect, and Telluride Group.

A total production of about 32,000 pounds of lead is
orted from San Diego County for the years 1899,
07, and 1915, but its source is unknown (see Table 1).
oduction for 1899 (31,000 pounds) may have been
m present-day Imperial County.

LIMESTONE AND DOLOMITE

Although limestone and dolomite have many uses, deposits in San Diego County have been worked mainly as sources of crushed and broken stone for use as roofing granules, poultry grit, and decorative stone.

Geologic Occurrence

The largest and most accessible deposits of limestone in San Diego County are exposed in a group of low hills near Dos Cabezas siding of the San Diego and Arizona Eastern Railroad, in the southeast part of the county (Photo 46, Figs. 41, 42). These deposits consist of irregular and disconnected bodies of crystalline limestone and magnesian limestone which are interlayered chiefly with biotite schist and minor quartzite of preCretaceous age. The rocks are intruded widely and irregularly by diorite, by relatively large bodies of quartz diorite (tonalite), and by dikes of granite pegmatite and aplite. The metamorphic rocks are folded and faulted, but generally strike northeast and dip moderately to the northwest. The limestone bodies vary widely in size and shape.

The deposits have been worked intermittently and on a small scale as a source of roofing granules, poultry grit, and decorative stone. The two principal properties in the area are the Golden State and Heathman, which are described below. Two very small deposits, the Mary Jane and one unnamed, are described in the accompanying tabulated list.

Additional crystalline limestone occurs on San Ysidro Mountain, in the northeast part of the county. These deposits include the Verruga, which was worked from 1921 to 1923 for building and monument stone, and the Sentenac, which is undeveloped (Fig. 39). The White Peak property, which encloses part of the Verruga Deposit, was worked briefly in the 1940's and 1950's for roofing granules.

Photo 46. Aerial view north-northwest, showing Dos Cabezas area and vicinity. Layers of crystalline limestone (ls) with quartzite and schist are intruded by tonalite (quartz diorite, t) and overlain partly by volcanic flows (Alverson andesite, v). Elsinore fault strikes northwest along base of south side of Coyote Mountain. Parts of Fish Creek gypsum deposits are exposed along crest of ridge just to right of Fish Creek.

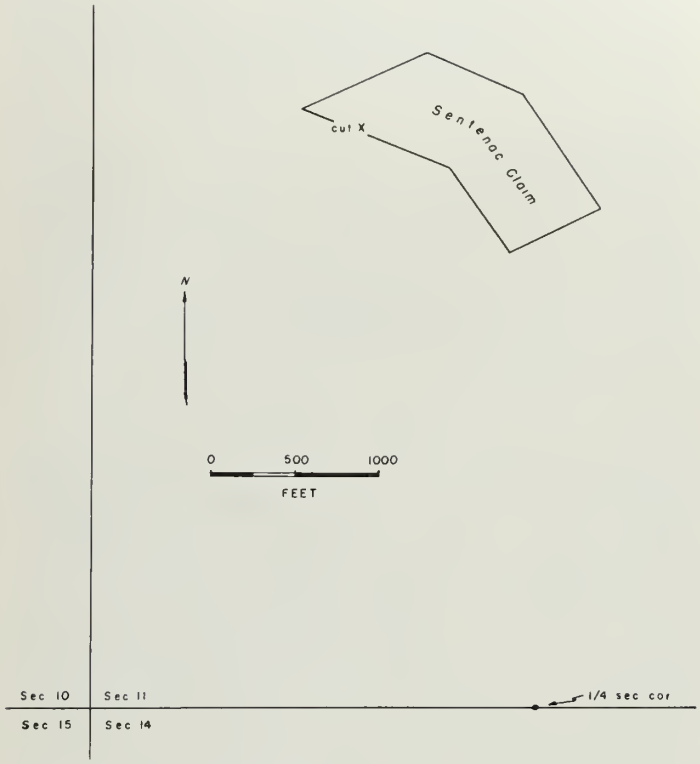


Figure 39. Map showing Sentenac patented claim, which covers the Sentenac crystalline limestone deposit near Ranchita.

Caliche is calcite-rich material that forms by evaporation near the surface of certain arid and semiarid regions. Caliche or caliche-like deposits are limited to the southwestern part of San Diego County. The richest and best known of these is the Jamul Ranch Deposit, which in 1891 was the source of the raw material for a small cement plant in Jamul Creek Canyon (see description below). This effort to produce cement, the second in California, failed. Two additional deposits of caliche—Kuebler Ranch and Lakeside—are described in the tabulated list. Small quantities of caliche from the Lakeside Deposit were used as a soil conditioner during the 1920's.

The only deposit of dolomite in the county that has been described is the Elliot Deposit, near the eastern boundary of the county, on the south slope of the Coyote Mountains (see description below). This deposit was worked briefly as a source of roofing granules in the early 1950's. The White Cap Deposit, east of Jacumba, consists of magnesian limestone, and also has been worked as a source of roofing granules. The Deer Park Deposit, north of Pine Valley, ranges in composition from limestone to magnesian limestone; a small quantity of this rock was used at the Stonewall Gold Mine before 1900.

Additional deposits of crystalline limestone occur as layers in the thick section of metasedimentary rocks exposed on the steep southwest slope of the Santa Rosa Mountains, in the northeast corner of the county (Dibblee, 1954, p. 21). These deposits are undeveloped.

Possible Uses

Cement that is now consumed in San Diego County is purchased from producers in Riverside and San Bernardino Counties. The plants nearest to San Diego are at Crestmore (Riverside Cement Company), in Riverside County, and at Colton (California Portland Cement Company), in San Bernardino County. Limestone deposits near which cement plants to serve the San Diego area possibly could be located, are at Dos Cabezas in southeastern San Diego County, and in the Coyote Mountains in western Imperial County. The Dos Cabezas deposits are within one mile of the San Diego and Arizona Eastern Railroad, and the deposits in Imperial County are within eight or nine miles north of the railroad. The reserves of the Dos Cabezas deposits are undetermined, but a possible cement plant that would consume this rock would require reserves of about 25,000 to 30,000 tons of limestone for each 100,000 barrels of cement (376 pounds) to be produced, plus additional silica- and aluminum-rich rock, and gypsum (from information furnished by Bowen, 1957a, p. 117, 119; 1957b, p. 303). In 1957, the six cement plants in Southern California ranged in annual capacity from about two to six million barrels (C. H. Gray, California Division of Mines, personal communication, 1958). The cost of such plants is estimated to be about $12 per barrel of annual capacity, or $1,200,000 for each 100,000 barrels (Bowen, 1957b, p. 303).

Limestone also is used as concrete aggregate, as an agricultural mineral, and as an additive to acid soils. The soils of Southern California are mainly alkaline, however.

Elliot Deposit

Location: Secs. 26, 27, 34 and 35, T. 15 S., R. 8 E., S.B.M.; about 5½ miles north of Dos Cabezas, on the south flank of the western part of the Coyote Mountains.

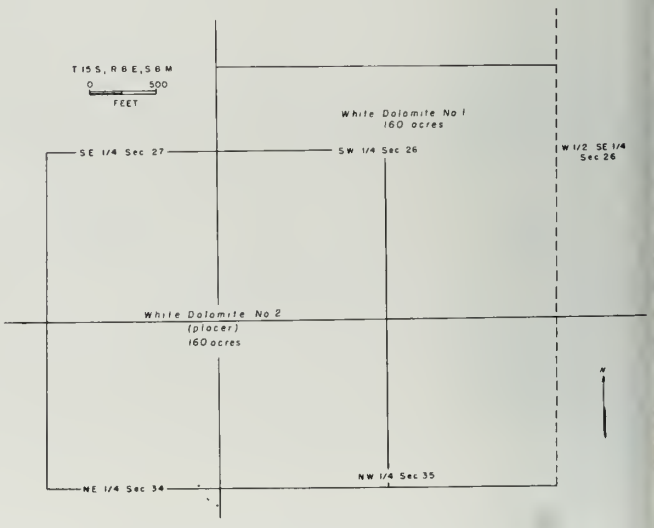


Figure 40. Map showing unpatented property holdings that cover the Elliot dolomite deposit, Coyote Mountains.

Photo 47. View northwest toward workings in Elliot dolomite deposit, which is low on south side of Coyote Mountains.

Ownership: Fred M. Elliot, c/o Mac's Store, Manzanita, Pine Valley Post Office; Rena Rath Elliot, 433 Juniper Street, San Diego 1; and James Elliot, San Diego, own two unpatented association placer claims which cover 320 acres (1957).

The Elliot family located the White Dolomite Numbers 1 and 2 Claims in 1924. These claims comprise the W.½ W.½ SE.¼, S.½ N.½ SW.¼, and the S.½ SW.¼ Sec. 26; the SE.¼ SE.¼ Sec. 27; the NE.¼ NE.¼ Sec. 34; and the N.½ NW.¼ Sec. 35 (Fig. 40.) The deposit has been worked only briefly, during 1952-1953, as a source of roofing rock. It is within Anza-Borrego Desert State Park.

The Elliot property covers part of a body of preCretaceous metamorphic rocks which underlies the southwest side of the western part of the Coyote Mountains. The rocks consist mainly of interlayered biotite schist and crystalline dolomite which are cut by pegmatite dikes. The Elliot workings develop a layer of dolomite that is perhaps several hundred feet thick, and at least several hundred feet long, which strikes east-northeastward and dips about 40° to the northwest. The dolomite contains a small proportion of thin layers of biotite schist. In the workings the dolomite is generally milky-white, although impure strata contain contact minerals such as red-brown garnet and green diopside. Where the dolomite has been mined, its texture is medium- to coarse-grained.

Following is an analysis of a sample from the Elliot Deposit collected by O. E. Bowen, Jr., of the Division of Mines and Geology, and analyzed by Abbott Hanks, Inc., San Francisco in June 1955: SiO_2, 0.26 percent; Fe_3O_4, 0.09 percent; Al_2O_3, 0.15 percent; CaO, 31.08 percent; MgO, 20.71 percent; and P_2O_5, 0.06 percent. In addition to roofing rock this material might be used as a refractory, as agricultural dolomite, concrete aggregate, ballast, road metal, or road base.

Principal development is an oval, bench-like cut about 10 to 20 feet wide, 10 to 20 feet high and 30 to 40 feet long, low on the steep southern slope of the Coyote Mountains (Photo 47). During 1951, the Milroy Roofing Company, of South Gate, worked the deposit for about six months in an attempt to produce roofing rock. Several thousand tons of dolomite was quarried which consisted mainly of talus composed of angular fragments of white dolomite as large as 10 feet in diameter. In March 1957 only a small shack and a loading bin remained on the property.

Golden State (Dos Cabezas Marble Placer) Deposit

Location: W.½ Sec. 23, T. 16 S., R. 8 E., S.B.M.; in the southeastern part of the county, about one mile northeast of Dos Cabezas. Within Anza-Borrego Desert State

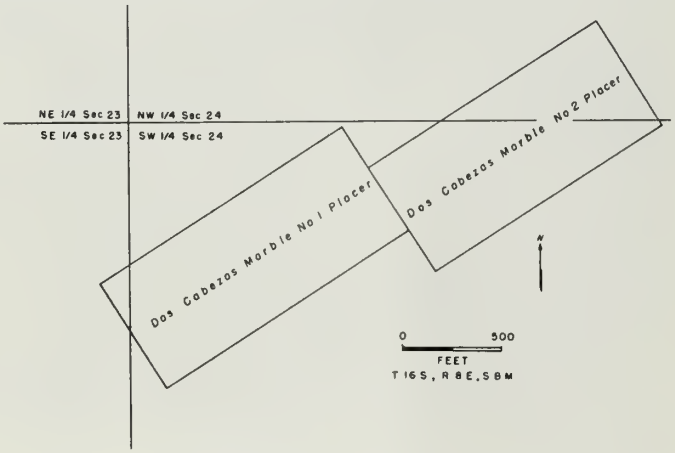
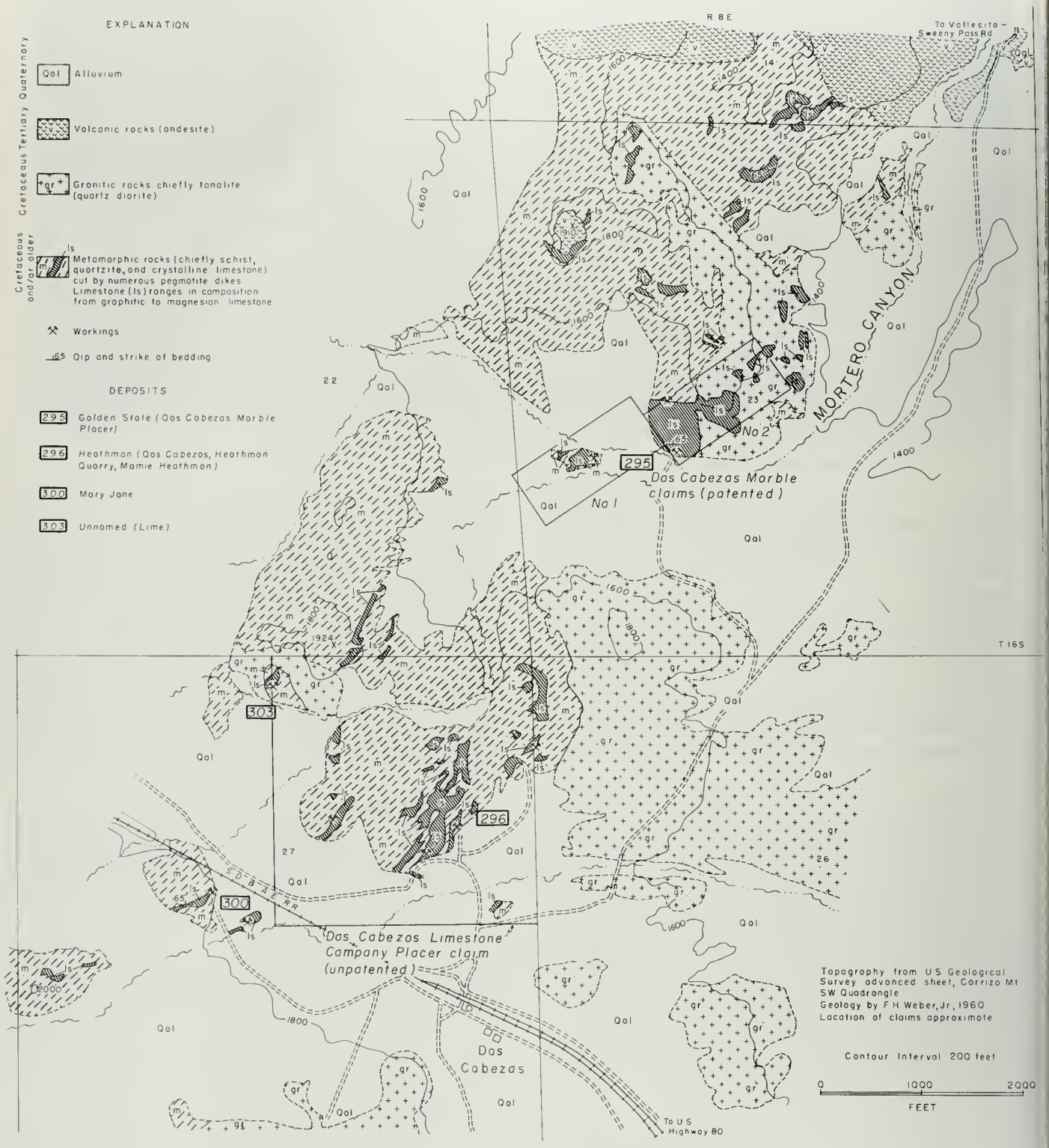


Figure 41. Map showing patented claims that cover part of the Golden State crystalline limestone deposit, near Dos Cabezas.



GENERALIZED GEOLOGIC MAP OF THE DOS CABEZAS LIMESTONE DEPOSITS, SAN DIEGO COUNTY, CALIFORNIA

Figure 42.

Photo 48. View north-northwest, showing Golden State crystalline limestone deposit. Limestone underlies southeastern slopes of prominent hill, which is about a mile north of Dos Cabezas. The cut in the middleground is about 135 feet long.

Park. *Ownership:* B. A. Sweet, Pine Tree Portland Cement Company, Escondido, owns all but a small part of two northeast-trending, essentially end-to-end patented claims which cover 37.97 acres, mainly in the middle of the W.½ Sec. 23 (Fig. 41). Small parts of the claims are held by C. I. Smith and others, c/o 408A Rodriguez, Watsonville (1957).

The Golden State Deposit was probably first prospected in the 1920's, and was worked most recently about 1950, as a source of crushed stone for use as roofing granules. The present owner leased the property in 1956 from Ed Roberts of San Diego, and purchased it in 1957. He contemplated using the deposit as a source of limestone for a proposed cement plant in southeastern San Diego County or southwestern Imperial County. In May, 1960 the property was idle and there was no equipment on it.

The Golden State property lies in the northeastern part of the area that encloses the Dos Cabezas Limestone Deposits, as shown in Photo 46 and Fig. 42. The rocks in the northeastern part of the area consist chiefly of interlayered biotite schist, subordinate crystalline carbonate rocks, and minor quartzite which are intruded widely, but irregularly, by diorite, Cretaceous quartz diorite, and dikes of granite pegmatite. The Golden State property contains the largest body of carbonate rocks in the district. This body, which consists of limestone and subordinate magnesian limestone, is exposed along the south slope of a north- to northwest-trending ridge which dominates the middle of Section 23 (Photo 48). The body is very crudely hourglass-like in plan, with its long axis trending east along the ridge slope. The bedding of the deposit strikes east-northeastward and dips 50°-80° northwest, into the slope. The body is about 900 feet long, and ranges in thickness from about 75 to 450 feet. It is bordered on the east by quartz diorite, on the north by quartz diorite and diorite, and on the south and west by alluvium. Additional, smaller carbonate bodies enclosed by quartz diorite lie to the northeast of the main body.

About 600 feet southwest of the main body, in the most southwesterly part of the property, is a low, isolated outcrop which consists of carbonate bodies interlayered with other metamorphic rocks. The largest of these bodies is about 250 feet long and 150 feet in maximum width.

Limestone and magnesian limestone of the Golden State property are thinly to thickly bedded and are very resistant to erosion. Rocks of limestone composition are fine- to very coarse-grained and range in color from white to pale gray. The gray color is most commonly caused by graphite which is disseminated sparsely and finely through the calcite. Some limestone beds contain thin, dark-gray bands which are composed of a relatively large proportion of graphite with calcite; less common are pale orange bands which are composed of finely disseminated garnet in calcite. Rocks of magnesian limestone composition generally are fine- to medium-grained and cream-colored. A sample that was taken by the writer across the widest part of the main carbonate body contained the following percentages of its principal constituents (analysis by Twining Laboratories, Fresno, June 1960): CaO, 46.51 percent; MgO, 7.35 percent; SiO_2, 3.27 percent; Al_2O_3, 0.79 percent; Fe_2O_3, 0.19 percent; and P_2O_5, 0.29 percent.

The principal workings of the property consist of two shallow cuts at the southern edge of the main body. These cuts have a combined length of about 210 feet. The oldest working on the property is a small, shallow cut at the western part of the north edge of the main body. Additional workings consist of a few minor cuts and pits in the most southwesterly deposits.

The main body of the Golden State property comprises the principal reserves of carbonate rocks in the district. Relatively large tonnages of this body could be mined by open pit methods, and it is assumed that limestone of the same composition extends down the dip of the body, and probably beneath the alluvium which lies to the west and south.

Heathman (Dos Cabezas, Heathman Quarry, Mamie-Heathman) Deposit

Location: NE.¼ Sec. 27, T. 16 S., R. 8 E., S.B.M.; southeast part of the county, about ¼ to ½ mile north of Dos Cabezas siding of the San Diego and Arizona Eastern Railroad; now within Anza-Borrego Desert State Park. *Ownership:* Charles Dunston, Dulzura, owns one 160-acre unpatented association placer claim (1958).

The limestone deposits in the Dos Cabezas area were described first in 1925 by W. B. Tucker (1925, p. 370) who reported that 480 acres in Sections 22, 23, 26, and 27 were claimed by M. A. Turner and Associates of San Diego. R. W. Heathman (stepfather of the present owner), and others, relocated the NE.¼ of Section 27 in 1924. The property remained idle until 1950 when it was leased to the Campo Milling Corporation which processed limestone mined from this deposit in the Pacific Mill at Campo (see also Pacific Deposit, under "Feldspar"). This company produced roofing granules, chicken grit, and agricultural limestone for two or three years.

Photo 49. View north across limesto milling equipment at Dos Cobezos sidi toward Heothman crystolline limestone d posits in low hills in background. Princip quarry (photo 50) is visible just to left top of wooden looding ramp.

More recently the property was leased to Don Weaver, of Jacumba, who mined about 5,000 tons of limestone from it. Most of this material was crushed, screened and bagged adjacent to the railroad at Dos Cabezas (Photo 49). About two-thirds of the material mined was ground to minus ⅜ inch, plus 10-mesh, and marketed in Southern California as roofing granules. The rest was ground to minus 10-mesh and sold as poultry grit in San Diego. The property was mostly idle from early 1957 until early 1960, when Weaver began mining limestone from it for use as decorative stone in the San Diego region.

The Heathman property lies within the area covered by the Dos Cabezas limestone deposits which are shown herein on Fig. 42 and Photo 46. The property includes a group of low, closely adjacent hills which are underlain by irregularly layered biotite schist, subordinate crystalline limestone, and minor quartzite. These rocks are cut by irregular intrusive bodies of diorite and quartz diorite and thin dikes of granite pegmatite and aplite. The layered rocks, which are of preCretaceous age, most commonly strike north-northeastward and dip moderately to steeply west-northwest. The limestone layers are irregular in plan and vary widely in dip, length and thickness. Those layers that have been mined range in dip from about 30°-55° northeast, in thickness from 40 to more than 100 feet, and in length from less than 300 to about 1,000 feet. The limestone is fine- to very coarse-grained, and ranges in color from white, to white with alternating gray bands composed of calcite and finely disseminated graphite, or alternating pale orange bands composed of calcite and finely disseminated garnet. Uncommonly to sparsely distributed in the limestone are thin layers of schist and thin layers of tactite composed chiefly of red-brown garnet and green diopside.

The following average composition was calculated from analyses of four random-type samples collected by O. E. Bowen, Jr. of the Division of Mines and Geology, from the quarry described above: (analyses by Abbott Hanks, Inc., San Francisco, June 1955)—SiO_2, 3.46 percent; Fe_3O_4, 0.03 percent; Al_2O_3, 2.46 percent; CaO, 50.68 percent; MgO, 0.96 percent; and P_2O_5, trace. In additio to roofing rock, decorative stone, and chicken grit, roc of this composition might be used as a steel flux (if it doe not decrepitate when heated), as agricultural limestone concrete aggregate, ballast, and road base. Because of th presence of the intrusive rocks, and zones of biotite schis within the limestone layers, these deposits must be mine selectively.

The deposit has been worked mainly from two quar ries, about 500 feet apart, which are about one-fourt mile north of Dos Cabezas. The larger of the two quarrie is about 125 to 150 feet long, about 50 to 75 feet i maximum width, and 20 to 30 feet high along its mai face (Photo 50). Additional workings comprise thre shallow cuts, two of which lie about one-fifth mile north-east of the main quarries, and one which lies about one-fourth mile to the west. (Also see "Unnamed (Lime)" in the tabulated list.)

Photo 50. Heathman limestone deposit, Dos Cobezas. Closeup of moin quarry shown in center right background of photo 49. Thin dork layers within limestone are moinly schist.

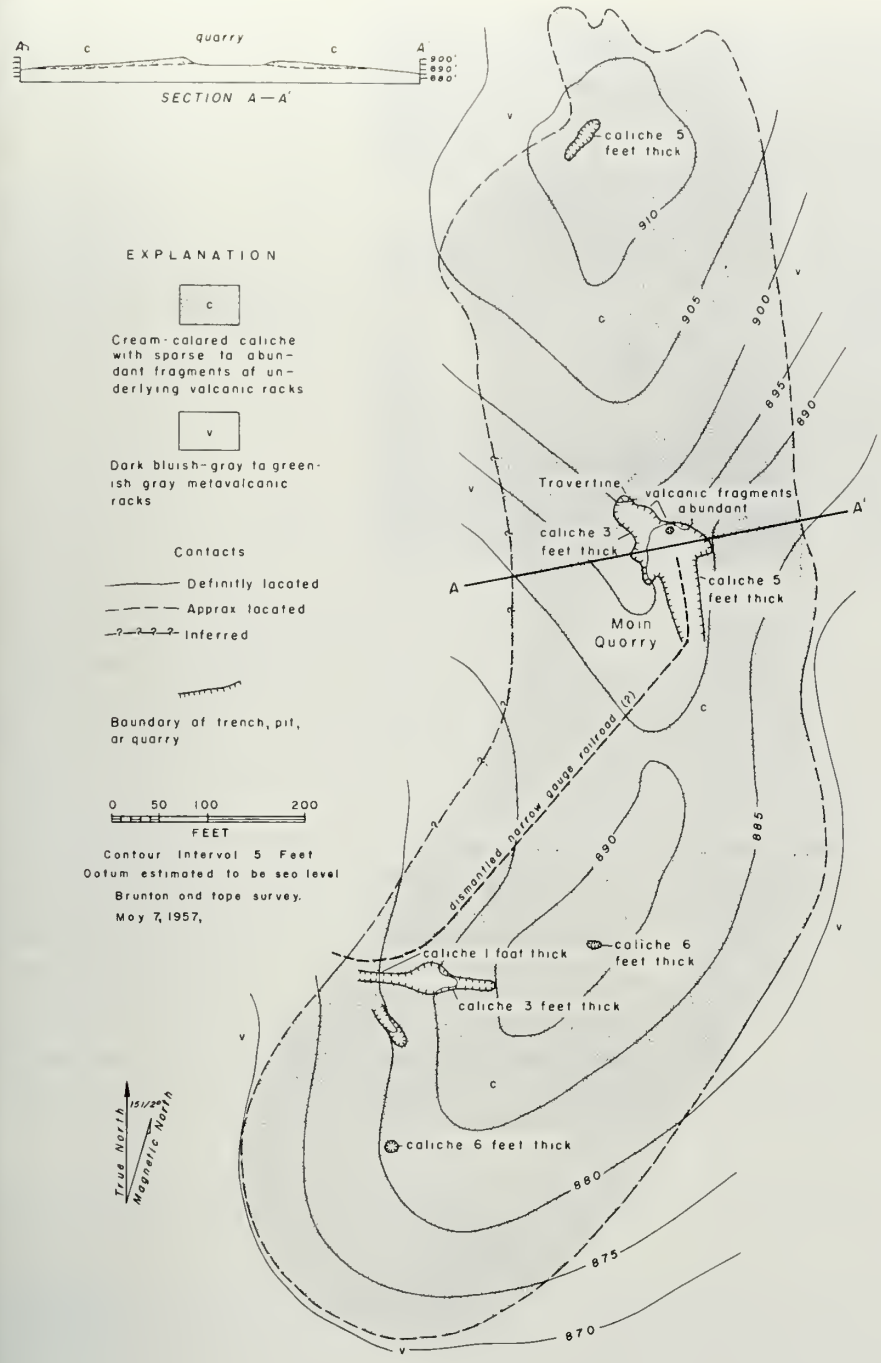


Figure 43. Geologic sketch map and cross section of the Jamul Ranch limestone deposit, San Diego County, California.

mul Ranch (Jamul Portland Cement Co.) Deposit

Location: Near the center of the E.½ Sec. 27 (pro-cted), T. 17 S., R. 1 E., S.B.M.; about 18 miles east-utheast of San Diego City Hall, on the Jamul (Daley) anch. The deposit is on the mesa-like crest of a group low hills, about 2½ miles by dirt road and trail south-uthwest of the ranch headquarters. *Ownership:* Daley George R. Daley) Enterprises, Murphy Canyon Road, n Diego (1957).

The Jamul Portland Cement Company was organized 1889 to manufacture portland cement. In 1891 this ompany placed into operation on the Jamul Ranch a small plant of 150 barrels per day capacity (Irelan, 1890, p. 309-310; Storms, 1893, p. 383). The venture lasted less than one year, however. Apparently the cost of transport between the plant and San Diego was higher than had been anticipated; thus the price of the cement was not competitive with that of portland cement shipped from England to San Diego via water. This enterprise represented the second attempt in California to produce portland cement. The site of the plant is on the east side of Jamul Creek Valley, about 700 yards west-northwest of the deposit from which the raw material was supplied.

Photo 51. View north-northeost show port of Moin quorry in Jomul Ranch li stone deposit, which consists of o ne flot loyer of caliche-like limestone conte ing frogments of underlying metavolco rocks. Port of layer cut by quarry is 5 t feet thick.

The Jamul Ranch Deposit consists of a thin mantle of caliche-like material which lies on a gently humped surface underlain by metavolcanic rocks (Fig. 43). The deposit is about 1,400 feet long, 350 feet in average width, and ranges in thickness from less than one foot on the edges to between six and eight feet in the middle. Approximately 85,000 tons of material remain in the deposit (calculation based on an average thickness of six feet through the north-trending crest and an average density of 2.0). The carbonate rock is cream-colored, commonly porous, and poorly indurated (Photo 51). It most resembles caliche, although the origin is not obvious. In a single exposure at the northwest end of the northern quarry (Fig. 43) the material has a travertine-like appearance. Throughout the deposit the carbonate rock is mixed with angular fragments of the underlying metavolcanic rocks which consist of dark grayish-green, dark grayish-blue and dark-gray meta-andesite and meta-basalt. These fragments are sparse to abundant and range in length fro less than one inch to three feet.

Following are analyses of samples collected from th deposit by O. E. Bowen, Jr., of the California Division Mines and Geology (analyses by Abbott Hanks, Inc., Sa Francisco, June 1955).

	SiO_2	Fe_3O_4	Al_2O_3	CaO	MgO	P_2
North quarry	8.32%	0.28	1.16	48.49	1.23	0.
South quarry	13.34	0.61	3.20	44.24	1.40	0.

The deposit is developed by a north-northwest-trenc ing (north) quarry about 160 feet long near the cente of the deposit, and an east-trending, partially quarrie trench (south quarry) about 140 feet long near th southwest boundary (Fig. 43). There are also two 50 foot exploratory trenches and two exploratory pits. road bed that resembles the bed of a narrow gauge rail road extends from the northern quarry to the plant sit and north along the east slopes of Jamul Creek Valley

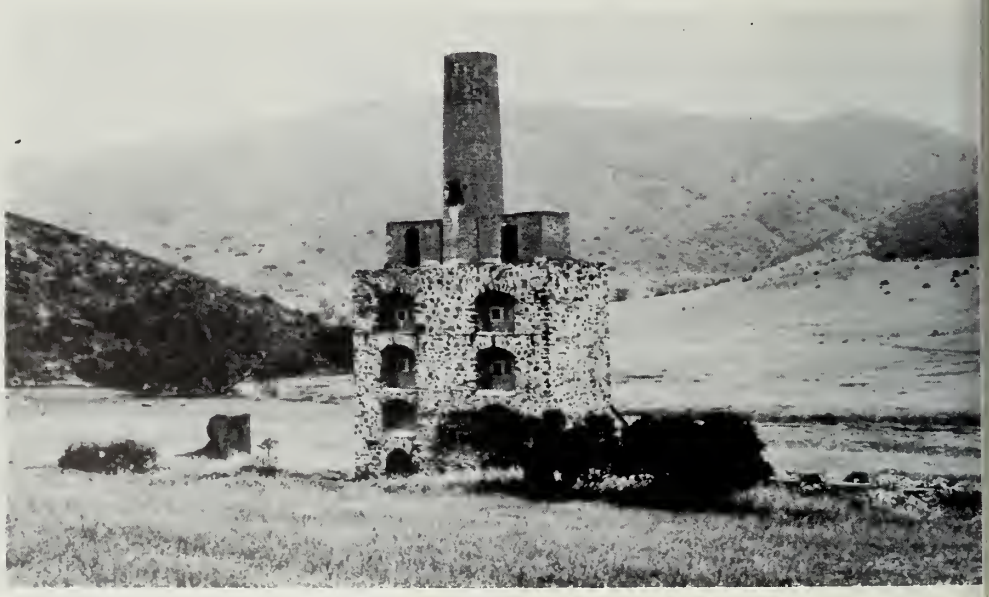


Photo 52. Remains of kilns of Jamul Cement Compony plont, Jamul Creek Valley, 1957.

The remnants of the old cement plant remain on the operty (Photo 52). These consist mainly of a large one and brick structure which houses three vertical ns, each about 6½ feet in diameter (Bowen, 1954). ne structure is 35 feet high and the stack extends other 30 feet. The kilns were probably wood-fired. A w yards to the north of the structure are the remains five pot kilns, each also about 6½ feet in diameter.

rruga (Verruga Marble) Deposit

Location: Center E.½ W.½ Sec. 10, T. 11 S., R. 4 E., B.M.; 2¾ miles west-northwest of Ranchita store, low the southwestern slope of San Ysidro Mountain. *Ownship:* Constance J. Ehmke, 543 E. Grand Ave., Escondo, owns one patented 20-acre placer claim which mprises the SW. ¼ SE.¼ NW.¼ and NW. ¼ NE.¼ W.¼ Sec. 10 (1958).

The Verruga Deposit was first worked from 1921 to 23 when the Verruga Marble Company, of San Diego, arried limestone from it for use as building stone. nished stone (or marble) produced by the company as used in the construction of several buildings in San iego, and for the Lee Highway Milestone opposite the S. Grant Hotel, also in San Diego. The quarried stone as cut and polished on the property. The operation ased reportedly because transportation costs of $8 per n from the quarry to the railroad at Lakeside proved o high (Tucker, 1925, p. 372). More recently, the part the deposit covered by the White Peak property, hich is described in the accompanying tabulated list, as worked for crushed stone used as roofing granules.

The Verruga Deposit consists of two nearly parallel, ongate bodies of crystalline limestone which cut a westuthwest trending interfluve. The more westerly body ikes north-northeastward, and the more easterly one rth-northwestward. The distance between the bodies idens southward from about 250 feet at the north to 0 feet at the south. Both are enclosed in schist and dip out 75° to the west. The more westerly of the bodies the more extensively developed. It is exposed nearly ntinuously along its strike for about 1,200 feet, and nges in width from less than 25 to probably no more an 100 feet. At the south end it is about 25 to 30 feet ick. The limestone is white to pale bluish-gray, dense, d coarse- to very coarse-grained. The body was worked ng its southeastern edge from two small quarries which e about 150 feet apart. Each of the quarries trends rthward. The more southerly one is about 150 feet ng and its face has a maximum height of about 30 feet Photo 53). A short inclined shaft was sunk from a point the base of the face. The more northerly quarry is out 75 feet long and its face has a maximum height of out 25 feet. An inclined shaft also was sunk from a int at the base of the face of this quarry. The part of e limestone body opened by this quarry is interlayered ith a band of schist about five feet thick.

The more easterly body is about 750 feet long and as ide as 100 feet. Its northern part is covered by the White Peak property.

Phata 53. Verruga crystolline limestone deposit, 2¾ miles west-northwest of Ronchita. View north taword mare sautherly af twa small quarries, shawing crystolline limestane, ot left, in cantoct with schist, on right. Rack wos quorried far building stone from 1921 ta 1923.

Following are chemical compositions calculated from analyses of six samples collected from the western body (described above) by O. E. Bowen, Jr., and C. H. Gray, Jr., Division of Mines, and analyzed by Abbott A. Hanks, Inc., San Francisco (June 27, 1957). (1) The first composition is based on an average of analyses of four samples collected from the more southerly of the two quarries. (2) The second is an analysis of a single sample collected from near the western margin of the western body. (3) The third is an analysis of a single sample collected from the more northerly of the two quarries.

	SiO_2	Fe_2O_3	Al_2O_3	CaO	MgO	P_2O_5
(1)	0.20	0.05	0.05	55.42	0.27	0.14
(2)	1.51	0.17	0.39	47.16	6.44	0.02
(3)	0.14	0.04	0.04	55.18	0.33	0.51

In addition to having been a source for dimension stone, the deposit might be considered as a possible source of lime for use in the manufacture of glass, although most users prefer rock that contains not more than 0.02 percent ferric oxide. Rock from this deposit would probably average 0.05 percent, or more, ferric oxide. Other uses for the deposit might also be considered. However, it is too small to be considered as the source of limestone for a cement plant.

White Cap (Blockman) Deposit

Location: W.½ Sec. 11, T. 18 S., R. 8 E., S.B.M.; about three miles due east of Jacumba, adjacent to the Mexican border. *Ownership:* Bryan H. Hathaway, 4567 Florida St., San Diego 16, holds one unpatented 20-acre placer claim (1958).

The White Cap Claim covers a small deposit of limestone which crops out of nearly flat terrain. Although the claim was located in the early 1940's, the deposit has been known for many years and was discussed briefly by Tucker (1925, p. 372). Crushed stone, for use as roofing granules and poultry grit, has been produced from white

Limestone, dolomite

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Blockman				See White Cap deposit in text. (Logan 47:301).
	Borrego Springs	Secs. 2 and 3, T11S, R7E, SBM; east of Borrego Valley, in Anza-Borrego Desert State Park.			Existence not substantiated. (Logan 47:301; Merrill 14:673-674).
292	Coyote Mountain deposit	Near the center of sec. 3, T10S, R6E, SBM; on the southwest side of Coyote Mt., about 6 miles northeast of Borrego Springs. Probably in Anza-Borrego Desert State Park.	Undetermined (1958)	Small crystalline limestone-dolomite deposit of undetermined extent and composition.	Prospected briefly as possible source marble, probably in 1920's. (Osterholt, 1934).
293	Deer Park (Glacier) deposit	SW¼NE¼ sec. 1, T15S, R4E, SBM; Deer Park district, about 5 miles north of Pine Valley and less than ¼ mile north of Pine Valley Creek, in a northeast-trending canyon.	Undetermined (1957) C. M. Walker, Descanso (1925)	Two bodies of carbonate rock are enclosed in metamorphic rocks which range from quartz-biotite schist to tactite. The larger body, on the north side of Pine Creek road, strikes northward and dips steeply east. It is between 100 and 125 ft. long, and is 30 to 40 ft. in width. The rock is pale gray to white, and fine- to medium-grained. It ranges in composition from limestone to dolomitic limestone and is partly siliceous. The smaller body, about 500 ft. north of the larger body, was not examined.	The deposit was reported by Merrill (1914, p. 673) to be covered by the North and South Glacier claims. Tucker (1925) reported that the deposit was covered by one claim of the Schley group (see tabulated list under "Gold"). Tucker also stated that the marble had been burned in a kiln on Indian Creek for use at the Stonewall gold mine. (Logan 47:301; Merrill 14:673, 685; Tucker 25:370-372; Tucker and Reed 39:pl.1).
	Dos Cabezas				See Heathman deposit in text. (Logan 47:301; Tucker 25:370).
	Dos Cabezas Marble Placer claim				One of the claims that cover the Golde State deposit, which see in text. (Tucker and Reed 39:pl.1).
294	Elliot deposit	Southeastern part of county.			See text. (Logan 47:301).
	Glacier				See Deer Park deposit. (Merrill 14:673).
295	Golden State (Dos Cabezas Marble Placer) deposit	Dos Cabezas area.			See text. (Logan 47:301; Merrill 14:674; Tucker and Reed 39:pl.1).
296	Heathman (Dos Cabezas, Heathman quarry, Mamie-Heathman) deposit	Dos Cabezas area.			See text. (Logan 47:302; Tucker 25:37 Tucker and Reed 39:44, pl.1).
	Heathman quarry				See Heathman deposit in text. (Tucker and Reed 39:44).
	Jacobs Ranch	Listed by Tucker (1925) with "other outcrops of limestone" as 3 miles south of Ramona.	E. Jacobs, Ramona (1925)		Unsubstantiated. No additional published information. (Tucker 25:372)
	Jamul Portland Cement Company				See Jamul Ranch deposit in text. (Irelan 90:309-310; Logan 47:302).
297	Jamul Ranch deposit (Jamul Portland Cement Company)	Near Jamul.			See text. (Anonymous 53:5, 8; Aubury 06:184; Bowen 54; Goodyear 90:139-14 309; Irelan 90:309-310; Logan 47:30 Storms 93:383).

Limestone, dolomite

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
98	Kuebler Ranch (McCarthy Ranch) deposit	Center of the W½ sec. 29, T18S, R1E, SBM (proj.); 8 miles east-northeast of San Ysidro.	Claude Kuebler, Kuebler Ranch, San Ysidro (1957)	A deposit of cream-colored caliche at the north bend of an intermittent stream whose origin is a spring in the SW¼NE¼ sec. 29. The deposit covers several thousand square feet. Its thickness is undetermined. A similar but smaller deposit is near the center of sec. 32, T18S, R1E, SBM, beneath a cultivated field.	Undeveloped. (Logan 47:302).
99	Lakeside (Lakeside Lime and Marl, Lime) deposit	Secs. 1, 2, and 11, T15S, R1W, SBM (proj.); on the El Cajon grant, within 2½ miles north of Lakeside.	Undetermined (1957) W. A. Meyer, Lakeside (1925)	Small patches of caliche-like material lie on a granitic surface. The principal deposit, in the S½SE¼ sec. 1, is exposed by several shallow benches which show clayey, greenish-white caliche(?). An analysis of a sample by the State Dept. of Agriculture gave 83.7 percent calcium carbonate; the material was defined by that Dept. as "medium to high agriculture lime" (Tucker, 1925, p. 373). A second deposit, which is very white and as thick as 10 to 20 ft. caps the north side of a saddle between 2 small hills near the center of the NW¼NE¼ sec. 11.	Patented land. Undetermined amount of output in the mid-1920's used as a soil conditioner by local farmers. (Logan 47:302; Tucker 25:372-373; Tucker and Reed 39:45, pl.1).
	Lakeside Lime and Marl deposit				See Lakeside deposit. (Logan 47:302; Tucker 25:372-373; Tucker and Reed 39:45, pl.1).
	Lime				See Lakeside deposit. (Tucker and Reed 39:pl.1).
	"Lime"				See "Unnamed (Lime)". (Tucker and Reed 39:pl.1).
	"Limestone"				See Golden State deposit in text. (Tucker and Reed 39:pl.1).
	Mamie				See Heathman deposit in text. (Tucker and Reed 39:55).
	Mamie-Heathman				See Heathman deposit in text.
	"Marble deposit"	Secs. 14 and 15, T11S, R4E, SBM; west of Ranchita, in Montezuma Valley.	Undetermined (1957)		A map locality of Tucker and Reed (1939, pl.1). Unsubstantiated by the present writer. (Tucker and Reed 39:pl.1).
	Marie				See Mary Jane deposit. (Tucker and Reed 39:55, pl.1).
100	Mary Jane (Marie) deposit	South edge of the NW¼ sec. 27, T16S, R8E, SBM; about ½ mile west-northwest of Dos Cabezas siding, on the south side of the San Diego and Arizona Eastern railroad.	Undetermined (1957)	Two small bodies of crystalline limestone which are about 500 ft. apart. The more west-northwesterly body consists of a layer of limestone which strikes northeast and dips moderately northwest into the southeast slope of a small hill; the layer is about 250 ft. long and ranges in thickness from 25 to 75 ft. The more east-southeasterly deposit consists of two low outcrops of siliceous limestone which are surrounded by alluvium. The larger outcrop is about 200 ft. long and 100 ft. wide.	Developed by shallow cuts. Output estimated to be less than 500 tons.
	McCarthy Ranch				See Kuebler Ranch deposit. (Logan 47:302).
	"?"				A map locality of Tucker and Reed. See "Unnamed (?)". (Tucker and Reed 39:pl.1).

Limestone, dolomite

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	San Diego Desert Marble Company				An early explorer for minerals in the Jacumba region. Especially interest in the Dos Cabezas limestone deposit and the Jacumba manganese deposits. (Kunz 05:150).
301	Santa Rosa Mts. deposits	Santa Rosa Mts., northeastern part of the county. Mostly in Anza-Borrego Desert State Park.	Undetermined (1958)	Extensive, but undescribed, northwest-trending layers of carbonate rocks occur with schist high on the southwest flank of the Santa Rosa Mts.	Accessible only by foot, over very steep terrain. (Dibblee 54:21, pl.2)
302	Sentenac deposit	Near the center of sec. 11, T11S, R4E, SBM; Montezuma district, about 2 miles northwest of Ranchita store, on San Ysidro Mt.	Ray Jacobs, Julian (1958)	An unexplored pendant of crystalline limestone in hybrid rocks; it strikes northwest, dips steeply southwest, and cuts across the crest of a narrow, northeast-trending ridge. The pendant seems to have the shape of a segment of an orange which tapers downward. It is between 1,200 and 1,500 ft. long, and ranges in width from nearly 0 at the two ends to between 200 and 250 ft. in the middle. Its composition is undetermined. A smaller pendant lies several hundred ft. to the northeast.	Covered by one lode claim of 20.7 acres which was located for gold. It was patented in 1905 by Paul Sentenac (see map of claim in text). The deposit is in a very brushy area, about 800 ft. higher, and ½ mile northwest of the nearest road. Accessible only by very steep trail from the ranch house at the northwest corner of sec. 14. (Tucker 25:372; Tucker and Reed 39:pl.1).
303	Unnamed (Lime)	About 250 ft. nearly due south of the north quarter corner of sec. 27, T16S, R8E, SBM; about one mile northwest of Dos Cabezas siding.	See "Remarks" column	Deposit consists of a knob-like exposure of limestone about 250 ft. long, as wide as 50 ft., and as high as 30 or 40 ft. Limestone is enclosed by metamorphosed diorite and other rocks. The rock is wavily banded and contains abundant graphite. Color ranges from medium gray to pale bluish gray or grayish white. Texture ranges from fine- to medium-grained.	Probably partly within Heathman property (NE¼ sec. 27) and partly in Anza-Borrego Desert State Park. Explored by shallow open cuts. Production negligible. (Tucker and Reed 39:pl.1).
	Unnamed (?)	Sec. 27, T16S, R8E, SBM; Dos Cabezas area.			A map locality of Tucker and Reed (193 Within Heathman property which see i text. (Tucker and Reed 39:pl.1).
304	Verruga (Verruga Marble) deposit	North of Montezuma Valley.			See text. (Logan 47:302-303; Tucker 25:370, 371, 372, 373; Tucker and Reed 39:45, pl.1).
	Verruga Marble deposit				See Verruga deposit. (Logan 47:302-30 Tucker 25:370, 371, 372, 373; Tucker and Reed 39: 45, pl.1).
	Volk deposit				See White Peak claim. (Tucker 25:372; Tucker and Reed 39:pl.1).
305	White Cap (Blockman) deposit	East of Jacumba.			See text. (Logan 47:301; Tucker 25: 372).
306	White Peak claim (Volk deposit)	Center of the S½N½ sec. 10, T11S, R4E, SBM; about 2-2/3 miles west-northwest of Ranchita store, on the south slope of San Ysidro Mountain.	W. W. Johnston, Route 3, Box 210, Escondido (1958)	Property covers the north part of the more easterly of two crystalline limestone bodies which are described in the text as the Verruga deposit. Body strikes north-northwestward and dips steeply west in schist. Width of outcrop in vicinity of workings is about 100 ft. Limestone is medium- to coarse-grained and generally milky white to pale bluish gray.	One unpatented lode claim located in 1939. Property is adjacent to the Verruga property which lies to the southwest. This deposit was worked briefly by the owner immediately pric to World War II and in 1956. Product was sold for roofing granules and chicken grit. Small grinding mill or property. Developed by shallow cuts and trenches. (Tucker 25:372; Tucker and Reed 39:pl.1).

ck in the deposit by J. H. Hubble, Jacumba, during e mid-1940's and by Don Weaver, Jacumba, in 1951. eaver selectively mined about 1,000 tons of white ignesian limestone which was ground to minus three-ghths inch, plus 10-mesh in a crude mill on the prop-ty. The mill was nearly intact in March 1957. Its capac- is about five tons per hour.

This deposit consists of a lens of crystalline magnesian nestone, with minor proportions of tactite, in schist. he lens strikes N. 30° W. and dips 60° to 75° west. It between 500 and 600 feet in length and between 100 d 150 feet in maximum width. The limestone ranges om pure white, through white with speckled-gray nds, to pale gray. The tactite is an alteration of silica-ch strata in the limestone. It is gray-green, very fine ained, and composed mainly of diopside, red-brown rnet, and minor quartz. These rocks have been cut by nall bodies of quartz diorite.

The following average composition was calculated om analyses of four random-type samples collected by . E. Bowen, Jr., of the Division of Mines and Geology om this deposit (analyses by Abbott Hanks, Inc., San ancisco in June 1955): SiO_2, 0.64 percent; Fe_3O_4, 0.11 rcent; Al_2O_3, 0.35 percent; CaO, 38.36 percent; MgO, .28 percent; and P_2O_5, trace.

Development consists of several shallow cuts and enches.

THIUM COMPOUNDS

Lithium is used principally in the form of lithium com-ounds which in turn are used primarily in lubricants d ceramics. Lithium minerals are used in ceramics. ew uses in the field of lithium alloys and isotopes prob-ly are being developed (Ver Planck, 1957c, p. 311). he principal domestic sources of lithium are pegmatite eposits in an area along the border between North and uth Carolina, and brines from Searles Lake in Inyo ounty, California.

The principal pegmatite mineral now a domestic source lithium is spodumene (lithium, aluminum silicate) hose ores may contain as low as 1 percent lithium oxide. wo pegmatite minerals that were former important do-estic sources of lithium are amblygonite (lithium, alu-inum fluorophosphate) and lepidolite (a lithium-bear-g mica). The Stewart Pegmatite Deposit, in the Pala strict in San Diego County, contained two large bodies lepidolite which were mined sporadically from 1892 1928, and during one short period were the foremost urce of lithium in the United States. The deposit now mined-out largely (see description below).

Many additional pegmatite deposits in the county con-in lithium-bearing minerals, but in much smaller pro-ortions than the Stewart Deposit formerly did. Most of ese deposits are described herein under "Gem Min-als." An exception is the Royal Deposit, south of Ban-er, which has been a source of lepidolite for mineral llectors (see description in accompanying tabulated t).

Stewart Mine (American Lithia Company)

Location: E.½ NW.¼ Sec. 23, T. 9S., R. 2 W., S.B.M.; Pala district, about 1⅓ miles northeast of Pala, on the southeastern flank of Queen Mountain. *Ownership:* Mrs. Blanche Crane, 405 South Tremont, Oceanside; managed by Leo J. Mies, 508 Third Street, Oceanside. Mrs. Crane owns one north-trending patented claim which covers most of the SE.¼ NW.¼ Sec. 23 and extends into the S.½ NE.¼ NW.¼ Sec. 23 (Fig. 23) (1957).

The Stewart Deposit was once the most important source of lithium in the United States. It was reportedly discovered by an Indian deer hunter named Vensuelada "in the early days of California history" (Kunz, 1905, p. 124). Later, Henry Magee was reported to have located a claim on the deposit as a potential quicksilver mine, but then abandoned it. Then, Don Thomas Alvarado, a local Mexican landowner, attempted to develop the deposit as a possible source of building stone. He considered the lepidolite-rubellite rock, which was abundant in the dike, as a peculiar kind of marble. It is reported that about 1883 John Stewart located a claim on the deposit (Aubury, 1906, p. 308), and later learned its economic possibilities when a German chemist, who was familiar with the lepidolite ores of Europe, identified the micaceous purple mineral as lepidolite.

Mining began in 1892 and production increased steadily to 1900 then dropped off because of competition from mining of amblygonite in the Black Hills (Jahns and Wright, 1951, p. 59). The mine was active only intermittently from 1907 until 1914. Production increased from 1914 until 1920 and the Stewart Mine became the principal source of lithium in the United States. During 1920, 10,080 tons of lepidolite was produced. Production then began to fall off, and ceased by the end of 1928. Most of the mining was done by the American Lithia Company, New York, W. N. Crane, President. The National Industrial Chemical Corporation of New York worked the deposit for two or three years prior to its shutdown. One of the chief reasons for the cessation of mining, according to Jahns and Wright (1951, p. 59), was the development of the Harding Deposit in New Mexico. Some efforts were made to activate the deposit in the 1930's but these proved unsuccessful. In the mid-1950's representatives of the Pomona Tile Company leased the deposit, but did no work in it. The total output of the mine between 1892 and 1928 is reported by Jahns and Wright (1951, p. 51) to consist of about 22,500 tons of lepidolite and amblygonite that averaged 3 to 4 percent lithium oxide.

A thorough discussion of the geology and workings of the Stewart Deposit is given by Jahns and Wright (1951). The north-trending Stewart pegmatite dike, which is enclosed in a gabbro country rock, is exposed for about 3,000 feet along the southeastern slope of Queen Mountain (Photo 54). The Stewart Mine is in the southern part of the dike, where the pegmatite caps a north-trending ridge about 750 feet long. The dike dips gently to the west and shows a maximum thickness

Figure 44A. Plan of surface ond underground workings, Stewart mine. *After Jahns and Wright 1951, pl. 4.*

of about 80 feet in the mine area. The dike contains several zones of granitic pegmatite which are arranged in layers around a discontinuous quartz-spodumene core. Most of the lepidolite-rich pegmatite is in the footwall parts of this core (Fig. 44). The deposit was first worked by open cut methods on its east side for a length of about 400 feet (Fig. 44). Cuts with faces 10 to 20 feet high were developed. From north to south these were termed the North, Main and South cuts. The lepidolite bodies that were mined in the Stewart Deposit were described by Jahns and Wright (1951, pp. 60-61) as follows:

"Two principal bodies of lepidolite were mined in the surface and underground workings. One of them, which extended westward from the main cut, was about 200 feet long and 10 to 110 feet wide. Its thickness ranged from a knife edge to at least 20 feet, and was about 10 feet through much of the mined portions. This lepidolite is gray and bluish-gray to deep purple in color, and most of it contains albite and abundant prismatic crystals of rubellite. In contrast to this material is the lepidolite typical the other main ore body, which lies about 50 feet to the sout Most of this lepidolite rock is nearly pure, and only locally do it contain much albite and tourmaline. It is also characteristical coarser grained and more reddish to pinkish in color than tl material in the north ore body. The south ore body, which w poorly exposed in the south cut and was really discovered durir the course of later, underground operations, was approximate 200 feet long, 30 to 180 feet wide, and locally as much as 18 fe thick. It was mined largely during the twenties."

"In some places the lepidolite bodies are sharply defined fro the adjacent rock, and particularly from a large mass of quart rich pegmatite that lies between them. In many other place notably at the north bulge of the north ore body, the lepidoli pegmatite grades into quartz-albite pegmatite with abunda stringers, lenses and irregular stockworks of lepidolite. Much m terial of this sort is exposed in the walls of the north cut and tl appended underground workings. Additional masses of lepidoli pegmatite, some of them satellitic to the two main masses, are several other parts of the mine area, but most of them are rel tively small."

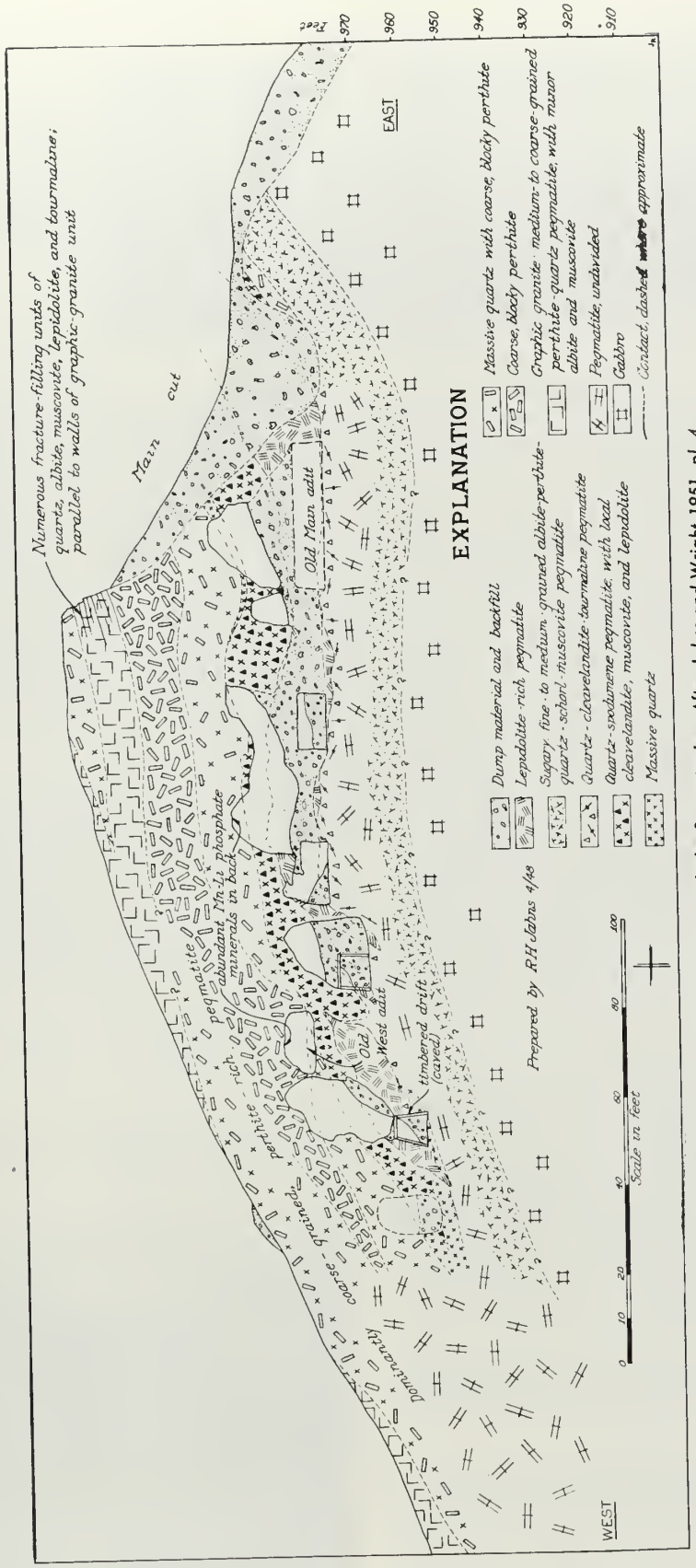


Figure 44B. Geologic section through the Stewart mine. After Jahns and Wright 1951, pl. 4.

Lithium compounds

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	American Lithia Company				See Stewart mine in text. (Aubury 06 308-310).
	Big Buck prospect	Reported by Tucker and Reed (1939) as "sec. 36, T9S, R2E, SBM;" south of Chihuahua Valley, in the north-central part of the county.			Listed by Tucker and Reed (1939) as a claim owned by A. Molino. Could not be located in sec. 36 by present investigator. (Tucker and Reed 39:5
	Pandora				See Royal deposit.
307	Royal (Pandora) deposit	Near the center of the E½ sec. 13, T13S, R4E, SBM; Julian district, about 2½ miles southeast of Banner, low on the southwest side of Rodriguez Canyon.	Undetermined (1958)	Deposit consists of a pegmatite dike that trends northwestward and dips gently southwest. The dike is enclosed in Bonsall tonalite and is partially exposed along its strike for several hundred ft. Only the upper and middle parts of the dike are well exposed. The border zone of the upper part consists of fine-grained pegmatite composed chiefly of perthite(?), quartz and muscovite. This grades downward gradually into an intermediate zone of medium-grained perthite(?), quartz, muscovite and schorl. The thickness of the upper part ranges from 4-5 ft. The middle part (core) of the dike consists chiefly of coarse-grained perthite(?) and quartz. It is 1-2 ft. thick. It also contains relatively large proportions of lepidolite, plus small amounts of grass green tourmaline, as thin crystals less than 1 in. in length, and pink and blue tourmaline.	Prospected at least as early as 1902. The dike is developed along its strike for about 100 ft. by a series of northwest-trending cuts. The mai cut, which is near the middle of the series, is 20 ft. long, 10 ft. wide, and 5 ft. high in the face. From th bottom of the face a stope is inclined gently, down the dip of the dike, for at least 15 ft. Deposit i a source of lepidolite for collector (Donnelly 34:370; Hubon 02:10; Merri 14:704, 706-707; Tucker 25:373; Tuck er and Reed 39:45, pl.1) Additional references that pertain to this area are: Antisell, 1853, p.18 Pratt, 1904, p.314; Schaller, 1917-1919 (1917), p.856; Sterrett, 1907-1915 (1907), p.1240; and Van Amringe 1938, pl.1.
308	Stewart mine (American Lithia Company)	Pala district, Queen Mt.			See text. (Aubury 06:306-310; Fairbanks 93b:35-36; Hubon 02:10; Jahns and Wright 51:14,15,16,19,26,29,31,3 38,39,40,41,46,47,49,50,57,59-61, pl.2, pl.4; Kunz 05:55,100, 124-125; Merrill 14:694,696, 697, 704, 707-70 Tucker 25:373-374; Tucker and Reed 39:42, pl.1).

Then underground mining began from openings at the base of the surface workings and by 1905 about 500 feet of underground workings had been developed from four adits. After the period of relative inactivity (1907 through 1914) an adit was driven eastward into the dike from the west side of the deposit. This adit served as a haulageway for extensive underground stopes which were developed in the deposit until it became idle in 1928. In mid-1957 the underground workings were completely inaccessible.

In regard to the possibilities of additional lepidolite reserves in the Stewart Deposit, Jahns and Wright (1951, p. 61) stated:

"The large bodies of lepidolite-rich pegmatite are along or near a marked benchlike roll in the dike. In most parts of the mine area, this terrace lay between the relatively steeply dipping part of the pegmatite at the outcrop and another relatively steeply dipping segment in the lowermost part of the mine. Most of the lepidolite-rich masses taper out, or become markedly discontinuous as traced down their dips into this more steeply dipping part of the dike. Other large lenses of lepidolite-rich

Photo 54. Pala district, view west. Stewart dike extends laterally ala Queen Mountain, from Stewart mine at left, to right edge of photograp Gem Star mine is just right of center of photo.

Photo 55. View west toward plant of Westvaco Chemical Division, Chula Vista. Magnesium compounds are produced from sea water bittern purchased from Western Salt Co., whose plant is ¼ mile to the north (left).

pegmatite may well be present in the dike, either north of the extensively stoped block of ground, or farther west and down the dip of the dike. The chances for such lenses in a down-dip direction probably would be enhanced materially if the steeply sloping segment of the dike in the vicinity of the lowermost mine workings should flatten. This possibility might well be tested by means of diamond-drill holes collared at points west of the small canyon that bounds the dip slope of pegmatite.

"Exploratory work directed northwestward from the North pit failed to reveal addtional masses of lepidolite, but such openings were not extended for great distances. The possibility that substantial quantities of lepidolite are north of the present underground workings also might be tested by means of diamond-drill holes. Although the two principal ore-bearing lenses are worked out, it is possible that there are other rich lenses of comparable size."

MAGNESIUM COMPOUNDS

A plant of Mineral Products Division of Food Machinery and Chemical Corporation at Chula Vista is one of four in California at which magnesium compounds are produced from sea water or sea water bittern (Ver Planck, 1957d, p. 315). The Chula Vista plant is the only one of the four, however, that utilizes only sea water bittern; the others also use dolomite as a raw material, in addition to bittern or sea water. During World War I calcined magnesite was produced at Chula Vista by the International Magnesite Company from deposits outside the county (see description in tabulated list).

Mineral Products Division (California Chemical Corporation, Westvaco Chemical Division, Westvaco Chlorine Products Corporation)

Location: The plant is near center Sec. 16, T. 18 S., R. 2 W., S.B.M.; adjacent to San Diego and Arizona Eastern Railroad which is to the east; and one-quarter mile north of the plant of Western Salt Company (Photo 55, Fig. 54). Several acres of bittern storage ponds lie north-northwest of the plant. *Ownership:* Mineral Products Division, Food Machinery and Chemical Corporation, 2121 Yates, San Diego (1958).

Magnesium chloride for use in oxychloride cement was first produced from bittern of the Western Salt Company at Chula Vista in the mid-1910's. But in 1916, both the salt and magnesium chloride operations were washed out by the flood caused by a failure of the Otay Dam to the east (Mason, 1919, p. 528-530; Ver Planck, 1958, p. 115).

Magnesium compounds

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	California Chemical Corporation				See Mineral Products Div., Food Mach. and Chem. Corp. (Ver Planck 58:115).
	International Magnesite Company	Chula Vista.	International Magnesite Co. (R. Schiffman, president), Pasadena (1925)	Produced calcined magnesite from magnesite obtained first from deposits near Porterville in Tulare Co. and near Bissel in Kern Co., and later from a deposit on Santa Margarita Island, Mexico.	Operated during World War I. The calcined magnesite was marketed in the eastern United States for use in the manufacture of steel and in California for use in plastics. (Bradley 25:76).
09	Mineral Products Division, Food Mach. & Chem. Corp. (California Chemical Corp., Westvaco Chlorine Products Div., Westvaco Chem. Div.)	Chula Vista.			See text, and Westvaco Chlorine Products Corp. under "Bromine." (Mason 19:528-530; Ver Planck 57a:95; 57c:313, 319, 322; 58:115).
	Westvaco Chemical Division				See Mineral Products Div., Food Mach. and Chem. Corp. (Mason 19:528-530; Ver Planck 57a:95; 57e:313, 319, 322; 58:115).
	Westvaco Chlorine Products Corp.				See Mineral Products Division, Food Mach. and Chem. Corp. (Ver Planck 58:115).

The salt works was rebuilt soon, but magnesium chloride was not produced again until late 1919, when the California Chemical Company started production. A few years later this company's operation was purchased by the California Chemical Corporation which built a Kubierschky tower and in 1926 began production of bromine, in addition to magnesium chloride. The operation continued until 1937, when Westvaco Chlorine Products Corporation purchased both the Chula Vista and Newark, California operations of California Chemical Corporation and continued to produce magnesium chloride and bromide at the Chula Vista plant. The corporation stopped production of bromine in 1945, however. The name of Westvaco, now a division of Food Machinery and Chemical Corporation, was changed to Mineral Products Division in 1960.

The present operation is described by Ver Planck (1957d, p. 319) as follows: "Bittern, the principal raw material, is obtained from the adjoining solar salt plant of the Western Salt Company and further evaporated by the use of heat. Salt and carnalite ($KCl.MgCl_2.6H_2O$) that crystallize are discarded and magnesium chloride is obtained by concentrating the residual liquor." Ver Planck also stated that "much of the output is used for magnesium oxychloride cement."

MANGANESE

As the manganese deposits of San Diego County are low grade and siliceous, none has been mined commercially. Manganese occurs most commonly in the county as black oxide minerals which form thin, wisp-like seams in quartzite layers enclosed chiefly in schist (Photo 56). These seams are only rarely as thick as several inches. At two or three localities in the county, pink rhodonite (manganese silicate) and spessartite garnet (silicate of manganese and aluminum) occur with the manganese oxide minerals.

Two deposits east of Fallbrook (Clark and Machado) and one northeast of Jacumba (Del Monte) have been described as manganese associated with granitic rocks (Trask and others, 1950). These could not be located during the present investigation.

The largest of the known manganese-bearing deposits in San Diego County are (1) the Jacumba Deposits (including the Sherry Ann Prospect), in the extreme southeastern part of the county; and (2) the Sunrise Deposit, which is in the east-central part of the county (see descriptions in the accompanying tabulated list). Even these deposits, however, are estimated by the writer to average much less than 10 percent manganese and more than 50 percent silica.

MICA

The pegmatite deposits of San Diego County have long been considered by prospectors as possible sources of sheet mica. Many of the deposits contain as much as perhaps 5 percent of relatively coarse-grained muscovite. When considered with the price of high grade sheet muscovite, which in 1961 was as high as $8 per pound

Phata 56. Dark gray manganese axides in quartzite layer in schist, lacality abaut 2 miles narthwest af Jacumba. View is down dip. 1 illustrates a typical uneconamic accurrence of manganese in San Di County.

for 6-inch x 8-inch sheets, the deposits seem all the mo lucrative. No sheet mica has been produced in t county, however. Sheet muscovite for commerce must completely clear, and free from flaws, which inclu "reeves," "wedging," "warping," and "ruling." In ad tion, it is estimated that only 2 to 3 percent of the mi mined from current sources is marketed as sheet mic Another difficulty that would be encountered by a po sible operator of a mica-bearing pegmatite deposit San Diego County is the problem of marketing; fabrica ing plants for crude mica are only in the eastern part the United States. Processed sheet muscovite is used, hov ever, in the electronics industry of the west coast.

Mica Gem Group

Location: Sec. 25 and E.½ Sec. 35, T. 17 S., R. 8 E S.B.M.; in southeastern part of county, about five mil northeast of Jacumba. *Ownership:* J. H. Hubble, J cumba, or Route 1, Box 26, Santee, holds 20 unpatent lode claims (1957).

The owner located most of the claims of the Mi Gem group between 1936 and 1940. Prior to 1936, Se tion 25 had been partly covered by claims of the Marde group which was worked briefly during the early 1920 for feldspar and quartz (see tabulated list under "Fel spar"). Since 1936, activity on the property has bee limited to minor development and assessment work. Th total production of feldspar, quartz, and mica is neg ligible.

Muscovite occurs with feldspar and quartz in numero granite pegmatite dikes which crop out of hilly terrai east and northeast of Table Mountain. The dikes ger erally have a northerly trend, and most of them di gently to the west. They are enclosed in quartz diorit

The principal development is in a nearly flat lyin dike which is exposed as an erosional remnant in a saddl near the center of the SW.¼ of Section 25. The dik is exposed for a length of several hundred feet, and

Manganese

Map no.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
0	Clark prospects	Secs. 7 and 18, T9S, R2W, SBM; about 7 miles east of Fallbrook, and a little more than 1 mile southeast of Rainbow.	Undetermined (1958) W. S. Clark, Fallbrook (1950)	"...a pit exposes granite impregnated with black oxide of manganese in SE¼NW¼ sec. 18...and...an open cut in the SE¼SW¼ sec. 7, exposes an aplite dike within which manganese occurs as dark brown stains". (F. S. Hudson in Trask and others, 1951, p. 208).	Deposits could not be located by present investigator in 1958. Hudson stated that "nothing was seen at either claim that would carry over 5 percent manganese." (Trask and others 43:85,165; 50:208).
	Del Monte prospect	T17S, R8E, SBM; "4 miles northeast of Jacumba". (Spangler Ricker in Trask and others, 1950, p. 208).	M. J. Flynn, San Ysidro (1941)	Ricker stated that the deposit consists of manganese oxides in a shear zone in granite. Manganese minerals exposed for a length of 20 ft. and a width of 2 ft. Ricker also stated that a representative sample assayed 14.5 percent manganese, 3.3 percent iron, and 65.6 percent silica.	Undeveloped. Location of deposit could not be verified by present investigator in 1957. (Trask and others 43:85, 165; 50:208).
	Desert Queen prospect	Sec. 22, T13S, R8E, SBM; Anza-Borrego Desert State Park.	Undetermined (1957) H. W. Maddox (1939)		No additional published information. (Tucker and Reed 39:54).
	Engineer's Springs	Sec. 22, T18S, R2E, SBM; about 3 miles south of Engineer Springs, near Mexican Border.	Undetermined (1958) Dr. C. C. Valle, San Diego (1918)	Reported by Trask and others (1943, p. 165) to consist of "manganese oxides in rhyolite." Hudson, in Trask and others (1950, p. 208), found only altered rhyolite at the deposit, however.	Could not be located by present investigator. Perhaps same as Dulzura deposit, which is described herein under "Sand and gravel, and crushed and broken stone." (Trask and others 43:85, 165; 50:208).
a b	Jacumba deposits	Sec. 1 and NE¼ sec. 12, T18S, R7E; and SW¼ sec. 6 and NW¼ sec. 7, T18S, R8E, SBM; 1 to 1½ miles west-northwest and northwest of Jacumba.	Undetermined (1957)	Deposits consist of manganese minerals associated with quartzite layers in schist. The rocks are cut by abundant pegmatite dikes. The quartzite layers strike northwestward and dip 40°-60° northeast. Manganese oxides occur along fractures and bedding planes, mainly as stains and crusts. Deposit No. 311a is the principal deposit in the area; it is less than 50 ft. long and about 6 ft. wide; it contains minor proportions of manganese oxides, with sparse rhodonite and spessartite. The deposit is developed by several trenches. Deposit No. 311b is several hundred ft. long and 10 to 30 ft. wide; it caps a low ridge. This deposit contains a very small proportion of manganese oxides. It is also developed by several shallow cuts.	These are low-grade siliceous deposits. No production. See also Del Monte prospect, Jacumba group, and Ramrod prospect.
	Jacumba group	Jacumba area, about 1 to 1½ miles northwest of Jacumba.	Undetermined (1957) Dr. M. C. Harding, 861 Sixth Avenue, San Diego (1939) B. F. Stanwood and J. J. Curl, San Diego (1950)		Property consisted of unpatented claims in the NW¼ sec. 5 and the NE¼ sec. 6, T18S, R8E, SBM, as described by Tucker (1924) and others. Because no deposits could be located by the writer in the exact area designated by the previous investigators, it is assumed that the claims actually covered deposits to the west, in the W½ sec. 6 and sec. 7, T18S, R8E, and secs. 1 and 12, T18S, R7E, SBM. These deposits are described herein under Jacumba deposits and Sherry Ann prospect. (Trask and others 43:85, 165; 50:208-209; Tucker 24:374; Tucker and Reed 39:30, pl.1).
2	Machado prospect	"SW¼NW¼ sec. 6, T9S, R2W, SBM;" about 7 miles east-northeast of Fallbrook, just east of U.S. Highway 395, near the Riverside County line. (F.S. Hudson in Trask and others, 1950, p. 209).	Undetermined (1958) M. Machado, Temecula (1950)	"...a manganese stained zone in a mass of pegmatite and aplite, which strikes N.70°W., along the course of the hill."	Present investigator could not locate deposit in 1958. F. S. Hudson (Trask and others, 1950, p. 209) stated that "not over 50 pounds of ore was visible. The prospect is not promising." (Trask and others 43:85, 165; 50:209).

Manganese

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Ramrod prospect	"T18S, R8E, SBM; near Jacumba" (Trask and others, 1950, p. 209).	V. W. Weaver (1941)		Trask and others (1950, p. 209) state that the deposit "is said to be of little value." Location of deposit could not be verified in 1957 by present investigator. (Trask and others 43:165; 50:209).
	Ruby deposit	See "Remarks" column.	Undetermined (1957) Don A. Ruby, Boulevard (1918)	Described by F. S. Hudson (Trask and others, 1950, p. 209) as a "bed of siliceous manganese ore enclosed in quartz-mica schist. The strike is N.60°W., the dip is north at a high angle. The schist occurs as a body less than 50 feet thick" in granite. Rhodonite, manganese garnet, and manganese oxides also were reported to occur.	This deposit has been described as ab "2 miles southeast of Boulevard" in sec. 16, T18S, R8E, SBM. A deposit could not be located by the writer 1957 in the area 2 miles south of Boulevard; and sec. 16, T18S, R8E, SBM would be in Mexico. This depos may be the same as the Sherry Ann prospect which is northwest of Jacu (Boalich 18:11; Trask and others 43 66, 85, 165; 50:209).
313	Schmiddmitt prospect	NE¼ sec. 34, T13S, R5E, SBM; on the east side of Mason Valley, in Anza-Borrego Desert State Park.	Undetermined (1958)	Manganese oxides with quartz in schist.	A prospect explored briefly in the 1950's by Gustav Schmiddmitt and Associates.
314	Sherry Ann prospect	SE¼NE¼ sec. 1, T18S, R7E, SBM; about 2 miles northwest of Jacumba.	Charles Ashby, 4518 Bayard, San Diego (1957)	A zone of low-grade manganese oxide and silicate minerals in quartzite. Zone is slightly less than 50 ft. long and is about 6 ft. wide. It strikes northwest and dips 65° northeast. The silicate minerals are rhodonite and spessartite, which are sparse.	Four unpatented claims. Explored by shallow trench.
315	Sunrise deposit	NE¼NE¼ sec. 10, T13S, R5E, SBM; in Anza-Borrego Desert State Park, about 9 miles east of Julian.	Undetermined (1957) Calvin W. Garrison, 3659 Cherokee St., San Diego (1939)	The deposit is on the crest of a ridge that trends south from the northwestern wall of the unnamed canyon which drains the northeastern part of the Oriflamme Mts. Hydrous manganese oxides occur as crusts and stains in two layers of quartzite, 1 ft. and 5 ft. thick, which are enclosed in dark-gray biotite schist and gneiss. The rocks strike northward and dip about 85° west. The lengths of the manganese bearing beds were not determined, but are estimated to be at least 50 or 100 ft. or more.	Development consists of a 50-ft. cros cut adit and several shallow pits a trenches. Long idle. No productio (Trask and others 43:85, 165; 50:20 Tucker 39:30 pl.1).
316	Tule Mt. deposit	North edge of the NE¼ sec. 14 or south edge SE¼ sec. 11, T17S, R7E, SBM; about 6 miles northwest of Jacumba, low on the west slope of Tule Mt.	Undetermined (1957)	Crusts of manganese oxides in quartzite.	A prospect. Unverified. (Fred M. Elliot, Manzanita, personal communication, 1957).
317	Turner prospect	SE¼NE¼ sec. 31, T14S, R5E, SBM; Deer Park district, about 6½ miles north-northeast of Pine Valley.	Undetermined (1957) J. O. Turner, San Diego (1950)	Manganese oxides coat fractures in quartzite lenses in Julian schist. According to F. S. Hudson (Trask and others, 1950, p. 21) selected samples from the dump might assay as high as 5 percent manganese oxides.	(Trask and others 43:165; 50:211).
318	Undetermined	NW¼NW¼ sec. 25, T15S, R7E, SBM; about 16 miles north of Jacumba, on the south side of Bow Willow Canyon.	H. W. Bryant and Coburn Sapp, San Diego (1951)	Very sparse manganese oxides occur as crusts and stains in quartzite. The quartzite strikes north-northeastward and dips 75° west.	A prospect. Developed by a 10-ft. sh and a 10-ft. trench.
	Unnamed	Northern part of Anza-Borrego Desert State Park.		Hydrous manganese oxides occur with minor rhodonite.	Mineral collectors locality. No additional published information. (Tucker and Reed 39:29).

Mica

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Carlsbad deposit	Northeast of Warner Springs.			See tabulated list under "Feldspar".
19a (ep-it) 19b (ill)	Mica Gem group (Jacumba No. 1, Marden)	Northeast of Jacumba.			See text. See also Little Randsburg prospect under "Tungsten," and Marden deposit under "Feldspar". (Tucker and Reed 39:46).

idth of at least 100 feet. Its thickness ranges from 4 12 feet. The upper and lower one-thirds of the dike onsist chiefly of fine-grained graphic granite with less undant muscovite, and very sparse magnetite and red rnet. The mica books, which average about three-uarters inch in diameter, are fairly well distributed the layers. The central third, or core, of the dike onsists chiefly of coarse-grained perthite and quartz, nd its central part is commonly entirely quartz. Elsehere in the area, dikes contain books of mica that range diameter from one-eighth inch to one foot. However, ooks over one or two inches in diameter are generally ontorted, and, therefore not of possible value as sheet ica.

The dike is developed by an open cut about 125 feet ng and 10 to 40 feet in width. Its face ranges in height om 10 to 15 feet. Material that has been removed from e cut is stockpiled adjacent to it. Other workings in e Mica Gem group consist of trenches, pits, and cuts, ost of which are very shallow.

A mill to process mica-bearing rock was constructed 1956 on the site of a former, less efficient mill. It is in e NE.¼ SE.¼ Sec. 35, about one mile south-southwest f the main cut. The operators use an inclined-slit screeng process to separate the mica from the other pegmatite inerals. The process includes several steps. It involves ry-grinding the rock, then passing it through a series of -shaped troughs which contain narrow slits on the ottom. Flakes of mica pass through the slits and are eparated from equidimensional grains of feldspar and uartz which do not pass through the slits. The final roduct is composed of 10 percent waste rock and 90 ercent scrap grade mica ground to minus ⅛-inch mesh. he owner also contemplates recovery of feldspar and uartz. Capacity of the mill is 40 tons of rock per day. s of early 1957, no mica had been produced in the mill, nd the property was idle.

MINERAL FILLERS

Minerals that occur in San Diego County which might be used as fillers include clay, limestone, mica, quartz-feldspar sand, and pyrophyllite. With the exception of quartz-feldspar sand, the minerals are described individually elsewhere in this section. Quartz-feldspar sand is described under "Specialty Sands."

MINERAL PAINT

The Palagonite Deposit near Rancho Santa Fe was explored first in the early 1900's as a possible source of mineral paint. This deposit consists of yellow-brown hydrous iron oxide minerals associated with pyrophyllite (see description in text under "Pyrophyllite").

MOLYBDENUM

The principal ore mineral of molybdenum is molybdenite (molybdenum sulfide), which occurs most commonly as soft, bluish lead-gray, scale-like crystals. The known molybdenum deposits of San Diego County comprise small parts of granite aplite bodies in which molybdenite has two principal modes of occurrence: (1) very sparsely disseminated crystals; and (2) zones of limited extent which contain concentrations of crystals of the mineral with abundant quartz, and sparse pyrite and ferrimolybdite. Known areas underlain by such zones of concentration probably range from less than one hundred to perhaps several thousand square feet. Most of the known molybdenite-bearing aplite bodies in the county are dikes which trend northwestward to north-northwestward. Generally the aplite bodies may be distinguished from the surrounding country rock because they are slightly stained by yellow-brown hydrous iron oxide minerals. Rocks that contain concentrations of molybdenite may be stained pale yellowish green.

The known molybdenite-bearing aplite deposits in the county are: Dillbeck and Lippner, near Campo (see descriptions below); Bour and Judson Ranch, northwest of

Mineral paint

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Palagonite group				See Palagonite deposit in text under "Pyrophyllite." (Merrill 14:668, 689-691; Symons 30:156; Tucker 25: 374; Tucker and Reed 39:46, pl.1).

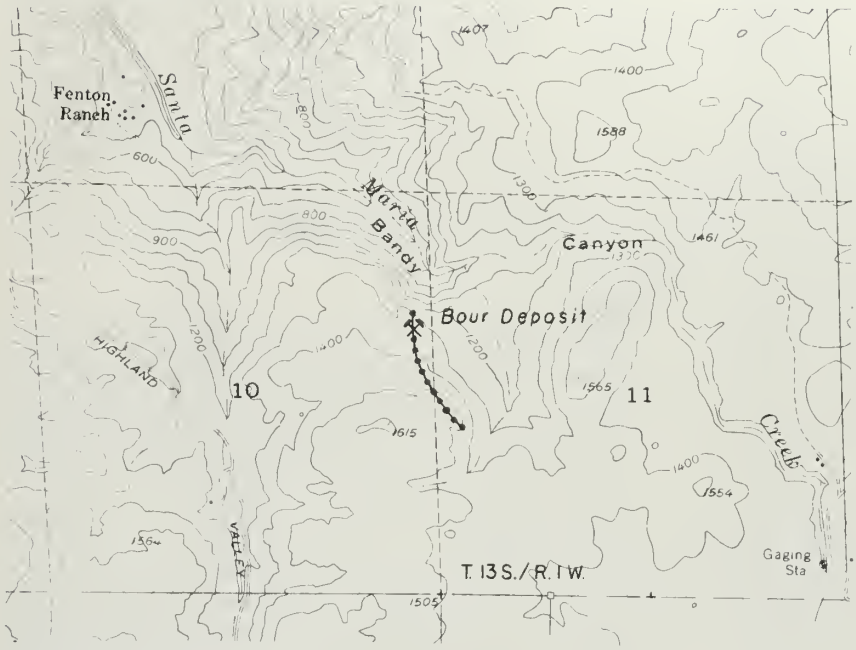


Figure 45. Map showing location of Bour m denite deposit. Molybdenite is near the north en a north-northwest-trending granite aplite dike.

Ramona (see description of Bour below); Harvey Ranch, east of El Cajon; and Fernbrook, southeast of Ramona. Two deposits—Mayers Ranch, southeast of Dulzura; and the Sutherland Ranch Deposit, east of Ramona—have been described by Tucker (1921b, p. 380) and others as molybdenite-bearing quartz veins. These two deposits were not investigated by the present writer.

The molybdenite deposits of San Diego County have been generally unproductive. The Bour Deposit yielded one ton of 60-percent concentrates in 1917 and the Lippner Deposit yielded a small output during World War II. Ore mined at the Bour Deposit average between ½ and 1 percent molybdenum.

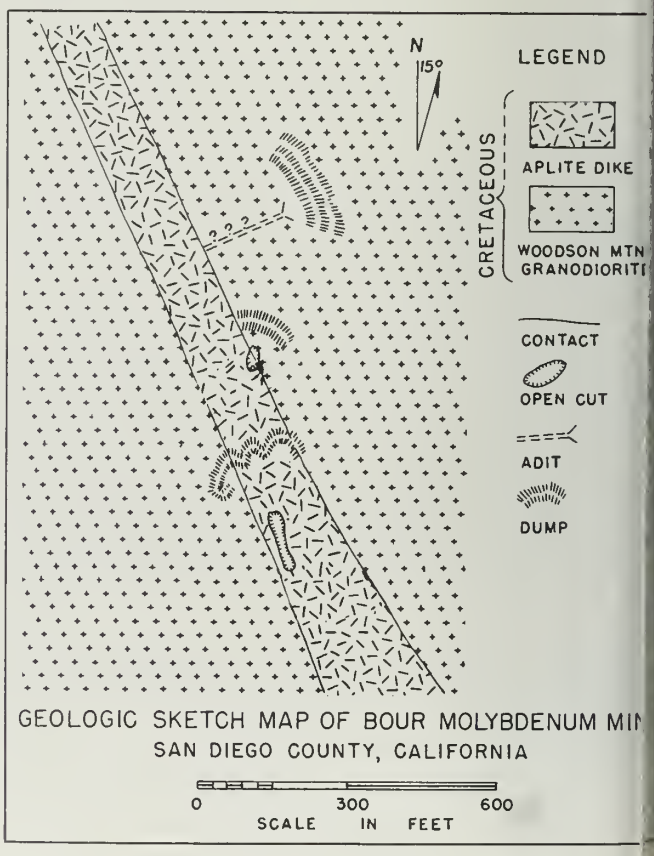
Bour Deposit (Molybdenum Syndicate Limited, Santa Maria Mining and Milling Company)

Location: SE.¼ NE.¼ Sec. 10 and middle of the west edge Sec. 11, T. 13 S., R. 1 W., S.B.M.; about six miles west-northwest of Ramona, along a north-northwest trending ridge south of Bandy Canyon (Santa Maria Creek). *Ownership:* Helen L. Gild, 1255 7th Ave., San Diego 1 (1958).

The Bour molybdenite deposit is covered by a patented 40-acre agricultural homestead. It was explored in the late 1910's by the Santa Maria Mining and Milling Company and the Molybdenum Syndicate Limited of San Diego. It has been idle since that time.

Molybdenite, with a minor proportion of pyrite, is distributed sparsely and irregularly in parts of a north-northwest trending granite aplite dike which is enclosed in granodiorite. The dike can be traced, as a fairly prominent ridge, south-southeastward from Bandy Canyon for at least 1,500 feet (Figs. 45, 46). Most of the dike is barren

Figure 46. *Modified from Carlisle and Cleveland 1958.*



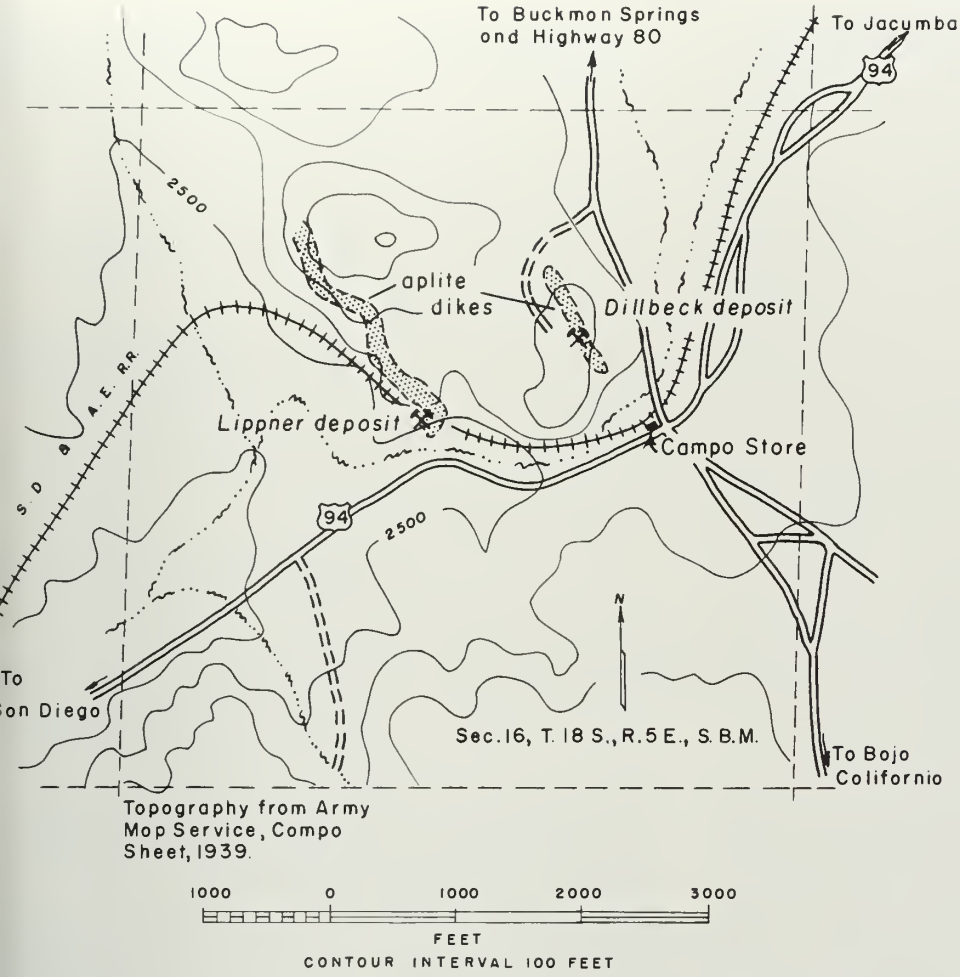


Figure 47. Map shawing Dillbeck and Lippner malybdenite deposits, Campa. Molybdenite is sparsely disseminated in zanes in granite aplite dikes in tanalite.

molybdenite. Of chief interest were two molyb-enite-bearing zones between 500 and 1,000 feet south-utheast of Bandy Canyon. The more northerly zone is out 10 feet long, and the more southerly zone is about feet long. In the vicinity of the more southerly zone e dike averages about 200 feet in width. Molybdenite ystals in this zone rarely are greater than ¼ inch in aximum dimension. Yellow ferrimolybdite uncommonly rms crusts on weathered surfaces. Rock mined and illed in 1917 from this part of the dike was reported to erage between one-half and 1 percent molybdenite Tucker, 1921b, p. 379).

The principal workings on the property consist of a allow 115-foot cut which opened the more southerly of e molybdenite-rich zones in the dike. This cut trends orth-northwest, along the crest of the ridge. North of e cut, on the east-northeast side of the ridge, an adit tends S. 40° W. into the ridge for about 240 feet Tucker, 1921b, p. 379), and intersects the dike about 0 feet below its outcrop (Fig. 46). This adit was caved 1958. A 25-ton mill was installed on the property in 17. One ton of concentrates averaging about 60 per-nt molybdenite, was produced by oil flotation before e operation was stopped late in 1917. No structures or uipment remain on the property.

Dillbeck Deposit

Location: SW.¼ NE.¼ Sec. 16, T. 18 S., R. 5 E., S.B.M.; in the southeast part of the county, along the crest of a hill, about one-quarter mile northwest of Campo store (Fig. 47). *Ownership:* Hugh B. Martin, Campo, owns the SW.¼ NE.¼, the NW.¼ NE.¼, the NE.¼ NW.¼, and additional property, of Sec. 16 (1958).

The Dillbeck Deposit probably was opened about 1914, at the same time as the Lippner Deposit, which is about 2,000 feet to the southwest. During the 1930's the Dillbeck Deposit was leased to the Campo Molybdenum Company, T. W. Buckel of Holtville, president (Tucker and Reed, 1939, p. 30). The deposit has no record of production, however.

Molybdenite occurs sparingly in a granite aplite dike which trends northwestward, is about 1,000 feet long and 100 to 200 feet wide (Fig. 47). Most of the dike is barren of visible molybdenite, although a large part of it is stained slightly with yellow-brown hydrous iron oxide minerals. Visible, disseminated crystals of molybdenite were observed in two small zones. The more southerly of the two zones is in the south-central part of the dike, just southeast of the crest of the hill. It trends northeastward, is about 75 feet long, and ranges in width from 5

Molybdenum

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Aiken				See Lippner deposit in text. (Horto 16:59; Tucker 21b:379; 25:351).
	Aitken				See Lippner deposit in text. (Boali and Castello 18b:23).
	Bauer				Probably same as Bour deposit, which see in text. (Tucker and Reed 39: pl.1).
320	Bour deposit (Molybdenum Syndicate Ltd., Santa Maria Mining and Milling Co.)	West-northwest of Ramona.			See text. (Boalich and Castello 18b Calkins 17a:73-76; Carlisle and Cl land 58:21-22; Hewett and others 3 88; Horton 16:59, 60-61; Merrill 1 669; Stewart 57:367; Tucker 21b:37 25:351; Tucker and Reed 39:30, pl.
	Campo molybdenum mines (Midway)				See Lippner deposit in text. (Tucke and Reed 39:30, pl.1).
	Campo deposits				See Lippner and Dillbeck deposits in text. (Merrill 14:669; Tucker and Reed 39:30).
321	Dillbeck deposit	Near Campo.			See text. (Tucker and Reed 39:30-31
	Echo mine	"Near Lakeside"		"Molybdenite in pyrrhotite"	Reported in a list of mineral specim donated to Division of Mines. Don C. C. Clarke. Locality unconfirme See also Harvey Ranch and Fernbroo deposits. (Symons 39:495).
	El Dorado				Map location given for each of 3 cla (others Midway and Mother Lode) located before 1939 on patented property which now belongs to Lipp See Lippner deposit in text. (Tuc and Reed 39:pl.1).
322	Fernbrook (Woolsey) deposit	NE¼SE¼ sec. 7, T14S, R1E, SBM; nearly 6 miles southwest of Ramona, just south of Fernbrook store.	Undetermined (1958) Mrs. Charlotte Ronan, 3402 Olive St., San Diego (1939)	A body of granite aplite of undetermined surface dimensions contains disseminated crystals of molybdenite as large as ¼ in. in diameter. Several thin seams observed contain as much as several percent molybdenum oxide. However, most of the rock is barren. Average grade of rock undetermined.	On patented land. Explored by a par circular pit about 25 ft. in diame and 5 to 10 ft. deep, which is adjacent, on the east, to the old Ra - Lakeside road. Woolsey property probably part of same deposit. (Tucker 21b:380; 25:351; Tucker an Reed 39:31, pl.1).
323	Harvey Ranch deposit	Sec. 19, T15S, R2E, SBM; about 10 miles northeast of El Cajon, and north of U. S. Highway 80.	Undetermined (1958) T. J. Harvey, Lakeside (1925)	Small crystals of molybdenite occur in an aplite dike through a zone 130 ft. wide. Dike strikes N.20°W. (Tucker,1921b).	Undeveloped. Present writer could n locate deposit in 1958. (Tucker 21 380; 25:351; Tucker and Reed 39:pl
324	Judson Ranch deposit	Near the center of the SW¼ sec. 1, T13S, R1W, SBM; about 5 miles west of Ramona, on the south side of the crest of an east-trending ridge.	Undetermined (1955) Charles Judson, San Pasqual (1939)	Aplite dike crops out prominently, forming crest of small ridge. Dike 50-60 ft. wide, strikes nearly east and dips steeply south. Molybdenite visible as very small, sparsely distributed crystals along southern part of dike. Molybdenite-bearing aplite shows characteristic faint yellow-green stain on surface.	On patented land. Explored by open 50 ft. long, 5 to 10 ft. wide and to 15 ft. deep. Tucker and Reed (1939) reported small production. (Calkins 17a:73-76; Hewett 36:38; Tucker 21b:380; 25:351; Tucker and Reed 39:31, pl.1). (R.M.S.)
	Katherine prospect				See tabulated list under "Tin".
325	Lippner (Aiken, Aitken, Campo molybdenum mines (Midway)) deposit	Near Campo.			See text. (Boalich and Castello 18b 23; Hanks 86:124; Horton 16:59; Merrill 14:669; Tucker 25:351; Tucker and Reed 39:30, pl.1).
	Mayers Ranch deposit	T18S, R2E, SBM; north side of Cottonwood Creek, 5-6 miles southeast of Dulzura.	Undetermined (1958)	Molybdenite in quartz veins.	Deposit not confirmed during present vestigation. (Eng. Min. Jour., vo 104, p. 1017, 1917; Horton 16:59; Tucker 21b:380; 25:352).

Molybdenum

op o.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Midway				Map location given for each of 3 claims (others El Dorado and Mother Lode) located before 1939 on patented property now owned by Lippner. See Lippner deposit in text. (Tucker and Reed 39:pl.1).
	Molybdenum Syndicate Ltd.				Controlled Bour deposit in 1915. See Bour deposit in text. (Boalich and Castello 18b:23; Calkins 17a:73-76).
	Mother Lode				Map location given for each of 3 claims (others El Dorado and Midway) located before 1939 on patented property now owned by Lippner. See Lippner deposit in text. (Tucker and Reed 39: pl.1).
	Ramona				Map name of Tucker and Reed (1939, pl.1) for Judson Ranch deposit, which see. See also Bour deposit which is in same area. (Tucker and Reed 39:pl.1).
	Santa Maria Mining and Milling Co.				This company once reported to have leased the Bour deposit, which see in text. (Horton 16:59, 60-61; Merrill 14:669).
	Sutherland Ranch deposit	T13S, R2E, SBM; "about 7 miles from Ramona on the Julian road."	R. L. Case, Escondido (1921)	"Molybdenite occurs in quartz veins from 1" to 5" wide" (Tucker, 1921b).	Deposit not confirmed during present investigation. (Tucker 21b:380).
	Woolsey deposit				See Fernbrook deposit. (Tucker 21b:380; 25:351; Tucker and Reed 39:pl.1).

perhaps 15 or 25 feet. The molybdenite crystals, which e as large as one inch in diameter, occur in clusters, to rm elongate, lenticular to seamlike sub-zones as long as e foot (Fig. 48). The other zone is about 200 feet rthwest of the one noted above. It is similar in minerogy, but much smaller.

Two grab samples collected at random from the dike the writer assayed 0.58 and 0.16 percent molybdenum isenhauer Laboratories, Los Angeles, 1958).

The only workings on the property are those that exored the zone of mineralization described first. This ne was explored by a northeast-trending trench about 0 feet long, 5 to 15 feet wide, and as much as 5 feet ep. An ore bin remains near the northeast end of the ench. A narrow dirt road connects the deposit with the ved road between Campo and Buckman Springs.

pner (Aiken, Aitken, Campo Molybdenum nes (Midway)) Deposit

Location: SE.¼ NW.¼ Sec. 16, T. 18 S., R. 5 E., B.M.; in the southeast part of the county, about one-lf mile due north of the store in Campo. *Ownership:* nthony A. Lippner, Campo, owns the SE.¼ NW.¼ c. 16. However, one-sixteenth of the mineral rights are tained by the State of California; and the San Diego d Arizona Eastern Railroad owns an 80-foot right-of-ay through the property (1958).

The occurrence of molybdenite at Campo was reorted first in the publications of the California Division Mines and Geology by Hanks (1886, p. 124). The ppner Deposit was opened in 1914, when a cut was ade through the deposit during construction of the roadbed for the San Diego and Arizona Eastern Railroad. Soon after that date, E. T. Aiken (or Aitken) of Campo and Ray Robinson of Los Angeles prospected the deposit unsuccessfully. During the 1930's and early 1940's, A. G. Foster of Campo and William Davis of San Diego attempted sporadically to develop the deposit. They built a flotation plant of 20 tons capacity near the deposit and probably shipped a small quantity of concentrates. In the mid-1940's the United States government reportedly rejected a shipment of concentrates because it was too low in grade (A. A. Lippner, personal communication, 1958).

The Lippner Deposit consists of the south end of a north-northwest trending biotite granite aplite dike which is about two-fifths of a mile long (Fig. 47). Molybdenite is known to occur in the dike along the

Figure 48. Sketch showing grains of molybdenite in aplite of Dillbeck deposit, Campo.

sides of the northwest-trending railroad cut mentioned previously for at least 100 feet and to the south of the cut for 100 to 150 feet. The mineral occurs in the area as sparse, disseminated crystals and in several irregular zones of concentration of limited extent with abundant quartz and very sparse ferrimolybdite and pyrite. The molybdenite crystals are no larger than one-half inch. The surface of areas underlain by concentrations of molybdenite commonly are stained yellowish-green, and the surface of barren parts of the dike generally are stained yellowish-brown. Molybdenite was not seen in parts of the dike north of the railroad cut that were examined by the writer.

The workings in the dike consist of an inclined shaft, now caved, and very shallow, superficial cuts along the south-trending slope south of the railroad cut.

NICKEL

Nickel is a very critical alloy metal of which deposits in the United States furnish only a very small proportion of the total domestic supply. Thus, practically any nickel-bearing deposit in the United States is of potential interest as a possible source of the metal. San Diego County contains two significant nickel-bearing deposits: the Friday Deposit, southeast of Julian (see description below); and the Old Ironsides Deposit, north-northeast of Ramona (see description in tabulated list). Near the Friday Deposit is a smaller deposit named the Copper Brick. These deposits consist of relatively small bodies composed essentially of nickel, cobalt, copper, and iron sulfide minerals enclosed in gabbroic rocks. None of the deposits has been worked profitably.

During the mid-1950's exploration programs were carried out at the Friday and Old Ironsides Deposits, with the assistance of loans from the Defense Minerals Exploration Administration. The program at the Friday property included the preparation of a geophysical map of an area of about three-fourths of a square mile surrounding the deposit. The outline of gabbroic bodies in the county which possibly contain additional nickel-bearing deposits similar to those described below are shown on Plate 1.

Friday Deposit

Location: SW.¼ Sec. 15, T. 13 S., R. 4 E., S.B.M.; Julian District, about 3½ miles southeast of Julian. The property is transected by State Highway 79. *Ownership:* Merrill MacAfee, 3901 Engehl Drive, Los Angeles, and Raymond W. and Thelma C. Jacobs, P.O. Box 207, Julian, own 10 acres of patented land in the SW.¼ Sec. 15, and three unpatented claims (1957).

The iron oxide-rich outcrops of the Friday nickel-cobalt-copper deposit probably first attracted gold prospectors in the 1870's and 1880's, when the gold mines in the Julian District were being developed. It is known that the present workings were opened prior to 1914. Since 1914, several companies have obtained options on the property, but very little work has been done, and no nickel ore has been produced from the deposit.

The following description of the geology and wor ings is mainly a summary of a report by Creasey (194 p. 15-29). The Friday Deposit is developed by a 16 foot vertical shaft, from which a 55°-incline exten south-southwestward to the 180-foot level (Fig. 48). 105-foot drift trends east-northeastward from the sha on the 132-foot level. At the end of this drift, a 17-fo crosscut trends northwestward to a vertical winze whic extends to the only stope in the mine, on the 180-fo level. The stope is about 30 feet long, five feet in avera width and seven feet high. A crosscut trends sout southeastward from the stope for about 60 feet, ar abuts a 150-foot drift which extends east-northeastwa from the bottom of the main shaft. Six short, exploratoı crosscuts and drifts extend outward from the ma workings on the 132- and 180-foot levels. As no produ tion is reported from the property, it is assumed th rock mined from the stope area was stockpiled or use in mill tests.

The Friday Nickel-Cobalt-Copper Deposit is an irre ular, elongate body which strikes N. 75° E., dips steepl north-northwest, and pitches to the northeast. It is e posed along the east-northeast part of the 132-foot leve in the walls of the winze between the 132-foot and 18 foot levels, and in all sides of the stope on the 180-fo level. Approximate minimum dimensions of the body ar strike-length, 130 feet; pitch-length, 140 feet; width, 6 t 22 feet, tapering downward; and vertical extent, abo 50 feet (between the 132- and 180-foot levels). Crease stated (1946, p. 25) that "the body was formed by r placement of the Cuyamaca gabbro along fractures c the north side of an inclusion of schist that nearly para lels the ore in strike, but dips about 60° southward."

The deposit is nearly completely oxidized from tl surface to the 132-foot level. A few pockets of residu sulfides were observed on the 132-foot level, but a larger and more common in the walls of the winz nearer the 180-foot level (Creasey, 1946, p. 25). In tl lower part of the stope, on the 180-foot level, the body unoxidized. The most common sulfide mineral is pyrrh tite; others identified are pentlandite (nickel-iron sulfide violarite (nickel-iron sulfide), pyrite, and chalcopyrit Magnetite also is present. Creasey stated (1946, p. 27 that the unoxidized part of the body probably woul average between 2.5 and 3.0 percent nickel, between 0 and 1.0 percent copper, and as much as 0.15 perce cobalt. He also stated that the average for both oxidize and unoxidized ores would be about 2.0 percent nicke

In 1957, Julian Nickel Mines, Incorporated, carrie out an exploration program in the area under the supe vision of B. I. Nesbitt of Vancouver, British Columbi a consulting geological engineer. The purpose of th program was to delimit the Friday nickel-bearing bod and to survey 700 acres in the E.½ SW.¼ Section 1 and part of Section 15 for possible additional bodie Part of the money was furnished by the United Stat government through a Defense Minerals Exploratio Administration contract originally assigned to MacAfe and Company, Los Angeles. Ten diamond drill hol

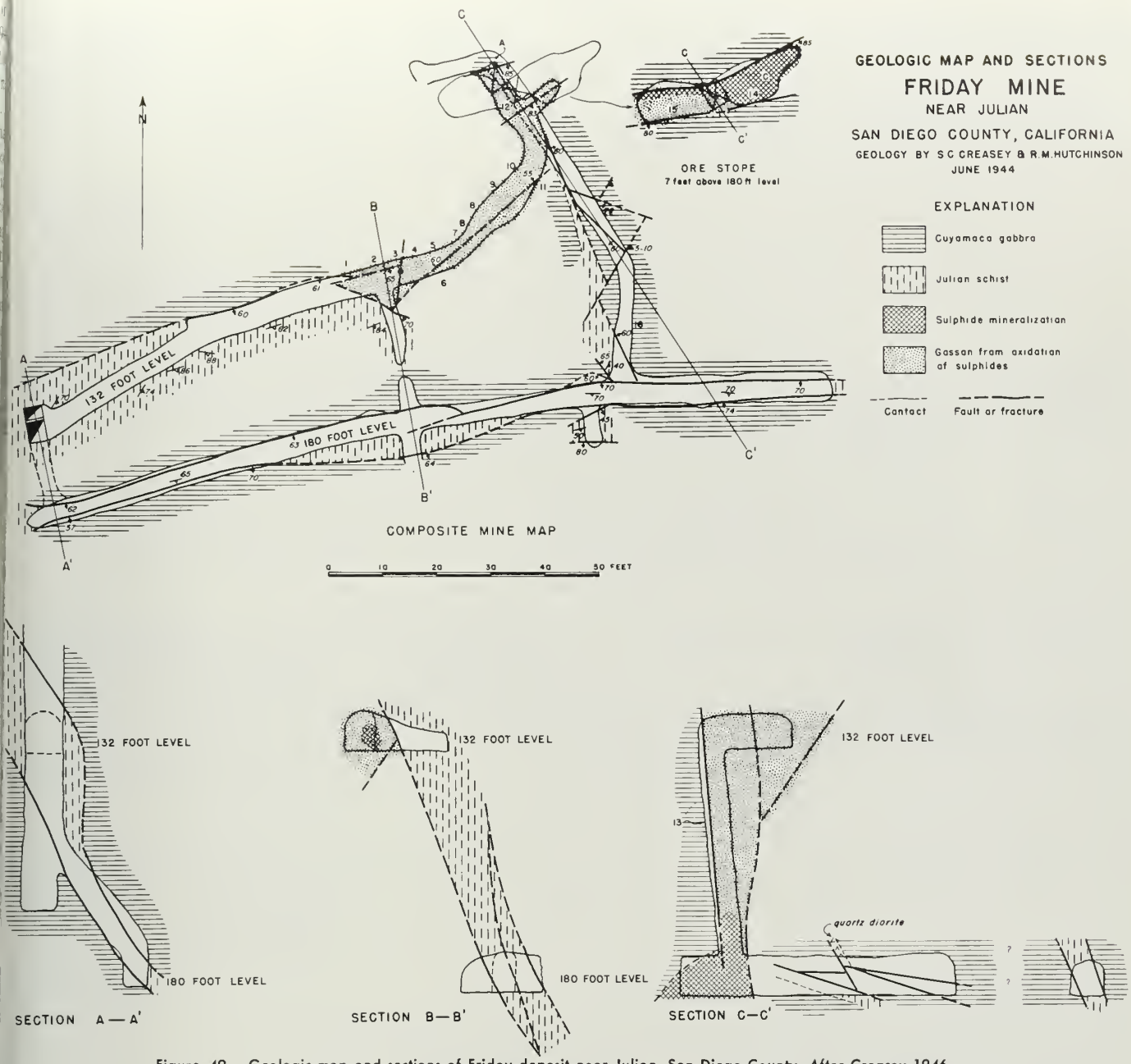


Figure 49. Geologic map and sections of Friday deposit near Julian, San Diego County. *After Creasey 1946.*

were sunk; and self-potential, resistivity, and magnetometer surveys were carried out by Sherwin F. Kelly, Geophysical Services, New York.

Two diamond drill holes intersected 8 feet and 17 feet of sulphides about 20 feet east of the known limit of the body on the 180-foot level. The other holes, which also were drilled to intersect possible extensions of the body were barren, and Mr. Nesbitt (unpublished report, Julian Nickel Mines, 1957) concluded that, "In view of the above results, it was decided that the Friday orebody is either too small or too badly faulted to warrant further expenditure to determine its size and metal content." A self-potential survey was carried out over the entire Friday property, but failed to disclose anything of interest.

A magnetometer survey was carried out over 700 acres in Section 15 and the E.½ Section 16. Three "highs" were located and drilled, but no sulfide-rich bodies were encountered. Mr. Nesbitt stated that the "highs" probably were caused by unaltered pyrrhotite in unweathered portions of the gabbroic rocks.

In respect to future possibilities of the area, Creasey (1946, p. 16-17) concluded that

"Additional small bodies of nickel ore may be found by further exploration, but the remoteness from railways would make it difficult to mine economically nickel deposits of small mine tonnage, and the known occurrences of ore give little hope of developing economically large low-grade reserves, such as would justify the construction of a mill . . ."

Nickel

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Copper Brick deposit	Sec. 15 or 16, T13S, R4E, SBM; southeast of Julian.	Reported by Boalich and Castello (1918a) as Robert Melrose, Julian, who is now deceased.		Copper-nickel prospect near Friday mine (Boalich and Castello 18a:18; Merrill 14:667).
326	Friday deposit	Julian district.			See text. (Boalich and Castello 18a: 17, 18; Calkins 17b:77-82; Chesterman 57:451, 452; Creasey 46:15-29; Donnelly 34:370, pl.4; Eric 48:320; Everhart 51:107; Hubon 02:7; Hudson 22:212-228, 238-241, pls. 10,11; Merrill 14:666-667; Nesbitt 57: Sandberg 47; Short and Shannon 30:8; Tolman and Rogers 16; Tucker 21b:380-381; 24:50; 25:330, 352-353; Tucker and Reed 39:31, pl.1).
	Gilson (Napoles) prospect	In the area along the boundary between SW¼ sec. 15 and SE¼ sec. 16, T13S, R4E, SBM; Julian district, southeast of Julian.	Undetermined (1957) Sidney Vistcher(?), Lincoln Acres, San Diego (1940) S. Gilson (1902)	Hubon (1902) described the deposit as "Copper sulfides...in 12-ft. vein...in porphyry...strikes northwest." Merrill (1914) stated "Rumor mentions an ore body 15 ft. wide, averaging 8 percent nickel at 130 ft. depth".	Workings noted by Hubon (1902) consisted of 25-ft. shaft. Exact location of deposit not determined by present investigator. (Hubon 02:7; Merrill 14:670).
	Lucky Strike group	SE¼ sec. 16, T13S, R4E, SBM; southwest of Julian, west of Friday mine.	Sidney Vistcher, Lincoln Acres, San Diego (1940)	Gossan deposit in Cuyamaca gabbro. A "nickel and cobalt showing".	Possibly old Gilson property. A prospect only. (W. B. Tucker, 1940, formerly California Div. of Mines, unpublished field notes).
327	Old Ironsides prospect	Center of the N½ NW¼SW¼ sec. 6, T12S, R2E, SBM; about 8½ miles north-northeast of Ramona, on the west side of the prominent loop in Black Mt. truck trail.	Valle's Mining Syndicate, Howard and Paul Valle, 2424 5th Avenue, San Diego (1955)	A nickel-, cobalt-, and copper-bearing gossan crops out over an area 325 ft. long and 40 to 60 ft. wide in gabbro. Exploration indicates gossan zone continuous to 60-ft. depth, although sparse nickel and iron sulfides are visible in some less-oxidized zones explored by trenches.	Claims located in 1939 and taken over by present owners in 1952. Prior to 1954, deposit prospected by surface stripping and cuts and 2 vertical drill holes 50 and 90 ft. deep, about 80 ft. apart in a northwest direction. Assays of surface samples indicated nickel content about 0.5%. July to October 1954, under DMEA loan, 2 holes diamond drilled from single set-up 160 ft. northwest of nearest older hole. Hole No. 1, inclined 30° 45°E., drilled to 219 ft.; No. 2, inclined 30° nearly east, drilled to 387 ft. Samples from No. 1 hole, interval 159 to 160.5 ft., contained 0.77% nickel and 1.46% copper in pyrrhotite and chalcopyrite. All other diamond drill data indicate unaltered gabbro at 60-ft. depth, with some sparse pyrite irregularly disseminated. Assays of trench samples showed 0.11 to 0.45% nickel, 0.007 to 0.35% cobalt and 0.27 to 0.69% copper. (H. K. Stager, U.S.G.S., personal communication, 1955). (R.M.S.)
328	Red Hill and Copper Butte claims	Center sec. 15, T13S, R4E, SBM; southeast of Julian.	William Kollar and Ida McDonald, Box 273, Julian and Charles A. Palmer, 8006 E. Graves, South San Gabriel (1957)	Deposit consists of an outcrop of gossan in norite (San Marcos gabbro). Probably contains very minor proportions of nickel-bearing minerals.	Explored by a 100-ft. adit.
	Talley group	Julian district.	A. A. Sutten, Supt., Julian (1918)		"At Julian". Presumed to be near Friday mine. No additional published information. (Boalich and Castello 18a:18).
	Unnamed	Sec. 17 or 18, T17S, R8E, SBM; about 4½ miles due north of Jacumba, in the Carrizo Canyon area.	San Diego and Arizona Eastern Railroad, San Diego (1959)	At least two small bodies of nickel-copper sulfide bearing rock are exposed in Tunnel No. 8 of the railroad.	Deposit discovered when tunnel was being driven in 1918. (Written communication, from H. A. Toberman, Los Angeles, to Ian Campbell, 1959).

Orbicular gabbro

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
29	Dehesa deposit	NE¼ sec. 15, T16S, R1E, SBM; about 6 miles east of El Cajon, on the north side of Sweetwater River Valley.	Undetermined (1957)	"A large mass of gabbro, portions of which have an orbicular structure and show a highly ornamental surface when polished" (Merrill, 1914, p. 674). According to Merrill and others the orbicular material had been found only as boulders and not in place. The rock is gray to olive green. The ground mass is composed of a fine- to coarse-grained aggregate of plagioclase (variety anorthite), hornblende, and hypersthene. The nuclei of the spheroids generally are composed of very fine-grained radially or concentrically arranged aggregates of the ground mass minerals. The rims are composed of concentric layers of plagioclase, hornblende or hypersthene.	Undeveloped. Orbicule-bearing material could not be found at this locality recently. (Aubury 06:58-61; Fairbanks 93:85; Kessler and Hamilton 04; Kunz 05:14, 15, 112-114; Lawson 04: 383-396; Merrill 14:674-676; Tucker 25:369).
330	Lawson Peak deposit	Middle of the west edge of the NE¼ sec. 6, T17S, R3E, SBM; about 8½ miles south-southwest of Alpine, about one mile east of Lawson Peak.	Undetermined (1958)	Spheroids of orbicular gabbro occur in a north-trending zone exposed on a southwest-facing slope. The zone totals only several hundred square ft. in exposed area. The spheroids range in diameter from less than about 1 in. to several inches. They consist of alternating dark and light spheroidal layers which are composed of fine- to medium-grained aggregates of amphibole, plagioclase and other minerals in varying proportions. The minerals commonly have a radiating structure.	An undeveloped deposit of very limited extent. It can be reached via a jeep trail which extends northward from Carveacre road at a point near the center of sec. 6.
	Orbicular diorite (napoleonite)				See Dehesa deposit. (Kunz 05:14, 15, 112-114).
	Pala	Pala district, summit of Hiriart Mt.		Nodules of orbiculer gabbro found weathered out of rock on the crest of Hiriart Mt. were described by Schaller (1911d). He stated that they were 2 to 2½ in. in diameter and were composed of olivine, hypersthene, hornblende, feldspar, and iron oxides. He also stated that they had a radiating structure.	Deposit probably is covered by the Vanderburg claim, which see under "Gem minerals". (Schaller 11d:58-59).
331a 331b	Sheephead Truck Trail deposits	West edge of the NW¼ sec. 16 and near the center of sec. 21, T16S, R5E, SBM; one mile east and northeast of Buckman Springs.	Undetermined (1958)	Rocks in cut along truck trail are composed of orbicular gabbro whose orbicules are as large as several inches.	An undeveloped deposit. (Merriam 58: 24-33).

ORBICULAR GABBRO

Three deposits of orbicular gabbro are described in the tabulated list below. The rock is discussed more generally herein under "Gem Minerals" and under "Gabbroic Rocks" in the section on "Sand and Gravel, and Crushed and Broken Stone." See also under "Gabbroic Rocks" in the section on "Geologic Features."

PEAT

The San Luis Rey Deposit, north-northeast of San Luis Rey, is the only known deposit of peat in San Diego County (see description below). A small amount of peat from this deposit was marketed in the late 1940's as a soil conditioner, which is the principal use of the commodity. Peat also is used as an ingredient or filler in mixed fertilizers, as a packing material and filtering agent, in dye stuffs and tanning substances, and for other uses.

San Luis Rey Deposit

Location: Center Sec. 33, T. 10 S., R. 4 W., S.B.M.; in the northwestern part of the county, about 2½ miles north-northeast of San Luis Rey. *Ownership:* The deposit is on patented ranch land owned by E. C. Zahnizer, 1020 Seventh Avenue, Oceanside (1956).

Peat

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
332	San Luis Rey deposit	North-northeast of San Luis Rey.			See text. (Anonymous 56; San Diego County Div. Nat. Res. 48:26-27; Jennings 57:403,406).

Perlite

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
333 (mill)	Harborlite Corporation	Plant is located about a mile northwest of Escondido, along State Highway 78.	Harborlite Corp., Route 78, Escondido (1957) (Operated by Ortho Products in 1961)		The Harborlite Corporation mills perl shipped from San Bernardino County Arizona. The material expanded is marketed as acoustical and wall pla ter aggregate and as filter aid. I mid-1957 plant capacity was 120 cub ft. of plaster aggregate per hour a 20 cubic ft. of filter aid. The plaster aggregate was being markete mostly in the San Diego area, Escor dido, and a small amount in San Bernardino. The filter aid was bei marketed in San Diego.

The San Luis Rey deposit was exposed in mid-1947 beneath a small lake which was drained as part of a regional agricultural improvement program. The deposit underlies an area of about 25 acres; a 40-foot test pit sunk late in 1947 did not reach the bottom of the deposit (San Diego County Division of Natural Resources, 1948, p. 26). The peat is black, uniform in texture, and composed largely of decomposed tules (Jennings, 1957, p. 406). A small amount, produced in the late 1940's for use as a soil conditioner, contained 85 percent water. Leasing problems and mining difficulties caused this project to be abandoned, and the deposit has been idle since that time. Deposits similar to this one may be exposed as additional lakes in the region are drained.

PERLITE

Deposits of perlite are not known in San Diego County, but perlite from San Bernardino County and Arizona has been processed by Harborlite Corporation in Escondido and marketed as acoustical and wall plaster aggregate and as a filter aid.

PETROLEUM AND NATURAL GAS

No petroleum or natural gas has been produced in San Diego County. Thirty-one wells were drilled for these commodities between 1910 and 1953, but only three intersected strata containing shows of petroleum and gas (Jennings and Hart, 1956, p. 71). Most of the w were drilled into marine sedimentary rocks of Terti age from points along a narrow area which exte southward along the coast from Oceanside to the bor between the United States and Mexico. One well drilled on the eastern edge of the county, at a point ab 1½ miles north of Ocotillo Wells.

PHOSPHATES

The known phosphorus-bearing deposits of San Die County contain only very small proportions of phosp rus minerals, and thus are not presently economic. Th occurrences include the Linda Vista terrace deposits the Del Mar area and elsewhere; localities on the oc floor, from which have been dredged nodules that c tain abundant francolite (fluorapatite) (Dietz, Eme and Shepard, 1942, p. 818); and many deposits wh contain very minor proportions of apatite (calcium ph phate and other elements), especially the gem miner bearing pegmatite dikes of the Pala, Mesa Grande, a Rincon districts.

Elemental phosphorus and phosphoric acid have ma uses, and phosphorus is the principal constituent of fe lizers. Phosphorus used in California is mined from posits in the northern Rocky Mountain states.

Phosphates

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
334	Linda Vista deposits	SW¼ sec. 13, T14S, R4W, SBM; at Del Mar.	Undetermined (1958)	Pea- to marble-sized, reddish-brown nodules are a constituent of the widely exposed Linda Vista terrace deposits. Nodules collected by the writer from the locality shown on the map assayed 0.13 percent phosphorus pentoxide. The nodules contain a substantial proportion of iron.	Undeveloped deposits. (Emery 50:213-221).
	Otay	"..mesa east of Otay."		"..a deposit of white calcareous material forming a layer or stratum in the mesa east of Otay. This shows, on analysis, less than 2 percent of phosphoric acid..".	An unsubstantiated occurrence reported only by Merrill. (Merrill 14:717).
	Unnamed	Sec. 26, T11S, R4E, SBM; Montezuma Valley area, about 1 or 2 miles southwest of Ranchita (Merrill, 1914).	Undetermined (1957)	"..apatite in crystalline limestone..".	An unsubstantiated occurrence reported only by Merrill (1914), who stated that the deposit was "at one time, controlled by David McGregor, of the Montezuma Mining Company." (Merrill 14:717).

Pyrites

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Friday deposit				See text under "Nickel". (Chesterman 57c:451, 452).

TASH

During World War I, potash was in very short supply the United States, because foreign sources were sev-ed and because prewar domestic sources could not fur-sh enough of the chemical for both domestic and mili-y needs. Thus, its price skyrocketed from a prewar ice of $35-$40 per ton for high grade salts, to about 00 per ton by 1917. One of the emergency sources of tash during this period was kelp, from which potas-m chloride was produced by four companies in the n Diego area between 1916 and 1919 (see Table 1). hese four companies were: Hercules Powder Co., Swift d Co., Kelp Products Co., and San Diego Kelp Ash . (Boalich and Castello, 1918a, p. 23). The dried kelp oduced in the county averaged about 15 percent K_2O. ost of the potash produced on the Pacific Coast at that ne from kelp was used as fertilizer, but the output of e plant in the San Diego area was used as an ingredient potassium nitrate to make munitions.

In 1959, such products as algin, carrageenin, and agar ere being produced in San Diego, but mainly from kelp tained from beds off the coast of Baja California.

RITES

Pyrites is a commercial name given to the group of on sulfide minerals that includes pyrite, pyrrhotite, and arcasite. The most significant deposit of pyrites in uthern California is the Friday Deposit, near the center San Diego County (Chesterman, 1957c). Even this eposit, however, is not large enough to be considered a commercial source of pyrites (for description see erein under "Nickel").

YROPHYLLITE

Pyrophyllite (hydrous aluminum silicate) is a soft, icaceous mineral which resembles talc, with which it is ompetitive commercially. Pyrophyllite is used chiefly s an insecticide carrier, and much less abundantly as an xtender in paints, and as an ingredient in ceramics and ubber.

In San Diego County pyrophyllite occurs in hydrother-ally altered layers of the Santiago Peak volcanics, which robably are Jurassic or Cretaceous in age. These rocks re exposed discontinuously in a belt that extends north-estward from Baja California. along the east edge of e coastal plain, to a point near Corona in Riverside ounty. The known pyrophyllite deposits occur only in small area which lies a few miles northeast and east of ancho Santa Fe. In this area the volcanic rocks consist ainly of flows and tuffs which range in composition rom rhyolite to andesite.

The pyrophyllite-bearing layers trend west-northwest-ward to northwestward, dip steeply to the northeast, and range in degree of alteration from rocks that contain only minor proportions of pyrophyllite to rocks composed almost wholly of pyrophyllite. Most common are rocks that contain mixtures of pyrophyllite and quartz, with much smaller proportions of other minerals. Pyrite and its alteration products, yellow-brown hydrous iron oxide minerals, are widespread and constitute a deleterious im-purity which prevents nearly all pyrophyllite mined in San Diego County from being used in ceramics or as an extender in paints. The Pioneer Mine was developed in the largest deposit composed almost entirely of pyro-phyllite in the area, and is part of the San Dieguito De-posits which were described in detail by Jahns and Lance (1950, 32 p.). The Harris Deposit, about 250 yards south-southwest of the Pioneer, and the Four-Gee Deposit, about two miles due east of the Pioneer, are composed of pyrophyllite-quartz mixtures. The Palagonite Deposit, 2½ miles north-northwest of the Pioneer, contains thin layers that consist nearly entirely of pyrophyllite and natroalunite (?). A fifth deposit, about two miles south-east of the Pioneer, probably is similar in composition to the Four-Gee, but is undeveloped.

The yellow-brown stained outcrops of the San Die-guito Deposits probably were prospected originally dur-ing the early 1890's, or perhaps even before, for gold. The Palagonite Deposit was prospected in the early 1900's as a source of mineral paint, but production of such material probably was negligible. The Pioneer De-posit first was worked for pyrophyllite in 1945, and from that year until the end of 1957 yielded about 100,-000 tons of crude pyrophyllite. The Four-Gee and Har-ris Deposits were developed in 1953 and 1956, respec-tively, and by mid-1957 had yielded about 3,000 and 2,000 tons of crude material, respectively. Crude pyro-phyllite mined in the county is marketed for less than $5 per ton, and therefore must be mined by the most simple mining methods, generally only by use of bull-dozers. In 1957, crude pyrophyllite was being ground at two mills in the county: Harborlite, in Escondido; and Pioneer, in Chula Vista. By 1961, the Pioneer mill had been raised, and the Harborlite mill was being operated by Ortho Products. Processed pyrophyllite mined in San Diego County has been marketed almost entirely as an insecticide carrier.

Four-Gee (Golem) Deposit

Location: Near the center of the NE.¼ Sec. 19, T. 13 S., R. 2 W., S.B.M.; about 6¾ miles south-southwest of Escondido city hall and one mile south-southeast of

Photo 57. Four-Gee pyrophyllite dep near Rancho Santa Fe. View east t west end of deposit. Lower bench, at r center, is being cut along southern of pyrophyllite layers.

the spillway for Lake Hodges reservoir. *Ownership:* Section 19 is patented ranch land owned by Howard G. Golem, Four-Gee Ranch, Route 1, Box 989, Escondido (1957).

The Four-Gee Pyrophyllite Deposit is about two miles due east of the Pioneer and Harris Deposits, on the east part of the southern slope of the hills north of La Jolla Valley. It was discovered in 1952 and was first mined in 1953. According to the owner, the total output from the property by the end of July 1957 was about 3,000 tons.

The deposit consists of a west-northwest trending, steeply dipping zone of alteration within flow and pyroclastic rocks of the Santiago Peak volcanics. This zone cuts diagonally along the south slope of the hills, dropping in elevation from west-northwest to east-southeast. Pyrophyllite has been mined from two localities in the zone, about 1,000 feet apart. The more east-southeasterly of the localities, which contains the first-opened workings of the property, consists of a crudely elliptical-shaped area of intense alteration which extends outward to the north and south from the main elongation of the zone (Photo 57). The commercial pyrophyllite rock in this area apparently is confined to its western part, within two layers about 10 to 15 feet apart which strike N. 80° W. and dip about 65° north. The layers are at least 100 to 150 feet long and range in thickness from 25 to 30 feet. They consist chiefly of pyrophyllite with a very minor proportion of quartz, and sparse yellow-brown iron oxide minerals which coat fractures and weathered surfaces. The pyrophyllite rock is soft, creamy-white to buff, very fine-grained, and schistose. Rock between the two layers and in the eastern part of the area is highly silicified.

The more west-northwesterly of the two areas was opened after 1957 and was being worked in 1960. This part of the zone contains a layer of pyrophyllite rock which is at least 150 to 200 feet long, but which was not examined in detail.

The working that develops the more west-northwe erly of the two pyrophyllite-bearing areas consists a cut which trends laterally along the zone. This is estimated to be 300 to 400 feet long, and to have face 0 to 20 feet in height and a bench 0 to 30 or feet in width. Pyrophyllite was mined selectively fr the cut by benching (Photo 57). The more west-nor westerly area is developed by a very shallow cut whi trends at least 200 feet along the zone.

Mining consists of loosening the rock with a bu dozer which then scrapes the loose material into pi from which it is loaded into trucks. In August 1957 t material mined was shipped to the American Miner Company, Los Angeles, where it was ground to min 325 mesh in a Raymond ring roller mill. The mill product was being marketed almost entirely as an i secticide carrier.

Harris Deposit

Location: Center Sec. 23, T. 13 S., R. 3 W., S.B.M about 2½ miles east-northeast of Rancho Santa Fe. A jacent to the San Dieguito River bed which is to t west of the deposit, and the Pioneer Deposit which to the east. *Ownership:* Charles W. Harris, Box 11 Rancho Santa Fe, owns the W.½ of Section 23 in ad tion to most of Sections 13 and 14 (1957).

Mr. Harris and his son, Richard, are mining the upp part of a small hill which is near the southwestern ed of a large pyrophyllite-bearing area which also includ the Pioneer Deposit (Fig. 50). The Harris Deposit about 250 yards south-southwest of the main Pione workings. Development of the deposit began in Ap 1956, and by the end of July 1957, about 2,000 tons pyrophyllite had been mined.

The deposit consists of silicified and pyrophyllitiz silicic flow and pyroclastic rocks which are part of t Santiago Peak metavolcanics. The material mined ge erally is white to grayish-white on fresh surfaces, a generally stained with yellow to red iron oxides in fra

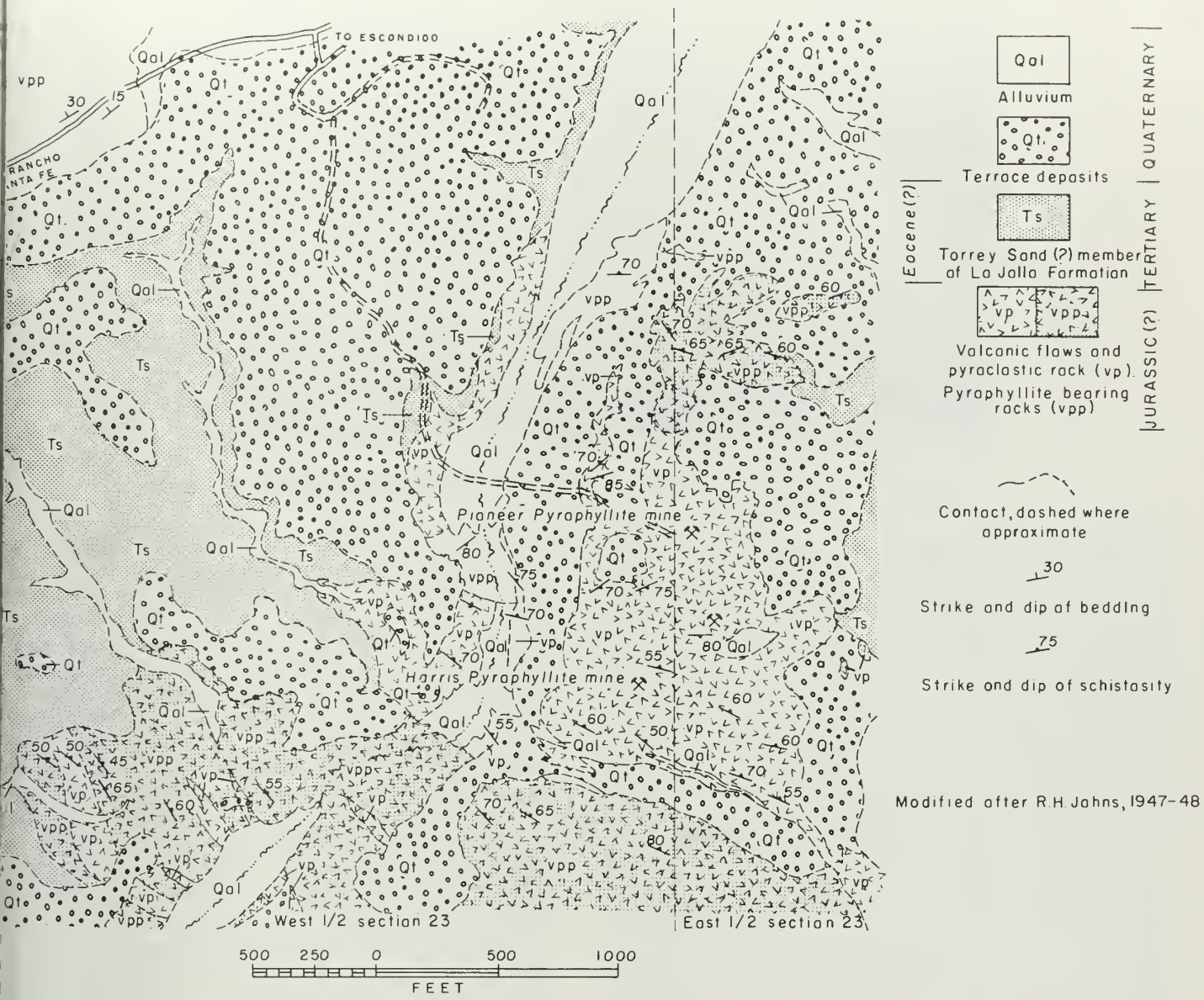


Figure 50. Geologic map of the San Dieguito pyrophyllite area, San Diego County. *After Johns and Lance 1950.*

res and on weathered surfaces. It is moderately soft d has a schistose texture. Reserves of medium grade em to be plentiful, as only the top of the pyrophyllite-aring hill has been mined. Additional pyrophyllite-aring rocks on the Harris property crop out in the ½ NW.¼ Section 23 along the west bank of the San eguito River, and in the SW.¼ Section 23 as elongate, rthwest-trending bodies (Fig. 50).

The mining procedure is very simple. A bulldozer with ɔper attached loosens the rocks on the top of the hill. ıen the dozer scrapes the material to one side of the l from where it is loaded into a truck below (Photo). In mid-1957, the pyrophyllite was being trucked to e Harborlite Corporation, Escondido, for milling.

Photo 58. Harris pyrophyllite deposit. View southward. Dozer is shoving pyrophyllite-rock to point from which it can be shoved over the edge of the plateau-like area shown, into a truck below.

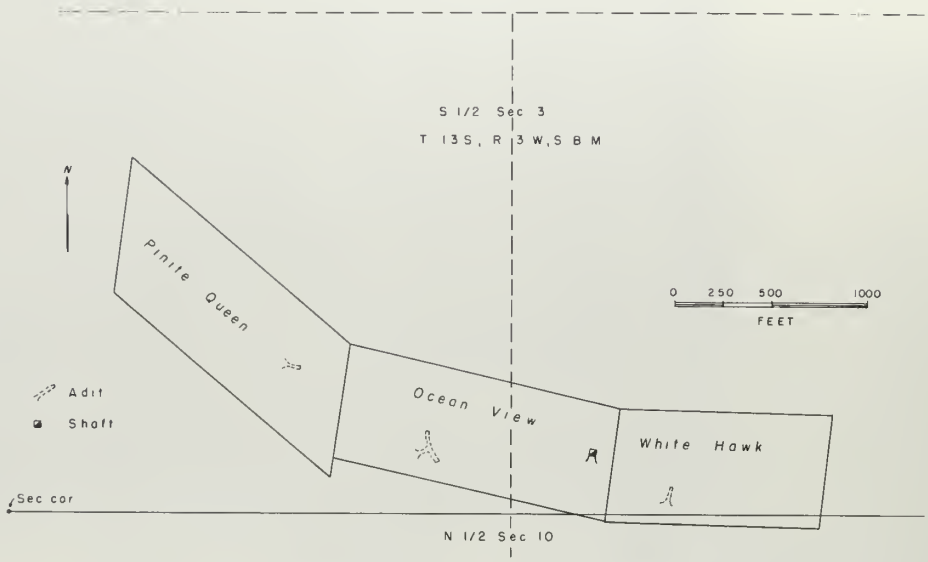


Figure 51. Map showing patented claims and workings on Palaganite pyrophyllite depasit, near Rancho Santa Fe, San Diega Caunty.

At Harborlite the material was first crushed to three-fourths inch in a jaw crusher, then was fed into a Raymond ring roller mill of 1½ tons-per-hour capacity which was operated in closed circuit with a cyclone separator and blower. When the pyrophyllite particles were ground to the desired size they were blown out of the mill and into the separator, and ultimately into a cone-shaped bin which was tapped at the bottom for sacking. Specifications of the product were 90 percent through 325 mesh. The material was marketed during spring and summer in the Imperial Valley, Yuma, and Phoenix areas as a carrier for insecticides. In early 1961, this mill was being operated under the name of Ortho Products.

Palagonite Deposit

Location: S.½ S.½ Sec. 3, T. 13 S., R. 3 W., S.B.M.; nearly 3½ miles north-northeast of Rancho Santa Fe, on about the middle of the south slope of Hill 1192, as shown on the Rancho Santa Fe Quadrangle Map, U. S. Geological Survey. The deposit can be reached by trail from the end of a dirt road in the NE.¼ NE.¼ Sec. 10. *Ownership:* Ada M. Tate (trustee), 811 N. Maryland, Glendale (1958).

Three end to end, west-northwest trending lode claims were located on the Palagonite pyrophyllite deposit before 1902, and patented in 1914. From west-northwest to east-southeast these claims are the Pinite Queen, Ocean View, and White Hawk (Fig. 51). The deposit was explored as a possible source of mineral paint early in the 1900's by the Palagonite Industrial Mining Company, San Francisco. In 1914 the property was controlled by the Pacific Paint Products Company of Los Angeles (I. P. Janssen, President) (Merrill, 1914). Production from the deposit probably is negligible.

Pyrophyllite is the principal mineral constituent of thin, hydrothermally altered layers of the Santiago Peak series of metavolcanic rocks, which in this area include sili porphyritic rocks, tuff, and volcanic breccia. Th rocks strike N. 70° W. and dip 50° northeast. T principal mineralized zone is about 5 feet wide and pr ably at least 2,000 feet long. It is covered mainly by Ocean View Claim. The pyrophyllite-bearing lay which in this zone are as much as several inches in wid are interlayered with gray, silicified rocks. The pyroph lite-bearing layers range in color from creamy-white creamy-white with interlayered very thin, dark-gr wavy bands. Differential thermal analyses and X-ray c fraction tests by Dr. J. A. Pask (University of Califor at Berkeley, 1958) and thin section identification sh that the rock is a very fine aggregate composed chie of pyrophyllite with minor to small proportions of alur (or natroalunite), quartz, an unidentified crystalline caceous mineral, and finely disseminated pyrite. The d part of the rock contains pyrite in much larger prop tions. The rock was thought to be palagonite or pir by the early developers (Merrill, 1914, p. 689).

The workings on the Palagonite property extend alo the mineralized shear zone for about 2,000 feet (Fig. 5 From east-southeast to west-northwest, they consist (1) a north-northeast-trending crosscut 75 feet long (the White Hawk Claim); (2) a north-northeast trend trench from the end of which extends an inclined sh now caved (on the Ocean View Claim); (3) a northea trending, 50-foot adit with an appended 100-foot d (on the Ocean View Claim); and (4) an east-trendi 50-foot adit (on the Pinite Queen Claim).

Pioneer Deposit

Location: Near center Sec. 23, T. 13 S., R. 3 W., S.B.M.; about 2½ miles east-northeast of Rancho Sa Fe, adjacent on the south and east to the San Diegu River. *Ownership:* Thomas H. Block, address undet

Photo 59. Pioneer pyrophyllite deposit, 2½ miles east of Rancho Santa Fe. View northeast from Harris property. In middleground is moderately pyrophyllitized rock mined superficially in 1957.

mined (formerly associated with Torrance Sand and Gravel Products, Torrance), owns the SW.¼ NE.¼, the W.½ SE.¼, and the SE.¼ SE.¼ Sec. 23 (160 acres) (1960).

The Pioneer pyrophyllite deposit probably first attracted gold prospectors to its iron-stained outcrops as early as the 1890's (see Clifton Mine under "Gold"). The deposit remained unworked until 1945, however, when it was developed as a source of pyrophyllite by F. A. Matthews and associates, under the name Pioneer Pyrophyllite Products. For a short time after beginning to operate, the company shipped its mined material to Los Angeles for treatment, but then acquired a mill in Chula Vista. In 1950, the mine and mill were purchased by Mrs. Dorothy Benner, with Matthews remaining as manager of the operation. Pyrophyllite was produced almost continuously from the property from 1945 to 1956, when the operators entered bankruptcy. During that period the company also had operated the Pacific feldspar mill at Campo for a short time and had produced expanded perlite for use as lightweight aggregate from a deposit in Inyo County.

Early in 1957, Torrance Sand and Gravel Products acquired the Pioneer property and mill, and the Pacific mill, and by mid-1957 had produced a small tonnage of pyrophyllite. The present owner is believed to have acquired the property in 1959 or 1960. Also in 1959 or 1960 the mill at Chula Vista was raised. The total output from the deposit, as of 1960, is estimated to be slightly more than 100,000 tons of crude pyrophyllite.

The workings of the Pioneer Mine are in the SW.¼ NE.¼ Sec. 23, in the north-central part of a north-trending area, of less than one-fourth square mile, which contains the principal exposures of pyrophyllite-bearing rocks in the San Dieguito area (Photo 59). A detailed discussion of the geology of these deposits is provided by Jahns and Lance (1950). The pyrophyllite deposits are alterations of the Santiago Peak volcanic rocks which are believed to be Jurassic or Cretaceous in age. In the San Dieguito area these rocks consist of flows and pyroclastics which strike northwestward, dip steeply northeast, and are mainly andesite to quartz latite in composition. Within the mine area are all gradations from unaltered volcanic rock to rock that consists almost wholly of pyrophyllite. The alteration is most pronounced along northwest-trending zones. These zones also contain abundant, fine-grained silica which, in some places, is present to the virtual exclusion of pyrophyllite. Only locally has the pyrophyllitization been intensive enough to yield rock of commercial value.

The principal pyrophyllite body and the one from which nearly all the output has been obtained is about 150 feet long and 15 feet in average width. The pyrophyllite of this body is generally white on fresh surfaces, is soft, and has a slight soapy feel. The rock is schistose, and contains very small to moderate proportions of quartz, and very small proportions of other minerals. Weathered surfaces are commonly stained yellow-brown to brownish-red by hydrous iron oxides. The next highest grade pyrophyllite-bearing rock in the area is pyrophyllite-quartz schist. This rock forms a west-northwest-trending zone about 150 feet long and 50 feet wide on the northeast side of the pyrophyllite body.

The pyrophyllite body was mined originally from two northwest-trending, end to end trenches which were cut into a gently rounded west- to southwest-facing hill slope. The southeastern or upper trench was 140 feet long, 15 to 45 feet wide, and 10 to 25 feet deep; the northwestern, or lower trench was about 70 feet long, 50 feet wide, and 20 feet deep at its face (Jahns and Lance, 1950, p. 29). At an undetermined date during the mid-1950's the operators cut down the southwest sides of

Pyrophyllite

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
335	Four-Gee (Golem) deposit	Near Rancho Santa Fe.			See text. (Wright 57g:456).
	Golem				See Four-Gee deposit in text.
336	Harris deposit	Near Rancho Santa Fe.			See text. (Jahns and Lance 50:1-32).
337	Palagonite deposit				See text. (Merrill 14:668, 689-691; Symons 30:156; Tucker 25:374; Tucker and Reed 39:46, pl.1).
338	Pioneer deposit	Near Rancho Santa Fe.			See text. (Aubury 06:371; Jahns and Lance 50:1-32; Richard 35:353; Rogers 12:281; Sanford and Stone 14:24).
	San Dieguito pyrophyllite area				See Harris and Pioneer deposits in text. (Jahns and Lance 50:1-32).
339	Unnamed	SW¼NW¼ sec. 30, T13S, R2W, SBM; about 4 miles east of Rancho Santa Fe, north of La Jolla Valley.	Undetermined (1958)	A small, north-trending pyrophyllite-bearing deposit about 200 ft. long and 75 ft. wide which is overlain by Poway conglomerate. The deposit is exposed along the steep east bank of a southwest-trending tributary of Lusardi Creek.	An undeveloped deposit.

the trenches to leave two adjacent benches whose floors coalesce southwestward with the slope. These benches, and surrounding, shallowly bulldozed areas, constitute the main workings of the property. Additional workings consist of shallow shafts, cuts, and pits.

At the former mill in Chula Vista, the crude pyrophyllite was first broken to minus two inches in a jaw crusher. Then it was ground in a Raymond ring roller mill which was operated in closed circuit with a cyclone separator and blower. Finally, the pyrophyllite particles were blown into a bin that fed a sacking machine. The milled product, 95 percent of which passed through a 325-mesh screen, was marketed as an insecticide carrier. A small part of the material has been used in ceramics.

QUARTZ (INCLUDING QUARTZ CRYSTAL) AND QUARTZITE

Deposits of common quartz and quartzite that are of interest to present-day commerce generally must contain at least 97 or 98 percent silica (SiO_2). Thus, the only deposits in San Diego County that can be considered as possible present sources are selected massive quartz bodies (including veins), and inner zones of most pegmatite bodies. In addition certain of the pegmatite deposits also contain clear quartz crystals which are of commercial interest. Additional quartz-bearing deposits in the county, but all probably less than 97 percent silica, consist of quartz-feldspar sand, beach and dune sand, and quartzite.

The only common quartz mined in the county in recent years has been small tonnages used for decorative stone; small quantities of quartz crystal that have been produced recently have been used in jewelry and for specimens. In the past, small to moderate tonnages of common quartz were mined from pegmatite and massive quartz bodies; and very small quantities of quartz crystal were mined from pegmatite deposits. The use of this material and possible additional uses are noted in the following individual discussions of the five types of deposits that occur in the county.

Inner Zones of Pegmatite Deposits

Quartz in the inner zones of pegmatite deposits occurs mainly as interlocking anhedral crystals of common quartz as much as several feet or more in length. The mineral also may occur as well-formed, clear crystals which line cavities (or pockets). Such clear crystals that are large and unflawed may be of electronic or optical grade (for specifications of electronic grade quartz see p. 666, U.S. Bureau of Mines Bulletin 585, "Mineral Facts and Problems"). Similar large, clear crystals that are flawed are of fusing grade. Additional grades of quartz crystal are jewelry and specimen. Common quartz from pegmatite deposits and massive quartz bodies may be used in the manufacture of ferrosilicon and silicon metal, in metallurgical fluxes, and ceramics, as poultry grit, as filter and insulating material, as an abrasive, as decorative stone, and as a filler and extender.

Most of the common quartz that has been produced in the county was recovered as a byproduct of former feldspar mining operations. It was used chiefly in ceramics. The principal output was from such operations at the Buckthorn and Pacific Deposits, whose inner units and mine dumps still contain appreciable quantities of the mineral. Additional pegmatite bodies in the county that have been worked for common quartz include deposits in the Jewel Valley area, especially the White Butte and the Walker (Photo 60). The White Butte Deposit was worked briefly in 1958 for quartz that was used as an ingredient in the manufacture of silicon at the shortlived operation of the Silicon Metals Division of the Ward-Lee Chemical Corp. near Plaster City, in Imperial County. The writer had estimated in 1957 that the White Butte Deposit contained about 4,000 to 5,000 tons of quartz, and that the Walker contained 5,000 to 10,000 tons above

Photo 60. View northeost showing Walker quortz deposit. (See tabuloted list for description.)

ıe surface of the surrounding terrain. Small tonnages of ıle pink quartz were mined in 1960 from the Rose ıuartz Deposit in the Mesa Grande district for use as ccorative stone.

Small quantities of quartz crystals of electronic grade ıve been mined in the county at the Senpe Mine on liriart Mountain in the Pala district (Wright, 1957h, p. 59), and at the Clark Mine in the Rincon district (see escriptions in the tabulated list in the section on "Gem linerals"). Hand sorted quartz of fusing grade that was ıined at he Rose Quartz Deposit, in the Mesa Grande istrict, was used to make the glass for the first 200-inch ıirror of the Hale telescope at the Palomar Observatory. This mirror was not ground propertly, however, and nother had to be made, using quartz from another state). ıt the Vanderburg and other mines, small to moderate uantities of relatively large crystals from colorless to noky and pale rose have been mined for use as ornaıental stone, jewelry and specimens.

Many additional pegmatite deposits described in the ıbulated list under "Feldspar" and "Gem Minerals" conıin small to relatively large masses of quartz. These inlude deposits in the Pala and Mesa Grande districts (see erein under "Gem Minerals") and in the Laguna Junction area (see herein in tabulated list under "Feldspar"). The largest deposits in the Mesa Grande district were stimated by R. H. Jahns (personal communications, 957) to contain no more than 5,000 tons of mineable uartz.

lassive Quartz Bodies (Including Veins)

Massive quartz bodies in San Diego County consist ıainly of small to large interlocking anhedral crystals of common quartz which may range from colorless to milky to pale rose. (See the preceding section for possible uses of massive quartz.)

The largest known body of massive quartz in the county is the Lowrey Deposit, southwest of Descanso (see description below). This deposit is undeveloped largely and is estimated to contain between 25,000 and 50,000 tons of quartz above ground. Other relatively large massive deposits in the county are the Ajax, southwest of Descanso; and the Round Potrero, north of Potrero (see description below). Several small bodies, each of which contains less than several hundred tons of quartz, are exposed in the Jewel Valley area, south of Manzanita (or Wisteria) (Fig. 52). These include the Risley and Fanning Deposits, and the deposits on Round Mountain, which are near pegmatite deposits (see Jewel Valley in preceding section on "Inner Units of Pegmatite Deposits").

Quartz veins, in the county, that have been explored for gold generally are very thin and hence can not be considered as possible sources of quartz for commerce. In addition, most of these deposits contain detrimental iron-bearing sulfide and oxide minerals. Large quartz-rich tailings or dumps were not noted on gold mining properties in the county.

Bedded Quartz-Feldspar Sand

The largest quartz-bearing deposits in San Diego County consist of beds of quartz-feldspar sand of Eocene age. These rocks occur in a narrow belt along the coast (see Pl. 1). Their geology is described herein under "Geologic Features" and their utilization under "Specialty Sands."

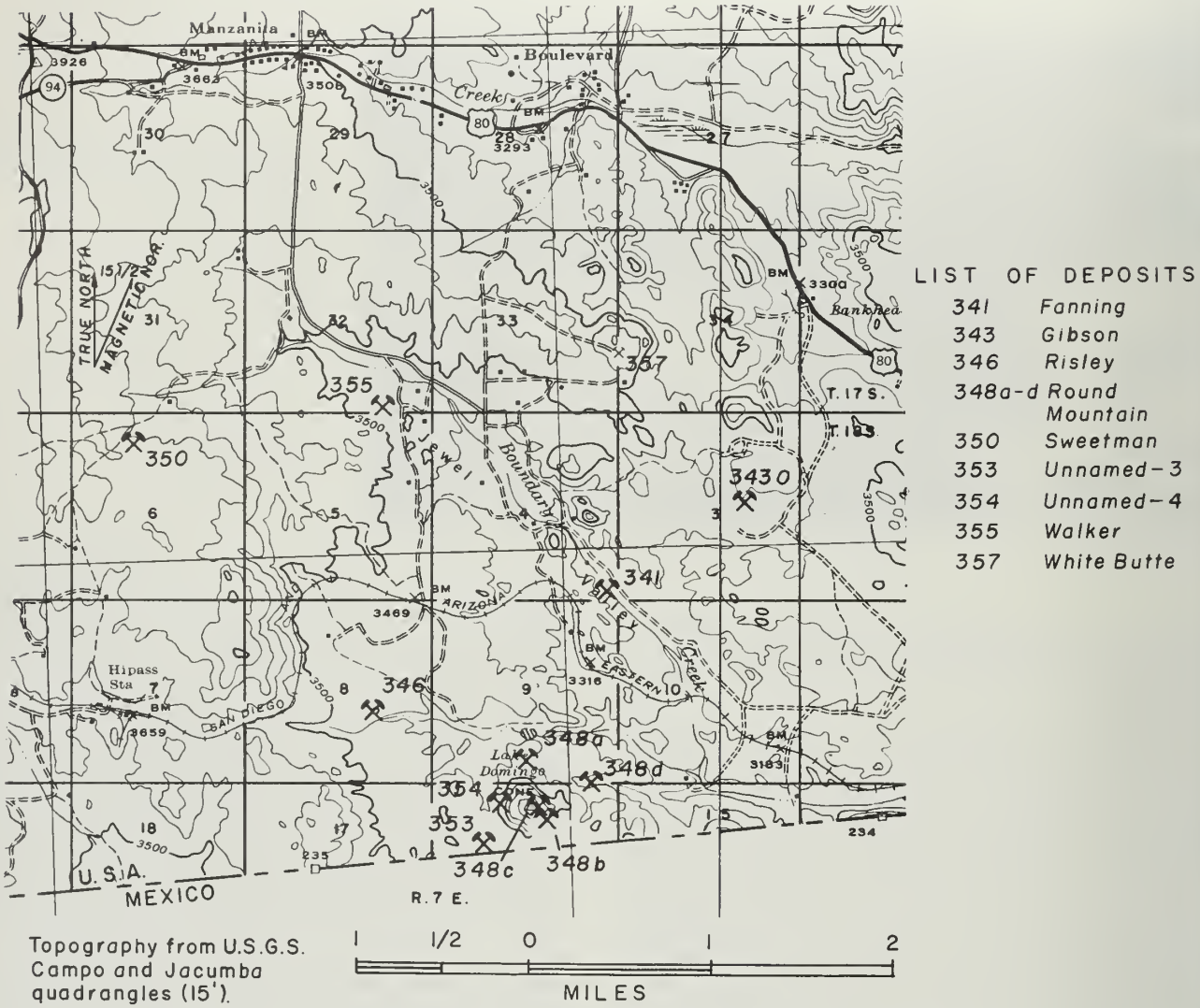


Figure 52. Map of Jewel Valley and vicinity, showing location of quartz and quartz-bearing deposits.

Beach and Dune Sands

The beach sands along the sea coast, and dune sands east of Clark Lake are composed essentially of quartz, with smaller proportions of feldspar and other minerals. These are discussed herein under "Specialty Sands."

Quartzite

Commercial deposits of quartzite for use as silica have not been discovered in San Diego County. Deposits of noncommercial grade occur as bodies of various sizes interlayered with other metamorphic rocks and in granitic rocks. Although these deposits are known to be impure, none probably has been sampled adequately. Specimens collected by Miller (1935, p. 120) from two deposits in the southeast part of the county contained 58 and 91 percent silica, with lesser proportions of feldspar and ferro magnesian minerals.

Quartzite is used as the primary ingredient in silic bricks. It also may be used as an abrasive, and as a sourc of silica for portland cement. The Red Rose quartzit deposit, near Suncrest, is quarried as a source of dimen sion stone (see description herein under "Dimensio stone").

Some of the principal undeveloped quartzite deposit in the county include the Featherstone, northeast o El Cajon; layers as wide as 100 feet in the Cuyamac area (Hudson, 1922, p. 8); bodies as thick as 300 fee in the Ramona region (Merriam, 1946, p. 227-228); an layers as wide as perhaps 50 feet or more in the Do Cabezas area. The Featherstone and Cuyamaca Deposit are described in the accompanying tabulated list.

owrey Deposit

Location: W.½ SE.¼ Sec. 34, T. 15 S., R. 3 E., S.B.M.; bout three miles southwest of Descanso Junction, within he fenced area that constitutes the Rolling Hills Ranch. The deposit can be reached from Jatapul Valley Road ia the Bell Bluff Truck Trail. *Ownership:* Capt. W. W. Lowrey, Route 1, Box 481, Alpine, California (1956).

The Lowrey Quartz Deposit lies on the northern edge of the plateau-like area that is bounded on the north by the Sweetwater River Valley. The deposit is oval in plan, strikes east-northeastward, and appears to dip very steeply to the south. It is about 400 feet long, and ranges in width from 30 feet at the east-northeastern edge to about 100 feet in the middle. At its highest point, the body extends about 40 feet above the surrounding terrain. The deposit is estimated by the writer to contain between 25,000 and 50,000 tons of quartz above the surface of the surrounding terrain. The quartz is glassy white at the surface, stained slightly with hydrous iron oxides, and fairly well shattered.

The deposit has been explored along its south-southeastern edge by several shallow trenches, and on its east-northeastern end by a west-southwest trending trench about 100 feet long. In 1958, a small amount of quartz from this deposit was used as an ingredient in a short-lived silicon-manufacturing operation near Plaster City in Imperial County. There has been no sustained production, however.

Rose Quartz Mine *

Location: E.½ NE.¼ SE.¼ Sec. 24, T. 11 S., R. 1 E., S.B.M., and W.½ NW.¼ SW¼ Sec. 19, T. 11 S., R. 2 E., S.B.M.; Mesa Grande district, nearly 3½ miles west-northwest of Mesa Grande. The deposit is most easily reached from Ramona, via Pamo Valley Road, Lusardi Truck Trail, and a steep ¾-mile jeep trail. *Ownership:* E. W. Eberhardt, 1744 Redondo St., San Diego (1957). The nature of the property holdings was not determined. The property may include the Crystal Quartz and White Quartz Claims.

The Rose Quartz Deposit was opened by Edward H. Davis in 1903, and subsequently worked by a Dr. Northrup, of San Diego, until about 1910. These men produced selected milky-white to rose-colored quartz which was processed into gems and ornamental objects. The property was idle until 1934 when approximately 12 tons of hand sorted fusing quartz was mined and shipped to Washington, Pennsylvania, for use in making the first 200-inch mirror for the Hale telescope of the Palomar Observatory. This material was mined by the Crystal Quartz Company, a Hollywood syndicate. A small tonnage of pale pink quartz was mined in 1960 for use as decorative stone.

The deposit is part of a west-trending pegmatite dike which cuts diagonally across a steep-sloped, east-trending interfluve. The dike is at least 2,000 feet long and, in the vicinity of the mine workings, it dips 35° to 40° southwest and is about 80 feet in maximum thickness. The country rock is schist.

The dike consists of a discontinuous core of massive quartz, an intermediate zone of massive quartz-perthite pegmatite, and a thick wall zone of somewhat finer-grained graphic granite with scattered strips of biotite. The perthite crystals in the intermediate zone range in diameter from 6 inches to as much as 17 feet, and average about 4 feet. Schorl prisms as long as 4 or 5 feet are distributed irregularly through this zone. The quartz core, which attains a maximum thickness of between 25 and 35 feet, contains anhedral crystals of quartz that commonly are six feet or more in diameter. Most of the quartz is milky white, but some is clear. The clear quartz ranges in color from dark smoky through pale rose. A minor proportion of bluish green beryl forms equant crystals about 12 inches in maximum dimension. Garnet is scattered through the rock as dark red euhedra as much as ⅝ inch in diameter.

Only the most deeply colored quartz and a few clear crystals of garnet in the main core segment have a potential value as gem or ornamental materials. The feldspar of the intermediate zone, and the non-gem quality quartz of both this zone and the core, may be of even greater potential value. As the core consists almost wholly of quartz, a pure product could be recovered with only a little hand sorting. The principal core segment that is exposed in the main cut seems to be a lens that tapers out both along the strike and with depth. The remaining part of this segment probably contains as much as 3,500 tons of recoverable quartz, part of which is of fusing grade and possibly of optical grade. The intermediate-zone pegmatite, as exposed in and near the main cut, contains an average of about 35 percent coarse perthite. About 5,000 tons of such pegmatite occurs in this part of the dike, and approximately 1,500 tons of No. 1 grade potash feldspar might be coverable by hand sorting. However, this is too small a tonnage for a serious operation.

Round Potrero Deposit

Location: South edge SE.¼ SW.¼ Sec. 25, and north edge NE.¼ NW.¼ Sec. 36, T. 17 S., R. 3 E., S.B.M.; 3½ miles north-northwest of Potrero, in McAlmond Canyon. *Ownership:* The deposit is on the Round Potrero (formerly McAlmond) Ranch, Potrero, which is owned by Stafford Hannon, Brawley (1957).

The Round Potrero Deposit consists of an undeveloped vein of massive, milky quartz which is enclosed in quartz diorite. The vein is exposed in a hillock, about 50 feet high, which is on the south side of the floor of McAlmond Canyon, about one mile by trail southwest of Round Potrero pond. The vein strikes north-northwesward and dips about 60° southwest. It is about 150 feet long and ranges in thickness from 15 to between 30 and 40 feet. It contains an estimated 7,000 to 8,000 tons of quartz above the floor of the canyon.

Although the color of the quartz as seen from a distance is milky white, it has a very pale pink tinge when

* The following was obtained mainly from a detailed description of the Rose Quartz deposit kindly furnished by Dr. R. H. Jahns, California Institute of Technology (personal communication, 1957).

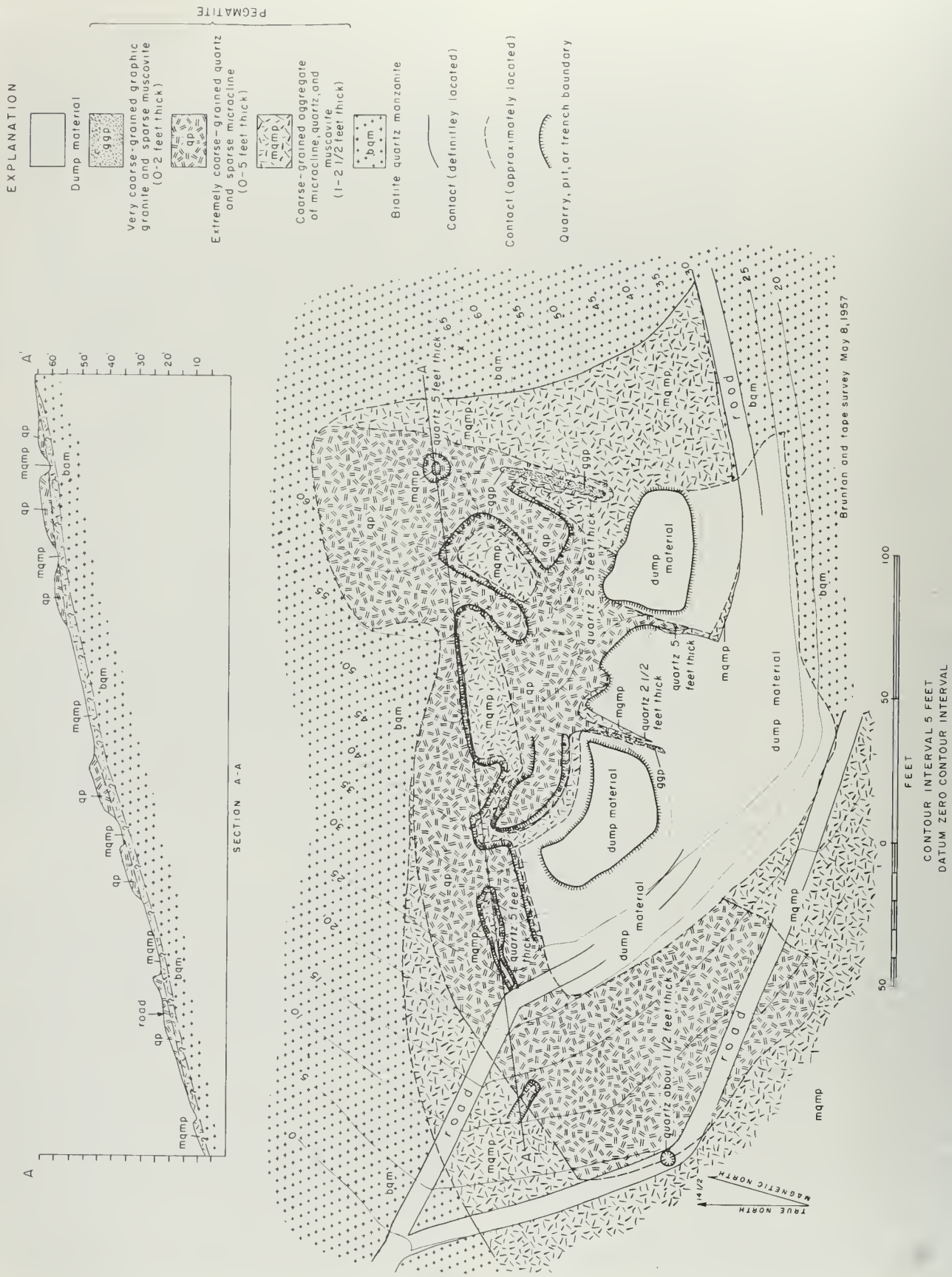


Figure 53. Geologic sketch map and cross section of the White Butte pegmatite deposit, Jewell Valley area, San Diego County.

Quartz, quartzite

Map No	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
340	Ajax deposit	SW¼ sec. 2, T16S, R3E, SBM(proj); about 3½ miles southwest of Descanso.	Henry L. Walters (1941)	Massive, shattered, white quartz body which strikes N.33°W. and dips 85° northeast; the body is exposed as an elliptical outcrop 700 ft. long and 150 ft. wide. Area is underlain by Woodson Mountain granodiorite.	Located in 1941. Explored by short trench. Production negligible. (Everhardt 51:114-115, pl.3).
	American Encaustic Tiling Company				See White Butte deposit. (Miller 35: 134; Sampson and Tucker 31:445; Tucker 25:375).
	Benton Ranch	Laguna Junction.			See Laguna Junction deposits in tabulated list under "Feldspar". (Sampson and Tucker 31:445; Tucker 25:375).
	Buckthorn deposit	North of Live Oak Springs.			Deposit once was an important source of feldspar. It also yielded some quartz. Relatively large quantities of quartz remain in deposit and in dump. See description in text under "Feldspar." (Clark and Carlson 57:464; Tucker and Reed 39:34, pl.1).
	Burroughs				See Risley deposit. (Sampson and Tucker 31:446; Tucker 25:375).
	Carlsbad group	Northeast of Warner Springs.			See tabulated list under "Feldspar". (Sampson and Tucker 31:446).
	Clark mine	Rincon district.			Once the source of a small quantity of electronic grade quartz crystal. See under "Gem minerals" in tabulated list.
	Crystal Quartz	Mesa Grande district			A map location of Tucker and Reed (1939, pl.1). Probably same deposit as Rose Quartz, which see in text. (Tucker and Reed 39:pl.1).
	Crystal Silica Company	East of Oceanside.			See text under "Sands, Specialty." (Anonymous 55:128-130; Gay 57b:547-564; Lenhart 55a:48-50; Sampson and Tucker 31:446-448; Tucker and Reed 39:51, pl.1).
	Cuyamaca	T13S, R4E, SBM; about 6 miles south-southeast of Julian.	Undetermined (1957)	Beds of fine-grained, bluish, dense quartzite were reported by Hudson (1922) to occur commonly in Julian schist. A bed 50 to 100 ft. thick extends for nearly 2 miles along the crest of the main north-trending ridge east and northeast of Cuyamaca reservoir. Biotite is common in some of the beds.	Undeveloped. (Hudson 22:183).
	Delphos				Formerly considered part of Burroughs (Risley) deposit. Now claimed as part of Round Mountain group, which see. (Sampson and Tucker 31:446; Tucker 25:375; Tucker and Reed 39: pl.1).
	Dos Cabezas				See tabulated list under "Feldspar". (Sampson and Tucker 31:448; Tucker 25: 375).
341	Fanning (Gladding, McBean; Lillian Fanning Ranch) deposit	SE¼SE¼ sec. 4, T18S, R7E, SBM; in Jewel Valley, 2½ miles south of Boulevard. (see map in text).	Deposit probably on the Fred Samsell ranch (1957). Lillian Fanning, Lillian Fanning Ranch, Boulevard (1939)	A small pegmatite dike strikes northwestward. It contains a core of milky quartz several ft. in maximum thickness. The dike is about 50 ft. long.	Explored by a short trench and a small cut. (Tucker and Reed 39:51, pl.1).

Quartz, quartzite

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
342	Featherstone deposit	Center of the N½N½ sec. 26, T14S, R1E, SBM; on the Barona Indian Reservation, about 7 miles northeast of El Cajon.	Barona Indian Tribe, Barona Indian Reservation (1957)	A pendant of quartzite in granitic rocks. The pendant underlies the surface of a low, oval hill. The deposit is about 3/8 of a mile long and 1/8 of a mile wide. The quartzite is fine- to medium grained and is composed chiefly of quartz and sparse feldspar, with very sparse garnet, hematite, and other accessory minerals.	Undeveloped.
	Flynt Silica and Spar Company				See Buckthorn deposit in text under "Feldspar". (Sampson and Tucker 31: 448).
343	Gibson deposit	Near the center of the E½ sec. 3, T18S, R7E, SBM; east of Jewel Valley, about 2½ miles east-southeast of Boulevard.	Holt M. Gibson, Star Route, Bankhead Springs, San Diego County (1957)	A pegmatite dike which crops out as a small quartz-fragment covered knoll, and dips moderately north. Dimensions undetermined.	Patented ranch land. Developed by a small open cut from which an adit extends northward for about 50 ft., down the dip of the dike. Worked briefly for quartz in 1955 by lessee, Howard Ross, of Lakeside. Production negligible.
	Gladden & McBean (Gladding, McBean)				Shown by Tucker and Reed (1939, pl.1) in the SE¼ sec. 4, T18S, R7E, SBM. Probably the same as the Fanning deposit, which see. (Tucker and Reed 39:pl.1).
344	Haldredge deposit	SE¼SE¼ sec. 23(?), T11S, R1W, SBM; about 6 miles south-southwest of Valley Center, on the southwest side of Paradise Mt.	Harley H. Haldredge, Rt. 4, Box 708, Valley Center (1958)	Reported as a deposit of rose quartz about 50 ft. long and 15 ft. wide (W. M. James, Valley Center, personal communication, 1958).	Undeveloped. Not examined by writer.
	Himalaya Consolidated Quartz				See Himalaya mine in text under "Gem minerals." (Tucker and Reed 39:pl.1).
	Hoover (Lakeside, Turner) deposit	Near Suncrest.			See tabulated list under "Feldspar."
	Jacumba No. 2 claim				Now part of Mica Gem group, which see in tabulated list under "Mica". (Tucker and Reed 39:pl.1).
	Laguna Junction	Laguna Junction and vicinity.			Quartz-bearing pegmatite deposits. See tabulated list under "Feldspar". (Everhardt 51:pl.2).
	Lakeside				See Hoover deposit in tabulated list under "Feldspar". (Sampson and Tucker 31:448; Tucker 25:375; Tucker and Reed 39:pl.1).
	Langer deposit	Near Lake Wohlford.			See tabulated list under "Feldspar". (Sampson and Tucker 31:448).
	Lillian Fanning Ranch				See Fanning deposit. (Tucker and Reed 39:51, pl.1).
345	Lowrey deposit	Near Descanso.			See text. (Everhardt 51:114-115, pl.3).
	Marden deposit	Northeast of Jacumba.			See tabulated list under "Feldspar". (Tucker and Reed 39:pl.1).
	Marden Silica Deposit	NW¼ sec. 33, T17S, R7E, SBM; south of Boulevard.			A map location of Tucker and Reed (1939). Probably misplotted and actually synonymous with either (1) the Walker deposit, which was leased to Jack Marden, National City, in the 1920's (Tucker, 1925, p. 377); or (2) the Marden deposit that is northeast of Jacumba (see description in the tabulated list under "Feldspar"). (Sampson and Tucker 31:429, 448-449; Tucker 25: 359, 376; Tucker and Reed 39:pl.1).

Quartz, quartzite

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Mesa Grande deposit	West of Mesa Grande.			See tabulated list under "Feldspar." (Sampson and Tucker 31:449).
	Moore deposit	East of Jacumba.			See tabulated list under "Feldspar." (Sampson and Tucker 31:449).
	Mykrantz deposit	South of Ramona.			See tabulated list under "Feldspar". (Sampson and Tucker 31:449).
	Osborne	Near Campo.			See Quality deposit in text under "Feldspar." (Sampson and Tucker 31: 449; Tucker 25:376).
	Pacific mine	Northwest of Campo.			Once the principal source of feldspar in the state. It also yielded large quantities of quartz. See text under "Feldspar." (Sampson and Tucker 31: 449).
	Pacific Sanitary Porcelain				See Pacific deposit in text under "Feldspar".
	Patten Lode				A map locality of Tucker and Reed (1939). See Powers group under "Feldspar". (Tucker and Reed 39:pl.1).
	Pilz deposit	On Tecate Mt.			See tabulated list under "Feldspar". (Sampson and Tucker 31:449).
	Potrero	Sec. 17(?), T18S, R3E, SBM; one mile east of Cottonwood Creek, south of State Highway 94.	Undetermined (1957)		"Prominent outcrop of quartz-rich pegmatite dike on crest of ridge--outcrop 50 feet wide." This deposit could not be located by present investigator in section 17 in June, 1957. (Sampson and Tucker 31:449; Tucker 25:376; Tucker and Reed 39: pl.1).
346	Risley (Burroughs) deposit	N½SE¼ sec. 8, T18S, R7E, SBM; in Jewel Valley, about 3½ miles south-southwest of Boulevard. (see map in text).	Undetermined (1957) C. W. Risley, Electric Bldg., San Diego (1939)	A milky quartz deposit that caps a small but prominent hill. The deposit is crudely circular, 50-75 ft. in diameter, and between 20 and 25 ft. in maximum thickness. Deposit dips very gently west. Some hydrous iron and manganese oxides stains.	Developed by minor cuts. Very little total production. (Merrill 14:688; Sampson and Tucker 31:446; Tucker 25:375; Tucker and Reed 39:51, pl.1).
347	Rose Quartz mine	Mesa Grande district.			See text. (R. H. Jahns, California Institute of Technology, personal communication, 1957).
348	Round Mountain (Delphos) deposits	Center of the S½S½ sec. 9, and the N½ sec. 16, T18S, R7E, SBM; Jewel Valley area, between 3½ and 4 miles south of Boulevard, near the Mexican border. (see map in text).	E. T. Ward, El Centro and Shook Crammer (1957)	Owners have located claims on four undeveloped quartz deposits which, for convenience, are herein called Round Mountain deposits (a), (b), (c), and (d) (see map in text). Deposit (a) consists of a quartz body that strikes eastward and dips 30° north; it is about 4 to 5 ft. thick, and is exposed for a length of 25 ft. Deposits (b) and (c) probably are parts of a single quartz body which crops out on both the south (b) and north (c) slopes of Round Mt., within 100 ft. of the top. The body strikes approximately eastward and dips about 10° north. Part (b) is about 50 ft. long and ranges in thickness from 3 to 8 ft. Part (c) is faulted into two segments which total 70 ft. in length and range in thickness from 6 to 10 ft. Deposit (d) consists of 5 quartz bodies which crop out in a narrow zone about 175 ft. long. This zone strikes west-northwestward and is Y-shaped in plan. The width of the surface exposure of the 5 bodies ranges from 4 to 15 ft.	In view of the small size of these quartz bodies, and their inaccessibility, they cannot be considered as important potential commercial sources of silica. (Sampson and Tucker 31: 446; Tucker 25:375).
349	Round Potrero deposit	Northwest of Potrero, in south-central part of county.			See text. (Tucker and Reed 39:pl.1).

Quartz, quartzite

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	San Vicente				See Mykrantz deposit in tabulated lis under "Feldspar". (Sampson and Tuc 31:449; Tucker 25:376).
	Senpe (Sempe, Senpa) mine	Pala district.			Some electronic grade quartz recovere See tabulated list under "Gem minerals". (Jahns and Wright 51:49; Wright 57h:460).
	Spanish Bayonet deposit	North of Descanso.			See tabulated list under "Feldspar". (Everhardt 51:114, pl.3).
350	Sweetman (?) deposit	NW¼(?) sec. 6, T18S, R7E, SBM; west of Jewel Valley, about 3 miles southwest of Boulevard. (See map in text).	Undetermined (1957) J. W. Sweetman, Jacumba (1939)	Tucker (1925) stated that, "the deposit consists of a number of outcrops of quartz that occur in the granite."	Probably same deposit described by Tucker (1925) as "seven miles west of Jacumba". Undeveloped. Not visited by present investigator. (Sampson and Tucker 31:449; Tucker 25:376).
	Turner				See Hoover deposit in tabulated list under "Feldspar." (Tucker 21:376).
351	Unnamed - 1	NW¼ sec. 18 and SE¼ sec. 7, T15S, R5E, SBM; about 4 miles north-northeast of Pine Valley, just west of Pine Creek truck trail.	Undetermined (1957)	Small quartz bodies.	Undeveloped.
352	Unnamed - 2	SE¼SE¼ sec. 24, T17S, R3E, SBM; about 4½ miles north of Potrero.		A quartz body between 30 and 40 ft. in diameter, and 5 to 8 ft. thick, crops out on the crest of a ridge. The body dips gently east.	Undeveloped. Accessible by foot from Round Potrero (formerly McAlmond) Ranch headquarters.
353	Unnamed - 3	NW¼ sec. 16, T18S, R7E, SBM; Jewel Valley area, about 4 miles south-southwest of Boulevard. (See map in text).		A pegmatite dike that crops out on a low ridge about 200 ft. north of the international border. The dike strikes northeastward, dips about 5° northwest, and ranges in thickness from 6 to 8 ft. A lower layer, 3 to 4 ft. thick, is chiefly graphic granite; an upper layer, 3 to 4 ft. thick, is composed chiefly of glassy, milky quartz with minor feldspar. The feldspar is more sparse toward the top of the layer. The upper layer is exposed in a crudely circular area about 30 ft. in diameter.	Developed by shallow trench 30 ft. lon
354a	Unnamed - 4	NW¼ sec. 16, T18S, R7E, SBM; about 4 miles south-southwest of Boulevard. (see map in text).	Undetermined (1957)	An unexplored body of milky quartz about 30 ft. long and 5 ft. wide.	
354b	Unnamed - 5	Middle of the east edge of the NW¼ NE¼ sec. 23, T17S, R4E, SBM; about 600 ft. east-southeast of Morena reservoir dam, on the north edge of the road that traverses the south edge of the reservoir.	Undetermined (1961)	A northwest-trending quartz body about 40 ft. long and 25 ft. wide is exposed on a hill slope which dips steeply northeast. The quartz is milky white to pale pink, dense, but partly fractured. Some of the fractures contain iron oxide stains.	Undeveloped.
	Vanderburg deposit	Pala district.			Primarily a gem mine, although some quartz crystal for non-gem purposes has been mined. See tabulated list in section on "Gem minerals".

Quartz, quartzite

Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
Walker deposit	SE¼SE¼ sec. 32, T17S, R7E, SBM; in Jewel Valley, 2 miles southwest of Boulevard. (see map in text)	Roy Hansen Ranch, Manzanita, San Diego Co. (1958)	Deposit consists of a north-striking, nearly vertical pegmatite dike which is exposed as a small rounded hill about 50 ft. high. The dike is separable into two fairly distinct layers: (1) the western layer is mainly milky quartz, and ranges in thickness from 10 to 25 ft. Some potash feldspar occurs as pods within the quartz; (2) the eastern layer is chiefly potash feldspar, and is as much as 25 ft. thick. About 5,000-10,000 tons of quartz is estimated to remain in the deposit above the floor of the surrounding terrain.	Patented land. Developed by several minor cuts and trenches. Quartz that was mined in the 1920's was shipped to Los Angeles. Idle since that time. (Sampson and Tucker 31:449; Tucker 25: 376-377; Tucker and Reed 39:52, pl.1).
Ward and Williams deposit	North-northeast of Boulevard.			See tabulated list under "Feldspar".
White Butte deposit (American Encaustic Tiling Co.)	South of Boulevard.			See text. (Miller 35:134, Sampson and Tucker 31:445; 25:375).
White Quartz No. 2	Mesa Grande district.			A map location of Tucker and Reed (1939, pl.1). Probably same deposit as Rose Quartz, which see in text. (Tucker and Reed 39:pl.1).
White Rose deposit	North-northwest of Campo.			See tabulated list under "Feldspar".

ewed from the outcrop. Hydrous manganese and iron kides coat fractures.

'hite Butte Deposit (American Encaustic Tiling Company)

Location: Secs. 33 and 34, T. 17 S., R. 7 E., S.B.M.; in ıe southeastern part of the county, about 1½ miles ɔuth of Boulevard (Fig. 52). *Ownership:* Hallie M. Gibɔn, P.O. Box 223, Jacumba, owns two unpatented placer laims. In March 1957 the property was leased to the Vard-Lee Chemical Corporation, 6303 Reseda Blvd., Reseda.

The American Encaustic Tiling Company mined an stimated 1,000 to 3,000 tons of quartz from this deposit, robably during the 1920's. In 1958 the Ward-Lee Chemcal Corporation briefly mined the deposit as a source of quartz for a silicon plant near Plaster City, Imperial County.

The White Butte Deposit consists of a pegmatite dike which essentially forms a dip slope on the south side of a ill whose summit is about 150 feet above the surroundng terrain. The hill consists principally of biotite quartz nonzonite. The dike strikes about N. 65° W., dips from 12° to 20° south, and ranges in thickness from less than ive feet to at least 10 feet. Its exposures on the slope show strike-length of about 350 feet and a dip-length of bout 250 feet (Fig. 53). The dike consists of at least wo, and probably three zones: (1) The bottom zone is composed of a fine to medium-grained aggregate of quartz, potash feldspar, and books and plumes of muscoite. The quartz and feldspar are commonly intergrown o form graphic granite, and in a single exposure the rock s layered to form "line rock." (2) The central zone (core) of the dike is composed chiefly of a coarse to ery coarse-grained aggregate of transparent to milky quartz, and very sparse potash feldspar. This zone ranges n thickness from one to seven feet, and if an average thickness of three to four feet can be assumed, approximately 4,000 to 5,000 tons of quartz remain in the layer. (3) Small exposures of fine- to medium-grained pegmatite occur in the west wall of the main quarry, and near the east edge of the dike. These may be remnants of an upper zone that was less resistant than the quartz-rich core, and has been nearly stripped by erosion. This pegmatite ranges in composition from graphic granite, with sparse muscovite, to nearly pure potash feldspar.

The workings consist chiefly of an irregular quarry in the center of the deposit, and numerous trenches and pits.

RARE EARTH ELEMENTS

Several minerals that contain rare earth elements (including yttrium and cerium) are disseminated sparsely in a small proportion of the pegmatite deposits exposed in San Diego County. These minerals (which are listed herein under "Uranium and Thorium") have not been found in large enough proportions in the county to constitute ore.

SALINE MINERALS

See herein under "Boron," "Gypsum," "Lithium Compounds," "Potash," and "Salt."

SALT

Salt is an essential ingredient of man's diet. Also it is used as an industrial chemical, from which is derived all of the chlorine and much of the caustic soda and soda ash used in the United States. Salt also is used in refrigeration and cooling when mixed with ice (Ver Planck, 1957e, p. 487-488). The principal sources of the commodity in California are solar evaporation plants of the Leslie Salt Company at the south end of San Francisco Bay.

Photo 61. Western Salt Company operation at south end of San Diego Bay. Aerial view south-southwest.

One of the principal sources of salt in Southern California is the operation of the Western Salt Company at the south end of San Diego Bay (see description below). Here salt has been produced continuously by this company since about 1869. The mineral is obtained by evaporating sea water in ponds constructed on impermeable marshland. At least 1½ million tons had been produced by 1959.

Salt was produced similarly for undetermined periods between 1870 and 1900 at several additional localities in the San Diego Bay area, including (1) Portuguese Flat, at the north end of San Diego Bay; and (2) tidal flats at the mouth of the Sweetwater River, on the east side of the bay. It also was produced briefly at the turn of the century in La Punta Works at the south end of the bay, and from 1912 to 1920 by the Chollas Valley Salt Company at the mouth of Chollas Valley, on the east side of the bay. Since 1920, the Western Salt Company has been the only producer in the county.

The only attempt in the county to produce salt outside of the San Diego Bay area was made by the California Salt Company * at a locality south of Oceanside. This company produced a small quantity of salt, during a short period just before the turn of the century, by evaporating brine pumped from holes drilled in sloughs.

* This company is not related to the present-day operation of the California Salt Company at Amboy, and probably is not related to the one of the same name in the San Francisco Bay area (W. E. Ver Planck, personal communication, 1959).

Western Salt Company

Location: Secs. 9, 16, 17, 18, 19, 20 and 21, T. 18 S. R. 2 W., S.B.M. (partly projected); southwest of Chu Vista, at the south end of San Diego Bay; the mill west of Fruitdale, adjacent to the San Diego and Arizon Eastern Railroad. *Ownership:* Western Salt Company 1245 National Avenue, San Diego (1958). D. M. Mille Vice President and General Manager; N. B. Dittenhave Plant Superintendent.

The operation of the Western Salt Company at th south end of San Diego Bay was started in 1869, accorc ing to a representative of the company (personal commu nication, 1958), and salt probably has been produce continuously in the area by the company since that tim During a period that extended at least from 1902 to 191 the company was owned and operated by E. S. Babcoc who also owned the Coronado Hotel in Coronad (Bailey, 1902, p. 133; Merrill, 1914, p. 713). Since 192 the Western Salt Company has been the only produce in the area, and now is one of the principal producers o salt in Southern California. The company also operate plants at Newport Beach in Orange County and at Salt dale in Kern County. The total output of salt in the Sa Diego Bay area since 1870 is at least 1½ million tons, o which probably all but a few thousand tons has bee produced by Western Salt Company.

The following description of the operation is mainl from a description prepared in 1953 by W. E. Ver Planck

Figure 54. Map shawing Western Salt Campany evaparating pands at sauth end of Son Diego Bay. Plant is adjacent to railraod, just west of Fruitdale. Westvaco Divisian Magnesium plant is abaut a quarter of a mile to the narth.

California Division of Mines and Geology, and published in 1958 (Ver Planck, 1958, p. 59-65).

At San Diego, salt is produced in ponds which have been constructed on salt marshes formed at the mouth of the Otay River (Fig. 54, Photo 61). The marshes consist mainly of soft mud covered with a crust stabilized by grass and roots. An area of about 1,200 acres is divided into 29 ponds, which are irregular in plan, and are separated by levees. Twenty of the ponds are used for concentrating the brine, and nine for subsequent crystallization of the salt. The crystallizing ponds range in size from 5 to 17 acres, and cover a total area of about 100 acres.

Water in San Diego Bay contains about 3½ percent dissolved solids, about the average concentration of the ocean. It is admitted to the concentrating ponds on the west side of the mouth of the Otay River, periodically from mid-March until mid-December, through gates during high tide. The brine evaporates as it passes through the series of concentrating ponds, and reaches the last

Salt

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
357a 357b	California Salt Company	T12S, R4W, SBM; along sea coast, near Oceanside. (Map locations were plotted by interpretation of published data).			Operated 1901-1902. The company sunk wells 30-50 ft. deep in nearly dry sloughs. Brine was pumped from wells into evaporating ponds. One operation (a), near Carlsbad, contained acres of evaporating ponds; another (b), near La Costa, contained 25 acres of ponds. (Bailey 02:133-134; Ver Planck 58:118, 160).
358	Chollas Valley Salt Company	East edge of T17S, R2W, SBM (proj.); on the east side of San Diego bay, northwest of National City.	J. P. Duncan, 1420 National Ave., San Diego (1914)		Salt was produced by sea water evaporation. The company produced 600 to 700 tons of salt per year from a "small" plant (Merrill, 1914). Production is recorded for period from 1912 to 1920. Plant facilities now removed. (Merrill 14:716; Ver Planck 58:113,160).
	La Punta Salt Works	T18S, R2W, SBM; at south end of San Diego Bay.	Schaeffer Brothers (1900)		Salt was produced by solar evaporation at the La Punta works, the exact location of whose site is undetermined. On the U. S. Geol. Survey map of the San Diego quadrangle (1904 ed.) La Punta siding is shown in the center of the E½NW¼ sec. 21, T18S, R2W. It is assumed that the La Punta works were adjacent to the siding, on marshland which is now covered by evaporating ponds of the Western Salt Company, which see. Production recorded for 1896-98 and 1900. (Ver Planck 58:160
359	Portuguese Flat	West of San Diego, in the Lindbergh Air Field area.			Prior to 1900, salt was produced by evaporation from tidal flats in this area. (Roy Kepner, San Diego County Division of Natural Resources, personal communication, 1958).
360	Sweetwater Creek	On east side of San Diego Bay, northwest of Chula Vista.			Bailey (1902) stated that "as early as 1872 salt was made in the Sweetwater Creek near National City, and in the Otay, but nothing has been done there for a number of years." (Bailey 02: 134; Goodyear 88:518).
361	Western Salt Company	South end of San Diego Bay, Chula Vista.			See text. (Anonymous 54:6-7; Bailey 02 133, 134; Hubon 02:10; Mason 19:528-530; Merrill 14:713-716; Tucker and Reed 39:48-49, pl.1; Ver Planck 57: 483, 485; 58:42, 59-65, 160).

Photo 62 (below). Western Salt Company, south end of San Diego Bay; view northwest. At left, dragline is loading salt into rail cars from drained crystallizing ponds. Salt is transported in cars to mill at the right.

Photo 63. View southwest toward mill of Western Salt Company, Chula Vista. Stockpile of harvested salt is to right of plant; concentrating and crystallizing ponds are in background.

ond at a specific gravity of 15°-20° Bé., at which point ypsum begins to precipitate. The brine is held in this ond until it reaches 25.8° Bé., at which point it is satrated with salt, and most of the gypsum has precipitated ut. The saturated brine then flows down a south-trendng canal to a point about one-half mile southwest of the ill at Fruitdale, where it is raised eight feet and allowed flow into the crystallizing ponds. As the salt crystalzes, the gravity of the remaining solution is stabilized t 30° Bé. by periodically withdrawing some of the magesium rich bittern, and adding new saturated brine. This revents magnesium chloride from crystallizing out with he salt.

Harvesting of the salt begins between June 1 and 15, nd continues through mid-November. The crystallizing onds are drained and harvested individually. The drained ittern is sold to Mineral Products Division, Food Mahinery and Chemical Corporation, which recovers magesium chloride at a neighboring plant (see under "Magnesium Compounds" in this report). The salt, which s in hard layers 8 to 10 inches thick, is loosened and eveled by a tractor with scarifier blade attached, then oaded into dumpcars by a ¾-cubic yard, tread-mounted dragline (Photo 62). The cars, which have a capacity of about three cubic yards, are operated in series of eight on portable tracks laid across the salt. The dragline removes all but a one-inch layer of salt, which is left so that none of the underlying mud will be mixed with the harvested salt. After the salt has been harvested, the crystallizing ponds are immediately refilled with saturated brine.

As the salt is harvested, it is transported to the mill area, washed and stockpiled (Photo 63). Washing removes the remaining brine, and the remaining traces of gypsum that has precipitated with the salt. Salt from the stockpile is crushed and screened in a mill of 60 tons-per-hour capacity. Four products are produced: minus 4 mesh; plus 4 mesh, minus 7/16 inch; plus 7/16 inch, minus ⅝ inch; and minus ⅝ inch. The products are marketed in Southern California and western Arizona for use in refrigeration, food processing, water softening, livestock and poultry feed, petroleum refining, soap making, curing of hides, chemicals, and for other uses. In early 1958, the salt was sold for $8.50 per ton in 20-ton bulk lots.

SAND AND GRAVEL, AND CRUSHED AND BROKEN STONE * †

The tremendous increase in population of the San Diego region from 1947 to 1960 was reflected by a nearly sevenfold increase during those years in the production of processed sand and gravel, and crushed and broken stone (Fig. 4). In 1947 about 1,270,000 tons of these commodities, valued at $1,400,000, were produced in the county; and in 1959, by contrast, about 8,600,000 tons, valued at about $13,600,000, were produced. In 1959, these commodities constituted about 94 percent of the total value of the mineral production of the county, and slightly more than twice the estimated value of all of the gold produced in the county to date. In that year the county ranked second in the State to Los Angeles County in total value of these products. A continued growth of the rock products industry in San Diego County is indicated by (1) a large amount of planned military construction in the county, and (2) an expected steady increase in the population.

In 1959 the production of sand in San Diego County was 1,950,000 cubic yards valued at $3,500,000; the production of processed gravel and crushed stone (including "decomposed granite") was 3,160,000 cubic yards valued at $6,850,000; and the production of broken stone was about 60,000 tons valued at $210,000 (San Diego County

* In this report the general definitions of the U.S. Bureau of Mines are used to differentiate deposits of "sand and gravel" from those of "crushed and broken stone": Deposits of "sand and gravel" are sedimentary deposits whose constituents can be mined without blasting or fragmentation. Deposits of "crushed or broken stone" are those which must be mined by blasting or fragmentation. In commercial usage, sand includes fragments which range from 200-mesh to ¼ inch and gravel includes fragments which range from ¼ inch to 3½ inches.

† By F. Harold Weber, Jr., and Roy M. Kepner, Jr., Assistant Director, San Diego County Division of Natural Resources, San Diego. The section was written by Weber from engineering data compiled mainly by Kepner and geologic data brought together by Weber.

Phata 64 (right). Canyan wall at hydraulic site (1958) af Mission Canyan aperatian af H. G. Fentan Material Campany. This view narth shows lens af sandstane in Paway canglamerate which lies nearly flat.

Phata 66 (abave). View east taward Carrall Canyan aperatian af H. G. Fentan Material Campany. Alluvium derived fram Paway canglamerate excavated with dragline far pracessing inta crushed gravel far aggregate. Harizantal surface in backgraund and immediate faregraund is part af Linda Vista terrace. Poway conglomerate expased in walls af canyans.

Phata 65 (belaw). Claseup of expos shawn in phata 64. Raunded ta semi-an lar clasts abave and belaw sand lens mainly metavolcanic racks; interstitial terial is mainly sand and silt.

Phata 67 (left). Alluvium derived fram Paway canglamerate, Carrall Canyan depasit, H. G. Fentan Material Ca. It cantains less silt than Poway canglamerate in place. *Phata by Thomas E. Gay Jr.*

vision of Natural Resources, 1960, p. 14). Processed nd and gravel and crushed stone are used chiefly as ncrete aggregate, road base and fill. Broken stone is ed chiefly as riprap.

In mid-1958 about 37 companies were producing one more of the commodities included in this discussion. he principal producers of processed sand and gravel, d crushed stone at that time were Caudell and John-n, H. G. Fenton Material Company, and Nelson and oan. The three next largest in terms of production, t much smaller than the three named above, were nyon Rock Company (V. R. Dennis), Daley Corpora-on, and H. W. Rohl Company. The principal producer broken stone in the county was J. R. Stringfellow mpany, with offices in Riverside. Of the remaining 30 erators, many were producing only small tonnages of nd or "decomposed granite." The active and inactive ck producing operations and deposits are described in e accompanying tabulated list.

The oldest still-active rock producer in San Diego ounty is the Jamacha Sand and Gravel Company which egan operations on a very small scale in 1906. The rliest large producer of sand and gravel and crushed one in the county was the Independent Stone Company, f Spring Valley, which probably was formed about 910, or slightly earlier. This company was operated until he early 1920's when it was merged with Fenton-Sump-ion-Barnes Company, which had been formed about 912. With the merger the two companies became known s the Fenton-Parker Company, which in turn later was enamed the H. G. Fenton Material Company, as it is nown today. In order of beginning, the other major roducers began operations as follows: Daley Corpora-ion, 1913 (at present site, as Mission Rock Company); Nelson and Sloan, 1923 (at present site); Canyon Rock Company (V. R. Dennis), 1929 (at present site); Caudell nd Johnson, 1937; and H. W. Rohl Company, 1950.

The principal sources of sand and gravel in the county are (1) the Poway conglomerate of Eocene age, and alluvium and terrace deposits derived from this formation; and (2) river bed deposits. One company produces sand and gravel from the San Onofre breccia, of Miocene age. Sand alone is produced from most of the productive river bed deposits in the county and from sandstone of Eocene age (see also in section on "Specialty Sands"). Crushed and broken stone is produced chiefly from metavolcanic rocks. Small quantities of crushed and broken stone have been obtained from volcanic rocks, crystalline limestone and dolomite, gabbroic rocks and from pegmatite deposits. Possible future sources of most rock types being utilized as sources of sand and gravel, and crushed and broken stone during 1959 were plentiful, but were farther from centers of population than deposits being worked during that year.

Mining of uncemented, fragmental deposits, such as the Poway conglomerate, river bed deposits, and the San Onofre breccia, is done mainly with power shovels, tractors, and draglines. Most deposits of massive rock are quarried by use of blasting. Material that has been mined or quarried for use as aggregate and similar products is processed in continuous belt systems which range from simple to complex. Plants in which only sand is processed may consist only of a series of screens, whereas plants in which both sand and gravel or crushed stone are processed may contain several steps involving crushing, screening, and washing to obtain the desired sizes of products. Generally, however, the material mined is washed only if portland cement concrete aggregate is produced. Massive rock quarried for use as riprap is not processed. In 1958, operations that produced sand and/or gravel or crushed stone ranged in hourly capacity from 6 to 200 tons. Water used in the plants was being obtained mainly from company-owned wells (see also section on "Water for mining" in another part of this report).

In the future, large quantities of rock products will be needed for expected construction of houses, streets, and commercial and government buildings. Large subdivisions now are being laid out north of Mission Valley on Linda Vista Mesa, and in El Cajon Valley. Other projects will include freeways and a modernization of U.S. Highway 80. Long-term, high-cost U.S. Navy projects, which will consume large quantities of rock products, are planned for North Island, Camp Pendleton, and Miramar Naval Air Station. A seaplane base is planned for the South Bay.

Statewide discussions of (1) "Sand and Gravel" and (2) "Crushed and Broken Stone" are provided by Gay (1957b, p. 495-520; 1957c, p. 565-590).

Sources of Material, and Methods of Mining and Treatment

Sand and Gravel

Processed sand and gravel are, by far, the principal portland cement concrete and bituminous aggregate materials used in the county, and are used also as road base and fill material (see section on "Products and Marketing"). The sources of sand and gravel are described in the following paragraphs.

Poway Conglomerate, and Alluvium and Terrace Deposits Derived From the Poway Conglomerate. The Poway conglomerate, of Eocene age, and alluvium and terrace deposits derived from the Poway conglomerate, are the principal sources of gravel in San Diego County, and also are important sources of sand. This formation and its derivatives are exposed widely in a region bounded, roughly, by Mission Valley on the south and by the San Dieguito River valley on the north (see Pl. 1). The deposits underlie irregular areas which total about 125 square miles (see also section on "Geologic Features"). The Poway conglomerate consists chiefly of thick, massive beds of conglomerate, with interlayered lenses and beds of sandstone, conglomeratic sandstone, and shale (Photos 64, 65, 68). In undisturbed outcrops, the formation generally is well consolidated, but only locally is it well cemented; younger deposits derived from the formation generally are unconsolidated (Photos 66, 67). The conglomeratic members are composed chiefly of rounded clasts of silicified metavolcanic rocks

Photo 68. Murroy Conyon operation, H. G. Fenton Moterial Campany. Poway conglomerate is mined with shovel which dumps paorly consolidoted materiol into truck which tronsports it to plont. Cemented material not suitable for use in plant is discorded (foreground).

with a matrix of sand, silt and clay. The clasts range in size from pebbles to boulders, and average between one inch and two inches in diameter (Bellemin and Merriam, 1958, p. 208). Conglomeratic beds are estimated to contain from one-quarter to one-fifth silt and sand (Bellemin and Merriam, 1958). The younger deposits generally contain a smaller proportion of silt- and clay-sized particles than the Poway conglomerate itself, and thus are easier to process (see below). Caliche (calcium carbonate) is common in the upper part of the Poway conglomerate (Hanna, 1926a, p. 214), and when mined and processed is reported by local operators to be a deleterious impurity in sand products. Detailed analyses of the Poway conglomerate from many localities are available for reference at the regional office of the California Division of Highways in San Diego.

Of the nine operations where rock products were being produced in 1958 from the Poway conglomerate or its derivatives, five yielded both processed sand and gravel and four yielded only gravel. Those operators that w producing processed sand and gravel are: Caudell Johnson (Mission Valley and Los Penasquitos Can operations); H. G. Fenton Material Company (Mis and El Cajon Valleys operations); and Nelson and Sl (San Clemente Canyon operation). Most of the sand be produced at the operations of H. G. Fenton Mate Company in Mission and El Cajon Valleys, however, being produced from the bed of the San Diego Ri and processed in the same plants as material mined fr the Poway conglomerate. Those operations at wh only processed gravel was being produced are Cau and Johnson (Carroll Canyon operation); Daley Cor ration; and H. G. Fenton Material Company (Car and Murray Canyon operations). (See accompany tabulated list for description of individual operations.

Several methods of mining the Poway conglomer are used by the rock producers. The four operators w plants along the north side of Mission Valley use th distinct methods. (1) The H. G. Fenton Material Co pany deposit in Murray Canyon is cemented locally a therefore is mined selectively from an irregular, bench pit (Photos 68, 72). At this deposit a power shovel ex vates the undisturbed conglomerate from a vertical fa and after cemented portions are discarded (Photo 6 loads useable material directly into pit trucks wh transport it about one-eighth mile to the plant. The op ation of the Daley Corporation in Murphy Canyon similar to this one. (2) At the Caudell and Johnson op ation in Mission Valley tractor-drawn rippers are e ployed to loosen the conglomerate exposed beneath gently sloping terrace-like area above the north side Mission Valley (Photo 69). The material is then scrap by tractors into piles where it is picked up by self-loa ing, self-propelling carryalls and transported about or quarter mile to the primary crusher at the south edge the terrace-like area. (3) The H. G. Fenton Mater Company Deposit on the north side of Mission Valley well consolidated, and is mined by use of power shov

Photo 69 (below). Part of Mission Volley aperotion af Caudell and Johnson; view eost. Pawoy conglomerate is mined (for left) with troctor scropers. Mined material is scooped up by corryalls ond transported to dumping point ot left end of belt (right). Moteriol is possed through grizzly and jaw crusher, given o preliminory wosh, then transported on the belt via a surge pile to the plant below in Mission Volley (see photo 71).

m steep-walled quarries; blasting is required in some ts of the deposit. The material quarried is trucked a ort distance and dumped over the edge of the quarry the canyon below, where a hydraulic monitor further aggregates the loose material, and washes most of the and clay out of it (Photo 70). The partially washed k then is loaded by dragline into pit trucks which nsport it one-quarter mile to the plant.

The five additional operations, which are north and rtheast of Mission Valley, are located on unconsoli- ed deposits of alluvium or terrace material which are ived from the Poway conglomerate (Photo 66). These erators are: Caudell and Johnson, and H. G. Fenton terial Company in Carroll Canyon; Nelson and Sloan San Clemente Canyon; Caudell and Johnson in Los nasquitos Canyon; and Monarch Materials Co. (H. G. nton Material Co.) in Sycamore Canyon. At these erations material is excavated to water level with drag- es and transported one-eighth mile to two miles to nts in pit trucks or carryalls.

n 1958, constituents of the Poway conglomerate were ng processed wet at seven of the nine plants (Fig. Photo 71) and dry at only two (Fig. 56, Photo 72). e dry plants are those of H. G. Fenton Material Com- ny (Murray Canyon), where only bituminous con- te aggregate and fill material are produced; and Cau- l and Johnson (Carroll Canyon), where only road e is produced. All of the plants that produce all the

Photo 70. Mission Valley operation, H. G. Fenton Material Company. Poway conglomerate, mined in quarry above and to northeast of this locality, is dumped over edge of cliff above. Preliminary wash by hydraulic monitor in photo removes a large proportion of silt and clay. Material then loaded with dragline into trucks and transported to plant.

Photo 71 (below). Mission Valley plant of Caudell and Johnson (foreground), where sand and crushed gravel products and concrete mix are produced. Crushed material from surge pile behind photographer (see photo 69) is fed into plant in valley below via belt in foreground. In center background is operation of Woodward Sand Company.

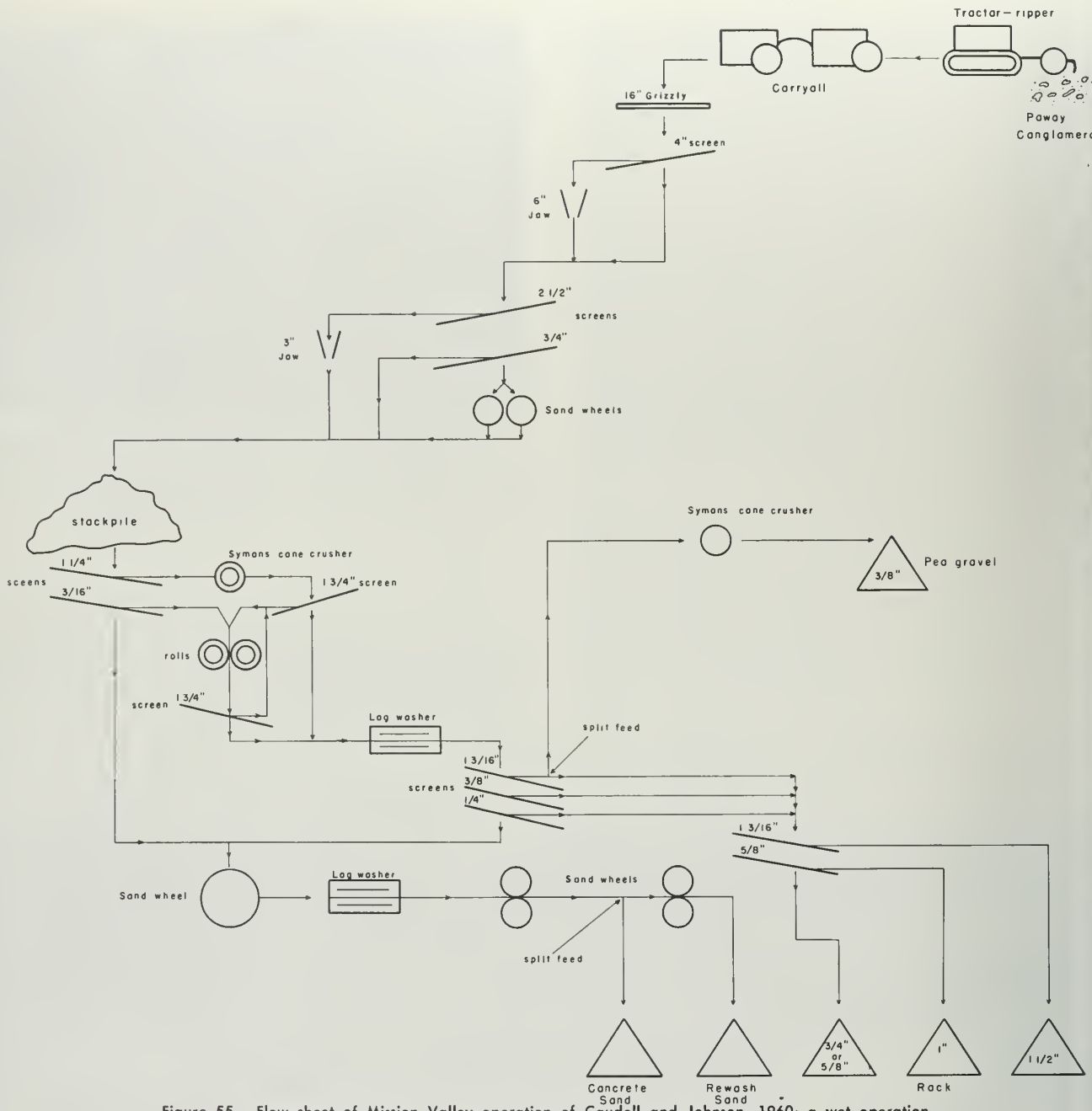
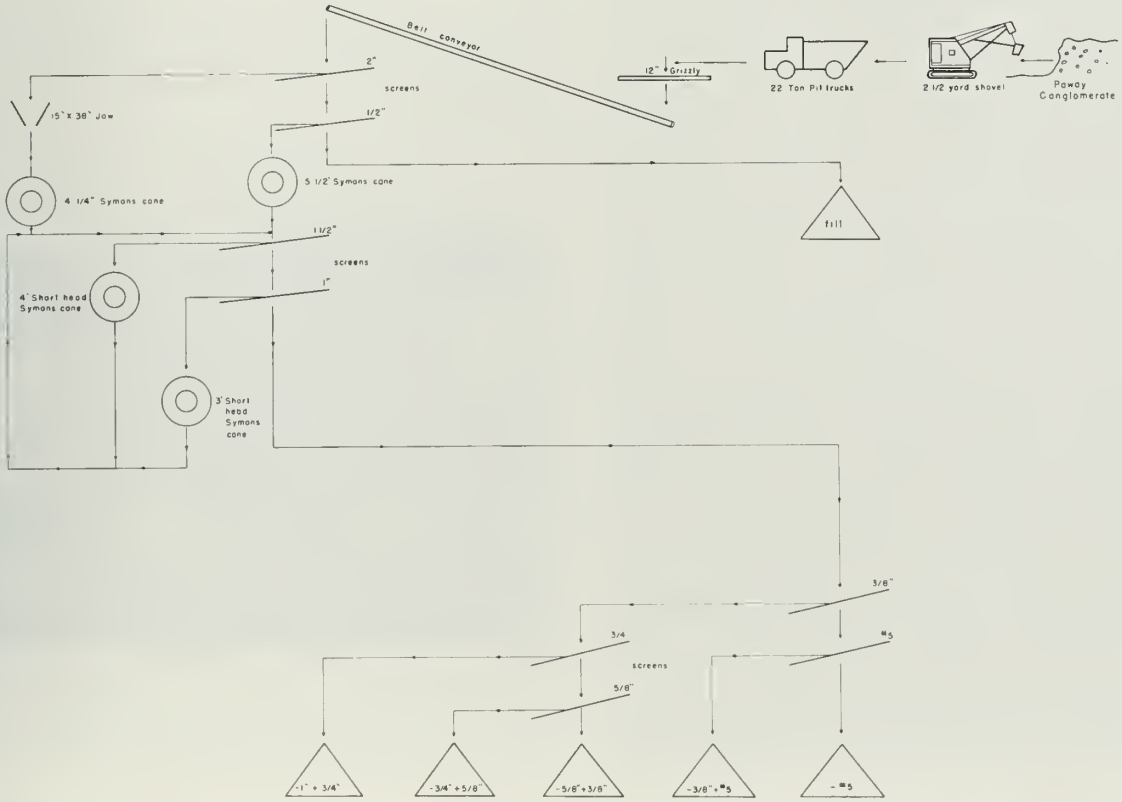


Figure 55. Flow sheet of Mission Valley operation of Caudell and Johnson, 1960; a wet operation.

standard sizes of sand and gravel are operated wet. Each plant that processes conglomeratic material differs from the others in detail, but all use the same general procedure. The conglomeratic material first is passed through a grizzly to remove oversize fragments and debris. Then it is passed through a primary jaw crusher. In some plants it is next passed through a secondary jaw crusher. At plants operated dry, the material then is screened. At most plants operated wet, the material next is given an initial wash to remove fines, and then is screened, or is screened then given the initial wash. The larger sized fragments (one-quarter inch to two inches) from the screens are passed through Symons standard and/or short head cone crushers, and/or roll crushers. The last steps involve final washing, screening, and stockpiling. E washing steps generally are needed in the processing Poway conglomerate from undisturbed outcrops. A vium and terrace deposits derived from the Poway ge ally have been partially washed by natural processes. operations where sand from river bed deposits is p essed in the same plants with conglomerate, the raw s usually is added at the final washing step. In 1958 the p ductive capacities of the plants ranged from 80 to tons of rock or rock and sand per hour. Processed s produced from the Poway conglomerate consists ch of naturally rounded fragments, and processed gr consists mostly of fragments with at least one artifici broken face.

Photo 72. Murroy Conyon operotion of H. G. Fenton Material Compony; view southeost. At this operotion, mined Powoy conglomerote is processed dry for use solely in production of bituminous concrete mix.

Figure 56 (below). Flow sheet of Murroy Conyon operation of H. G. Fenton Moterial Compony. Operotion is entirely dry. Jonuory 1960.



River and Stream Bed Deposits. The principal sources of sand for use as fine aggregate and fill material in San Diego County are river and stream bed deposits, from which also are produced minor tonnages of crushed gravel and very minor tonnages of uncrushed gravel for use as coarse aggregate.

The principal rivers and streams of San Diego County are intermittent and flow mainly toward the southwest and west. From south to north these are the Tia Juana, Otay, Sweetwater, San Diego, San Dieguito, San Luis Rey, and Santa Margarita Rivers, and San Mateo Creek. The sediments in their beds are derived mainly from granitic, metasedimentary, and metavolcanic rocks, and, in areas within a few miles of the coast, from Tertiary sedimentary rocks. The rivers are characterized by low gradients, drowned mouths, and relatively fine-grained sediments which consist chiefly of sand and small to very small proportions of silt and gravel. The constituents are composed essentially of quartz and feldspar, with a small proportion of dark minerals. Layers of clay are relatively common in some deposits. The parts of river beds that are suitable as sources of sand and gravel extend from points between 2 and 6 miles upstream from the mouths, to points between 6 and 30 miles upstream. The longest stretch of river bed being worked in 1958 was that of the San Diego River, which was being worked discontinuously from a point 6 miles upstream from its mouth to a point about 24 miles upstream. Most river bed deposits in the county are no longer replenished by natural stream-flow, because of the construction of dams upstream on their tributaries.

Of six principal river beds in the county, five contain mostly sand and one contains substantial proportions of both sand and gravel. The beds that contain mostly sand are those of the San Diego, Tia Juana, San Luis Rey, San Dieguito, and Sweetwater Rivers, which are the major sources of sand in the county, and also furnish very minor tonnages of gravel. The bed of the San Diego River is the most productive, and contains 10 of the 19 operations that produce sand from river bed deposits (Photo 71). The sand in the bed of the San Diego River is relatively coarse and both plaster and concrete sand are produced from it. The sand in the bed of the Tia Juana River is finer grained than that of the San Diego River and is suitable mainly for use as plaster sand. The coarsest river bed sediments in the county are those of the Otay River which at the Nelson and Sloan Deposit are composed of about one-half gravel and one-half sand. A deposit in Smugglers Gulch, a tributary of the Tia Juana River, contains a large proportion of gravel and a small proportion of sand. The principal producers of sand, or sand and gravel, from river bed deposits in the county are Canyon Rock Company, Caudell and Johnson, H. G. Fenton Material Company, Jamacha Sand and Gravel Company, Nelson and Sloan, Sierra Sand Company, and Woodward Sand Company.

All but one of the river bed deposits are mined with portable draglines or skiploaders, and excavated downward to the tops of zones that contain excessive layers of clay, or to the tops of the water levels in the b The exception is the very small Sweetwater operati at which sand is recovered from beneath a pond by s tion through a hose. Draglines are used at the large op tions of Caudell and Johnson, H. G. Fenton Mate Company, Nelson and Sloan, and Woodward Sand C pany, which range in productive capacity from 10 200 tons of sand per hour. Skiploaders are used in a tion to a dragline at the Mission Valley operation Woodward. Either draglines or skiploaders are used the smaller operators. Draglines in use in the county 1958 ranged in capacity from ¾-cubic yard to 2½ c yards, and skiploaders from ½-cubic yard to 1½ c yards.

At one operation (Denton Sand and Gravel C pany), sand is dumped directly from the excavation o a belt which feeds the plant. At all others, san dumped into trucks or tournawagons, which range capacity from 5 tons to 10 cubic yards, and transpo to plants for distances that range from less than 1, feet to 12 miles. The average haul is one-quarter to c half mile. At the plants the material is dumped dire onto grizzlies or onto storage piles.

At the 14 operations (e.g., Gross Sand Co., Woodw Sand Co.) where sand or sand and uncrushed gravel the only products, the unprocessed material first is pas through a grizzly, to remove roots, debris, and bould then it is screened and washed, and stockpiled, or sto

Photo 73. View southeast, showing H. W. Rohl Company operatio Oceanside. Sand and crushed gravel products are produced from Onofre breccia.

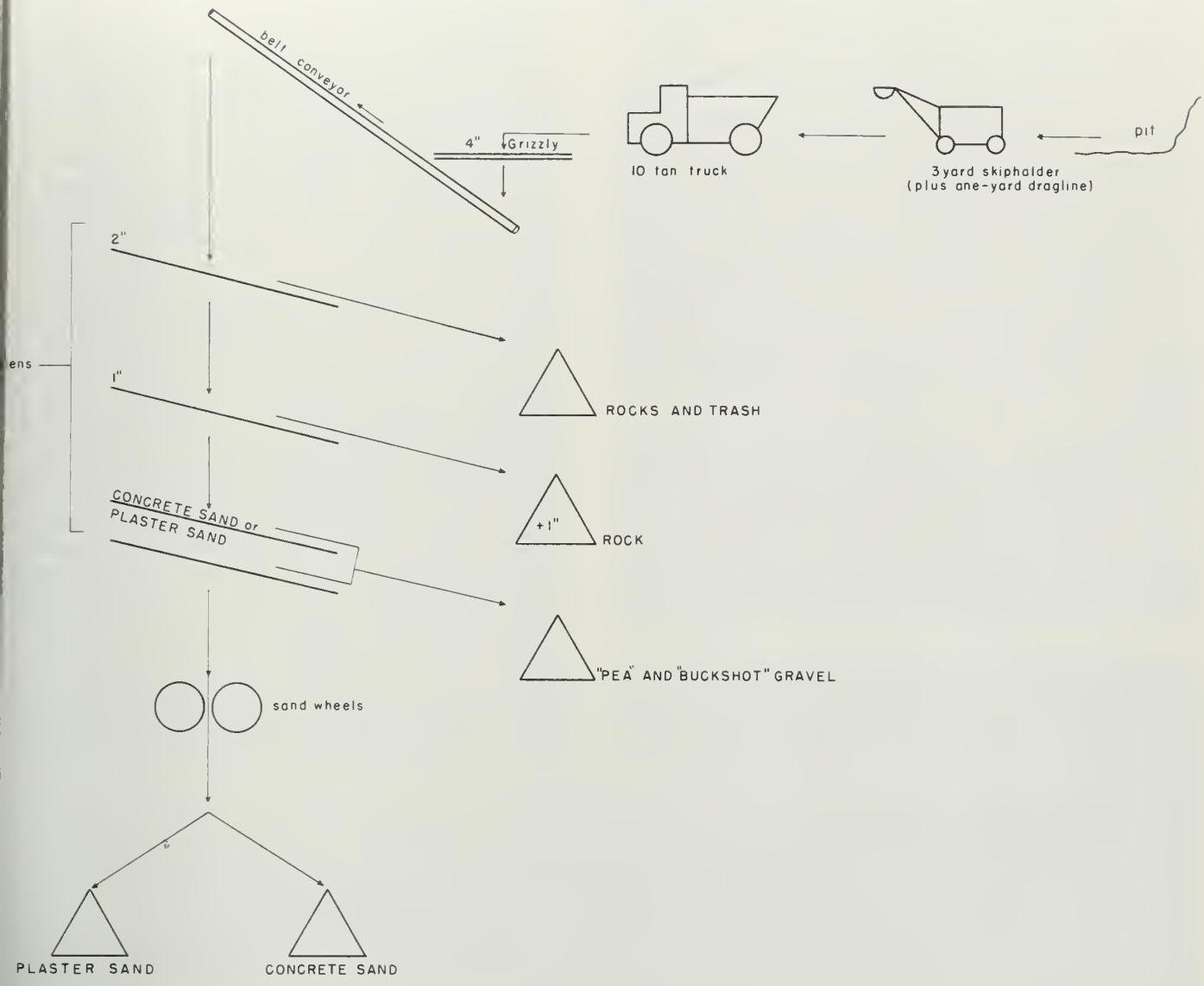


Figure 57. Flow sheet of Woodward Sand Plant, Mission Valley. 1960.

bunkers for loading into trucks for transport (Fig. 57). : some plants the sand first is washed, then screened; d at some of the very small ones it is processed dry. ee accompanying tabulated list for descriptions of indi- dual operations.)

Where crushed gravel also is produced from riverbed posits (H. G. Fenton Material Company, Nelson and ɔan, and Smith Construction Company), several steps e added to the system described above, including a v crusher following the grizzly, and one or more types roll and/or cone crushers. A representative of one mpany estimated that between one-fifth and one-third the fragments of the gravel produced at its Otay operation were uncrushed. In 1958, the capacities of the largest plants that were treating riverbed material were as much as 100 to 150 tons of sand, and as much as 200 tons of both sand and gravel combined per hour.

San Onofre Breccia. Processed sand and gravel for use as concrete aggregate was being produced in 1960 from the San Onofre breccia by the H. W. Rohl Company, Oceanside (Photo 73). This breccia, which is Miocene in age, consists chiefly of poorly consolidated, semiangular clasts of quartz-amphibole schist with interstitial sand and silt (Photo 16; also see section on "Geologic Features"). The maximum dimensions of the clasts range from less than several inches to more than five feet. An abundance

of silt in the deposit worked by Rohl has forced the installation of extra washing units; and a dearth of sand has forced the company to recycle certain material, which usually is considered waste at most operations, to recover as much sand as possible. In addition, sand from normally deleterious clay balls also is recovered (see description of operation in accompanying list).

The San Onofre breccia is exposed in the county as a narrow belt along the coast, mainly in Camp Pendleton, where mining is prohibited. Thus the possibility of wide use of this unit as a source of sand and gravel is limited.

Sandstone of Eocene Age. A friable, quartz-feldspar sandstone of Eocene age is exposed as an irregular belt that extends northward from a point southeast of Del Mar into Orange County (see also in section on "Geologic Features"). The Crystal Silica Company, Oceanside, produces plaster sand and a variety of specialty sands from these deposits (see section on "Specialty Sands"). At a locality near Del Mar, the Sorrento Sand Company produces small tonnages of concrete sand from alluvium which is derived from nearby exposures of this sandstone.

Beach Deposits. Extensive beach deposits of Recent sand and gravel are exposed along the coast of San Diego County. The deposits of sand have not been exploited, but pebbles of various rock types were recovered at beach localities between Oceanside and San Diego from 1915 to 1949 for use in grinding and filtering systems. Pebbles no longer are recovered in the county, mainly because porcelain balls have replaced pebbles in grind systems, and because most of the beaches now are u only for recreation. (See Bird Rock in section on "Ab sives"; and Ponto Beach in the tabulated list that acco panies this section.)

Crushed and Broken Stone

Crushed stone is an important aggregate material a also is used as road base, roofing granules, poultry g and drain rock. Broken stone is used mainly as rip (see section on "Products and Marketing"). The sour of crushed and broken stone are described below.

Granitic Rocks. Partly decomposed granitic roc near metropolitan areas of the county are a source "decomposed granite" ("DG"), which is used as fill n terial, road base and drain rock. Granitic rocks also a a major source of the broken stone used as riprap, a have been a source of small quantities of the crush stone used mainly for roofing granules.

A large part of the interior of San Diego County underlain by partly decomposed granitic rocks (see 1). Because of the low cost of decomposed granite, ho ever, deposits of commercial interest occur only alo the western edge of the exposed part of the batholith Southern California, between 8 and 20 miles of the coa and within a few miles of the centers of consumptio Deposits of granitic rocks suitable for use as sources decomposed granite are weathered deeply, probably depths ranging from 10 to 100 feet or more. Residu boulders of undecomposed rock generally are comm throughout most of the commercial deposits. In S Diego County the granitic unit that commonly is t most deeply weathered is the Green Valley tonalit which is exposed widely in the western part of the bath lith (see section on "Geologic Features").

Photo 74 (below). Decomposed granite operation at Jamacha Junction of San Diego Cement Company subsidiary of Caudell and Johnson; view southwest. Tractor scrapers shove "DG" into bunker (left); oversize boulders are discarded in area shown at right edge of photograph. From bunker, material is either transported by belt to mill shown above, or used without processing.

In 1958, decomposed granite was being obtained commercially from 22 deposits by 17 companies, many of which were construction companies that used their production solely in their own construction projects. In the San Diego region, six deposits were active in the hills south of El Cajon, four in the hills south of Lakeside, two near Poway, and one in the Mission Gorge area (for names of operators, see accompanying tabulated list). In the northwest region of the county, five deposits were being worked in 1958 near Vista, three near Escondido, and one near San Marcos. In addition to the company-operated pits, a moderate number of small "DG" pits were being operated sporadically by the County of San Diego for use mainly in road work. The State of California was operating one pit for the use of firms holding state contracts.

Decomposed granite generally is excavated with bulldozers which rip the surface of the deposits, then shove or carry the loose material to bunkers, where it is stored for processing or loaded for transport. Residual boulders are shoved to one side of the property (Photo 74).

The degree to which decomposed granite is processed depends on the products each operator sells. If the material is marketed as fill it is sold generally without any treatment. For other uses it may be screened, and at the Caudell and Johnson operation (Photo 74) at Jamacha Junction, the excavated fragments are broken down with a jaw crusher. Because most decomposed granite deposits are superficial, operators use portable processing equipment which can be disassembled quickly and moved to other sites.

Relatively unweathered granitic rocks of Cretaceous age have been the source of a major proportion of the broken stone quarried in the county for use as riprap; they also have been a source of small quantities of crushed stone used for roofing granules and poultry grit (see Campo Milling Company, Hatfield Creek Quarry, and A. G. Foster in accompanying tabulated list).

During the mid- and late 1950's two deposits of granitic rocks were quarried for riprap, both by the J. R. Stringfellow Company, of Riverside. These deposits are the Marron Quarry, near Oceanside; and the Meadowlark Ranch Quarry, north of Rancho Santa Fe. The former quarry was operated only for a short period in the mid-1950's because it yielded fragments only as large as 10 tons, and the operator needed 20-ton fragments for construction of a jetty. The Meadowlark Ranch Quarry, which was opened in 1957 to replace the Marron Quarry, yields fragments that range from five pounds to 20 tons.

Metavolcanic Rocks. Metavolcanic rocks in the southwestern part of San Diego County are mainly a source of (1) crushed stone for use as bituminous and portland cement aggregate; and (2) broken stone, for use as riprap. In addition, small tonnages of these rocks have

Photo 75 (below). Canyon Rock Company operation of V. R. Dennis at Mission Gorge; view southwest. Company produces sand from bed of San Diego River (left background) and crushed stone from massive metavolcanic rocks shown in quarry walls. Mission Valley is at left in distant background.

been used as roofing granules and very small quantities as decorative stone (see also in the section on "Products and Marketing"). The geology of the metavolcanic rocks is described in the section on "Geologic Features."

Two companies—Canyon Rock Company (V. R. Dennis) and K. H. Golden Company—currently produce crushed stone from metavolcanic rocks. Both operators work deposits in the Mission Gorge area, north of Grantville. Canyon Rock Company has operated a quarry in this area since 1929, and now produces both crushed and broken stone. It is the only operator in the county that produces all of the so-called standard sizes of coarse aggregate from metavolcanic rocks (see "Aggregate" in section on "Products and Marketing"). All other operators that produce all of the standard sizes of aggregate utilize the constituents of the Poway conglomerate. Canyon Rock Company works its quarry by benching, using blast holes drilled as deep as 150 feet with wagon drills (Photo 75). The quarried stone is processed by use of a primary jaw crusher, screens, secondary jaw crusher, classifiers, cone crushers, log washers, and final classifiers. Plant capacity is about 200 tons per hour. K. H. Golden Co., Inc., produces three sizes of crushed stone for use solely as aggregate in bituminous concrete.

During the early part of the century the Independent Stone Company produced large quantities of aggregate from a deposit of metavolcanic rocks near Spring Valley (see description in accompanying tabulated list). This company, through mergers, became the H. G. Fenton Material Company, now one of the larger rock products companies in the San Diego region. During the 1910's and 1920's the San Diego Stone Company produced crushed stone products from the Sweetwater quarry, near Sweetwater Dam.

During the 1940's, exposures of gray-green metavolcanic rocks a few miles northeast of Rancho Santa Fe were quarried for use as roofing granules (see Calavera Rock Company, and Carmean and Greenstone quarries in accompanying tabulated list). A deposit of similar rocks near Carlsbad has been a source of small quantities of decorative stone (see Evans Point Deposit in accompanying tabulated list).

Near Dulzura a deposit of hydrothermally altered, yellow-brown to brick-red metavolcanic rocks has been prospected as a possible source of decorative stone (see Dulzura in accompanying tabulated list).

Volcanic Rocks of Tertiary Age. Small quantities of crushed stone for use as roofing granules have been produced sporadically near Jacumba from a layer of brick-red to grayish-pink lapilli tuff of Miocene age (also see section on "Geologic Features"). As the lapilli of this rock average less than one inch in diameter and are poorly cemented, the rock can be mined easily without blasting, by use only of a bulldozer with ripper attached. The material mined has been prepared for sale simply by crushing (see Weaver Deposit in accompanying tabulated list). Attempts to use this rock as an "agricultural mineral" and as aggregate for concrete blocks have fai It apparently is too reactive to be used as concrete agg gate, and the State Bureau of Chemistry has ruled t for agriculture the material can be sold only as a " amendment." (See Weaver Deposit and McGuffie Fo dation in accompanying tabulated list.)

A body of dacite, east of Oceanside, yielded crusl stone for use as concrete aggregate and road base dur a short period in the 1930's (see Calavera Rock Comp in accompanying tabulated list).

Crystalline Limestone and Dolomite. Several ope tors occasionally have worked deposits of crystall limestone in San Diego County as sources of crusl stone for use as white roofing granules and poultry g These deposits are the Heathman and Elliot Deposits n Dos Cabezas, the White Cap Deposit near Jacumba, a the White Peak Deposit near Ranchita (for descripti of deposits, see section on "Limestone-Dolomite"). T Heathman Deposit also has been worked for decorat stone.

Shale of Tertiary Age. In some localities in Califor shale has been used as fill material. Shale exposed in S Diego County (Rose Canyon shale in coastal area a several units in desert area) is not hard enough to considered as a source of crushed stone (see also "Sh Expansible").

Gabbroic Rocks. National Quarries, Inc., Escondi has sold some dark bluish-gray gabbro for use as dec rative stone (see description in text under "Dimensi Stone"). Three deposits of orbicular gabbro in t county might also be considered as possible sources decorative stone (see section on "Orbicular Gabbro" Roofing granules have been a byproduct of the Esc dido Quarries operation near Harmony Grove.

Pegmatite Deposits. The White Butte Pegmatite D posit, south of Boulevard, and the Rose Quartz Depos near Mesa Grande, have been worked for small qua tities of quartz for use as decorative stone in gardens a in walls. Other deposits that contain appreciable quan ties of quartz, some with a pale pink tinge, are describ herein under "Quartz and Quartzite."

Some types of pegmatite, especially "line rock," m prove desirable as decorative stone (see section on "Ge Minerals"). Pegmatite was used for this purpose in t construction of the Singing Hills Country Club.

Dumortierite-Bearing Rock. A dike-like body, sou of Alpine, that contains lavender dumortierite, is a po sible commercial source of decorative stone (see Dehe Dumortierite Deposit in section on "Kyanite, Sillimanit Andalusite, Dumortierite and Topaz").

Products and Marketing

The following sand and gravel, and crushed and br ken stone products were being marketed in San Dieg County in 1958: concrete aggregate, riprap, fill materi road base, roofing granules, drain rock and decorati stone.

***Aggregate** **

. large part of the processed sand and gravel, and shed stone produced in San Diego County is used as regate in portland cement concrete and bituminous crete (asphalt). A part of the processed sand pro- ed also is marketed as aggregate for interior plaster. The average price of fine aggregate (sand) marketed the county in 1957 ranged from $0.75 to $1.50 per , plus delivery charge. The Woodward Sand Com- y, however, was selling a relatively high quality plas- sand for $1.80 per ton. The Crystal Silica Company kets a very high quality plaster sand. In 1959, con- te sand produced at the Otay operation of Nelson Sloan was selling for $2 per ton, while plaster sand t was being produced cheaply by the same company m the Tia Juana River bed was sold for $1 per ton. st of the fine aggregate produced in the county con- s of processed sand obtained from river and streambed osits. A small proportion is obtained from the Poway nglomerate, and a very small proportion from the San ofre breccia, and from sandstone of Eocene age.

The following sizes of coarse aggregate, or coarse and e aggregate combined, are produced most commonly the county: ¾-inch to dust; ⅜-inch to ⅝-inch ("pea vel"); minus ⅝-inch to 1 inch (variously called ⅝- h or ¾-inch); 1 inch to 1½ inches; 1½ inches to 2½ hes; and 2½ inches to 3 inches (produced infre- ently). Only the five largest companies produce all of se sizes of aggregate. The sizes used most commonly portland cement concrete are ¾-inch to 1½ inches; d for bituminous concrete are ¾-inch to dust. In 1957 e price of coarse aggregate in San Diego County ranged m $1.50 to $1.80 per ton, plus delivery charge. Coarse gregate for use in portland cement concrete consists inly of processed gravel obtained from (1) the Poway nglomerate and its derivatives, and (2) riverbed de- sits. Aggregate for use in bituminous concrete consists inly of processed sand and gravel from the Poway nglomerate and its derivatives and crushed stone pro- ced from metavolcanic rocks. Some bituminous ag- egate is produced from riverbed deposits. Ideally, ushed stone is considered too harsh (too angular) for e as portland cement concrete aggregate, but a sub- ntial proportion of the crushed stone production of e operator in the county—Canyon Rock Company—is ed for this purpose. Most sizes of coarse aggregate pro- ced in the county consist chiefly of fragments with at st one artificially broken face.

The total production of aggregate of some companies, d a large proportion of some of the others, is used in jacent bituminous (black top) and portland cement ncrete mix plants. For example, H. G. Fenton Material mpany produces "Pre-Mixed Concrete" at its Mission Valley operation. Caudell and Johnson operates the San Diego Cement Company which produces "Transit-Mixed Concrete." Nelson and Sloan, and Sierra Sand Co., also produce portland cement concrete, and Daley and H. G. Fenton Co. produce bituminous concrete. Several independent producers of concrete or concrete products buy from adjacent producers of fine and coarse aggregate.

Riprap

In 1957, nearly 250,000 tons of riprap, valued at almost $1,000,000, was produced in San Diego County (San Diego County Division of Natural Resources, 1957, p. 20). During that year at least 95 percent of the stone produced was used in the Mission Bay Park Project to construct jetties and to cap or line the sides of man-made islands.

Fragment size and classification of stone used for riprap generally are different for each job. Classes A and B stone used for shore facing in the Mission Bay Park Project ranged in size as follows: Class A, 1 pound to 1½ tons; Class B, 1 pound to 3 tons; with specified percentages of sizes within the general classes. Blocks to face the Mission Park jetty ranged from 7 to 20 tons; the core of the jetty was constructed of quarry-run material, with the largest pieces as heavy as five tons.

During the 1950's, riprap also was used in San Diego County in construction of the 10th Avenue mole pier; the San Diego River Flood Control Project; Sutherland Dam north of Ramona; and in naval seafront projects. In 1957, J. R. Stringfellow Company, of Riverside, was the principal producer of riprap in the county.

In the past, large quantities of riprap have been used in construction of dams and for waterfront projects. Included with these are the Sweetwater Dam, 1887; El Capitan Dam, 1933-35; and the San Diego breakwater, 1894. For the breakwater, A. E. Babcock obtained riprap from a deposit of granitic rocks near Foster. The Simpson-Pirnie Company, which was active from 1887 to 1932, produced riprap and rubble as well as dimension stone (it is described in the section on "Dimension Stone"). National Quarries, Incorporated, one of the larger producers of dimension stone in the county, has sold granite for use as riprap in seafront projects at Camp Pendleton.

In San Diego County riprap is produced from quarries in granitic and metavolcanic rocks which generally are not far from the marketing destination of the product. In 1958 the principal sources of riprap in the county were the following quarries: Meadowlark Ranch, near Rancho Santa Fe; Canyon Rock Company, Mission Gorge; and Fletcher quarries, Mission Gorge (see description in accompanying tabulated list).

Riprap is quarried by use of various blasting techniques, including coyote hole blasting for obtaining larger material. The rock is loaded for transport with large tractors, shovels, and cranes. The cost of riprap depends on several factors, including size range, minimum and maximum sizes, and the variety of sizes of rock required. The average price of riprap in San Diego County in 1957 was about $4 per ton, including transportation and emplacement.

**Aggregate is divided into two principal size ranges: fine aggregate and coarse aggregate. Fine aggregate is composed of sand-size particles which range in diameter from 200-mesh to ¼-inch, and coarse aggregate is composed of particles larger than ¼-inch. Fine aggregate is subdivided into interior plaster sand (No. 4 to 0) and portland cement concrete sand (⅛-inch to 0). The range and proportion of sizes of fine and coarse aggregate for individual uses and jobs is determined by various sets of standard and special government and commercial specifications.

Sand and gravel, and crushed and broken stone.

MAP NO.	COMPANY AND OPERATIONS (OR DEPOSIT)	LOCATION	STATUS	HISTORY	GEOLOGY	SIZE OF EXCAVATION	PRODUCTS	MINING, PROCESSING, REFERENCES, OTHER DATA
362a	Acme Truck Co., 6979 Mission Gorge Rd., San Diego 10, Pit No. 1	NW.¼ SE.¼ Sec. 35, T. 15 S., R. 2 W., S.B.M. (proj.); about 3½ miles northeast of Grantville, on southeast side of Mission Gorge	Active (1958)		Partly decomposed granitic rocks	30 acres	Decomposed granite (DG)	Use portable equipment. Lease property from Fletcher Co.
362b	Pit No. 2	Center SE.¼ Sec. 27, T. 15 S., R. 1 W., S.B.M. (proj.); about 0.3 mile south of Santee	Active (1958)		Partly decomposed granitic rocks	10 acres	Decomposed granite (DG)	Use portable equipment. Lease property from Cameron Bros., Santee.
	American Sand Co.							See Denton Sand and Gravel Co.
	Babcock, A. E., Lawyers Block, Fourth and E, San Diego (1906)	S.½ SE.¼ Sec. 35, T. 14 S., R. 1 W., S.B.M.; about 3½ miles north-northwest of Lakeside, near Foster	No longer in business	Operated near turn of century	Light gray granitic rocks		Broken stone used for riprap	Stone quarried near turn of century for use as riprap in construction of San Diego breakwater. Deposits in this area later worked by Simpson-Pirnie, Southern California Granite Co., Cameron-Deering, National Quarries, and others for dimension stone. (Aubury 06:52).
	Beeler Canyon Sand and Gravel Co., Waldrip Eng. Co., Hollydale (1955)	Center Sec. 25, T. 14 S., R. 2 W., S.B.M.; 2 miles south of Poway, in Beeler Canyon	Ceased operation 1955	Operated 1954-55. Lease purchased by Caudell and Johnson	Alluvium derived from the Poway conglomerate			See Caudell and Johnson. (Lenhart 55b:96, 98).
	Bird Rock deposit	La Jolla (site)			Ocean beach		Beach pebbles	See section on "Abrasives."
363	Bryant, D. G., San Marcos	West edge SW.¼ Sec. 23, T. 11 S., R. 3 W., S.B.M.; about 4 miles east of Vista, at north end of Twin Oaks Valley	Active (1958)		Partly decomposed granitic rocks	5 acres	Decomposed granite (DG)	One employee. Leases property from Sheldon Merriam, Twin Oaks.
364	Calavera quarry owned by: G. M. Kelly, Room 1130, Bank of America Bldg., S.D. (1958)	On boundary between SE.¼ Sec. 34, T. 11 S., R. 4 W., and NE.¼ Sec. 3, T. 12 S., R. 4 W., S.B.M. (proj.); about 6 miles east-southeast of downtown Oceanside, on north side of Cerro de la Calavera (a prominent hill)	Inactive	Worked in late 1930's by Calavera Rock Co., Oceanside (J. S. Getty, Supt.)	Intrusive dacite, of Tertiary age. Rock is fine-grained, light greenish-gray, vesicular to amygdaloidal	Quarry, 800-ft. long, 200 ft. high	Crushed stone used for concrete aggregate and road base	Total production from this deposit probably is several thousand tons. In 1940 company moved operations to Carmean deposit, which see. (Larsen 51:35-36; Larsen and Switzer 39:562-568).

	Calavera Rock Co., Oceanside, J. S. Getty, Supt. (1946)	----------	----------	Operated from late 1930's to 1946, first at Calavera, then Carmean quarry	----------	----------	----------	See Calavera and Carmean quarries, herein.
365	California, State of; Division of Highways, 4075 Taylor St., San Diego 10 ("Conrad" pit)	NW.¼ NW.¼ Sec. 28, and SW.¼ SE.¼ Sec. 21, T. 16 S., R. 1 W., S.B.M.; about one mile south of Grossmont	Active (1958)	Owned by State since 1954	Partly decomposed granitic rocks	13 acres	Decomposed granite (DG) and broken stone for road base and fill	D8 dozer and ripper to grizzly, then on conveyor belt to vibrating screen to two bunkers. Used by various contractors holding State Highway contracts. Have scale house; all loads weighed.
366	Camp Pendleton	Center SW.¼ Sec. 5, T. 17 S., R. 6 W., S.B.M.; in San Mateo Canyon, about 4½ miles east of San Clemente	Active (1958)	----------	San Mateo Creek bed	20 acres	Sand and gravel	
	Campo Milling Corp.	Operated Pacific feldspar mill at Cameron Corners, near Campo	Ceased operations about 1952-53 (?)	Operated short period during early 1950's	----------	----------	Crushed stone for use as roofing granules and poultry grit	Managed first by T. J. Williams, then Farrar Matthews. Produced two types of chicken grit (one from granitic rocks and one from fossil shells obtained in Imperial Co.). Also worked crystalline limestone deposit at Dos Cabezas briefly.
	Canyon Rock Co.	----------	----------	----------	----------	----------	----------	Operated by V. R. Dennis, which see. (Tucker and Reed 39:49).
367a	Carlsbad Rock and Sand Co., P.O. Box 576, Carlsbad Sand operation	NE.¼ SW.¼ sec. 13, T. 11 S., R. 5 W., S.B.M.; about 3 miles east of Oceanside	Active (1959)	Started 1953	San Luis Rey River bed	5 acres (15 ft. deep)	Fill and plaster sand	Excavate and load with 1½-yard skiploader; truck 0.1 mile to plant. Dump through 4-inch grizzly. Belt conveyor to bucket elevator to 3-ft. × 6-ft. × 3/16-inch vibrating screen. Dry process. Hourly capacity 23 tons. One employee. Lease property from Earl D. and Ella D. Amsler.
367b	Decomposed granite pit	East edge SE.¼ SE.¼ sec. 33, T. 10 S., R. 4 W., S.B.M.; about 2 miles northeast of Mission San Luis Rey	Active (1958)	----------	----------	5 acres	Decomposed granite (DG)	
368	Carmean quarry	North edge SE.¼ SE.¼ sec. 10, T. 13 S., R. 3 W., S.B.M.; about 3 miles northeast of Rancho Santa Fe, on southwest slope of group of hills north of La Jolla Valley	Inactive since 1946	Worked by Calavera Rock Co. (J. S. Getty, supt.) from 1940-1946	Dense, grayish-green meta-andesite which is aphanitic in texture. Known as "greenstone." Rocks in face of quarry contain 2 sets of joints: one strikes N. 30° E., dips 60° N.; other strikes N. 80° E., dips 75°-80° N.	Cut, 150-ft. long, 50-ft. high	Crushed stone marketed for use as roofing granules	Patented land owned by Paul Carmean, Whittier (1939). Operation ceased because granules produced were not bright enough to compete at that time with artificially colored granules (J. Getty, oral communication, 1945). Thus the material had to be marketed in bulk for a very low price. Total production estimated from size of workings to be at least between 10,000 and 20,000 tons. (Tucker and Reed 39:51, pl. 1).

Sand and gravel, and crushed and broken stone.—Continued

MAP NO.	COMPANY AND OPERATIONS (OR DEPOSIT)	LOCATION	STATUS	HISTORY	GEOLOGY	SIZE OF EXCAVATION	PRODUCTS	MINING, PROCESSING, REFERENCES, OTHER DATA
	Caudell and Johnson, Box 3098, San Diego 3	See below	Active (1959)	See below	----------	----------	See below	One of three principal sand and rock producers in San Diego County.
369a	Mission Valley operation (Rock and sand plant) (see flow sheet in text)	S.½ sec. 13, T. 16 S., R. 3 W., S.B.M. (proj); Pueblo lots 1108, 1109, 1183, San Diego Mission Lands; in Mission Valley, about 1½ miles northeast of interchange between U.S. Highways 80 and 395	Active (1959)	Started 1937	Poway conglomerate (clay overburden averages 3-ft. thick. Some decomposed rock)	100 acres	Concrete sand and crushed gravel (all standard sizes rock, ¼-inch to 2 inches, for use as aggregate); 3-inch rock on demand	Mined with tractors and rippers. Carryalls to grizzly, then through primary and secondary jaw crushers. Minus 1¼-inch rock washed to rid of excess clay and silt fines. Then all rock conveyed by belt to plant in valley below. At plant, material through 4¼-inch Symons cone crusher, then through rolls. Fines to 4-ft. Symons short head crusher. Through washer to stockpiles over tunnels. Conveyor to bunkers. Hourly capacity 150 tons; 100 employees; use 2 wells, plus ponds and float pumps. Aggregate test data: Average spec. gravity 2.62. L. A. rattler: 100 RPM, 5% loss; 500 RPM, 20% loss; absorption less than 1%. (Tested 1½ inches and ¾-inch rock).
369b	Mission Valley operation (sand plant)	N.½ sec. 24, T. 16 S., R. 3 W., S.B.M. (proj); portion Pueblo lots 1108, 1109, 1183, San Diego Mission Lands; Mission Valley, about one mile northeast of interchange between U.S. Highways 80 and 395	Active (1959)	Started 1957	San Diego River bed (some mud lenses in sand)	10 acres	Fill, concrete, and plaster sand	¾-yard dragline to 20-ton tournawagons. Haul maximum of ¼ mile to plant. Dump on grizzly which removes the few large rock fragments and roots. Conveyor to 1 double and 2 single sand wheel units. Held in stockpile, over tunnel feeders to bunkers. Hourly capacity 100 tons; 5 employees. Water from float pump. Excavated pits are refilled with discarded fines.
369c	Carroll Canyon operation	Portion secs. 1 and 2, T. 15 S., R. 3 W., and sec. 6, T. 15 S., R. 2 W., S.B.M.; 8 miles northeast of La Jolla	Active (1959)	Started 1953	Alluvium in Carroll Canyon derived from Poway conglomerate	10 acres	Crushed gravel for use as road base (1½ inches minus, and ¾-inch minus)	One yard shovel to carryalls to plant. Dump on 12-inch grizzly. Dry process. Through 20-inch × 36-inch jaw crusher to Traylor gyratory to 20-inch × 54-inch rolls. Conveyor to bunker. Electric power for plant from 75-kw generator except for the gyratory crusher (one GMC diesel) and the rolls (2 GMC diesels). Hourly capacity 120 tons; 5 employees.

369d	Poway operation	Secs. 21 and 22, T. 14 S., R. 2 W., S.B.M.; about 3 miles west of Poway, in Los Penasquitos Canyon	Active (1958)	Started 1946. In early 1958 was obtaining raw material from Beeler Canyon, but was preparing to open deposit near plant. Have ten-year lease on 1200 acres at Poway site	Poway conglomerate and alluvium derived from Poway	30 acres (Beeler Canyon)	Concrete sand and crushed gravel (standard sizes rock for use as aggregate)	One yard shovel to 20-ton bottom dump truck and trailer. Haul 3 miles to plant (4 trucks operating in early 1958). Dump on stockpile. Dozer pushes on 14-inch grizzly. Trommel scrubber removes sand. Then to 16-inch × 38-inch jaw crusher. Then through log washer to 3-foot Symons cone crusher to sizing screens. Use 16-inch × 30-inch rolls to balance sizes. In 1958 installed extra washing units to handle hillside deposits. Hourly capacity 150 tons; 11 employees. Water from well and holding basin.
369e	San Diego Cement Co. operation	West edge Sec. 36, T. 16 S., R.1W., S.B.M. (proj); junction Jamacha Road and State Highway 94, Jamacha Jct.	Active (1959)	Purchased from Fletcher Co. 1956	Partly decomposed granitic rocks	3 acres	Decomposed granite for use as "drain rock" (1½ inches minus) and road base (¾ inch)	Dozer with ripper excavates and pushes material into piles; then tournadozer pushes across quarry to stockpile. D-4 dozer pushes 7-inch grizzly. All stone over 7 inches to dump for reject. The rest is conveyed to vibrating screen. Minus ¾-inch to bunker. Plus 1½-inch through 8-inch × 32-inch jaw crusher. Returned through screen. Hourly capacity 150 tons; 6 employees.
	Conrad pit							See California, State of.
370	Coston Construction Co. P.O. Box 697, Lakeside	Near Center E.½ E.½ Sec. 23, T. 15 S., R. 1 W., S.B.M. (proj); In block 12, Lots H and O, El Cajon Valley Lands; about 1½ miles west of Lakeside	Active (1958)	Started 1951	Partly decomposed granitic rocks	One acre	Decomposed granite (for use as fill in company construction jobs only)	D-8 dozer and ripper. Skiploader to trucks.
371	Cowdrey, E. E. 901 Vista Way, Vista	Along boundary common to Secs. 25 and 26, T. 11 S., R. 4 W., S.B.M.; about one mile southwest of Vista, at corner of Vista Way and Copper Ave.	Active (1958)	Started 1951	Partly decomposed granitic rocks	10 acres total	Decomposed granite for use as fill	Company also produces blacktop.
	Crystal Silica Co.	Oceanside					Plaster and Specialty sands	See text under "Specialty sands."
372	Daley Corporation P.O. Box 4067, San Diego 4	Secs. 5 and 8, T. 16 S., R. 2 W., S.B.M. (proj); Lot 41, Rho Mission; about one mile northwest of Grantville, in Murphy Canyon	Active (1959)	Started at present site in 1913 as Mission Rock Co. Moved plant to present site from Mission Valley in 1958	Poway conglomerate	140 acres total	Crushed gravel: 60% minus ½ inch; 40% ½ inch to 1¼ inches for blacktop plant	Carryalls and tractor scrapers to plant. Through jaw crusher. Wash, screen, crushers, dry screen. Hourly capacity 80 tons; 9 employees. Operate blacktop plants. Water from wells in Murphy Canyon and float pump on pond. (Merrill 14:681-682; Tucker 25:377; Tucker and Reed 39:49, pl. 1).

Sand and gravel, and crushed and broken stone.—Continued

MAP NO.	COMPANY AND OPERATIONS (OR DEPOSIT)	LOCATION	STATUS	HISTORY	GEOLOGY	SIZE OF EXCAVATION	PRODUCTS	MINING, PROCESSING, REFERENCES, OTHER DATA
	Dennis, V. R. P.O. Box 3158, San Diego 3							
373a (plant) 373b (quarry)	Canyon Rock Co. (Plant and Quarry)	Sec. 3, T. 16 S., R. 2 W,. S.B.M. (proj); portion Blocks 61, 62, and 63, Mission Lands; about 2 miles northeast of Grantville, in Mission Gorge area	Active (1959)	Started at present location in 1929	Massive metavolcanic rocks of Santiago Peak series	Quarry 750-ft. long, 150-ft. high	Crushed stone (all standard sizes of rock for use as aggregate) and broken stone for use as riprap (up to 6 and 7 tons). Concrete sand	Nine-inch churn drill holes 150 feet deep, loaded with 40% powder; 20% secondary blasting. Loaded by 1½- or 2-yard shovel into 20-yard pit trucks. Haul ⅓ mile to surge pile. Through 40-inch × 48-inch jaw crusher to stockpile. Screened to plus 2½ inches, and this through 18-inch × 36-inch double jaw crusher; minus 2½-inch classified to ¾-inch minus. Oversize to 4-foot Symons fine bowl crusher; minus through log washer, classified and stockpiled. Sand from pit (see below) fed in at this point (after log washer). Sand through screw washer and stockpiled. Material loaded into trucks for transport by skiploader. Hourly capacity 200 tons; 40 employees (25 in plant and quarry, 2 at sand operation). Have soil pit on property for blending with rock to make concrete road base. Stone weighs 138 pounds per cubic foot. Water from ponds—700 gallons per minute into plant. (Tucker and Reed 39:49).
373c	Dennis, V. R. (cont.) (Sand pit)	Secs. 3 and 4, T. 16 S., R. 2 W., S.B.M. (proj.); about 1½ miles northeast of Grantville			San Diego River bed	10 acres in ponds	See above	Two-yard dragline; work to 8 ft. below water level. Trucks haul 1 or less mile to plant. (See above.)
373d	Santee Materials	SE.¼ SW.¼ Sec. 22, T. 15 S., R. 1 W., S.B.M. (proj); on northwest edge of Santee, on Edgemoor farm (lease property from County)	Active (1958)	Started 1950	San Diego River bed	5 acres	Concrete sand (65%) and plaster sand (35%)	One-yard dragline working 8 ft. deep, above water level. Transport by 6-yd. pit trucks ¼ mile to plant. Dump on 4-in. grizzly; then to feed hopper over belt to 5-ft. × 10-ft. vibrating screen; then to paddle washer to stockpile. Change screen to run different grade of sand. Sand loaded from stockpile by 1-yd. skiploader. Hourly capacity 35 tons; 4 employees. Water from well and pond. Only problem, small proportion rock fragments and roots.

	Denton Sand and Gravel Co., 6225 Fairmount Extension, San Diego							
374a	American Sand Co.	Southeast edge Sec. 8, T. 16 S., R. 2 W., S.B.M. (proj.); lots 1 to 7, Block 5; on west edge of Grantville	Active (1958)	Started 1951	San Diego River bed	4 acres	Plaster sand	¾-yd. dragline to 6-yd. trucks which haul ¼ mile to plant. Dump over grizzly to 4-ft. × 8-ft. vibrating screen operated dry. Then through washer to stockpile over tunnel. Elevated to bunker over final screen. Hourly capacity 50 tons; 3 employees. Sell by yard, do not use scales.
374b	Dehesa operation	Center west edge Sec. 15 and east edge Sec. 16, T. 16 S., R. 1 E., S.B.M.; about 1½ miles west of Dehesa	Active (1958)	Since 1948 leased from owners of Elliot Ranch	Sweetwater River bed	5 acres	Concrete sand	¾-yd. dragline to conveyor; sand passes over vibrating screen to bunker by elevator. Hourly capacity 35 tons; one employee. Property lease based on cu. yds. sand removed, not specific area.
375	Dulzura deposit. Owner undetermined	Near center Sec. 22, T. 18 S., R. 2 E., S.B.M.; Dulzura district, about 3 miles south Engineer Springs	Inactive (1957)	Prospected only, no production	Metavolcanic rocks are altered hydrothermally and colored yellow-brown to brick-red. Most of rock is soft, but some is silicified and perhaps useable as decorative stone	Two, adjacent, shallow trenches 200 ft. long and 20 ft. wide	Possible source decorative stone	
	Einer Brothers Escondido							
376a	San Pasqual pit	SW.¼ SW.¼ Sec. 30, T. 12 S., R. 1 W., S.B.M.; about 3½ miles southeast center of Escondido	Active (1958)	----------	Partly decomposed granitic rocks	10 acres	Decomposed granite (DG)	Own 30 acres.
376b	San Marcos pit	Sec. 11, T. 12 S., R. 3 W., S.B.M. (proj.); ¼ mile north of San Marcos post office	Active (1958)	----------	Partly decomposed granitic rocks	Small	Decomposed granite (DG)	Lease land from Jack Sheeter, San Marcos.
376c	Poway pit	Southwest corner of NE.¼ SW.¼ Sec. 14, T. 14 S., R. 2 W., S.B.M.; about 2 miles west of Poway	Active (1958)	----------	Partly decomposed granitic rocks	5 acres	Decomposed granite (DG)	Lease land from owners of DeJong dairy.
377	El Cajon Sand and Gravel Co.	SE.¼ NW.¼ Sec. 23, T. 15 S., R. 1 W., S.B.M. (proj.); on southeast side of hill in Mission Valley, about 1 mile northeast of Santee	Ceased operation in 1955	----------	Small hill composed of granitic rocks surrounded by alluvium	----------	Sand and crushed stone	Small operation.

Sand and gravel, and crushed and broken stone.—Continued

MAP NO.	COMPANY AND OPERATIONS (OR DEPOSIT)	LOCATION	STATUS	HISTORY	GEOLOGY	SIZE OF EXCAVATION	PRODUCTS	MINING, PROCESSING, REFERENCES, OTHER DATA
378	El Capitan quarry	SE.¼ Sec. 1, T. 15 S., R. 1 E., S.B.M.; about one mile west-northwest of El Capitan dam	Inactive since 1935	Operated 1933-35, during construction of El Capitan dam	Light-gray quartz diorite	Quarry 800-ft. long, 200-300-ft. high	Broken stone for use in construction of dam	Probably owned by City of San Diego.
	Escondido Rock and Sand Co., 333 N. Cedar St., Escondido	Sec. 30, T. 12 S., R. 1 W., S.B.M.; about 3½ miles southeast of the center of Escondido	Active (1958)	----------	----------	5 acres	Decomposed granite (DG)	Lease 30 acres from owners of Cloverdale Ranch.
379a	Escondido Sand and Gravel Works, Rt. 3, Box 18, 440 N. Tulip St., Escondido	Plant: Center NW.¼ Sec. 21, T. 12 S., R. 2 W., S.B.M. (proj.); Lots 1 and 2, Block 315, Rancho Rincon del Diablo; about 1¼ miles west Escondido City Hall	Active (1958)	In operation since 1911, when product was unprocessed river bottom sand. Present operation since 1951	----------	----------	See below	See below.
379b	Sand pit	E.½ E.½ Sec. 35, T. 10 S., R. 3 W., S.B.M.; about 10 miles northwest of Escondido, adjacent to U. S. Highway 395	Active (1958)	----------	Moosa Canyon stream bed	5 acres (10 acres under lease)	70% plaster sand: 30% concrete sand	Excavate stream bed to depth of 15 ft. (above water level). ¾-yd. dragline to 10-yd. trucks (or 20-yd. doubles) which haul 12 miles to plant. At plant through 4-ft. × 10-ft. and 2-ft. × 8-ft. Symons screens; then through screw-type washer to stockpiles. To loading bunkers by elevator. Hourly capacity 12 tons; 7 employees. (Undetermined 57:32).
379c	San Pasqual pit	South 30 acres of SW.¼ SW.¼ Sec. 30, T. 12 S., R. 1 W., S.B.M.; about 3½ miles southeast of center of Escondido	Active (1958)	Since 1953	Partly decomposed granitic rocks	Small cut	Decomposed granite (DG)	Small operation. Use tractor scraper.
379d	Los Penasquitos Canyon deposit	NE.¼ Sec. 26, T. 14 S., R. 2 W., S.B.M.; about 2 miles southwest of Poway, in Los Penasquitos Canyon	Inactive (1958)	----------	Alluvium derived from Poway conglomerate	7 acres	----------	Company not producing gravel products in 1958. Purchasing them from Caudell and Johnson.
380	Evans Point deposit	NW.¼ Sec. 15, T. 12 S., R. 4 W., S.B.M. (proj.); about 4 miles southeast of Carlsbad	Operated intermittently (1958)	----------	Greenish-gray metavolcanic rocks	----------	Ornamental stone, some riprap	Operators undetermined.

	Fenton, H. G., Material Co., 702 W. Washington St., San Diego 3	See below	Active (1959)	Before 1930's known as Fenton-Parker Material Co. which was formed by merger of Fenton-Sumption-Barnes and Independent Stone Co. in early 1920's.			See below	One of the three principal rock producers in San Diego Co. (Lenhart 53:104-105; Merrill 14:680-681; Tucker 21b:383; 25:377; Tucker and Reed 39:49-50, pl. 1).
381a 381b 381c	Mission Valley operation Plant Sand and gravel source Sand source	Sec. 18, T. 16 S., R. 2 W., S.B.M. (proj.); partition of Lot 36, Rancho Mission; about 2 miles west-southwest of Grantville, on north side of Mission Valley	Active (1959)	Started 1940	Poway conglomerate and San Diego River bed	75 acres	Concrete sand and crushed gravel (standard sizes rock for use as aggregate)	Quarry-like working in steep-walled canyon. Bench, drill, and shoot conglomerate; 1½-yd. shovel loads on pit trucks which dump on edge of cliff from where dozer shoves material over, and in front of hydraulic monitor below. Monitor (200 g.p.m., 200 lb. pressure) breaks up clay balls and washes away most fines. Then material picked up with dragline, trucked in 16-ton pit trucks ¼ mile to plant. Dumped through 12-in. grizzly to 15-in. × 28-in. jaw crusher, then to scrubber and screens. Oversize to gyratory crusher, rest to Symons crusher. Washed, screened, stockpiled. Some crushed gravel screened for various sized products used in adjoining branch of Pre-Mixed Concrete Co. Sand from river bed loaded into 12-ton pit trucks by ¾-yd. dragline, trucked ¼ mile to plant. At plant sand is fed into sand washer, screened, stockpiled. Hourly capacity 175 tons; 44 employees.
381d	Murray Canyon operation (see flow sheet in text)	SE.¼ Sec. 14, T. 16 S., R. 3 W., S.B.M. (proj); Pueblo Lot 1187, Mission Lands, San Diego; Murray Canyon, about one mile northeast of interchange between U.S. Highways 80 and 395	Active (1959)	Started 1923	Poway conglomerate	60 acres	Crushed gravel (¾ inch to dust; used entirely as aggregate in blacktop plants); also fill material	Use dozer and ripper where necessary; 2½-yard shovel to 22-ton pit truck, ⅛ mile to plant; dump on 12-inch grizzly; to screens: (1) minus ½-inch out, for fill material; (2) minus 2-inch, plus ½-inch to 5½-foot Symons short head cone crusher; (3) plus 2-inch to 15-inch × 38-inch jaw crusher, then to 4¼-foot Symons cone crusher. From two crusher units above to screens: minus 1-inch out, to final screens; plus 1½ inch to 4-foot Symons short head cone crusher and plus 1-inch, minus 1½-inch to 3-foot Symons short head crusher, and recycled in closed circuit; to final screens. A dry operation. Hourly capacity 200 tons; 17 employees.

Sand and gravel, and crushed and broken stone.—Continued

MAP NO.	COMPANY AND OPERATIONS (OR DEPOSIT)	LOCATION	STATUS	HISTORY	GEOLOGY	SIZE OF EXCAVATION	PRODUCTS	MINING, PROCESSING, REFERENCES, OTHER DATA
381e	Carrol Canyon operation	S.½ Sec. 2, T. 15 S., R. 3 W., S.B.M.; about 1½ miles northeast of Linda Vista siding	Active (1958)	Started 1958	Alluvium derived from nearby exposures of Poway conglomerate (Poway conglomerate in walls of canyon contain too high percentage fines for present processing system)	Pits in stream-bed (about 100 acres)	Concrete sand and crushed gravel (standard sizes of rock for aggregate)	Have 300 acres of property. 1½-yard dragline to 10-yard truck to 12-inch grizzly. Then to 15-inch × 28-inch jaw crusher to 4-foot × 12-foot screen, to 3-foot short head and 4-foot standard Symons crushers; then to 4-foot × 12-foot screen; washed; by conveyors to stockpiles over tunnels. Material is elevated to overhead concrete batch mixer which dumps into trucks. Water from well in stream bed. Hourly capacity 150 tons; 8 employees.
381f 381g	Otay operation (No. 1) Plant Deposit	Plant: N.½ NW.¼ SW.¼ Sec. 22, T. 18 S., R. 2 W., S.B.M.; about ½ mile southwest of Otay	Active (1959)	Since 1918	Otay River bed	200 acres	Concrete sand and crushed gravel (standard sizes of rock for aggregate)	In 1958 source of sand was about 3 miles east of plant, in Sec. 19, T. 18 S., R. 1 W., S.B.M.; haul to plant, dump on 15-inch grizzly; grizzly to 22-inch × 36-inch jaw crusher, then to 4-feet × 12-feet screen. Wash, then split 3 ways: (1) to 3-foot short head Symons crusher, (2) to 3-foot standard Symons, and (3) to 4-foot Symons Standard cone crusher in closed circuit. Stockpiled over tunnel. Hourly capacity 200 tons; 22 employees. Water from well.
381h	Monarch Materials Co.	Plant: NE.¼ Sec. 25, T. 15 S., R. 2 W., S.B.M. (proj); about 4 miles northeast of Grantville, just northeast of the head of Mission Gorge.	Active (1959)	Started 1954		200 acres (total)	Concrete and plaster sand and crushed gravel (standard sizes of rock for aggregate)	See below.
381i	Source of both sand and gravel	S.½ Sec. 20, T. 15 S., R. 1 W., S.B.M. (proj); about 2 miles east-northeast of plant			Alluvium and dissected alluvium derived mainly from Poway conglomerate (60% gravel, 40% sand)		See above	Work deposit to water level (blue clay just below, at 15 feet). 2½-yard dragline to 10-yard pit trucks. Haul 2 miles to plant. At plant material dumped onto 12-inch grizzly, then to hopper, and to 15-inch × 38-inch jaw crusher. Then to 4-feet × 12-feet screen, and initial wash. Oversize to 3-foot standard size Symons crusher, then to final screen and wash. Then to Symons in closed circuit. Sand from river bed deposit constitutes principal source of sand. Hourly capacity 200 tons; 19 employees. McCoy Redi-Mix buys gravel, but has own source

381]	Source of sand only	NE.¼ Sec. 36, T. 15 S., R. 1 W., S.B.M. (proj); about ½ mile east of plant						
	Chollas Valley operation	About 3 miles east downtown San Diego	Not operated since 1940's	Operated in 1930's and 1940's	Chollas Valley Creek bed (?)		Sand and gravel	
	Fenton-Parker Materials Co.							See H. G. Fenton Material Co. and Independent Stone Co. (Tucker 25:377, 378; Tucker and Reed, 39: pl. 1).
	Fenton-Sumption Barnes Co.			See last column				Formed about 1912 and produced sand and gravel from Otay, Tia Juana and beds of other rivers. H. G. Fenton was president. The company was merged with the Independent Stone Co. in early 1920's to become Fenton-Parker Materials Co., now known as H. G. Fenton Material Co., which see. (Merrill 14:680-681; Tucker 21b:383).
382a	Fletcher Quarries, Ed Fletcher Co., 2340 Fletcher Way, El Cajon	W.½ Sec. 35, T. 15 S., R. 2 W., S.B.M. (proj.); Lot D and portion Lot C, Block 70, Referee partition, Rho Mission; about 3½ miles northeast of Grantville, in Mission Gorge	Active intermittently (1959)	Operated since 1947 by various contractors, most recently by J. R. Stringfellow, Riverside	Mainly metavolcanic rocks of Black Mountain series; some granitic rocks of Cretaceous age in northeast part of property	Five large quarries which average 550 ft. long and 100 ft. wide (1958)	Broken stone, 50 pounds to 15 tons, used as riprap	Use various quarry methods. Some coyote hole blasting for recovery of large fragments. Also use churn drill benching and blasting. Stone loaded onto trucks for transport with shovel or dragline and skips. Most of the rock produced here used in Mission Bay Park project for construction during 1956-57 of three jetties and the 10th avenue mole pier.
382b	DG pit	SE.¼SE.¼ Sec. 15, T. 14 S., R. 2 W., S.B.M.; about 2 miles west of Poway, on northside of Los Penasquitos Canyon	Inactive since 1948		Partly decomposed granitic rocks		Decomposed granite (DG)	
383	Foster quarry	South edge SE.¼ Sec. 35, T. 12 S., R. 3 E., S.B.M.; about 2¼ miles west of Julian, north of State Highway 78	Inactive (1957)	Operated briefly during mid-1950's by A. G. Foster, Julian	Granitic rocks	Small quarry	Crushed stone used for road base	
384	Golden, Kenneth H., Co., Inc., 1367 Sixth Ave., San Diego 1	South edge SW.¼ Sec. 35, T. 15 S., R. 2 W., S.B.M. (proj.); about 3 miles northwest of Grantville, in Mission Gorge area	Active (1959)	Started 1953	Metavolcanic rocks of Black Mountain series. Have adjoining decomposed granite pit not being operated in 1957	40 acres	Crushed stone (stockpile 3 sizes, all to blacktop plant: 0-4 mesh; 4 plus to ½-in.; ½- to ¾-in.). Also produce cement-treated road-base	Wagon drill, shoot, and shove with dozer to 26-in. grizzly. Use breaking ball on quarry oversize. From grizzly to 30-in. × 42-in. jaw crusher; conveyor to 18-in. × 30-in. jaw, to 3-ft. standard Symons, to 4-ft. × 14-ft. screen. Oversize ¾-in. rock to 3-ft. short head Symons crusher and return through screen to stock pile, over tunnel. Conveyors to hot plant. Hourly capacity 100 tons; 4 employees. Buy D. G. from outside. Water from well 800-ft. deep.

Sand and gravel, and crushed and broken stone.—Continued

MAP NO.	COMPANY AND OPERATIONS (OR DEPOSIT)	LOCATION	STATUS	HISTORY	GEOLOGY	SIZE OF EXCAVATION	PRODUCTS	MINING, PROCESSING, REFERENCES, OTHER DATA
385	Goodman and Son, Lakeside	NE.¼NE.¼ Sec. 31, T. 15 S., R. 1 E., S.B.M.; about 2 miles south of Lakeside	Active intermittently (1958)	----------	Partly decomposed granitic rocks	Small	Decomposed granite (DG)	Lease property. All portable equipment.
386	Greenstone quarry	SW.¼SW.¼ Sec. 11, T. 13 S., R. 3 W., S.B.M.; about 3 miles northeast of Rancho Santa Fe, on southwest slope of group of hills north of San Dieguito River	Inactive since 1940's (?)	Probably worked for short period during 1940's, perhaps by Calavera Rock Co., which see	Dense, gray-green meta-andesite which is aphanitic in texture. Rock is known commercially as "greenstone"	Small	Crushed stone used as roofing granules	Owned by G. L. Dodds, Escondido, in 1939. About ¼-mile southeast of Carmean quarry, which see also. (Tucker and Reed 39: 51).
387	Gross Sand Co., P.O. Box 623, Lakeside	East edge SE.¼ Sec. 13, T. 15 S., R. 1 W., S.B.M. (proj.); portion Lot 107 and all Lot 108, Lakeside Farms; ½ mile northwest of Lakeside	Active (1958)	Started 1956	San Diego River bed (deposit contains some layers of clay)	15 acres (maximum depth of 40 ft.)	Plaster and concrete sand produced in equal amounts	½-yd. skiploader to 5-yd. truck; short haul, dump into hopper. Conveyor to 3-ft. × 10-ft. 2-deck screen. Sand washed and screened. Then to sand wheels, to conveyor, to stockpile. Run each grade of sand separately. Elevator from stockpile to bunker. Hourly capacity 10 tons; 2 employees. Water from well, reclaimed in settling pond. No scales, sell by load.
	Grove, C. B., 3216 Island Ave., San Diego 2	Center SE.¼SE.¼ Sec. 24, T. 16 S., R. 1 W., S.B.M.; about 3 miles southeast of El Cajon, adjacent to Jamacha road	Active (1958)	----------	Partly decomposed granitic rocks	12 acres	Decomposed granite (DG)	Dozer with ripper to grizzly. To portable screens and elevators which also are used at other deposit. Leased from Kelly Yount, El Cajon, on the basis of royalty of 12 cents a yard.
388a	Pit No. 1							
388b	Pit No. 2	NW.¼ NW.¼ sec. 10, T. 14 S., R. 2 W., S.B.M. (proj); about 3 miles west of Poway, and ½ mile east of U.S. Highway 395	Active (1958)	Started 1957 (?)	Partly decomposed granitic rock	5 acres	Decomposed granite (DG)	Same as above. Lease on royalty basis from owners of Sawday and Sexon ranches.
389	Hatfield Creek quarry Ownership undetermined (1958)	Center W.½ SW.¼ sec. 7, T. 13 S., R. 2 E., S.B.M.; about 2¾ miles east-northeast of Ramona, adjacent to State Highway 78	Inactive since 1951	Opened in 1920 as source of road base for new route of Highway 78. Also in 1920's rock from quarry used in construction of Sutherland dam. From 1946 to 1951 worked by Alfred Lewis as source of roofing granules	Light-gray granitic rocks	Small quarry	Crushed stone for use as roadbase, roofing granules, and poultry grit; broken stone for use as riprap	

390	Hester's Granite pit Leland Hester Rt. 2, Box 884, El Cajon	Portion of tract 1556, NW.¼ SW.¼ sec. 21, T. 16 S., R. 1 E., S.B.M.; about 5 miles southeast of El Cajon, on north side Sweetwater River Canyon	Active (1958)	Started 1947	Partly decomposed granitic rocks	[illegible]	[illegible] granite (DG); oversize used as fill	Owns 300 acres.
391	Hillside Materials L. W. Mitchell 3481 Glen Dr., Spring Valley	SE.¼ SW.¼ sec. 31, T. 16 S., R. 1 E., S.B.M.; about 1½ miles southeast of Jamacha Jct.	Active (1958)	Started 1954	Partly decomposed granitic rocks	14 acres	Decomposed granite (DG) for fill and other uses	D-4 ripper to grizzly. Doze over grizzly. Material used for fill is screened. Property leased from L. C. Farmer.
	Independent Stone Co., G. L. Parker, pres. 713 American Nat. Bank Bldg. San Diego (1921)	See below	Dissolved early 1920's	Operated mainly in 1910's; merged with Fenton-Sumption-Barnes in early 1920's to become Fenton-Parker Materials Co. which is now H. G. Fenton Material Co.	See below		See below	Chief advantage of both deposits described below was their proximity to the railroad. (Merrill 14:676-677, 680; Tucker 21b: 383; Tucker and Reed 39:50, pl. 1).
392a	Crushed stone operation (Spring Valley quarry)	Center E.½ sec. 30, T. 16 S., R. 1 W., S.B.M.; in Spring Valley, about ½ mile west of junction of State Highways 94 and 67			Metavolcanic rocks of Black Mountain series	Quarry 250 ft. long, 100 ft. high	Crushed stone used as aggregate and probably other uses	Produced 75,000 tons of crushed stone each year at peak of production.
392b	Sand operation	SW.¼ sec. 36, T. 14 S., R. 1 W., S.B.M. (proj); about ½ mile south-southeast of Foster, at north end of El Cajon Valley			Bed of tributary of San Diego River	Shallow excavations	Sand	Produced 40,000 tons sand each year at peak of production.
393	Jamacha Sand Plant Rt. 1, Box 653, El Cajon	NW.¼ NE.¼ sec. 31, T. 16 S., R. 1 W., S.B.M.; about 1½ miles east of Jamacha Jct.	Active (1958)	Started 1906; at present site since 1956	Sweetwater River bed	2 acres	Plaster sand (70%) and concrete sand (30%); and "Birdseye rock" (3/16-inch) for aggregate in cement blocks	¾-yard dragline to pit truck; 300 feet haul to plant. Dump over grizzly to 5-ft. × 8-ft. vibrating screen: oversize (3/16-inch average) to bin, rest through screw washer to open stockpile. Trucks are loaded with ⅜-yard skiploader. Hourly capacity 70 tons; 5 employees. Water supply from floating pump on pond.
394	Knox, John, Vista	Center N.½ Sec. 19, T. 11 S., R. 3 W., S.B.M.; west of Vista, on south side of Vista Way	Active (1958)			Small pit	Decomposed granite (DG) for fill and other uses	
	Lee, Ted, Vista	Sec. 19(?), T. 11 S., R. 3 W., S.B.M.; about ½ mile northeast of center of Vista, at corner Vista Way and Anza	Active (1958)			Small pit	Decomposed granite (DG)	

Sand and gravel, and crushed and broken stone.—Continued

MAP NO.	COMPANY AND OPERATIONS (OR DEPOSIT)	LOCATION	STATUS	HISTORY	GEOLOGY	SIZE OF EXCAVATION	PRODUCTS	MINING, PROCESSING, REFERENCES, OTHER DATA
395	Marron quarry, Abe Marron, Vista (owner)	E.½ NE.¼ Sec. 33, T. 11 S., R. 4 W., S.B.-M. (proj.); about 5 miles east of downtown Oceanside	Inactive (1959)	Worked in 1957 by J. R. Stringfellow	Granitic rocks related to Santiago Peak volcanics	Quarry face 100 ft. long, 80 ft. high	Broken stone 5 pounds to 10 tons for use as riprap	Operator used coyote hole blasting with equipment listed under "Stringfellow." Operation was moved to Meadowlark Ranch deposit in late 1957 because Marron deposit would not easily yield blocks larger than 10 tons, and 20-ton blocks were needed for construction of a jetty. While operating this deposit, company produced as much as 100 tons of stone per hour; 10 employees.
	McGrath, C. W., 5402 University Ave., San Diego							
396a	Pit No. 1	South edge SE.¼ SE.¼ Sec. 24, T. 16 S., R. 1 W., S.B.M.; about 3 miles southeast of El Cajon	Active intermittently (1958)	Started 1954	Partly decomposed granitic rocks	52 acres	Decomposed granite (DG)	Dozer and ripper to grizzly, then to screen. Oversize rejected. Load with skiploader. Property leased from a Mr. Parsons.
396b	Pit No. 2 ("Tunnel Hill" pit)	NE.¼ NE.¼ Sec. 31, T. 15 S., R. 1 E., S.B.M.; about 2 miles south of Lakeside	Active (1958)	Started 1951	Partly decomposed granitic rocks	18½ acres	Decomposed granite (DG)	Processed as above. Portable equipment.
397	McGuffie Foundation deposit	West edge SW.¼ NW.¼ Sec. 4, T. 18 S., R. 8 E., S.B.M.; on northeast side of Jacumba Valley, about 1½ miles northeast of Jacumba	Inactive (1959)	McGuffie Foundation (Fred W. Kearney, mgr.) worked deposit 1955-56	Red, volcanic cinders	Shallow pit	See column to right	Several hundred tons marketed as an "agricultural mineral" under name "Cal-mag" before State Bureau of Chemistry ruled that material could be sold only as a "soil amendment."
398	Meadowlark Ranch quarry J. R. Stringfellow Co., P.O. Box 6, Riverside	S.½ NE.¼ Sec. 29, T. 12 S., R. 3 W., S.B.-M.; about 6 miles north of Rancho Santa Fe, on San Marcos Creek	Active intermittently (1958)	Opened 1957 by Stringfellow	Massive, fine-grained granitic rocks	Quarry face 650-ft. × 85-ft. (1958)	Broken stone in fragments 5 pounds to 20 tons, used as riprap	Use coyote hole blasting with equipment listed under "Stringfellow" herein. Stone used in Mission Bay Park project; 22 men employed. Hourly capacity 250 tons. Property (50 acres) purchased in 1957 from owners of Meadowlark Ranch.
	Mission Rock Co.							Started operation in Murphy Canyon in 1913; L. T. Daley, president. Present operation described under Daley Corporation. (Merrill 14:681-682.)
	Mission Sand Co.	Mission Valley						See under "Nelson and Sloan."
	Momand, John							See Ponto Beach deposit.
	Monarch Materials	El Cajon Valley						

	Inc.						tive stone and riprap	also produces some "black granite" for use as decorative stone; and has sold moderate tonnages of black granite for use as riprap in sea front projects at Camp Pendleton.
	Nelson and Sloan, P.O. Box 488, Chula Vista	----------	----------	----------	----------	----------	----------	One of the three principal sand and rock producers in county.
399a	Otay operation	Plant: SE.¼NE.¼ Sec. 22, T. 18 S., R. 2 W., S.B.M.; Blocks 19 and 20, Bruchall's Addition, Township of Otay; less than ¼ mile southwest of center of Otay	Active (1959)	Continuous operation since 1923	See below	See below	Concrete and plaster sand; crushed gravel (standard sizes rock for aggregate). (⅜ in. minus and 7/16 in. minus to hot plant). Crushed gravel consists of about ⅕ to ⅓ naturally rounded material	At plant sand and gravel dumped through hopper to 15-in. × 30-in. jaw crusher to surge pile, to 3 deck vibrating screen. Through cone crushers to washer and classifier. Through sand wheels and drag washers to stockpile by overhead conveyors. Tunnels to hoppers. Hourly capacity 100 tons; 12 employees. Water from 300-ft. well and float pump on pond.
399b	(1) Source of sand and gravel	Otay River bed, about 5 miles east of plant	Active (1959)	Worked various deposits on river since 1923	Otay River bed (about ½ sand and ½ gravel)	40 acres	See above	2-yd. dragline to 10-yd. trucks. Haul 5 miles to plant and dump on stockpile. (See above for data on processing).
399c	(2) Source of sand and gravel	NE.¼NE.¼ Sec. 9, T. 19 S., R. 2 W., S.B.M.; about 3 miles west-southwest of San Ysidro, in Smugglers Gulch	Active (1959)	Opened 1958 (?)	Alluvium probably derived from terrace deposits; mostly gravel, small proportion of sand	----------	See above	Recently opened deposit. (See above for data on processing).
399d	(3) Source of sand	S.½SW.¼ Sec. 35, T. 18 S., R. 2 W. and N.½ Sec. 2, T. 19 S., R. 2 W., S.B.M.; less than one mile west of San Ysidro	Active (1959)	----------	Tia Juana River bed, which is mainly source of plaster sand, some concrete sand	----------	See above	Portable dragline to trucks; 2½ mile haul to plant. (See above for data on processing).
399e	No. 5 operation	NW.¼ Sec. 19, T. 15 S., R. 2 W., S.B.M. (proj.); portion Lot 72, Rho Mission; about one mile west of Camp Elliot headquarters, in San Clemente Canyon	Active (1958)	Started 1956	Alluvium derived from Poway conglomerate	20 acres total (pit 30 ft. deep 1958)	Concrete sand; crushed gravel (standard size rock for aggregate; 1-in. minus for concrete mix)	Lease land from Sim J. Harris. 2-yd. shovel to trucks which haul ⅛ mile to plant and dump on stockpile. Through 10-in. × 30-in. jaw crusher; then to 1-in. × 4-ft. × 15-ft., 3-deck scalping screen: plus one-in. gravel to rolls; ½-in. gravel to 4-ft. Symons cone crusher, then to plant. Crushed gravel from rolls (above) goes through 3-deck, 4-ft. × 12-ft. screen. Oversize from screen through 4-ft. Symons crusher in closed circuit. Hourly capacity 100 tons; 14 employees. Water from well (250 g.p.m., operated continuously).

Sand and gravel, and crushed and broken stone.—Continued

MAP NO.	COMPANY AND OPERATIONS (OR DEPOSIT)	LOCATION	STATUS	HISTORY	GEOLOGY	SIZE OF EXCAVATION	PRODUCTS	MINING, PROCESSING, REFERENCES, OTHER DATA
399f	Mission Sand Co.	NE.¼ Sec. 17, T. 16 S., R. 2 W., S.B.M. (proj.); about ½ mile southwest of Grantville, in Mission Valley	Active (1959)	Operated at present site since 1956; operated at other sites in general region prior to 1956	San Diego River bed	20 acres	Plaster sand	Property leased from Mission San Diego de Alcala. One-yd. dragline to trucks which haul to stockpile. Sand wheel washer to vibrating screens to scalp off oversize. Hourly capacity 45 tons; 5 employees. Haul sand to Nelson and Sloan plant No. 5 to blend in concrete mixture.
	Nelson, Ole	"Northern part of San Diego, east of the State Normal School" (Merrill, 1914)		Operated in 1910's				Produced crushed gravel for concrete aggregate. Perhaps beginning of Nelson and Sloan, which see (Merrill 14:682).
400	Patterson Trucking Co., 303 Hart St., El Cajon	Center Sec. 26, T. 15 S., R. 1 W., S.B.M. (proj.); about one mile east of Santee, off Woodside road	Active (1958)	Started 1955	Partly decomposed granitic rocks	30 acres	Decomposed granite (DG) (2 grades)	D-8 cat. dozer and ripper. Dozer shoves over 1¼-in. grizzly: oversize discarded. Also have ¾-in. screen for material for top oil mix. Hourly capacity 400 tons; 4 employees. Have weighing station.
401	Peters, W. H., Vista	Corner Escondido Ave. and South Santa Fe Ave., Vista	Active (1958)		Partly decomposed granitic rocks		Decomposed granite (DG)	Adjoins "Wood" pit (N. 707) of County of San Diego.
402	Ponto Beach (Abizaid) deposit	On the beach, about 8 miles south-southeast of Oceanside	Last worked 1948	During period 1915-1949 the beaches between Oceanside and San Diego were important sources of pebbles for grinding and filtering. (Also see Bird Rock deposit under "Abrasives")	Well rounded, water-rolled pebbles of several rock types, including metasedimentary and metavolcanic rocks	None	Pebbles for grinding and filtering systems	An important source of pebbles, especially for filtering, from 1945 to 1949 when the property was sold to the State by W. C. Abizaid. The beach was worked by John Momand who sold his output mainly to Crystal Silica Company. During last year of operation 200 tons of pebbles were produced, and marketed in three sizes between ½-in. and 3-in. Company now purchases pebbles from Baja California. (Gay 56d:559; Troxel 57:27; see also section on "Abrasives".)
403	Rohl, H. W., Co., Box 28, Oceanside	S.½ NW.¼ Sec. 23, T. 11 S., R. 5 W., S.B.M.; in Oceanside, near mouth of Lawrence Canyon, about ¼ mile east of freeway (U.S. 101)	Active (1959)	Started 1950	San Onofre breccia composed chiefly of semiangular fragments of glaucophane schist and interstitial sand and silt. Layers of sand interbedded. An abundance of silt and large fragments. Clayballs also present. Sand proportion only barely large enough	100 acres	Concrete and fill sand; crushed gravel (standard sizes rock for use as aggregate; minus 3/16-in. for blacktop)	Dozer from bench by gravity through grizzly to 1½-ft. primary screen: oversize through jaw crusher. Both fractions over belt together to plant (450-ft.). To scrubber which separates sand: (1) silt pumped to settling pond; (2) sand to Eagle classifier, then to Eagle twin screw washer, to Wenco single screw washer and to stockpile over tunnel; (3) from scrubber, gravel to 4-ft. × 12-ft., 3-deck screen, to 10-in. × 36-in. jaw [illegible] screen by [illegible] sand from clayballs. Hourly ca-

								percent by weight. Must recover sand from clayballs. Hourly capacity 150 tons; 6 employees (excluding office staff). Large tonnages of product go to adjacent Hazard blacktop plant. Water from well and pump on storage pond; plant consumes 3,000 gallons per minute.
	San Diego Cement Co.							See under Caudell and Johnson.
	San Diego, County of	Throughout county	Operated intermittently		Various types of rock; mainly partly decomposed granitic rock, some sand and gravel	Small pits mainly	Fill and other uses	The County operates about 20 deposits intermittently as sources of material used mainly in road repair.
404	San Diego Stone Co. quarry San Diego Stone Co. 643 Spreckels Bldg., E. A. Hornbeck, pres. (1921)	SW.¼ Sec. 17, T. 17 S., R. 1 W., S.B.M.; about ½ mile west of Sweetwater dam	Inactive since 1920's	Opened 1887	Metavolcanic rocks of the Black Mountain series	Quarry 200-ft. long, 50-ft. high	Broken stone for riprap	Deposit first worked in 1887 for stone used in construction of Sweetwater dam, which was first in the county. In 1910's and 1920's operated by San Diego Stone Co. which produced riprap for construction of jetties and for other uses. (Aubury 06:53; Merrill 14:680; Tucker 21b:383.)
405	Sierra Sand Plant, Rt. 2, Box 1095, Lakeside	E.½ NE.¼ Sec. 23, T. 15 S., R. 1 W., S.B.M.; about 1½ miles west of Lakeside	Active (1958)	Started 1955	San Diego River bed	4 acres (30-ft. deep)	Concrete sand (⅔) and plaster sand (⅓)	Lease property from A. J. Foster and McClain Bros. 1½-yd. skiploader to 10-yd. truck which hauls ½ mile to plant and dumps. Pick up by feed belt, to Cottrell 4-ft. × 10-ft., 3-deck screen, to Weir washer, to single stacker. Load trucks from stockpile with skiploader. Hourly capacity 60 tons; 2 employees. Water from well (pump 350 gpm). No scales. Also operate adjacent mix plant.
	Simpson-Pirnie Co.	Near Santee	Last operated 1932	Operated 1888 to 1932	Granitic rocks		Broken stone for riprap and rubble	Mainly a producer of "Dimension Stone," under which described. (Aubury 06:52-53; Merrill 14: 671-672, 673.)
406	Smith Construction Co.	On boundary between Secs. 28 and 33, T. 13 S., R. 3 W., S.B.M. (proj.); portion Lot L, Block 39, Rancho Santa Fe, San Dieguito Grant; about one mile southeast of Rancho Santa Fe	Active (1958)	Started 1937	San Dieguito River bed. Deposit contains some silt beds, ½- to 4-ft. thick	10 acres	Plaster sand; crushed gravel (¾-in. to ½-in.; and ½-in.)	Property consists of 40 acres. ¾-yd. dragline to pit trucks; short haul to plant. Dump over 8-in. grizzly. Conveyor from grizzly to 3-ft. × 5-ft. screen (dry) to stockpile. When float rock (gravel) hauled in, goes from grizzly to 8-in. × 16-in. jaw crusher, then to rolls, and to screws and washer. Hourly capacity 35 tons; 4 employees. Have 90-ft. wells delivering 800 gpm.

Sand and gravel, and crushed and broken stone.—Continued

MAP NO.	COMPANY AND OPERATIONS (OR DEPOSIT)	LOCATION	STATUS	HISTORY	GEOLOGY	SIZE OF EXCAVATION	PRODUCTS	MINING, PROCESSING, REFERENCES, OTHER DATA
407	Sorrento Sand Co.---- C. R. Guthridge, Rt. 1, Box 52, Del Mar	E.½ NE.¼ NE.¼ Sec. 25, T. 14 S., R. 4 W., S.B.M.; about 2 miles southeast of Del Mar, near mouth of Carmel Canyon	Active (1959)	Started 1952--------	Alluvium derived from nearby exposures of Torrey sand of Eocene age; deposit contains subordinate layers of clay	One acre	Concrete sand	Pick up with ½-yd. skiploader; haul 1,000 feet to plant in 5-yd. trucks. Screened and washed. (Screening removes clay lumps; washing removes smaller clay particles). Plant powered by gasoline engine. Hourly capacity 6 tons; 1 employee. Water from well which intersects water table at depth of 10 feet. Local contractors provide market.
	Spring Valley quarry	Spring Valley area-----	----------	----------	----------	----------	----------	See Independent Stone Co. (Tucker 21b:383; Tucker and Reed 39:50, pl. 1.)
	Stringfellow, J. R., Co., P.O. Box 6 Riverside	See under "Processing, etc."	Active in county (1959)	Major producer in S. Calif. of broken stone for use as riprap in seafront projects	See various quarries listed under "Mining, etc."	----------	Broken stone for use as riprap	Uses various equipment, including compressors, etc.; two 2½-yd. shovels; and one 1½-yd. shovel. Principal contractor for construction of jetties and for facing of islands in Mission Bay Park and other projects in San Diego region. Works Fletcher and Meadowlark Ranch quarries and formerly operated Marron quarry, which see.
	Sweetwater dam quarry	----------	----------	----------	----------	----------	----------	See San Diego Stone Co. (Aubury 06:53).
408	Sweetwater Sand Co. 2460 River Rd., National City	SE.¼ sec. 27, T. 17 S., R. 2 E., S.B.M. (proj.); portion Lot 1 and all Lot 9, Rho de la Nacion; adjacent to Sweetwater Rd., about 1½ miles northeast of downtown Chula Vista	Active (1958)	Started 1947--------	Sweetwater River bed; deposit contains layer of clay 3-5 feet thick at depth of 15 feet	15 acres	Plaster sand	Excavate as deep as layer of clay with 4-in. suction sand pump on floating platform. Material pumped through 2-in. screened intake, 50 feet through 4-in. pipe to plant. At plant sand is pumped to screen and washer which removes clay, then by conveyor to stockpile. Load trucks from two overhead bunkers. Hourly capacity 15 tons; 2 employees.
	Sylvan Gravel Co.---- J. P. Stibolt, pres. 8th and M Sts., San Diego (1914)	In Rose Canyon, near Selwyn Station of Atchison, Topeka and Santa Fe railroad (Merrill, 1914)	----------	Operated only in 1910's	Poway conglomerate or alluvium derived from Poway conglomerate	----------	Sand and gravel	(Merrill 14:681.)
409	Weaver deposit----- Don Weaver Jacumba	Center N.½ N.½ Sec. 35, T. 17 S., R. 8 E., S.B.M.; on the east edge of Table Mt., about 4 miles northeast of Jacumba	Active (1958)	First developed in 1940's as possible source of aggregate for concrete blocks. Since 1953, present operator has work-	Deposit of grayish-pink to brick-red volcanic cinders (or lapilli tuff) in alternating fine- and coarse-grained	Pit, nearly circular in plan, 100 feet in diam-	Crushed stone for roofing granules (about ⅛-inch)	First developed as source of concrete aggregate by Hazard Bloc Company, but proved too reactive. Material mined with D-8 tractor with ripper attached. Sixty percent at size before milling

					⅛-inch to 1-inch in size. Coarse-grained layers contain fragments commonly ½-inch to 6 inches. Calcite and chalcedony coat fragments			In addition to this deposit, J. H. Hubble, and later Don Weaver, worked a deposit of andesite lava adjacent to Mexican border, southwest of White Cap limestone deposit, in the SW.¼ Sec. 11, T. 18 S., R. 8 E., S.B.M.
	Woodward Sand Co., 2914 Bancroft, San Diego 4							
410a	Mission Valley operation (see flow sheet in text)	NW.¼ Sec. 19, T. 16 S., R. 3 W., S.B.M. (proj.); Lot 68, El Cajon Valley Co. Lands; in Mission Valley, about 1¾ miles east-northeast of interchange between U.S. Highways 80 and 395	Active (1958)	Started 1957	San Diego River bed	----------	Concrete, plaster, masonry, and fill sand. Some gravel	Own 6¼ acres, lease 90 acres. Excavate and load with 1-yd. dragline and 3-yd. tractor loaders, then to 10-ton trucks which haul 1 mile to plant. Screen to remove rocks and trash. Through washer to stockpile, over tunnel conveyor to loading bins. Batch weigh capacity 5 tons. Produce one type sand at time, then change screens. Hourly capacity 125 tons; 25 employees.
410b	San Pasqual operation	Sec. 34, T. 12 S., R. 1 W., S.B.M.; San Pasqual Valley, about 7 miles east of Escondido	Active (1961)	Started 1960 (?)	San Pasqual Creek bed	Shallow	Sand	Undetermined.
411	Zinniger Sand Plant, Route, Box 2415, Encinitas	E.½ SE.¼ Sec. 32, T. 13 S., R. 3 W., S.B.M. (proj.); part of San Dieguito Grant; about 1½ miles south of Rancho Santa Fe	Active (1958)	Started 1947	San Dieguito River bed; deposit contains mud balls and some layers of clay	One acre	Plaster and concrete sand	Skiploader to 5- or 10-yd. truck which hauls from 20 yards to ½ mile to plant. At plant, material to 3-ft. × 5-ft. vibrating screen. No washing. Power provided by gasoline engine. Hourly capacity 30 tons; 2 employees. Sell wholesale to local contractors and truckers.

Fill Material

Large tonnages of untreated decomposed granite, earth and sand are used as fill. In 1957, the average price of unprocessed decomposed granite for this use was about $0.50 per ton in San Diego County.

Road Base

Large tonnages of processed gravel, crushed stone, and decomposed granite are used as road base in the county. Road base is a low cost commodity which commonly consists of three-fourths inch minus crusher-run material.

Roofing Granules

Roofing granules have been produced from several sources in the county. The only production in 1959 was from a deposit of reddish lapilli tuff near Jacumba. In 1957, roofing granules also were being produced by grinding rejected bricks fired by the Union Brick Company (see also in section on "Clay"). Granules have been a byproduct recently at the black granite (gabbro) dimension stone operation of Escondido Quarries. Relatively large quantities of gray-green granules were produced from exposures of metavolcanic rocks near Rancho Santa Fe from about 1940 to 1946. It is said that one of the reasons for lack of continuing success of this operation was that the gray-green color of the product was not readily acceptable at that time. White granules have been produced from crystalline limestone and dolomite at several localities. Granules also have been produced from relatively unweathered light gray granitic rocks (for descriptions of deposits see under "Sources of Material, and Methods of Mining and Treatment").

Decorative (Ornamental, Garden) Stone

The red rose quartzite, used mainly as facing, also is used as decorative stone (see description in tabulated list under "Dimension Stone"). Small quantities of gray-green metavolcanic rocks, bluish-gray gabbro, and milky-white and pale-pink quartz have been used as decorative stone. Orbicular gabbro and some pegmatite (especially "line rock") may prove more desirable in the future for this use. (For descriptions of these deposits see herein under "Sources of Material, and Methods of Mining and Treatment.")

Poultry Grit

Poultry grit has been produced in San Diego County from crystalline limestone and from nearly unweathered granitic rocks.

Drain Rock

Small tonnages of crushed stone, including decomposed granite, of 1½ inches minus, crusher-run material is used as drain rock.

Reserves

Adequate sources of rock products will remain close to the advancing edge of metropolitan San Diego and its suburbs. As possible sources of sand there will be: (1) the bed of the upper part of the lower San Diego River; (2) the bed of the upper Sweetwater River; (3) the of the upper San Dieguito River; and (4) the quartz-sandstone of Eocene age which is exposed widely a the coast.

As possible sources of sand and gravel, the Poway glomerate and younger rocks derived from it prob are suitable at many localities. These localities include upper part of Rose Canyon and the most westerly so trending tributary of Los Penasquitos Canyon, near rento.

Possible sources of decomposed granite are com in the county, and if the urbanized region continue extend eastward with passing time, more areas unde by granitic rock will be closer to points of use.

The geology of the deposits mentioned above is cussed herein under "Sources of Material, and Meth of Mining and Treatment," and also in the section "Geologic Features."

SANDS, SPECIALTY

The term specialty sand commonly is applied to used for purposes other than aggregate, ballast or These sands are used in glass making, for sandblast and for engine, foundry and filter sand. In mid-1958 cialty sands were being produced in San Diego Cou only by the Crystal Silica Company, Oceanside. A posit of naturally bonded molding sand in the City of Diego was worked last in 1951. Glass sand was produ from a locality in the La Jolla area from 1919 to 1922

The Crystal Silica Company produces a very l quality plaster sand, a variety of specialty sands, ar small amount of miscellaneous clay at its operatio Oceanside (see description below). The company m beds of poorly consolidated feldspathic sandstone much as 40 feet thick, which are interlayered with beds of clay and silt. The deposit is part of the ne flat-lying Torrey sand member of the La Jolla format of Eocene age. This sand is exposed as a belt that exte northward from the Soledad Valley area near Del Ma a point beyond the boundary between San Diego Orange Counties (see Pl. 1). The belt ranges in w from less than two to at least five miles. A detailed cussion of the sand as exposed in the San Luis Rey (7 quadrangle, is provided by Jones (1958). A more c plete discussion of the La Jolla formation is given he in the section on "Geologic Features."

Within the wide area underlain by the Torrey s must be deposits that are very similar to the one wor by the Crystal Silica Comany, and which also are suit as sources of specialty sands. Such deposits might found to the east of the Crystal Silica Company op tion, along the Escondido branch of the Atchison, peka and Santa Fe Railroad, or along the coast betw Oceanside and Soledad Valley, within a short distanc the main line of the railroad. Possible complicating tors include the wide range of composition and textur the constituents of the Torrey sand, and the lentic character of different sand beds. In addition, north

eanside the Torrey sand is exposed in Camp Pendleton, ere mining operations are prohibited.

efore 1952, naturally bonded molding sand was quar- l from a deposit of sandstone of Pliocene age in the of San Diego. This sand is described by Wright 48, p. 59) as one of the finest-sized natural sands in ifornia. Sixty-five percent passes a 270-mesh sieve. e property now contains residences, however. Deposits sandstone of Pliocene age occur in other parts of the stal area of San Diego County and parts of these bably would be suitable for use as molding sand.

Also of interest as possible sources of specialty sands undeveloped deposits of beach sand along the sea st, and dune sand along the southeast shore of Clark y Lake, in the northeast part of the county.

A discussion of the treatment of specialty sands pro- ced in California, and the variety of their uses, markets, l prices is provided by Gay (1957d, p. 547-564). The ge in composition and/or texture and other desired aracteristics of sand for various uses also are described Gay. The foremost problem that would confront a ssible new producer of specialty sands in San Diego unty is the shortage of water. The treatment of sand quires a very large quantity of water. Water is rationed ry strictly by the City of Oceanside to the Crystal ica Company which must salvage used water by con- uous circulation through a series of settling ponds.

ystal Silica Company (Crystal Silica Sand Company) *

Location: Sec. 20, T. 11 S., R. 4 W., S.B.M.; about 3½ les east of downtown Oceanside, on Loma Alta Creek. he plant is adjacent, on the south, to the Escondido anch of the Atchison, Topeka and Santa Fe Railroad. *wnership:* Crystal Silica Company (R. S. Lebold, man- er), Box 180, Oceanside, owns the S.½ SE.¼ Sec. 20 0 acres) and leases most of the N.½ SE.¼ Sec. 20. A t that was active in 1953 in the SE.¼ Sec. 19, was aban- oned in 1954. The Crystal Silica Company is a sub- diary of the Ottawa Silica Co.

The Crystal Silica Company has produced plaster sand d specialty sands from this deposit since March 1928. mid-1956 the company was purchased by the Ottawa lica Company (G. A. Thornton, president), Ottawa, inois.

The company selectively mines beds of poorly con- lidated, white feldspathic sandstone which are probably rt of the Torrey sand member of the La Jolla forma- on, which is Eocene in age (Hanna, 1926a; Jones, 1958). he Torrey sand is exposed as a north-northwest trend- g belt which, in the Oceanside area, is more than five iles wide and generally dips very gently to the west. he beds of sandstone worked by the Crystal Silica Com- any are as thick as 40 feet, and are interbedded with in beds of silt and clay. The sandstone is fine- to very arse-grained and is generally composed chiefly of sub- ngular grains of quartz, sparse altered to unaltered feld- spar, minor interstitial clay and silt, and very sparse ferro- magnesian and heavy minerals. Useable material consists of about 65 percent quartz, 15 percent feldspar, 20 per- cent clay and silt, and a very minor proportion of ferro- magnesian and heavy minerals (Gay, 1957c, p. 550).

Recent analyses of the Crystal Silica Company sands are not available. Following are two analyses reported by Sampson and Tucker (1931, p. 447) that indicate the partial composition of (1) the raw bank sand and, (2) the glass sand product (−20 mesh) produced in 1931.

	1 *(percent)*	2 *(percent)*
SiO_2	78–80	90–92
Al_2O_3	6	3.80–4.50
Fe_2O_3	0.10	0.40–0.65
CaO	1.96	.....
$K_2O + Na_2O$	.....	2.86–3.25
MgO	1.02	.....
Ig. loss	.....	.....

Photo 76. South part of specialty sands operation of Crystal Silica Company at Oceanside; view east. Sand is produced from nearly flat-lying sand beds of Eocene age which underlie most of area shown in photograph. Plant is shown at left edge of photo; abandoned workings comprise bluffs in right fore- and middlegrounds.

During the first 25 years of operation, sand was re- covered from the hills immediately south of the plant, where a series of nearly continuous pits with faces as high as 40 or 50 feet was developed along an east-trend- ing belt one-half mile long and as wide as 500 feet (Photo 76). (T. E. Gay, Jr., unpublished report, California Divi- sion of Mines, 1954). The longest haul to the plant from this area was about one-half mile downhill. During 1952- 53 a pit was operated about one-half mile due west of this belt, in the SE.¼ Sec. 19, but this necessitated a longer haul. In 1954 an area north of Loma Alta Creek became available to the company and new pits were opened (Photo 77). Maximum length of haul from this area is about one-half mile mostly downhill. In 1958, the com- pany also was working in a pit directly south of the plant.

* Part of this description was taken from an unpublished field report prepared in 1954 by T. E. Gay, Jr., California Division of Mines.

Photo 77. Speciolty sonds operot Crystol Silico Co. ot Oceonside; northeost. Most of oreo photrophe cept hills ond mountoins in for bockgr is underloin by neorly flot-lying so Eocene oge thot is mined from nun workings ond processed in plont photo). Lotest workings opened q upper left; one of series of settling is shown obout center of left edge of

Before leasing the mining site north of Alta Loma Creek, the company churn-drilled 261 exploratory holes to locate mineable sandstone. Holes were put down to water level, generally from 15 to more than 50 feet below the surface. Nine million tons of useable sandstone was reported to have been disclosed by this program (Pit and Quarry, April 1955, p. 128). Then the organic overburden was stripped from the surface and the deposit was ready to be worked.

The beds of sandstone are mined selectively with rippers, bulldozers, and carryall scrapers, and the sand transported to the plant in the carryall scrapers. Material from the silt- and clay-rich layers interbedded with the sandstone is discarded.

Following is the latest available (mid-1954) mill flow scheme (T. E. Gay, Jr., unpublished report, California Division of Mines, 1954). At the plant the washing process begins as the sand is passed through a trommel and series of rotating screens which remove plus 4-mesh particles for discard as waste. Wet sand passing through the screens goes to a drag-type scrubber and agitator which removes the clay waste. Then the sand goes to a series of liquid cyclone separators which were installed in 1954 to enable the company to produce a high-quality glass sand. These reject the extreme fines, and des and abrade the sand. From this step the sand is depos in storage basins where it can be fed into one of sev rotary driers. After the sand is dried, it is passed thro a gyratory screening system which separates the products the company sells. These products are liste follows: —10 to +16 mesh, —12 to +35 mesh, —1 +40 mesh, —30 to 100 mesh (glass sand) and 50 n down to pan (high alumina fraction). The products either bagged or prepared for bulk shipment. The c use for sand produced by the Crystal Silica Compan as plaster sand in the building industry. Additional s is used in the manufacture of glass and ceramics, as sa blasting material, as locomotive and foundry sand, filter medium, and in roofing and guniting.

As a large amount of water is used in the wash process, and water is in limited supply in the region, City of Oceanside rations water to the company. Th fore, to save as much water as possible, waste-bea water is reconditioned by cycling through nine sett ponds. These ponds cover a large part of the prope north of the railroad tracks. In 1958 the company selling miscellaneous clay from these ponds to Gladd McBean and Company, Los Angeles.

Sands (specialty)

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
412	Clark Lake deposits	T9S, R7E, SBM; about 9½ miles northeast of Borrego Springs.	Undetermined (1958)	Dune sands composed essentially of quartz and feldspar on east side of Clark Lake.	Undeveloped.
413	Crystal Silica Company	Oceanside.			Produces silica sand for many uses. description in text. (Anonymous 55 128-130; Gay 57d:550, 556, 593, 563 Jones 58; Lenhart 55a:48-50; Sampso and Tucker 31:446-448; Tucker and Reed 39:51, pl.1).
414	San Diego Molding Sand Company	SW¼ sec. 35, T16S, R3W, SBM; 2700 block, Arroyo Drive, San Diego.	Undetermined (1960) Hubbard Molding Sand Co., 2001 La Paloma St. Alhambra (1951)	Horizontal layer at least 60 ft. thick of yellowish-buff clay-rich sandstone of Pliocene age. Overburden 4 ft. thick. One of finest sized natural sands in California (65 percent passes 270-mesh sieve.)	Operated from undetermined date to 19 Deposit was developed by open pit 4 ft. long and 50 ft. high. Pit floo contained houses in 1958. Concreti and shell fragments were removed before material was trucked to rail head. Sand was used as naturally bonded foundry sand. (Donaldson 45 131; Gay 57d:551; Wright: 48:58-59)

lant capacity has increased from about 120 tons per (dry) in 1930 (Sampson and Tucker, 1931, p. 447), 30 tons per hour (dry) by 1955 (Pit and Quarry, il 1955, p. 128), and about 50 tons per hour (dry) in -1957. In late 1957 the plant was undergoing a "major gram of remodeling, change and reconstruction" (G. Thornton, Ottawa Silica Company, personal com- nication, 1957).

The company also markets filter gravel produced from bles now obtained in Baja California and formerly m John Momand, a San Diego County operator (see to Beach in tabulated list under "Sand and Gravel, Crushed and Broken Stone").

LE, EXPANSIBLE

The Rose Canyon shale has been noted as a possible rce of expansible shale for use as lightweight aggre- e (Rogers and Chesterman, 1957, p. 522).

ER

A small amount of silver has been produced as a by- duct of gold mining operations in San Diego County. ce 1890, about 9,000 ounces has been produced, mainly m the Cleveland-Pacific and Oro Fino Mines near ondido, and from custom ore milled at the Ready lief Mill at Banner. Silver also occurs in tungsten, lead, l gold-bearing veins at Metal Mountain in the south- st part of the county (see under "Tungsten"), and at Cedar Creek and Bradbury Deposits (see under ead").

NE, DIMENSION

In 1958, granite and quartzite were being produced in n Diego County for use as dimension stone. The pro- ction of granite was by far the larger of the two and nstituted one of the leading mineral industries in the unty. This stone was being quarried by five companies m a total of eight quarries. During the year a single posit of quartzite was being worked. During the 1920's, rble was quarried briefly from a single deposit for e as dimension stone.

anite *

The production of granite for use as dimension stone s been a leading part of the mineral industry of San ego County since 1898. Granite had been produced eviously in the county, but only for use as riprap and bble. The production of granite for use as dimension ne has risen from 6,588 cubic feet, valued at $4,875, 1898, to a high in 1959 of 34,700 cubic feet valued at ghtly more than $168,000 (San Diego County Division Natural Resources, 1960, p. 14). In 1959, San Diego unty was the leading source of granite for use as mension stone in the State.

The production of granite in the county has fluctuated arkedly in the past. Periods of low production occurred ring the 1910's, the early 1930's, and the early 1940's; riods of high production occurred during the early 00's, the 1920's and from 1945 to 1960 (the present).

* The term "granite" is used commercially, and in this section of the report, to include any plutonic rock with a granitic texture.

About 37 granite quarries have been opened in the county since 1888. In 1958, five companies were working a total of eight of these quarries. The oldest and longest continuously operated granite-producing company in the county was the Simpson-Pirnie Granite Company which was active from 1888 to 1932. The most productive companies in 1958 were Escondido Quarries, Inc. and National Quarries, Inc. (see descriptions below).

The most complete discussion of the granite industry of San Diego County is provided by Hoppin and Norman (1950, 19 p.).

Geology of the Deposits

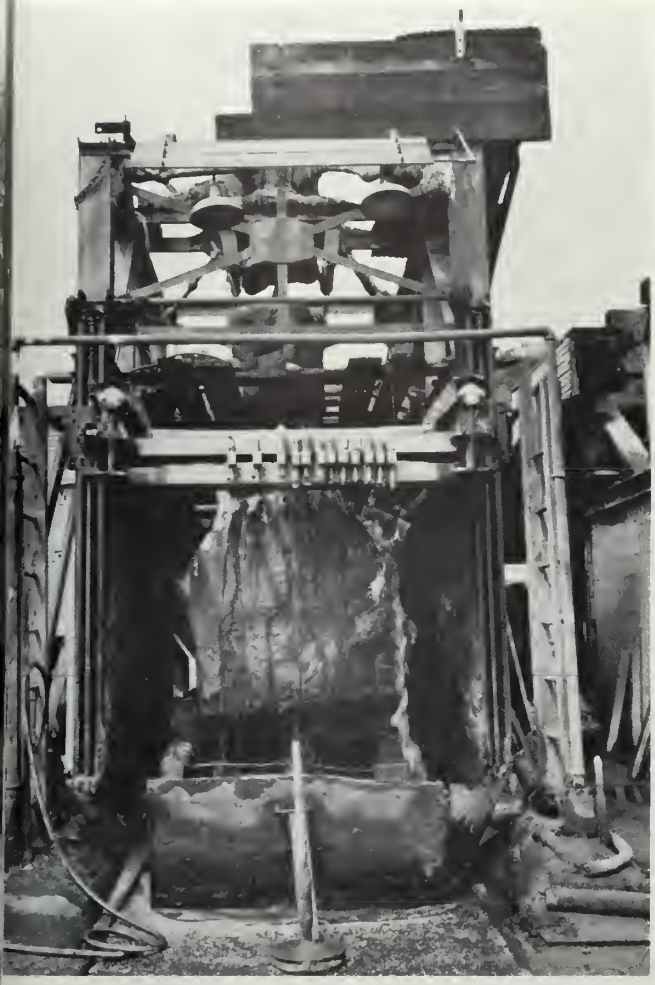
Granite is quarried in the county from bodies of gabbro and quartz diorite (including granodiorite) which are part of the batholith of Southern California (see description herein under "Geologic Features"). Dimension stone produced from gabbro generally is termed "Black Granite," and ranges in color from dark gray, through dark bluish-gray, to very dark gray; stone produced from quartz diorite or granodiorite generally is called "Gray Granite" or "Silver-gray Granite," and generally is pale gray in color. All but one of the present dimension stone operations lie along the western edge of the batholith, relatively close to centers of population and lines of transportation.

Black granite is produced in the county from the San Marcos gabbro, which occurs as irregular bodies as much as several miles in maximum surface dimension (see Pl. 1). Most of the present output is from deposits in the Escondido and Vista areas. Formerly it was quarried from deposits in the Bernardo area. An exceptionally dark-colored stone is produced at a quarry in the Pala area (descriptions of these areas are in section below named "Summaries of Areas"). Commercial black granite consists of large residual boulders of hard, fine- to medium-grained gabbro which are set in soft, partly decomposed gabbro (Photo 78). Workable boulders for use in making surface plates (which are used to calibrate delicate instruments) range in size from 5 to 25 feet, where plates 5 to 6 feet long are produced; boulders for use in making headstones and markers can be as small as 3 or 4 feet. The optimum diameter for boulders is perhaps eight feet (Roy Kepner, personal communication, 1958).

The light-colored (gray) varieties of commercial granite are produced from pale gray quartz diorite and granodiorite, which compose a large part of the batholith of Southern California. In mid-1958 gray granite was quarried from only one locality: the National Quarries quarry at Foster (Lakeside-Foster-Santee area), near which are many inactive quarries (Photo 79). Gray granite has been quarried in the past from a deposit near La Cresta, and many years ago from deposits in the Grossmont-La Mesa area (see descriptions of areas below). The most suitable deposits generally consist of massive, ledge-like outcrops. Distinct jointing, sheeting, and fracturing patterns in the rocks cause them to be amenable to block quarrying

Photo 78 (right). Residual boulders of gabbro (black granite) in weathered gabbro at locality near Vista. *Photo by Mary Hill.*

Photo 79 (below). Foster area. View southwest toward California Wire Sawyer Corporation which is a producer of surface plates from granite quarried by National Quarries at deposit shown at left edge of photo and from other deposits. Surface plates are used to calibrate delicate instruments. Old Cameron-Deering quarry is at right.



Phata 80 (left). Cutting a block of block granite into slabs with gang saw at Econdido Quorries, Inc. aperation of Pacific Cut Stane Co. *Phato by Mary Hill.*

Phato 81 (below). Polishing slab of black gronite at Escondido Quarries, Inc. operation of Pacific Cut Stane Ca. *Phota by Mary Hill.*

(Hoppin and Norman, 1950, p. 15). Joint blocks vary considerably in size, and range in width from 1 foot to 10 feet. Sheeting surfaces generally are parallel to the ground surface, and the distance between sheets ranges from one-half foot to six feet.

Future sources of granite in San Diego County probably lie near quarries that already have been worked successfully, although parts of many additional granitic bodies probably would also be suitable. Important factors to consider when contemplating development of a deposit to be used as dimension stone have been described by Goldman (1957, p. 591-592): these include hardness and workability, texture, color and strength. The mineral composition of the rock is unimportant except that deleterious iron sulfide minerals must be absent. Most presently operated quarries in the county are within a few miles of a railhead. In the future, however, deposits of a special nature, such as perhaps those with an orbicular structure, may be quarried from deposits much farther from transportation facilities than the present operations.

Quarrying and Preparation of Stone *

The granite quarries of San Diego County are small to moderate in size and consist of two general types: shelf quarries and pit quarries.

(1) The "shelf" method of quarrying is used to recover blocks of black granite from residual boulders of gabbro. Shelf quarries consist of horizontal, benchlike excavations. Boulders in the quarry face first are drilled, then blasted. The individual parts of the blasted boulders are transported to the quarry floor, with a derrick and boom, or with a bulldozer, where they are split into crude blocks with black powder. The Valley Granite Company, Escondido, drills boulders in place, as above, or attempts to determine the "grain" or joint system of the boulders in place, then rolls them to the quarry floor and shoots them there.

(2) The "pit" method is used mainly to work massive, ledge-like deposits of light-gray quartz-diorite or granodiorite (Gray granite). This method takes advantage of the jointing and other structural and textural features of the rocks. In pit quarries blocks are produced *in situ* by drilling, wedging, and blasting. The blocks then are removed by a derrick and boom for processing. A single deposit of gabbro is worked by use of the "pit" method: this is the Vista Black Deposit, which is at the bottom of a small valley.

After quarrying, blocks are cut into slabs with gang or wire saws, then polished (Photos 80, 81). A general discussion of quarry and preparation methods used in the dimension stone industry of California is given by Goldman (1957, p. 603).

Uses, Markets and Prices

Gray granite produced in San Diego County has been used since 1898 as monument and building stone, and during the 1910's and 1920's as paving blocks. Black granite was first produced in the county in 1921, and since the end of World War II has consttiuted more than 90 percent of the granite production in the county. Black granite is used for monument, building, and facing stone, and since about 1950 as "surface plates" for calibratior delicate instruments. About 15 percent of the total p duction of granite in 1957 was used to make surf plates.

Granite produced in the county is marketed throu out the United States and in Mexico and Canada (H pin and Norman, 1950, p. 9). In 1955 the value of un granite was $4.25 per cubic foot, f.o.b. quarry in C fornia (Goldman, 1957, p. 605). Dressed monument st was valued at $8.50.

In mid-1958, four companies were both quarrying finishing granite in the county for use as dimens stone: Pacific Cut Stone Company, Alhambra (Escond Quarries, Inc.); Allied Granite Company, Los Ange Pomona Granite Company, Pomona; and Valley Grar Company, Escondido. The National Quarries, Inc., condido, was producing only unfinished stone. Five co panies were finishing stone only: California Wire Saw Corporation, Lakeside; Clemens Granite Company, Cajon; Escondido Granite Company, Escondido; Py mid Granite Company, Escondido; and Southern C fornia Granite Company, San Diego.

Summaries of Areas

Lakeside-Foster-Santee Area (Gray Granite). Twe known quarries have been opened in this area, wh includes the towns of Lakeside, the site of Foster, a Santee. Only one of the 12 quarries was active in m 1958, however. The quarries are in ledge-like outcr of massive, light-gray granitic rock which ranges composition from quartz diorite to granodiorite. At s eral points operators also have worked boulders on surface. The stone produced in the area most commo is marketed as "Lakeside Silver-Gray Granite."

Two of the quarries are near Santee, alongside now-abandoned route of the San Diego and Cuyam Eastern Railroad which ran from San Diego to Fost The more westerly of these two quarries was opened 1888 by the Simpson-Pirnie Company, and worked this company until 1932. It was probably the first gran quarry opened in San Diego County. The company p duced riprap and rubble from 1888 to the early 190 paving blocks from about 1890(?) to the mid-1920's, a monument and building stone during the period from least as early as 1898 to 1932. The more easterly qua was opened by Jose Covas in 1900 and worked by h until 1926, then by American Marble and Granite Co pany until 1941.

A single quarry about 3½ miles northwest of La side was operated by several firms and individuals tween 1924 and 1949(?). It was opened by McKoon a last operated by Matson and Deering (see descripti in accompanying tabulated list under McKoon).

Eight of the 12 quarries are near the site of Fost which was the station at the north terminus of the S Diego and Cuyamaca Eastern Railroad. The sites of t original quarries were selected mainly because of th proximity to the railroad. The oldest known workin in the area were opened by the Waterman Granite Co

* A large part of this section is summarized from a discussion by Hoppin and Norman (1950, p. 7-8).

Photo 82. Escondido Quarries, Inc., Harmony Grove. Residual boulders of gabbro (block granite) are blasted, then worked downward toward quarry floor which is west (left) of area photographed. Boulders are as large as 25 feet in diameter. *Photo by Mary Hill.*

Photo 83. Southwesternmost of four black granite quarries in Gopher Canyon, owned by Pomona Granite Company. Deposit, now inactive, consists of residual boulders in weathered rock.

pany in the very early 1900's at a point about one mile west of Foster. Two other quarries—one adjacent to, and the other about one-fourth mile west of the Waterman workings—were opened by the Simpson-Pirnie Company between 1906 and 1915 and worked by this company until 1932, then by Cameron-Deering in 1945 and 1946. The larger of these quarries now is considered by local operators to be too deep to be worked profitably (see description under Cameron-Deering in accompanying tabulated list).

The Southern California Granite Company worked a quarry which is three-eighths of one mile west of the Waterman workings from 1919 to 1936. Simpson-Pirnie opened two more side-by-side quarries about 1½ miles southwest of Foster, worked them briefly in the late 1910's, then leased them to McGilvray, Raymond Corporation which worked them from 1921 to 1935. Other operators near Foster were W. A. Meyer (1922-1930) and Andrew Lehnberg (1912? to 1915? or 1920?).

Since 1955 a new quarry has been operated near Foster by National Quarries. This company sells stone to California Wire Sawyer Corporation which since 1955 has operated a finishing plant adjacent to the quarry (Photo 79).

Escondido Area (Black Granite). Seven quarries are clustered in an area of slightly more than one-quarter square mile which is about 3½ miles southwest of Escondido. The quarries are on the north and south slopes of a short, narrow canyon which cuts a narrow, north-trending hill composed of San Marcos gabbro. The deposits quarried in the area consist of large residual boulders of fine- to medium-grained, dark gray to dark bluish-gray gabbro (Photo 82). Stone from these deposits is used for building, monuments, and surface plates.

The first quarry in the area was opened by John Stri berg who worked this, and later one other quarry, fr 1923 until his death in 1952. Three quarries were act in mid-1958. One of these was the largest granite qua in the county, which was being operated by Escond Quarries, Inc. (see description below). The other t active quarries were being worked by the Valley Gran Company.

Vista Area (Black Granite). The 10 quarries in t Vista area are within 3½ to 4 miles east to northeast Vista, on the southwest tip of the San Marcos Mountai and in Gopher Canyon, on the northeast side of t mountains. The material quarried is obtained from ha residual boulders of San Marcos gabbro which is fine- medium-grained and dark gray to dark bluish-gr (Photo 83). Stone produced in the area is used for mor ments, building, and surface plates. It is marketed ge erally under such a name as "Vista Black Granite."

The first quarry in the Vista area was opened by P Matson in 1938, and was worked by him and vario partners until 1952. Since 1938 nine other quarries ha been opened, and in 1958 two of these were active: o was the National Blue Granite Quarry, being operat by the Pomona Granite Company; the other was t Vista Black Quarry, being operated by National Quarr (see description below). Other operators in the area ha been Fellows and Clutter (1945-46); California Cut Sto and Granite Company (1945 to 1947); and Texas Qu ries (1944).

Pala Area (Black Granite). The Magee Quar which is northeast of Pala, has been operated interm tently from 1923 to the present. The rock quarried he is very dark gray gabbro, one of the darkest stones in t county. In mid-1958 the quarry was being operated l the Allied Granite Company, Los Angeles.

La Cresta Area (Gray Granite). Two adjacent quar-es near La Cresta were operated by the Clemens Gran-e Company from 1945 to 1955. These quarries are in ght gray granitic rocks.

Bernardo Area (Black Granite). The site of the set-ement of Bernardo is near the point where the north ore of Lake Hodges intersects U.S. Highway 395, about ½ miles south of Escondido City Hall. The two quar-es in the area were worked for dark gray gabbro in the 20's. Only one of these could be located during the resent investigation: this was the quarry of the Bly tone Company which was worked from 1921 to 1924. he other quarry, that of W. E. Van Deventer, was orked from 1921 to 1925.

Grossmont-La Mesa Area (Gray Granite). Two uarries were operated during the early 1900's in the a Mesa-Grossmont area: these are the Charles Moore uarry which was operated from 1908 to 1913 and the acific Electric Company Quarry which was operated uring the 1910's. Output from the latter operation was ed only as paving blocks.

arble

The Verruga Crystalline Limestone Deposit, near anchita, was worked in the 1920's for marble used for uilding stone and for monuments (see description under Limestone-Dolomite").

uartzite

In mid-1958 the Red Rose Quartzite Deposit near Sun-rest, was being worked for stone used as facing (see escription below).

scondido Quarries, Inc. (Pacific Cut Stone and Granite Co.)

Location: W.½ NW.¼ SE.¼ Sec. 30, T. 12 S., R. 2 V., S.B.M.; near Harmony Grove, about 3½ miles outhwest of Escondido City Hall. *Ownership:* The uarry is operated by Escondido Quarries, Inc., P.O. Box 55, Escondido, which is controlled by Pacific Cut Stone nd Granite Co., P.O. Box 30, Alhambra. Pacific also ontrols Clovis Quarries at Academy, in Fresno County 1958). In 1958 the company had under lease the Strids-erg Crystal Black Quarry (see description in accom-anying list).

Pacific Cut Stone and Granite Co. has quarried "black ranite" from its property near Harmony Grove since 936 (Hoppin and Norman, 1950, p. 7). The company ow probably quarries between one-quarter and one-half f the dimension stone output in the county and is the eading producer of this stone in the county.

The company quarries large residual boulders of San Marcos gabbro which are surrounded by partly decom-osed gabbro (Photo 82). The boulders range in diameter rom less than 3 to about 25 feet. Only boulders larger han five feet are processed. The gabbro is fine- to me-dium-grained in texture and very dark gray ("black").

The deposit is developed by a quarry on the southwest art of a west-trending, elongate hill. The face of the uarry trends northwestward and opens to the southwest. It is about 125 feet long and 70 feet high (Goldman, 1957, p. 595). Boulders in the face first are blasted loose, excavated, then rolled down to the quarry floor. There they are split into crude blocks by blasting with black powder. The blocks are cut into slabs by two gang saws (Photo 80) or a four-strand wire saw. The gang saws cut about 1½ inches per hour. The slabs are finished at the plants of Pacific Cut Stone and Granite Co. in Alhambra, Los Angeles County, and in Clovis, Fresno County. The finished stone is marketed for use as surface plates, and as "Black Diamond Granite" for use as monuments and facing.

National Quarries (Johnson Brothers)

Location: Escondido region. The locations of the deposits worked by the company are described below. *Ownership:* Johnson Brothers, 923 Park Hill Drive, Escondido (1958).

National Quarries has quarried granite in San Diego County since 1945, and now ranks second in the county in granite production. The company markets only unfinished stone, which is sold wholesale to finishers: especially to (1) California Wire Sawyer Corporation, Lakeside, which produces surface plates; and (2) Pyramid Granite Co., Escondido, which produces monument stone and surface plates. The unfinished stone also is shipped to Los Angeles and as far east as Minnesota. A small proportion of stone quarried by the company is marketed as riprap and as decorative (ornamental) stone.

In mid-1958 National Quarries was operating two quarries and producing stone that ranged in color from "black," through "blue," to "Lakeside Gray." Black to blue stone was being obtained from the Vista Black (California Cut Stone Co.) Quarry which is about three miles due east of Vista (see description in accompanying tabulated list). Lakeside Gray stone was being produced at a quarry opened in 1955 adjacent to the finishing plant of the California Wire Sawyer Corporation at Foster, in the center of the SE.¼ SE.¼ Sec. 35, T. 14 S., R. 1 W., S.B.M. In addition to these quarries, National Quarries had an option to lease the Texas Quarries quarry in Gopher Canyon, about four miles east-northeast of Vista (see description in tabulated list).

National Quarries also has worked the following quarries in the county (see descriptions in accompanying tabulated list): (1) National Blue Granite quarry, in Gopher Canyon, 4 miles northeast of Vista, operated 1946-1952; (2) Magee quarry, 3¼ miles east-northeast of Pala, operated 1946-1957; and (3) Matson quarry, in Gopher Canyon, 4 miles east of Vista, operated 1952-1957.

Red Rose Quarry

Location: S.½ SW.¼ Sec. 35, T. 15 S., R. 1 E., S.B.M.; about three-fourths of one mile northeast of La Cresta. *Ownership:* A. Carlsen, 625 La Cresta Heights Road, El Cajon (1958).

Small tonnages of stone quarried at this deposit are marketed as rubble in the San Diego area under the name

Stone, dimension (granite)

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Allied Granite Co.		Allied Granite Co., Inc., 1480 S. Lorena, Los Angeles (1958)		Operates Magee quarry near Pala, which see.
415	American Marble and Granite Works (Jose Covas) quarry	Center of the S½ SW¼ sec. 26, T15S, R1W, SBM (proj.); about ½ mile southeast of Santee.	Undetermined (1958)	Light-gray granitic rocks with well-developed sheeting and jointing systems.	Worked from 1900 to 1926 by Jose Covas who produced stone marketed as "San Diego black granite". American operated the deposit from 1927 to 1941 and produced stone marketed as "Blue Diamond granite" which was used mainl for monuments. (Hoppin and Norman 50:4,7; Tucker 25:364; Tucker and Reed 39:pl.1).
	Atchison, Topeka, and Santa Fe Railway	Near Foster, about 3 to 3½ miles north-northwest of Lakeside.		Light-gray granitic rocks.	Operated in 1913. (Hoppin and Norman 50:7).
	Bernardo quarries	South of Escondido.			See Van Deventer and Bly Stone Co. quarries, which are described individually. (Hoppin and Norman 50:4,7; Tucker 25:363-64; Tucker and Reed 39:pl.1).
	Black Diamond quarry				See Escondido Quarries, Inc. in text. (Tucker and Reed 39:43).
416	Bly Stone Co. quarry	Center of sec. 10, T11S, R2W, SBM (proj.); about 4½ miles south of Escondido, and 3/8 of a mile west of U.S. Highway 395.	Undetermined (1958) Bly Stone Co., Los Angeles (1924)	Large residual boulders of dark-gray granitic rocks (San Marcos gabbro.)	Operated from 1921 to 1924. Small quarry. Known also as one of the two Bernardo quarries. Other is Van Deventer, which see. (Hoppin and Norman 50:4,6,7).
	California Cut Stone and Granite Co.				See Vista Black Granite quarry.
417 (Plant)	California Wire Sawyer Corp.	S½S½SE¼ sec. 35, T14S, R1W, SBM; near Foster, about 3½ miles north-northwest of Lakeside.	California Wire Sawyer Corp., Star Route, Lakeside (1958)		Operation at Foster started in 1955 and continued in 1960. Equipment consist of steel derrick, 3 wire saws, and Patch-Wagner semi-automatic finisher. Corp. produces surface plates, monument stone, and a small amount of facing stone from unfinished granite purchased from National Quarries. Most of the granite consumed at the operation is from two quarries: (1) a quarry adjacent to the finishing operation and (2) the California Cut Stone quarry at Vista (Black granite)
418	Cameron-Deering (Simpson-Pirnie) quarries	S½SE¼ sec. 35, T14S, R1W, SBM; about 3½ miles north-northwest of Lakeside and 1¼ miles west of Foster.	Undetermined (1958)	Massive outcrops of light-gray granitic rocks with well developed fracture systems.	Two adjacent quarries opened at an undetermined date before 1915 by Simpson-Pirnie Co., which see also, and worked by that company until about 1932. Cameron and Deering (and Matson and Deering) operated the quarries from 1945 to 1946 and marketed their product as "Silver-gra granite" and "Mission-gray granite." The larger and more important of the quarries now is considered by local operators as too deep to be worked profitably. Quarries yielded large output of stone used for monuments and paving. (Hoppin and Norman 50: 4,7,11,15,16,17; Merrill 14:672; Tucker 25:366).
419	Clemens Granite Co. quarry	S½SW¼SE¼ sec. 4, T16S, R1E, SBM; about one mile west of Suncrest.	Raymond Clemens, 3600 Suncrest Blvd., El Cajon (1958)	Light-gray granitic rocks with a slightly gneissic structure.	First worked by D. McCarthy, in 1945, who produced "Suncrest Silver-gray granite". From 1946 to 1955 the Clemens Granite Co. worked two quarries, 400 ft. apart. The stone produced was marketed as "Suncrest gray granite. Since 1955 the operator has not operated quarries but has finished stone on the property which he has purchased from other San Diego County quarry operators. Stone is marketed for use as monumcnts. (Hoppin and Norman 50:4,7).

Stone, dimension (granite)

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	(Jose) Covas				See American Marble and Granite Works. (Hoppin and Norman 50:7; Tucker 25:364; Tucker and Reed 39:pl.1).
	Daley Corporation				See Van Deventer quarry. (Hoppin and Norman 50:4,7).
	Deering and McDonald				See McKoon quarry. (Hoppin and Norman 50:7).
0	Ebony Black Diamond Granite Co. (Stockdale Granite quarry)	Near center of the W½ sec. 30, T12S, R3W, SBM; about 3 miles west-southwest of Escondido, near Harmony Grove. A few hundred ft. north-northeast of the Valley Granite Co. quarry.	Undetermined (1958) W. M. Hike, Escondido (1939)	Dark-gray granitic rocks (San Marcos gabbro) which comprise large residual boulders.	Worked between 1923 and 1936 by F. W. Stockdale and W. Walker of Escondido who produced "Ebony Black Granite" used for monument and building stone. In 1939 the quarry was leased to Pacific Cut Stone Co. In 1958 it was being worked by Valley Granite Co., which see. (Hoppin and Norman 50:4,7; Tucker 25:368-369; Tucker and Reed 39:43, pl.1).
1	Escondido Quarries, Inc. (Pacific Cut Stone and Granite Co.)	Near Harmony Grove, southwest of Escondido.			See text. (Goldman 57:595; Hoppin and Norman 50:4, 7, 8, 9, 11; Tucker and Reed 39:43).
	Eucalyptus Ranch quarry				See (W. E.) Meyer quarries. (Tucker 25:364-365; Tucker and Reed 39:pl.1).
2	Fellows and Clutter quarry	N½NW¼ sec. 22, T11S, R3W, SBM; 3 miles east of Vista, at the head of small north-northwest trending valley on the west side of the San Marcos Mts.	Undetermined (1957)	Dark gray granitic rocks (San Marcos gabbro).	Operated 1945-46. (Hoppin and Norman 50:4,7).
	Foster quarry	Lakeside-Foster area; "east of station" at Foster. (Merrill 1914).	Joseph Foster, Foster (1914)	Light-gray granitic rocks similar to those at nearby quarries worked by Simpson-Pirnie and Cameron-Deering.	Leased in mid-1910's by Pacific Electric Railroad Company which quarried stone for use as paving blocks. (Merrill 14:672).
3	Galbraith quarry	SW¼SW¼ sec. 14, T11S, R3W, SBM; about 4 miles east-northeast of Vista, on the east side of the San Marcos Mts.	A. J. Galbraith, San Marcos (1958)	Residual boulders of dark-gray granitic rocks (San Marcos gabbro).	Very small quarry. No record of production. Probably long idle.
	(John) Grant				Worked deposits in Grossmont, Santee, and Lakeside-Foster areas in 1910's. Produced gray stone. See also Waterman Granite Co. quarry. (Hoppin and Norman 50:7).
	Ireys Black Granite deposit	"2 miles northeast of Lakeside". (Tucker, 1925).	Undetermined (1958)	Diorite boulders.	Operated in 1920's for an undetermined period by Arthur Greenleaf of Lakeside. Small amount of material produced by 1925. (Tucker 25:365).
	Johnson, Emil, and Sons				See National Quarries in text.
	Lehnberg, Andrew	Two deposits: (1) Meyer quarry: SW¼ sec. 1, T15S, R1W, SBM (proj.); about one mile southwest of Foster. (2) near Lakeside.	Andrew Lehnberg, Foster (1914)	(1) Light-gray granitic rocks. (2) Boulders of diorite.	Lehnberg operated in the Lakeside-Foster area from 1912(?) to an undetermined date later in the 1910's. He worked a deposit known later as the Meyer quarry (which see) and a deposit of undetermined location near Lakeside. (Hoppin and Norman 50:7; Merrill 14:672, 673).
	(Alvin I.) Lodge				See McKoon quarry. (Hoppin and Norman 50:4,7).

Stone, dimension (granite)

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
424	Magee quarry	NE¼SW¼SE¼ sec. 19, T9S, R1W, SBM; Pala district, about 3¾ miles east-northeast of Pala.	Paul Magee and 2 brothers, Pala (1958)	Very dark gray gabbro which comprises boulders as large as 20 ft. in diameter.	Property consists of 80 acres. Operate by Robert J. Magee from 1922 to 1934; by Riverside Monumental Works in 1945 by National Quarries from 1946 to 195 and by Allied Granite Co. from 1957 t present (mid-1958). Riverside market ed the stone as "Mission black granite". National Quarries (which also see) marketed the stone as "Pala black granite" for use as monuments. (Hoppin and Norman 50:4, 7, 11, 18).
425	(Pete) Matson (Matson and Kouns, Matson and McDonald) quarry	Center W½W½ sec. 23, T11S, R3W, SBM; about 4 miles east of Vista, at the north end of Twin Oaks Valley.	Sheldon Merriam, San Marcos (1958)	Dark gray granitic rocks (San Marcos gabbro). Massive (ledge) rock or residual boulders 20 ft. in diameter in quarry face.	Worked from 1938 to 1944 by Matson and McDonald; from 1944 to 1946 by Matson and Kouns; from 1946 to 1952 by Pete Matson; and from 1952 to 1957 by National Quarries. The first three operators listed marketed their product from this quarry as "California black granite." The deposit is devel oped by a semicircular quarry whose face is about 30 ft. high. Idle in 1958. (Hoppin and Norman 50:4, 7, 11 17).
	Matson and Deering	Foster-Lakeside area.			Matson and Deering operated in Foster-Lakeside area from 1932 to 1936 (McKoon and Meyer quarries) and 1945 to 1946 (Cameron and Deering quarry). They produced "Mission silver-gray granite." See also McKoon and Meyer quarries. (Hoppin and Norman 50:7).
	Matson and Kouns				See Matson quarry. (Hoppin and Norman 50:7).
	Matson and McDonald				See Matson quarry. (Hoppin and Norman 50:7).
	(Daniel) McCarthy				See Clemens Granite Company. (Hoppin and Norman 50:7).
426	McGilvray, Raymond Corporation quarries	SE¼NE¼ sec. 2, T15S, R2W, SBM (proj.); about 1½ miles southwest of Foster.	Undetermined (1958)	Fine-grained, light-gray granitic rocks which form resistant outcrops along the north side of an east-trending canyon.	Two adjacent quarries opened by Simpson Pirnie Co., which see also, before 1920. McGilvray, Raymond Corp. lease property and worked these quarries from 1921 to 1935. This company finished stone on property and market ed it for use as monuments. Quarries are about 500 ft. apart. Each is a horizontal bench cut, more than 150 ft. long and about 25 ft. high. (Hoppin and Norman 50:4, 7; Tucker 25 365-366; Tucker and Reed 39:pl.1).
427	McKoon (Deering and McDonald, A. I. Lodge, Matson and Deering, Mission Silver-Gray Granite Co.) quarry	Near the center of the W½W½ sec. 10, T15S, R1W, SBM (proj.); about 3 miles northwest of Lakeside.	Undetermined (1958) A. I. Lodge (1949)	Light-gray granitic rocks.	Quarry operated between 1924 and 1949 (or later) as follows: McKoon, 1924-29; Mission Silver-Gray Granite Co., 1929-32; Deering and McDonald, 1932-36; A. I. Lodge, 1945-46; Matson and Deering, 1948-1950 (?). Idle since that date. All operators after McKoc produced stone marketed as "Mission silver-gray granite" which was used mainly for monuments. (Hoppin and Norman 50:4, 7; Tucker 25:367; Tucker and Reed 39:43, pl.1).
428	Merriam quarry	Center of the west edge of the SW¼ sec. 23, T11S, R3W, SBM; about 4 miles east of Vista, at north end of Twin Oaks Valley.	Sheldon Merriam, San Marcos (1958)	Dark-gray granitic rocks (San Marcos gabbro).	Small quarry leased for exploration by National Quarries as late as 1957. That company stated in 1958 that residual boulders in deposit are too smal for use.
429a 429b	Meyer, W. A., (Eucalyptus Ranch) quarries	Two quarries: (1) Meyer quarry: center S½SW¼ sec. 1, T15S, R1W, SBM (proj.); about 1½ miles south-southwest of Foster. (2) south edge SW¼ sec. 2, T15S, R1W, SBM (proj.); about	Undetermined (1958) W. A. Meyer, Lakeside (1925)	(1) Light-gray granitic rocks which occur as massive outcrops near crest of a small hill. (2) Pale bluish-gray granitic rocks.	Meyer operated in the Foster area between 1922 and 1930, principally at quarry no. 1 (Meyer quarry) which had been worked first by Andrew Lehnberg before 1920. From that quarry Meyer produced "Silver-gray granite" for us as monuments. Sawing and polishing equipment were on property during tim of operation. From 1932 to 1936, the quarry was worked by Matson and Deering. It now contains a water tank. (Hoppin and Norman 50:4,7; Tucker 25: 364-365).

Stone, dimension (granite)

Map	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
a b	Meyer, W. A., (Eucalyptus Ranch) quarries (continued)	2 miles southwest of Foster.			
	Mission Silver-Gray Granite Co.				See McKoon quarry. (Hoppin and Norman 50:7).
	(Charles G.) Moore quarry	S½SE¼SW¼SE¼ sec. 17, T16S, R1W, SBM; in La Mesa, adjacent to eastern city limit, and about ¼ mile south of U.S. Highway 80.	Residential property (1958)	Diorite.	The operator produced about 8 carloads of stone annualy from the quarry for an undetermined period starting in 1908 and continuing in 1913. The stone was marketed for use as monuments. See also San Diego Granite Works. (Hoppin and Norman 50:7; Merrill 14:672, 673).
0	National Blue Granite quarry	Center of the N½ SW¼ sec. 10, T11S, R3W, SBM; about 4 miles northeast of Vista, in the South Fork of Gopher Canyon.	Pomona Granite Co. (1958)	Dark-gray granitic rocks (San Marcos gabbro) which comprise large residual boulders.	Operated intermittently by Pomona Granite Co. (which see also) since 1943. From 1946 to 1952, quarry also was worked by National Quarries which produced stone marketed as "National blue granite". (Hoppin and Norman 50:4,7).
1	National Quarries (Emil Johnson Brothers)	Escondido region.			See text. (Hoppin and Norman 50:4, 7, 8, 11, 13, 14, 15).
	Pacific Cut Stone and Granite Co.				See Escondido Quarries, Inc. in text.
	Pacific Electric Railway Co.	"South of Grossmont Station". (Merrill, 1914).	E. Fletcher (1914)	Gray granitic rocks.	Small quarry operated in 1910's for stone used as paving blocks. (Merrill 14:673).
2	Pomona Granite Co. quarries	SW¼ sec. 10, T11S, R3W, SBM; about 4 miles northeast of Vista, on the southwest side of the South Fork of Gopher Canyon.	Pomona Granite Co., c/o E. H. Jones, P.O. Box 88, Pomona (1958)	Dark gray granitic rocks (San Marcos gabbro) which comprise large residual boulders (see photograph in text).	The company owns four quarries in the SW¼ sec. 10. Three of these (see accompanying map) are very small, inactive quarries clustered near the center of the S½SW¼ sec. 10. These were operated sporadically from 1945 until the mid(?)-1950's. The fourth quarry, in the N½SW¼ sec. 10, has been worked intermittently by the company since about 1943. This is the National Blue Granite quarry, which see also. Pomona markets its product as "Blue granite." (Hoppin and Norman 50:4, 7).
3	Potts, Don, quarry	E½SW¼SE¼ sec. 30, T12S, R2W, SBM; about 3½ miles southwest of Escondido, near Harmony Grove.	Don Potts, Escondido (1958)	Dark-gray granitic rocks (San Marcos gabbro).	Quarry opened on side of hill south of Harmony Grove road. Small production.
	Pyramid Granite Co.	Escondido.	Pyramid Granite Co., Escondido		Finishes stone only. Purchases unfinished stone from National Quarries, which see in text.
	Riverside Monumental Works				See Magee quarry. (Hoppin and Norman 50:7).
	Rossi quarry				See Southern California Granite Company. (Tucker 25:367; Tucker and Reed 39: 43-44, pl.1).
	San Diego Granite Works quarry	"Near Mt. Helix, one quarter mile east of Hotel Grossmont". (Merrill, 1914).	Fred Frickas, San Diego Granite Works, 11th and M. Sts., San Diego (1914)	Light-gray granitic rocks.	Operated for a short period starting in 1912. Company also operated C. G. Moore quarry (which see) for a short time. In 1914 company was processing stone from the Simpson-Pirnie quarry near Lakeside. (Hoppin and Norman 50:7; Merrill 14:672).
	Santee granite quarry				See Simpson-Pirnie Granite Co. (Aubury 06:52).

Stone, dimension (granite)

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
434	Simpson-Pirnie Granite Company	Worked three deposits: (434) Santee quarry: Near center SE¼ sec. 27, T15S, R1W, SBM (proj.); about ½ mile south of Santee, at the base of the eastern slope of a small hill. (418) Cameron-Deering and (426) McGilvray, Raymond Corp. quarries, at Foster. (For exact locations of these quarries see individual entries).	Undetermined (1958) Simpson-Pirnie Granite Co. (James Simpson, pres.), San Diego (1932)	(434): Massive, light-gray granitic rocks which are fractured in such a way that large blocks can be quarried. (418) and (426): Light-gray granitic rocks.	Company operated in San Diego Co. from 1888 to 1932. The company produced riprap and rubble from 1888 to the early 1900's, paving blocks from about 1890(?) to the mid-1920's, and monument and building stone during t period from at least as early as 188 to 1932. Stone quarried was transported by San Diego, Cuyamaca and Eastern Railroad to company finishir works in San Diego. Santee quarry (434) probably was operated continuously from 1888 to 1932; the more northerly group of Foster quarries (418) probably was operated from a date between 1906 and 1915 to 1932 (see description under Cameron-Deering); and the more southerly group c Foster quarries (426) was operated from an undetermined date to about 1920. More southerly group then was leased and worked by McGilvray, Raymond Corp., which see also. (Aubury 06:52-53; Hoppin and Norman 50:4,6,7 12; Merrill 14:671-672; 673; Tucker 25:367-368).
435	Southern California Granite Co. (Rossi) quarry	Near the center of the S½SW¼SE¼ sec. 35, T14S, R1W, SBM; about 3-3/4 miles north-northwest of Lakeside.	Southern California Granite Co., 3845 Imperial, San Diego (1958)	Massive, light-gray granitic rocks with well developed fracture system.	Operated by Southern California Granit Company (Dan F. Rossi, owner) from 1919 to 1936. Produced stone market ed as "Silver-gray granite" which wa used for monuments. Since 1936 company has finished stone purchased rough from other operators in San Diego County and in Georgia. Compan also explored deposits to west of main quarry, for about 3/10 of a mil to a point near the center of the south edge of the SW¼ sec. 35. (Hoppin and Norman 50:4, 7; Tucker 2 367; Tucker and Reed 39:43-44, pl.1)
	Stockdale (F.W. Stockdale) Granite quarry				See Ebony Black Diamond Granite Co. quarry. (Hoppin and Norman 50:7; Tucker 25:368-369; Tucker and Reed 39:pl.1).
436a 436b	Stridsberg, John quarries	Operated two quarries near Harmony Grove, about 3 miles west-southwest of Escondido: (436a) Superior Black quarry: north edge NE¼ sec. 31, T12S, R2W, SBM. (436b) Crystal Black quarry: near the center of the west edge of the SE¼ sec. 30, T12S, R2W, SBM.	(436a) Superior Black quarry: undetermined. (1958) (436b) Crystal Black quarry: sold to Escondido Quarries, Inc. (1958)	Dark-gray granitic rocks (San Marcos gabbro) which comprise residual boulders.	Started in 1923. Operated continuousl from 1926 to 1952 when operator died First produced "Superior black granite," then "Crystal black granite." Last operated Crystal black quarry. Produced monument sto (Hoppin and Norman 50:4, 6, 7, 11).
437	Texas Quarries quarry	Center S½NE¼ sec. 15, T11S, R3W, SBM; about 4 miles east-northeast of Vista, in the South Fork of Gopher Canyon.	Undetermined (1958)	Dark-gray and bluish-gray gabbroic rocks (San Marcos gabbro). Rock is finer-grained than "Vista black granite" which is produced by National Quarries from California Cut Stone and Granite Co. quarry.	Deposit first worked in 1944 by Texas Quarries. In mid-1958 National Quarries had an option to lease the property. This company reportedly would market stone produced here as "Imperial black granite." See also National Quarries, Inc. in text. (Hoppin and Norman 50:4,7).
438	Valley Granite Co. quarries	NE¼NW¼SE¼ sec. 30, T12S, R2W, SBM; near Harmony Grove, about 3 miles west-southwest of Escondido.	Valley Granite Co., W. T. Blackwood, 243 E. 5th St., Escondido (1958)	San Marcos gabbro. Residual boulders that are quarried range in diameter from 3 to 20 ft.	Operation began in 1944. Property consists of two quarries on the south-east side of a small hill: lower quarry now is abandoned and the company is working the second quarry which is higher on the hill. Face o the new quarry was about 70 ft. high in 1956. In 1958 company was openin a series of benches in order to work the deposit more easily. One-half o the output from this quarry is finis ed by the company at its grinding plant near the old quarry; this stone is marketed as "Escondido black granite" for use as monuments. The

Stone, dimension (granite)

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Valley Granite Co. quarries (Continued)				other half is sold rough to Escondido Granite Company. Valley Granite Co. also operates Ebony Black quarry, nearby, from which is produced a stone that is made into surface plates by Pyramid Granite Co., Escondido.
	(W. E.) Van Deventer (Daley Corporation) quarry	Sec. 10(?), T13S, R2W, SBM (proj.); about 4 to 5 miles south of Escondido. (Exact location undetermined).	Undetermined (1957)	Dark gray ("black") granitic rocks (San Marcos gabbro).	Known also as one of the two Bernardo quarries (other is Bly Stone Co. which see also). Reported by Tucker (1925) to be on south shore of Lake Hodges but could not be located by present writer in 1957. Operated from 1921 to 1925, mainly by Van Deventer. Daley Corporation produced some stone from this quarry in 1923. (Hoppin and Norman 50:4,7; Tucker 25:363-364).
	Vista Black Granite quarry	Middle of the west edge of SW¼ sec. 22, T11S, R3W, SBM; about 3 miles due east of Vista, near the bottom of a small west-southwest trending canyon.	National Quarries (Emil Johnson Brothers), 923 Park Hill Drive, Escondido (1958)	Dark gray granitic rocks (San Marcos gabbro) which comprise large residual boulders.	California Cut Stone and Granite Co. worked deposit from 1945 to 1947 and produced "Vista black granite." National Quarries has worked it since 1954 and from it produces "Western black granite" and "Vista black granite." Deposit developed by quarry 100 ft. long, 70 ft. wide, and 40 ft. deep, in which boulders are worked downward. Boulders are first blasted then blocks are lifted upward with derrick boom. Most of the unfinished blocks are sold to the California Wire Sawyer Corp. which makes surface plates from them at its plant near Foster. Some material is sent to Los Angeles and to Pyramid Stone Co. in Escondido for manufacture of monument stone and surface plates. See also National Quarries, and California Wire Sawyer Corporation. (Hoppin and Norman 50:4,7).
	Waterman Granite Co. quarry	Probable location: SE corner sec. 35 and SW corner sec. 36, T14S, R1W, SBM; and NW corner sec.1, T15S, R1W, SBM (proj.); about 3-3/4 miles north-northwest of Lakeside.	Undetermined (1958)	Massive, light-gray granitic rocks.	Workings comprise small cuts on slope above and to southwest of State Highway 67. Opened in 1894 for stone used in construction of jetty near Point Loma, at entrance to San Diego Harbor. Worked during 1903-04 by Waterman Granite Co. for stone used in construction of "four government buildings on Point Loma" (Aubury, 1906). Operated in mid-1910's by James and John Grant of Foster. (Aubury 06:53; Crawford 96:23; Hoppin and Norman 50:6,7; Merrill 14:672, 673).

Stone, dimension (marble)

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Verruga deposit	Near Ranchita, in the northeast part of the county.			In the early part of the 1920's marble was quarried at the Verruga deposit for use as building stone. See description in text under "Limestone-dolomite." (Logan 47:302-303; Tucker 25:370, 371, 372, 373; Tucker and Reed 39:45, pl.1).

Stone, dimension (quartzite)

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
2	Red Rose quarry	La Cresta area.			See text. (Goldman 57:602).

"Red Rose Quartzite" (Goldman, 1957, p. 602). The stone is used mainly in walls and as facing.

The deposit consists of red, iron-oxide stained quartzite which occurs as a pendant in granitic rocks (Goldman, 1957). The rock is massive, with steeply dipping joint planes. The blocks are blasted, pried loose, then split with plugs and feathers. In 1958, the quarry face was about 250 feet long, and 30 feet high at its highest point; the quarry floor was 100 feet wide at its widest point.

STRONTIUM

The Roberts and Peeler (Fish Creek Mountains) Deposit, which is on the eastern edge of San Diego County, is one of only three deposits in California that have been mined for strontium minerals (Ver Planck, 1957f, p. 607). This deposit, which is described below, consists of several cap-like erosional remnants of a celestite (strontium sulfate) layer which overlie gypsum. The mine has been operated in 1916, 1941-1946, and in 1956 and 1957.

Roberts and Peeler (Peeler and Roberts, Roberts Celestite) Deposit

Location: NE.¼ Sec. 13, T. 13 S., R. 8 E., S.B.M. (San Diego County); and west edge NW.¼ Sec. 18, T. 13 S., R. 9 E., S.B.M. (Imperial County); about 9½ miles south of Ocotillo Wells, and 1¾ miles northwest of the United States Gypsum Company quarry. *Ownership:* Roberts *et al.*, c/o M. N. Roberts, 291 S. Marengo Ave., Pasadena. Leased by J. A. Stephens, 4040 Cuervo, Hope Ranch Park, Santa Barbara (1957).

Claims were first located on this property in 1916 by David R. Roberts and W. F. Peeler, of Los Angeles. These men then mined about 40 tons of celestite fro the deposit and shipped it to E. F. Mortimer in L Angeles (Tucker, 1921a, p. 271-272). The property a parently then lay idle until World War II, when it w leased by the Pan Chemical Company. This compa mined 1000 tons of celestite ore, which averaged percent strontium sulfate, during the period from 19 to 1946. The latest reported activity on the proper took place in 1956 and 1957, when small amounts celestite were mined.

The Roberts and Peeler Deposit lies at the top of t south-southeastern end of a group of low hills which a composed chiefly of the Split Mountain formation Miocene age (Ver Planck, 1952, Pl. 20). In two are that comprise about 50 acres of the hills, the Split Mou tain formation is overlain by the following successio 10 feet of interbedded sand, sandy silt, and argillaceo gypsum, with the gypsum increasing toward the to and about 100 feet of gypsum. The celestite rock co formably overlies parts of the gypsum of the more ea erly of the two areas. This rock occurs as five capli erosional remnants of layers that consist of two zones: lower, very thin transitional zone of intercrystalliz gypsum and celestite; and an upper zone of celestite (Fi 58, Photo 84). The zone of celestite ranges in thickn from two to eight feet, and averages five feet (Durr 1953, p. 7). The largest of the celestite remnants w about 150 feet long and 50 to 100 feet in width befo mining, and the smallest is less than 25 feet in diamet The maximum dip of the gypsum and celestite is abo 15° to the east.

The celestite of the deposit is pale buff on fresh su faces and very fine grained, in contrast to the gypsu

Photo 84 (below). Roberts and Peeler celestite deposit, south of Ocotillo, on eastern edge of county. View east showing unmined part of easternmost coplike remnant of celestite of five which cap gypsum.

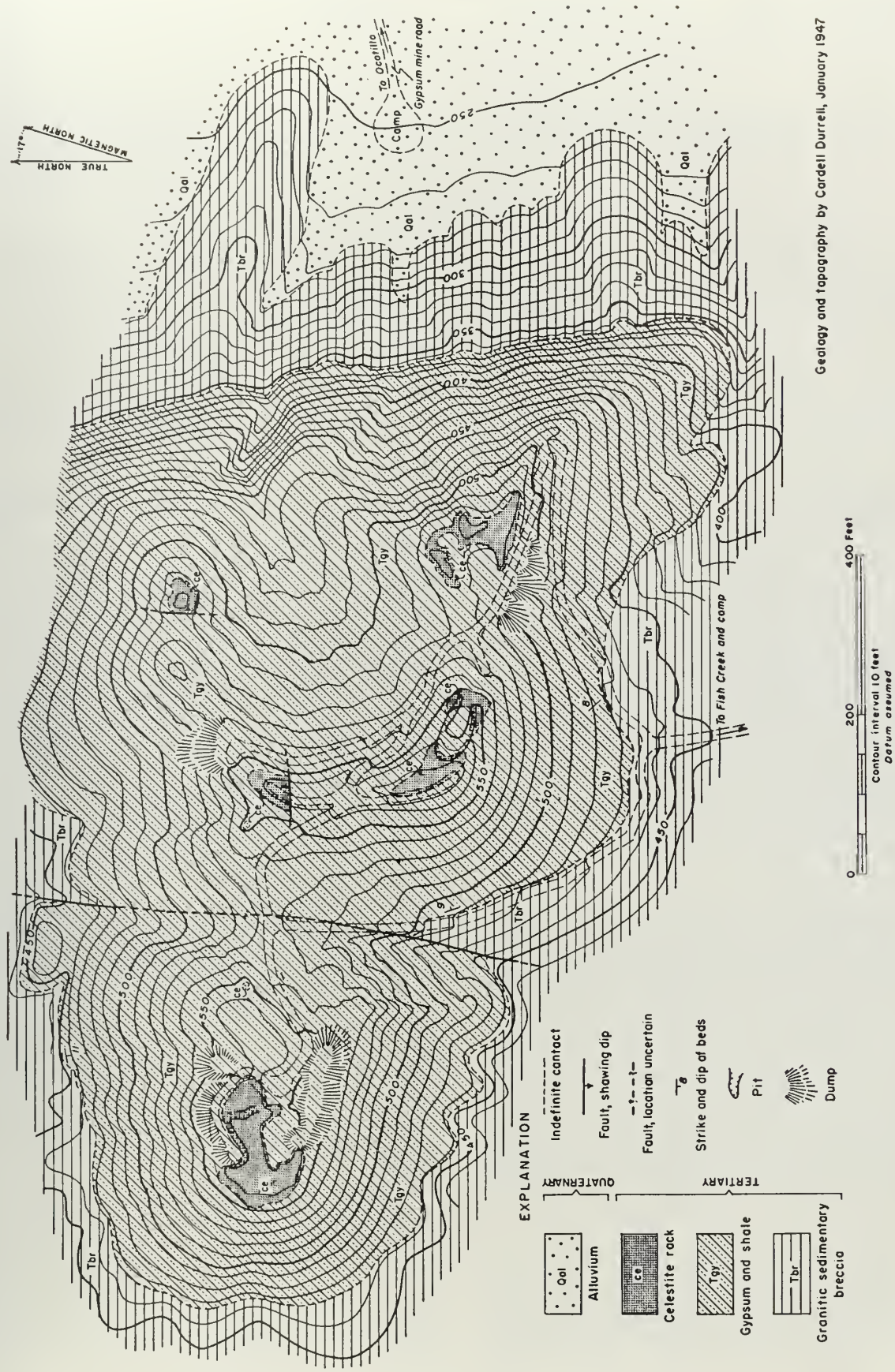


Figure 58. Geologic map of the celestite deposit near Ocotillo. *After Durrell 1952.*

Strontium

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Fish Creek (Fish) Mountains				See Roberts and Peeler deposit in tex (Hewett and others 36:154-155, 161)
	Last Canyon mine	"about 5 miles northwest of Jacumba" (Tucker and Reed, 1939).	Malcolm L. Gilmore, Boulevard (1939)		A deposit of strontianite described b Tucker and Reed (1939) which could not be verified by present investigator. Probably same as Unnamed in tabulated list under "Wollastonite" Carrizo Canyon deposit in tabulated list under "Tungsten". (Tucker and Reed 39:52).
	Mortimer deposit	Fish Creek Mts. area.			Probably same as Roberts and Peeler deposit, which see in text. (Boali and Castello 18a:34).
	(W. F.) Peler and D. R. Roberts				See Roberts and Peeler deposit in tex (Tucker 21a:271-272).
443	Roberts and Peeler (Peler and Roberts, Roberts celestite) deposit	South of Ocotillo Wells; partly in Imperial County.			See text. (Boalich and Castello 18a: Durrell 53:5-7; Harness 42; Hewett and others 36:154-155; Sampson and Tucker 42:143, pl.1; Tucker 21a:271-272; 26:284; Ver Planck 52:27-35, 7 72, pl. 20; 57f:607).
	Roberts Celestite deposit				See Roberts and Peeler deposit in tex (Sampson and Tucker 42:143, pl.1).

which is snow white on fresh surfaces and generally coarse grained. The celestite weathers medium buff to brown. Parts of the celestite are vuggy, with needlelike crystals lining vugs. Some shows a columnar structure.

An analysis of a sample collected from the deposit by Moore (*in* Hewett and five others, 1936, p. 161) yielded the following constituents: SiO_2, 0.90 percent; Al_2O_3, 0.49 percent; Fe_2O_3, 0.50 percent; CaO, 2.47 percent; MgO, 0.05 percent; SrO, 52.88 percent; BaO, 1.53 percent; MnO, trace: SO_3, 41.44 percent; CO_2, 0.71 percent; H_2O, 0.16 percent; total 101.13 percent; $SrSO_4$ calculated from SrO, 93.8 percent.

The mine workings consist of shallow cuts and trenches.

TIN

The most important ore mineral of tin is cassiterite (tin oxide) which is the only tin-bearing mineral that has been reported to occur in San Diego County. Tin has not been mined in the county, however. Cassiterite is a very minor constituent of the Himalaya, Little Three, and Blue Bell Pegmatite Deposits which are described herein under "Gem Minerals." Tin also is reported to occur at the Katherine Prospect, northwest of Borrego Springs; at the Cassiterite Placer Claim, east of Buckman Springs (Segerstrom, 1941, p. 552); and in placer deposits in Pine Valley (Merrill, 1914, p. 669). These localities are described herein in the accompanying tabulated list.

TUNGSTEN

As the tungsten deposits of San Diego County generally have proved to be small and of low grade, they have been worked only when the price of tungsten trioxide has been relatively high. Specifically, this has been during the two world wars, and during a period beginning with the start of the Korean conflict, 1950, and en ing in 1956 with the cessation of buying under U government purchase programs. Although at least individual tungsten-bearing localities are known in t county, they have yielded only a very small part of t tungsten production for California. The total output f the county is only about 4,000 short ton units of tungst trioxide, of which about 3,000 units was produced at t Pawnee Mine. Other mines with a production of at le 50 units are, in order of decreasing rank, the Payc Dyche Valley, Sundown, and Metal Mountain.

The first deposit to be worked for tungsten in t county was the Pawnee Deposit, which was opened 1917 and perhaps yielded a small output during Wo War I. The deposits that were worked during Wo War II are the Pawnee, Sundown, and Dyche Vall Mines, the Easy Group, and the Little Randsburg D posit. During the early to mid-1950's the Pawnee, Payc Dyche Valley, Metal Mountain and Live Oak Mines w productive intermittently.

During the 1950's, mills to process scheelite-beari ores were operated in the county at the Warlock Go Mine near Julian, by Fred and Cecil Creese; at Jacum by P. L. Henderson and B. L. Clark; in Grapevine Ca yon, by the Desert Star Mining Company; at Ramo by L. B. Spaulding; and at the Pawnee and Dyche Vall Mines.

Scheelite (calcium tungstate) is the most abounda tungsten-bearing mineral in the county. It occurs ge erally as small grains which range in color from pale gr to pale yellowish gray. The only truly distinctive pro erty of the mineral is a brilliant bluish-white fluorescen when exposed to ultraviolet light. Tungsten is us chiefly in the manufacture of alloy steel and tungst carbide, an abrasive.

Tin

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Blue Tourmaline				See San Diego group. (Schaller 16a: 351-354).
	Cassiterite placer claim	Sec. 19, T16S, R5E, SBM; between 1 and 1½ miles east of Buckman Springs.	Guy Hogan, Pine Valley (1941)	Owner reported (1941) that spectrographic analysis showed 0.01% tin.	One claim located prior to 1941. No workings could be located in the area in 1957. (Merrill 14:669; Segerstrom 41:552).
	Himalaya mine	Mesa Grande district.		Cassiterite is a minor accessory mineral in pegmatite deposit.	Described in text under "Gem minerals." (Schaller 16a:352).
44	Katherine prospect	Sec. 5(?), T10S, R5E, SBM; in Anza-Borrego Desert State Park, about 9 miles northwest of Borrego Springs, at the head of the principal south-southeasterly tributary of Indian Canyon Creek. (Map location probable.)	Mrs. George W. Wright, Route 1, Box 9B, San Jacinto (1953)	Small pendants of slate and mica schist in granitic rocks contain very small proportions of tin according to W. T. Bean (U. S. Bureau of Mines, unpublished report, 1949). Principal pendant strikes N20°E, dips 60°SE, is 400 ft. long, 50 ft. wide and 30 ft. thick. Pendant is "weathered brown and contains small seams of iron minerals in bedding planes. Slight tin mineralization associated with iron... No megascopic tin minerals." Also reported by owner to contain molybdenite.	Accessible via Jeep, only with difficulty. Property consisted of 16 unpatented claims in 1953. Explored only by small cuts. (W. T. Bean, U. S. Bureau of Mines, unpublished report, 1949). (R.M.S.)
	Laguna Mountains placers	East slope of Laguna Mts.		Cassiterite in placer deposits.	No additional published information. (Merrill 14:669; Segerstrom 41:552; Tucker and Reed 39:31-32).
	Little Three mine	Ramona district.		Cassiterite is a minor accessory mineral in pegmatite deposit.	Described in text under "Gem minerals". (Schaller 16a:352).
	San Diego group	Secs. 12 and 13, T9S, R3E, SBM; about 8 miles north of Warner Springs, on the north side of Chihuahua Valley.		Sparse cassiterite in pegmatite deposits.	Three claims (San Diego, Panama, and Exposition) were located for tin by R. Carson, E. L. Haney, and D.H.G. Fiske of Pasadena in 1915. Deposit is described herein in text under "Gem minerals" as the Blue Bell mine, which see. No production of tin. (Schaller 16a:351-354; Segerstrom 41: 552; Tucker and Reed 39:31).
	Unnamed	"South end of Viejas Mt., east of Alpine" (Merrill, 1914).			A reported occurrence that is unconfirmed. No additional published information. (Merrill 14:669).
	Unnamed	Pine Valley			Merrill (1914) stated that tin was reported from "placers in Pine Valley." Unconfirmed. (Merrill 14:669).
	Unnamed	"Defiance copper district north of the Santa Margarita Grant." (Merrill, 1914).			A reported occurrence that is unconfirmed. No additional published information. (Merrill 14:669).

The tungsten deposits of the county consist of two principal types, tactite bodies and veins. By far the more common of the two types are bodies of scheelite-bearing tactite. These bodies are enclosed variously in metamorphic rocks (mainly schist), in "hybrid" rocks composed mainly of quartz diorite and schist or gneiss, and in granitic rocks. The most productive deposits have been irregular bodies and layers of tactite enclosed in schist and "hybrid" rocks: these deposits include the Pawnee, Payoff, Dyche Valley, Sundown, and Live Oak. The parts of these deposits that have been mined probably averaged at least 1 percent tungsten trioxide.

Much less common than tactite bodies are scheelite occurrences in quartz veins which also contain gold or the association of gold, silver, and lead. Such deposits in the Metal Mountain (see description of Metal Mountain Mine below) and the Deer Park districts have yielded small quantities of tungsten ore.

The geographic distribution of the tungsten deposits and metamorphic and hybrid rocks in San Diego County is shown on Plate 1. The areas (or districts) that contain tungsten mineralization are as follows: (1) Beauty Peak area, along the boundary between Riverside and San Diego Counties (Pawnee Mine, Easy Group, and Teuscher Prospect); (2) Sunrise Highway-Mason Valley area (Sundown, and Live Oak Mines, Best Yet, Feldon, and Henderson Prospects); (3) San Ysidro Mountain area, north of Montezuma Valley (Payoff Mine, prospect with name undetermined); Metal Mountain district, north of Live Oak Springs (Metal Mountain and Crown Point Mines, and Blackstone and Last Dollar Prospects); (4) Grapevine Canyon-Grapevine Mountain area, east of San Felipe Valley (Long, Rys, and Smitty Prospects); (5) the area north of Jacumba (Little Randsburg, White Cloud, and Carrizo Creek Prospects); and (6) Deer Park district, which is described under "Gold" (Gold Standard Group and Oak Canyon Mine). The Dyche Valley Mine on Palomar Mountain is not grouped with other deposits.

Three regions that are underlain by metamorphic or hybrid rocks probably have not been prospected thoroughly for tungsten. These are (1) the southwest part of the Santa Rosa Mountains; (2) the region bounded by Los Coyotes Indian Reservation on the west and Borrego Valley on the east; and (3) the region along the Riverside County line that extends eastward from Beauty Peak to Coyote Creek.

Metal Mountain Mine *

Location: S.½ Sec. 9 and NW.¼ Sec. 16, T. 16 S., R. 6 E., S.B.M.; Metal Mountain district, about 7 to 7½ miles north-northwest of Live Oak Springs, in the southwest part of the In-Ko-Pah Mountains. *Ownership:* NW.¼ Sec. 16—L. B. Spaulding, P.O. Box 15, Ramona; L. B. Spaulding, Jr., Live Oak Springs; and Dewey A. Sherar; hold a 20-year mineral lease on the NW.¼ Sec. 16 (160 acres) from the State Lands Commission, State of California, Los Angeles. S.½ Sec. 9—H. W. Meador, Highway 94, Campo; L. B. Spaulding, Jr.; and Robe Harris, hold two unpatented, north-northeast trending partly overlapping lode claims which cover the middle o the S.½ Sec. 9 (1958).

The Metal Mountain tungsten-bearing deposits wer first prospected in the 1890's, for lead and silver, by C. E Campfield of Virginia City, Nevada (L. B. Spaulding personal communication, 1955). The workings of Camp field were extended a few feet in 1914 by Robert Ortl of Santa Monica, who also did a small amount of wor in 1950. L. B. Spaulding and associates began prospectin the area for tungsten-bearing mineralization in the earl 1950's and in 1954 obtained a 20-year lease, from th State of California, on the NW.¼ Sec. 16. The Met Mountain Mine was worked from 1954 to 1956. Durin that period the total output from the mine (and thre adjacent properties owned by Spaulding and/or one o more of his associates) was slightly more than 75 uni of tungsten trioxide (WO_3). The adjacent properties ar the Crown Point Mine, and the Blackstone and La Dollar Prospects, which are described in the accompany ing tabulated list.

All but one of the known tungsten deposits in th Metal Mountain district consist of scheelite-bearin quartz veins enclosed in north-northeast trending shea zones in schist. The one exception is the Last Dollar De posit which consists of a body of tactite in schist. Th schist is exposed as a north-northeast trending belt, su rounded by intrusive rocks, which is two miles wide i the southern part and pinches northward. To date th principal tungsten mineralization has been discovered i two shear zones which are about 2,500 feet apart. Th Metal Mountain property encloses the north part of th more east-northeasterly zone, and the Crown Point pro erty encloses the more west-northwesterly zone.

The more east-northeasterly shear zone has been trace south-southwestward for at least 1¼ miles, from th center of the S.½ Sec. 9, through Sec. 16, to a point i the NE.¼ NE.¼ Sec. 20. The part of the zone withi the Metal Mountain property that has been mined e tends along a west-northwest facing ridge slope from point near the northeast end of the zone to the cent of the N.½ SE.¼ NW.¼ Sec. 16, a distance of abo one-half mile (Photo 85). Two veins within the zo contain the principal workings of the mine. The mo south-southwesterly of the two veins, which is 500 600 feet long, and in the NE.¼ NW.¼ Sec. 16, contai the most productive ore shoot and the main working Where it encloses this shoot the vein strikes N. 25° E dips 70° southeast, and probably averages two to thr feet in width. The shoot is 30 to 40 feet long, but i depth was not determined by the writer. The second ve lies at the northeast end of the zone, in Sec. 9. This ve is as wide as eight feet.

The principal tungsten mineral in the deposit is sche lite, which near the surface is altered locally to tungsti An additional tungsten mineral present, but in very min proportions, is ferberite. Also occurring are pyrite, silve bearing galena, sphalerite, cerussite, and gold. Gang

* Prepared partly from data collected by R. M. Stewart.

Photo 85. Metal Mountoin tungsten deposits, obout 7½ miles north-northwest of Live Oak Springs. View northeast shows workings on opposite slope which indicate extent of east-northeast-trending zone explored for tungsten, lead, silver, and gold.

nerals, in addition to quartz, are sericite, chlorite, and molite. Tremolite commonly encloses crystals of eelite and galena. The average grade of the ore was determined by the writer. Ore in parts of the main rkings was reported by L. B. Spaulding (personal mmunication, 1955 and 1957) to average more than 2 cent tungsten trioxide.

The main workings of the mine consist of a 50-foot ft and a 130-foot drift adit. The adit trends S. 25° along the vein and intersects the bottom of the shaft. e collar of the shaft is at the north-northeast end of a llow 100-foot trench. Workings of the more norththeasterly vein, which are about 1,800 feet norththeast of the main workings, consist principally of o north-northwest trending cuts, 100 and 150 feet g. A third group of workings, which is located about dway between the other two groups, consists of two fts, about 50 feet apart, which are 25 and 60 feet in pth. These are probably the oldest workings in the trict. Additional workings on the property consist stly of shallow cuts and trenches.

During operation of the mine, ore was upgraded by rting and cobbing at the mine and hauled to a mill at mona. The mill, which is owned by L. B. Spaulding, nsists of a crusher, rolls, screens, and a single concentrating table. Concentrates have been sold and middlings red for rerun.

wnee (Carr, Oak Grove) Mine

Location: NE.¼ Sec. 6, T. 9 S., R. 3 E., S.B.M. (San ego County); and Sec. 31, T. 8 S., R. 3 E., S.B.M. Riverside County); about six miles northeast of Oak rove, along the boundary between San Diego and verside Counties. *Ownership:* Verdi Development mpany, 2623 Hyperion Ave., Los Angeles 23, holds unpatented claims (1957).

The tungsten-bearing deposits on the lower southeast pes of Beauty Peak were first prospected in 1917 by ert Simmons and John Wentworth of Aguanga, who eated 18 claims in the area, and perhaps produced a all quantity of tungsten-bearing concentrates. The area then was inactive until the late 1930's when the Pawnee Deposit was developed and worked on a small scale by Frank Carr of Aguanga. During World War II the deposit was worked by E. L. and William Carr. In 1951, the Pawnee Mine Incorporated, Beverly Hills, acquired the Pawnee property and in late 1955 or early 1956 sold it to the Verdi Development Company. It has been idle since 1956. Total output from all deposits in the area probably is slightly more than 3,000 units of tungsten trioxide (WO_3).

The tungsten-bearing deposits in the Beauty Peak area consist of bodies of scheelite-bearing tactite enclosed concordantly in metamorphic rocks. The metamorphic rocks are predominately schist and gneiss, which are cut by small, irregular bodies of granitic rocks. Of chief interest on the Pawnee property have been two bodies of tactite, about 1,100 feet apart, which lie on opposite sides of a north-trending ridge whose south end abuts Chihuahua Creek. The more productive of the two bodies lies near the southeast edge of the ridge, south of the line between San Diego and Riverside Counties (Photos 86, 87, Fig. 59). This body strikes N. 20°-25° E. and dips about 85° southeast. It ranges in known strike-length from 55 to 70 feet, and in width averages about 8 feet. It has been worked vertically to a depth of about 140 feet. The rock is composed of a medium- to coarse-grained aggregate of quartz; brown garnet, epidote, calcite, diopside(?), and scheelite. The ore mined probably averaged about 1 percent tungsten trioxide.

The less productive body lies on the west side of the ridge, in Riverside County. It has yielded only a small amount of tungsten ore. The body strikes north-northeastward and dips steeply southeast. Its dimensions were estimated by L. C. Penhoel (unpublished report, 1953) as follows: length, 75 feet or more; and width, 45 to 55 feet. It probably averages about ½ percent tungsten trioxide.

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 (Fig. 59). The two drifts range in length from 70 to

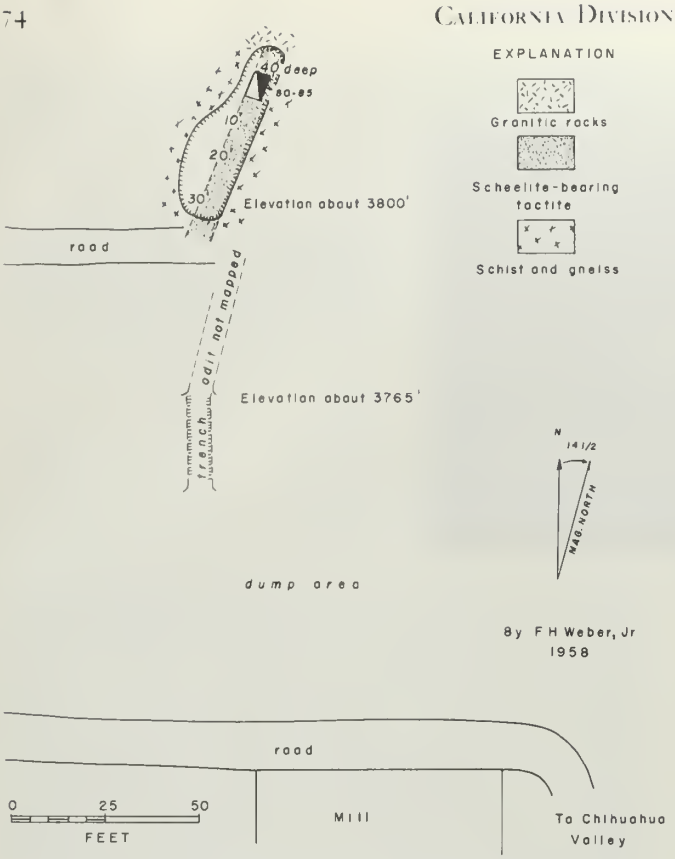


Figure 59. Map of Pownee mine, San Diego and Riverside Counties, showing more productive of two deposits, in San Diego County.

90 feet and are appended to stopes. From a point about 50 feet south of, and 35 feet lower than the southwest edge of the collar of the shaft, a drift adit trends N. 5° 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.

The less productive body was opened by a north trending cut about 125 feet long and 50 feet high, an two adits of undetermined length.

Ore was milled on the property. The mill was mainl intact, as of 1958, and contained a jaw crusher, rolls, ba mill, and two concentrating tables. It had a capacity about one to two tons per hour.

Sundown Mine

Location: NE.¼ Sec. 33, T. 14 S., R. 5 E., S.B.M about four miles northwest of Mount Laguna, and abo one-fourth mile west of Sunrise highway. *Ownersh* Nick Sutherland, Box 172, Descanso. Leased to Jac Jarvis, Route 2, Box 566, Lakeside (about 1955). In 194 the property comprised two patented claims.

The Sundown Tungsten Deposit, which was disco ered in 1941, was worked almost continuously fro that date through part of 1942, and intermittently as la as 1954. Total output from the mine is probably abo 150 units of tungsten trioxide (WO_3). The ore mine was milled on the property.

The deposit consists of a body of scheelite-bearing ta tite whose lateral extent is obscured by a veneer of all vium. The underground workings show an east-trendin tactite body at least 150 feet long and as much as 20 fe wide, which dips 65° to 70° north. The body is enclose in hybrid rocks that consist of quartz diorite and schis The tactite is composed essentially of quartz, garnet, an epidote. Ore mined in 1942 was reported by the operato to average more than 1 percent tungsten trioxide (WO_3 The deposit is noted for rather large scheelite crysta which were recovered from near-surface workings in very friable, brecciated quartz-garnet rock. One spec men from the deposit contained a broken scheelite cryst two inches in maximum dimension.

The deposit was prospected originally by means of 65-foot shaft, inclined 70° north, which was deliberate caved in 1947. On the 20-foot level of this shaft a dri trended eastward for about 30 feet, and at the end of t

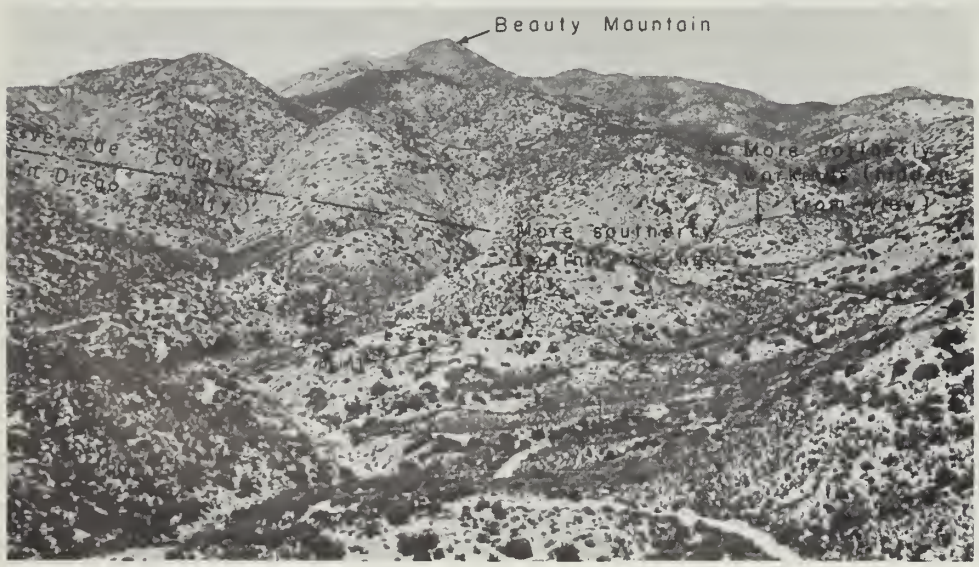


Photo 86. Beauty Mountain area, alo border between San Diego and Riversi Counties. View northwest shows mill a southern workings of Pownee mine, in S Diego County; northern workings are Riverside County.

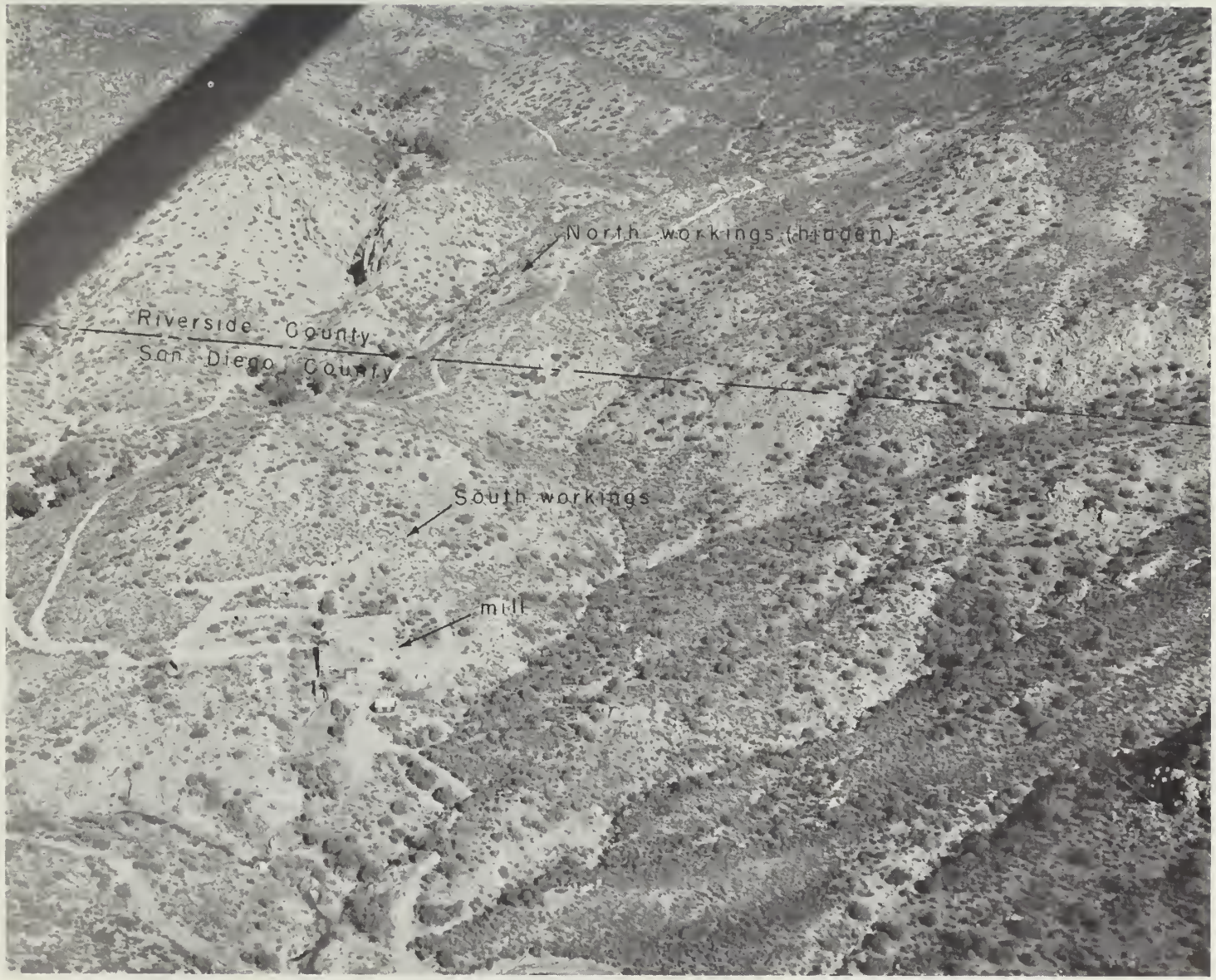


Photo 87. High oblique aerial view of Pownee mine area, San Diego and Riverside Counties, camera facing north. Bodies of tactite ore enclosed in metasedimentary rocks which are cut by pegmatite dikes and other minor intrusive bodies.

Tungsten

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Aguanga deposits				See Pawnee mine, Easy group, and Teuscher prospect. (Hess and Larsen 21:260-261; Kerr 46:165).
445	Bartling and Nelson deposit	Sec. 14, T10S, R3E, SBM; about 1½ miles north-northwest of Warner Springs; adjacent, on east, to Lost Valley truck trail.	H. G. Bartling, 4644 Whitwood, Long Beach 8 and Harold Nelson, 841 Junipero, Long Beach 4 (1958)	Fine- to coarse-grained scheelite in tactite in "mixed rocks". (Owner, personal communication, 1959).	One unpatented claim prospected by shallow pit.
	Beauty Mountain Tungsten Mines				See Teuscher prospect. (Jenkins 42:353 Tucker and Reed 39:32).
	Beauty Peak deposits				Beauty Peak is northwest of Chihuahua Valley, mainly in Riverside County. See the Pawnee mine, which is on the south flank of Beauty Peak, and mostl in San Diego County, and Easy group and Teuscher prospect. (Kerr 46:161).
446	Best Yet deposit	South edge SE¼ sec. 18 and north edge NE¼ sec. 19, T14S, R5E, SBM; Laguna Mountains, about 7¾ miles north-west of Mount Laguna, adjacent on east to Sunrise highway. In Anza-Borrego Desert State Park.	Property leased from U.S. Bureau of Land Management by W. G. George, 3564-45th Street, San Diego (1955)	Scheelite-bearing layers of tactite are enclosed concordantly in schist. These rocks strike N50°W and dip 65° east. The tactite layers are estimated to range in thickness from several inches to 1 ft. Parts of tactite layers that contain scheelite are fine-grained and consist chiefly of quartz with minor limonite and diopside.	The deposit was worked briefly in 1955. Development consists of 3 shallow shafts in a northwest-trending row. The most southeasterly shaft, which i about 25 ft. deep, is about 125 ft. from the most northwesterly one. The two most northwesterly shafts are caved. Production negligible.
447	Blackstone prospect	Near common corner between secs. 16,17,20 and 21, T16S, R6E, SBM; Metal Mountain district, about 6½ miles north-northwest of Live Oak Springs.	L. B. Spaulding, P.O. Box 15, Ramona, and L. B. Spaulding, Jr., Live Oak Springs (1958)	Two scheelite-bearing quartz veins about 20 ft. apart strike N10°W, dip 85° east, and are 1-1½ ft. wide. They are probably in the south-southwesterly part of the zone developed by the Metal Mountain mine to the north-north-east.	One unpatented claim prospected by shallow cuts and trenches.
	Carr Tungsten mine				See Pawnee mine in text. (Tucker and Sampson 40:48).
448	Carrizo Canyon deposit	NW¼NE¼ sec. 19, T17S, R8E, SBM; about 4½ miles north-northwest of Jacumba, and about 250 ft. east of the San Diego and Arizona Eastern railroad.	Undetermined (1957)	A small body of tactite in granitic rocks; contains quartz, grossularite and sparse scheelite.	Deposit can be reached by jeep trail from Dubber spur. Developed by a partly stoped, south-trending, 25-ft. adit.
449	Crown Point mine	SE¼SE¼ sec. 8, W½ SW¼ sec. 9, and E½ sec. 17, T16S, R6E, SBM; Metal Mountain district, 7 to 7½ miles north-northwest of Live Oak Springs.	L. B. Spaulding, P.O. Box 15, Ramona, L. B. Spaulding, Jr., Live Oak Springs, and H. W. Meador, Highway 94, Campo (1958)	Discontinuous scheelite-bearing quartz veins in a northeast to north-northeast trending shear zone. Zone is about 2,500 ft. west-northwest of a similar zone developed by the Metal Mountain mine.	Five unpatented, end-to-end, northeast to north-northeast trending claims. Explored by 3 groups of shallow workings. Small output included with total for Metal Mountain mine, which also see, in text.
	Desert Star Mining Company	Mill: NW¼SE¼ sec. 36, T11S, R4E, SBM; south of Montezuma Valley; bordered west edge of Grapevine Canyon road.	G. D. Seward, 8751 La Tijera, Los Angeles 45 (about 1955)		In 1954, this company very briefly explored and worked the Long and Rys deposits, which see also. Small mil used only very briefly. (R.M.S.)

Tungsten

Map no.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
0	Dyche Valley (Hagee) mine	NE¼SE¼ sec. 19, T10S, R2E, SBM; Palomar Mt. region, about 9 miles east of Rincon; on north side of Palomar Mt. crest highway.	E. T. Mendenhall, Mendenhall Ranch, Palomar Mountain Rd., San Diego County (1957); leased to P.L. Haddan, 831 N. Eucalyptus Ave., Inglewood (1957)	Zone of scheelite-bearing tactite enclosed concordantly in metamorphic rocks strikes N.10°E. It is exposed north-northeast of mine workings for about 2,000 ft. and south-southwest of workings for at least several hundred ft. It averages about 10 ft. in width.	Operated from 1943 to 1945 and in mid-1950's. Deposit was worked from a 100-ft. vertical shaft from which were appended 2 drifts and irregular stopes. Ore was milled on property. Additional workings consist of shallow cuts on north part of zone in SE¼NE¼ sec. 19. Production estimated to be about 250 tons of scheelite-bearing tactite which averaged 1½ percent WO_3. (U.S. Geol. Survey, short unpub. rept., 1953).
1	Easy group (Little Goffee (?) prospect)	Sec. 5, T9S, R3E, SBM; about 6 miles northeast of Oak Grove, near Riverside-San Diego County line.	Lloyd Mitchell, Aguanga (1939)	Zone of tactite along a fault strikes west-northwestward and dips steeply southwest. Zone is about 3 ft. wide.	Explored by a north-northwest trending trench about 50 ft. long. Small production. (Bateman and Irwin 54:39; Jenkins 42:353; Kerr 46:165; Tucker and Reed 39:32).
2	Felden deposit	W½E½ sec. 26, T13S, R5E, SBM; about 11 miles east-southeast of Julian, on the crest of the ridge south of Box Canyon. In Anza-Borrego Desert State Park.	State Division of Beaches and Parks controls land for which mineral rights are held by U.S. Bureau of Land Management. (1959)	Deposit consists of tactite interlayered with quartzite and quartz-biotite schist. Zone prospected is about 3/8ths of one mile long. Rocks strike N10°-20°W and are nearly vertical. Zone is as wide as 10 ft. and pinches to north and south. Lessee reported tactite to average one percent WO_3. Common minerals are quartz, brown garnet, "limonite" (including nontronite), and manganese oxides.	Deposit probably was first prospected by H. L. Jackson of Brawley and E. H. Johnson of San Diego in 1941 (W. B. Tucker, California Div. of Mines, unpublished notes, about 1941). Deposit was leased during 1950's by Frank Felden, 2486 Manchester St., Cardiff-by-the-Sea. This lease was relinquished about 1958. The deposit is explored by a 50-ft. cut and several shallow cuts and pits. Production is assumed to be very small or nil. (Kerr 46:165).
	Gold Standard group	Deer Park district.			Scheelite occurs in gold-bearing quartz veins. See tabulated list under "Gold." (Jenkins 42:353; Kerr 46:165; Partridge 41:317; Tucker 25:353).
	Hagee				See Dyche Valley mine.
3a (Map 3b 11)	Henderson deposit	Deposit: SW¼NW¼ sec. 20, T14S, R5E, SBM; Laguna Mountains, about 6-3/4 miles northwest of Mount Laguna; several hundred ft. south and east of Sunrise highway. Mill: borders south side of U.S. Highway 80, just west of Jacumba.	H. S. Long, 5656 Corbin, Tarzana. In 1955 leased to Paul Henderson and associates, 9300 El Cajon Blvd., La Mesa	Scheelite-bearing tactite. Bodies of undetermined size in schist. Tactite composed chiefly of quartz, diopside, and garnet.	Long owns the W½ and W½SE¼ sec. 20. Explored by several bulldozer cuts several hundred ft. long. Production negligible. See also Payoff deposit.
54	Last Dollar prospect	SW¼ sec. 21 and NW¼ sec. 28, T16S, R6E, SBM; Metal Mountain district, about 6 miles north-northwest of Live Oak Springs.	H. W. Meador, Highway 94, Campo (1958)	Zone of coarse-grained tactite in schist strikes north-northeastward and dips steeply west. Tactite consists of garnet, diopside, epidote, calcite, and sparse scheelite.	One unpatented claim explored by trench 20 ft. long and 5 ft. wide. Small production included with total for Metal Mountain mine.
	Little Goffee group				See Easy group. (Bateman and Irwin 54:39).
55	Little Randsburg prospect	SW¼ sec. 25, T17S, R8E, SBM; about 5 miles northeast of Jacumba.	J. H. Hubble, Jacumba or Rt. 1, Box 26, Santee (1957)	A small body of tactite in granitic rocks. Contains sparse scheelite.	Two unpatented claims, which are part of the Mica Gem group (described in text under "Mica"). Developed by 10-ft. shaft and shallow cut. Present owner stated (personal communication, 1957) that in 1940 T. J. Williams mined ore from the deposit worth about $2,000. Inactive since that time.

Tungsten

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
456	Live Oak group	SW¼ sec. 17, T14S, R5E, SBM; Laguna Mts., nearly 7½ miles northwest of Mount Laguna, and about ½ mile northeast of Sunrise highway. In Anza-Borrego Desert State Park.	L.A. Sours, Rt. 1, Box 686, Riverside, and E. A. and C.D. Rice (1955)	Deposit consists of an elongate body of tactite which crops out on the northeast side of a northwest-trending interfluve. The tactite is a fine- to coarse-grained aggregate composed mainly of quartz with minor proportions of garnet, diopside, and scheelite. The body trends northward and dips very steeply east. The extent of the scheelite-bearing rock was not determined, but the extent of the workings suggests it is no more than 75 ft. long and 5 to 8 ft. wide. The body is cut off against granitic rocks on the north by a fault which strikes northeastward and dips steeply northwest.	Property consists of 3 unpatented lode claims. These were leased in the mid 1950's to Fred and Cecil Creese of Julian who sub-leased them to A. G. Foster of Julian. The deposit was first explored by 2 shallow northwest trending cuts which were opened in a northeast-facing slope; the lower and more prominent cut is about 125 ft. long and is 25 ft. northeast of the upper and more southwesterly one which is about 100 ft. long. Abutting the face of the lower cut is a more recent working which consists of a south-southwest trending trench about 100 ft. long, 15 to 20 ft. wide, and as deep as 8 ft. Mining was done at the face of this trench and above it, to the south-southwest, in shallower trenches. Ore was sorted at the mine then transported to a mill at the Warlock gold mine near Julian.
457	Long deposit	Near the center of sec. 2, T12S, R4E, SBM; south of Montezuma Valley, on the ridge between Grapevine and San Felipe Canyons.	Harvey Long, Ranchita (1955)	Bodies of scheelite-bearing tactite in Julian schist, near contacts with quartz diorite.	Prospected by shallow pits and trenches. Explored by Desert Star Mining Company in early 1954, and small quantity of ore sorted. See also Desert Star Mining Company. (Stewart 58:38).
458	Los Coyotes prospect	East edge of the SE¼SE¼ sec. 24, T10S, R4E, SBM; about 6-3/4 miles due east of Warner Springs, on the Los Coyotes Indian Reservation.	Los Coyotes Indian Tribe, Warner Springs (1958)	Zone of scheelite-bearing tactite several hundred ft. long and about 5 to 10 ft. wide. Zone strikes northward and dips steeply east.	Prospected by R. R. Dye of Warner Springs in mid-1950's. Explored by shallow cut. No production.
459	Metal Mountain mine	North-northwest of Live Oak Springs.			See text. Also see Crown Point mine, and Blackstone and Last Dollar prospects. (Hubon 02:4; Merrill 14:668).
	Oak Canyon mine				Chiefly a gold deposit. Contains some tungsten mineralization. See tabulated list under "Gold".
	Oak Grove Tungsten Mine				See Pawnee mine in text. (Jenkins 42: 353; Partridge 41:318; Tucker 25:353)
460a 460b	Pawnee (Carr, Oak Grove) mine	Northeast of Oak Grove.			See text. (Eng. and Min. Jour., Mar. 1956, p. 132; Hess and Larsen 21: 260-261; Jenkins 42:344; 353; Kerr 46:161; Partridge 41:318; Tucker 25: 353; Tucker and Sampson 40:48; 41:58 584; 45:156).
461	Payoff mine	Center of the N½N½ sec. 6, T11S, R5E, SBM; about 2-3/4 miles north-northeast of Ranchita store, on San Ysidro Mt.	Fred M. Elliot, c/o Mac's Store, Manzanita, Pine Valley Post Office (1957)	A narrow, north-northeast trending zone of scheelite-bearing tactite interlayered with rocks that consist chiefly of biotite-quartz-sericite schist. The zone is nearly vertical, as wide as several ft., and probably more than 500 ft. long.	Two unpatented claims. Deposit was discovered in mid-1955 by Mr. Elliot and worked by him until the end of that year. During that period deposit yielded about 150 tons of ore which averaged one percent WO_3. The property was leased and worked during most of 1956 by Paul Henderson and Associates of La Mesa. It is developed by a 300(?)-ft. drift adit driven north-northeast from a point just south of a saddle in an east-northeast trending ridge. A 40-ft. winze was sunk 75 ft. from portal of the adit and a sub-level opened at the bottom of the winze. An 80-ft. winze was sunk from the sub-level. Ore was trucked 80 miles to the Henderson mill at Jacumba. The mine has been idle since the latter part of 1956. (Fred M. Elliot, personal communication, 1957). (F.H.W. and R.M.S.)

Tungsten

o	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
	Rys deposit	S½ sec. 1, T12S, R4E, SBM; south of Montezuma Valley, on the ridge between Grapevine and San Felipe Canyons.	Art Rys, Ranchita (1955)	Bodies of scheelite-bearing tactite in Julian schist, near contacts with quartz diorite.	Along ridge about 1 mile southeast of Long deposit. Prospected by shallow pits, trenches and cuts. See also Desert Star Mining Company. (Stewart 58:38).
	Smitty prospect	S½ sec. 22, T12S, R5E, SBM; east-central part of county, on the southwest side of a tributary to San Felipe Canyon, less than ¼ mile northwest of State Highway 78.	Orville Cumming, Sawday Ranch, Wynola, Star Route, Ramona (1958)	Narrow zones of very fine-grained tactite in "mixed" rocks that consist of schist and granitic rocks. Principal constituent of tactite is quartz, plus smaller proportions of epidote, hematite, diopside and scheelite. Rocks strike northeastward and dip steeply northwest.	NE¼SE¼ and S½SE¼ sec. 22 is patented ranch land which is part of the San Felipe Grant. Deposit was prospected for short time in mid-1950's by a Mr. Smith. Developed by several shallow cuts.
	Sundown mine	Laguna Mountains.			See text. (Bateman and Irwin 54:39; Jenkins 42:353; Kerr 46:165; Tucker and Sampson 41:587; 43:69-70).
	Teuscher prospect (Beauty Mountain Tungsten Mines)	Secs. 5 and 6, T9S, R3E, SBM; about 6 miles northeast of Oak Grove, near Riverside-San Diego County line.	W. H. Teuscher, 1543 W. 8th St., Upland (1958)	Small bodies of tactite in other metamorphic rocks. Similar to Pawnee deposit to north.	Property consists of 3 unpatented claims held since before 1939. Very small production. Explored by shallow open cuts and drill holes. (Jenkins 42: 353; Tucker and Reed 39:32).
6	Undetermined	Near the center of the NW¼ sec. 6, T11S, R4E, SBM; about 2-3/4 miles north-northeast of Ranchita store, on San Ysidro Mt.	Undetermined (1958)	Tactite in metamorphic rocks. Deposit similar to Payoff deposit which is about ¼ mile to the northeast.	Explored by short adit. No production.
7	Undetermined	NW¼ sec. 8, T14S, R5E, SBM; about 8-3/4 miles north-northwest of Mount Laguna.	Undetermined (1958)	Tactite bodies of undetermined extent in schist.	At least two prospects in area. Explored at same time as Live Oak deposit, 2 miles to south.
8a	Undetermined	Center of the east edge of sec. 25, T13S, R4E, SBM; about 6-3/4 miles southeast of Julian, on west slope of a north-trending ridge.	Undetermined (1958)	Scheelite-bearing deposit of undetermined extent in hybrid rocks.	A prospect.
8b	Undetermined	NW¼NW¼ and NE¼SE¼ sec. 27, T7S, R5W, SBM; Santa Margarita Mts., 2 miles west-northwest of De Luz.	S. Tatar, and G. Vrable, 610 Stanley St., Oceanside (1960)	Veins that are reported to contain scheelite, wolframite, and molybdenite.	A prospect. Developed during late 1950's. Not investigated by writer. (Tomo Ito, personal communication, 1960).
69	Unnamed	NW¼NW¼ sec. 11, T17S, R7E, SBM; about 8 miles northwest of Jacumba.	Undetermined (1957)	Scheelite may occur in a body of tactite several hundred ft. long on the eastern slope of the ridge west of the Crystal Gem beryl-bearing pegmatite deposit. The tactite is composed principally of epidote, garnet, and quartz.	Undeveloped.
70	White Cloud deposit	SW¼ sec. 21, T17S, R8E, SBM; about 4½ miles northeast of Jacumba.	J. H. Hubble, Jacumba or Rt. 1, Box 26, Santee, and Lee B. Covey. In March 1957 leased to "Curly" Dubro.	Deposit consists of a body of tactite in quartz diorite. The body is between 30 and 40 ft. in width and perhaps 75 to 80 ft. in length. It strikes N.20°E. and dips about 80° east. It consists chiefly of such minerals as diopside, wollastonite, chlorite, and grossularite garnet. The grossularite crystals are as large as 1½ in. in diameter. Scheelite is very, very sparse.	One unpatented claim located in 1956. Explored by several trenches, each less than 15 ft. long. Production negligible.

Undetermined

Map No	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
471	Carmelita claim	S½ sec. 26, or N½ sec. 35, T9S, R3E, SBM; south of Chihuahua Valley.	Undetermined (1958) Jeanne Marie Frey (1932)		One unpatented west-northwest-trendin lode claim surveyed for patent in 1932. Probably located for gold, feldspar, or gem minerals. Explore by several shallow cuts, as shown o patent plat. Millsite claim is 3,7 ft. to north-northeast, on north fo of San Luis Rey River. (Tucker and Reed 39:pl.1).

drift a crosscut extended about 20 feet to the north. Both of these workings were in ore. Two drifts that trended westward from the 20- and 65-foot levels, which were 10 and 20 feet long respectively, were not in ore. More recently opened workings consist chiefly of an east-trending open cut, whose maximum depth is about 15 feet, and shorter cuts at each end, forming an H-shaped excavation.

URANIUM AND THORIUM

Uranium- and thorium-bearing minerals are disseminated sparsely in a small proportion of the pegmatite deposits of San Diego County. These elements occur commonly in the following minerals; monazite (a phosphate of the cerium group); xenotime (a phosphate of the yttrium group); allanite (a complex silicate containing cerium); euxenite, fergusonite, and samarskite (complex columbium-tantalum minerals); and zircon (zirconium silicate). Most of these minerals have been noted in the county.

The pegmatite deposits of San Diego county were prospected widely for radioactive minerals during the early- to mid-1950's. The deposits that received the most attention are the Bird Rock, Fletcher and Allanite, which are in the central-southwest part of the county (see descriptions in tabulated list). Even these deposits were explored only superficially, however, and not mined.

A single recorded uranium-bearing sedimentary deposit in the county is the Olswick Deposit near Grantville. This consists of an unidentified uranium mineral that is disseminated in Poway conglomerate near its contact with granitic rocks.

VANADIUM

Vanadium has been reported from San Diego County only as a very rare constituent of pegmatite deposits in the Pala, Mesa Grande, and Rincon districts (Schaller, 1911b, p. 162-166; Palache and others, 1944, p. 600; Jahns and Hanley, unpublished). It occurs as the mineral pucherite (bismuth vanadate).

VERMICULITE

A single deposit of vermiculite is known in San Die County. This is the Circle Group Deposit, northeast Jacumba, in the extreme southeastern part of the coun (see description below). During the early 1950's an u successful attempt was made to market unexpand vermiculite from this deposit as a soil amendment. E panded vermiculite is used in the agricultural indust to improve the texture of heavy clay soils and for ro ing cuttings and germinating seed (Rollins, 1955, 98-99).

Vermiculite also is a very minor constituent of pegm tite deposits at Pala, Mesa Grande, and Rincon (Warir 1905b, pp. 363 and 368; Jahns and Hanley, unpublishe

Circle Group Deposit

Location: SW.¼ Sec. 16, and N.½ Sec. 21, T. 17 R. 8 E., S.B.M.; about five miles north-northeast of J cumba. *Ownership:* J. H. Hubble and Bryson Brow Jacumba, or Route 1, Box 26, Santee (1957).

The Circle Group comprises eight unpatented lo claims located in hilly terrain at the base of the sout west part of the Jacumba Mountains. Initial locations these claims were made in 1938. The deposit never h been mined successfully, although during 1952-53 attempt was made by a lessee to market the vermiculi unexpanded as a soil additive. In March 1957 no equi ment was on the property.

The vermiculite occurs as irregular masses with slightly to highly altered inclusions of gabbro in quar diorite (Photo 88). The inclusions are irregular and ran in length from less than one foot to several hundred fe They crop out over an area that trends west-northwe and is about one-half mile long and one-quarter mi wide. Many open cuts expose the altered gabbro, whic is composed chiefly of anhydrous and hydrous ma nesium-aluminum-iron silicate minerals. These inclu pyroxene; amphibole; chlorite; chrysotile, variety asbe tos; biotite; and vermiculite. Magnesite commonly forr

Uranium, thorium

Map No.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
72	Allanite (Keeney) prospect	NW¼NE¼ sec. 9, T14S, R2E, SBM; about 7 miles southeast of Ramona, north of El Capitan Reservoir; about 300 yards south of the intersection of the Gower and Mykrantz truck trails.	Undetermined (1957)	A pegmatite dike that strikes N65°E and dips 55° north. The dike is about 8 to 10 ft. thick. A border zone 2-3 ft. thick is composed chiefly of graphic granite with sparse blades of biotite to 4 in. in length. Allanite is reported to occur with the biotite. The core, 4 ft. thick, is composed chiefly of quartz with subordinate microcline crystals as long as 1 ft. The microcline contains inclusions of quartz, muscovite and magnetite. Length of the dike is several hundred feet.	Deposit explored by a northeast-trending 25-ft. trench, and a 10-ft. shaft sunk from the southwest end of the trench. No production.
73	Atomic Flat group	T17S, R8E, SBM; between 5 and 6 miles northeast of Jacumba. Partly in Anza-Borrego Desert State Park.	J. H. Hubble, Jacumba, or Rt. 1, Box 26 Santee, and Lee. B. Covey (1957)	Radioactive minerals were reported by owner to occur in pegmatite dikes. Not substantiated by writer.	Twenty claims. Not a commercial deposit at the present time. Explored by a few shallow cuts.
74	Bird Rock deposit	Secs. 1 and 2, T17S, R2E, SBM; about 8 miles east of Jamul and 2¼ miles northeast of Lyons Peak.	William M. Keenan, Big Springs Ranch, Jamul. Leased to: Kenco Enterprises Corp., J. A. Kennedy, Journal Bldg., 5th and Ash, San Diego (1955)	Pegmatite dike zone in granitic rocks. Discontinuous exposures of dikes indicate several parallel but not adjacent, dikes in zone. Dikes trend northwestward, dip steeply northeast, and range in width from 4 to 10 ft. Dikes contain abundant quartz and feldspar. High radioactivity indicated in some areas, and several tens of pounds of fergusonite (essentially a rare earth columbate and tantalate) have been recovered. Owner stated that spectrographic analysis indicated 22 to 28 percent rare earth oxides.	Explored by 2 groups of inextensive surface cuts 3000 ft. apart along pegmatite zone. (R.M.S.)
75	Fletcher deposit	S½ sec. 26, T15S, R1E, SBM(proj); along the old road between Harbison Canyon and U.S. Highway 80, about 1¾ miles south-southeast of Flinn Springs.	Ed Fletcher Co., 2340 Fletcher Parkway, El Cajon (1955)	Several northwest-trending pegmatite bodies 10 to 25 ft. thick. The deposit may have been explored earlier as a possible source of feldspar, but recent work has resulted from interest in radioactivity exhibited in zones of concentration of biotite mica.	Deposit prospected by an extensive series of bulldozer cuts and trenches. See also Hoover deposit in tabulated list under "Feldspar."
76	Olswick prospect	Sec. 32, T15S, R1W, SBM (proj); 3 miles west-southwest of Santee.	Ben Olswick, Rt. 1, Box 435, Santee (about 1955)	Deposit consists of unidentified uranium minerals in Poway conglomerate near its contact with granitic rocks. Rocks in prospect area consist of arkosic sandstone that contains red clay "balls."	Prospected by F. A. Taylor, Rt. 1, Box 855, Santee in mid-1950's. Explored by 10-ft. pit. (Atomic Energy Commission, Bakersfield, short unpublished report, about 1955).

Phata 88. View sautheast shawing p
af Circle graup vermiculite depasit na
east af Jacumba. Dark areas are alte
gabbra, naw campased partly af verm
lite. Mast af the lighter calared areas
quartz diorite which intruded the gabb

crusts and coatings on the other minerals. The vermiculite occurs as brownish-green foliated aggregates whose grains range in diameter from less than one-eighth inch to about three-fourths inch. Individual folia are brownish-green to bronze. The principal cut has exposed a nearly pure mass of vermiculite at least 15 to 25 feet wide, but of undetermined length (Photo 89).

The principal geologic deterrent to exploitation of this deposit is the irregularity of the distribution of the vermiculite in the altered gabbro. The expansion and density characteristics of the vermiculite have not been accurately determined, but crude tests on the highest grade material indicate an expansion ratio parallel to the c-axis of the mineral of only between 5 to 1 and 10 to 1.

VOLCANIC ASH

One deposit of volcanic ash (pumicite) is known San Diego County. This is the Pompai group Depos which is about nine miles north-northwest of Borre Springs, in Anza-Borrego Desert State Park. The depo is undeveloped. An important factor that must be co sidered in developing this deposit is its distance from market area.

WOLLASTONITE

Two very small deposits in San Diego County consi almost wholly of wollastonite (calcium silicate): one the Carrizo Gorge deposit near Jacumba; the othe which is unnamed, is near Julian (see descriptions

Phata 89. View narthwest shawing main warkings in Circle graup vermiculite depasit, nartheast af Jacumba. Left part af warkings cut a bady af vermiculite at least 15 ta 25 feet wide, but its length has nat been determined. Tule Mauntain is in backgraund.

Vermiculite

op o	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
7	Circle Group deposit	North-northeast of Jacumba.			See text. (Brooks and Roberts 54; Wright and others 54:69).

Volcanic ash

op o.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
8	Pompai Group deposit	Secs. 23 and 24, T9S, R5E, SBM; Anza-Borrego Desert State Park, about 9 miles north-northwest of Borrego Springs.	Undetermined (1957)	A layer of white volcanic ash that strikes northwestward and dips gently northeast. The layer probably is one mile long and at least 5 feet in average thickness. The ash is composed chiefly of a fine-grained aggregate of volcanic glass, with sparse quartz and biotite.	An undeveloped deposit. (Tucker and Reed 39:52-53).

Wollastonite

op o.	Name of claim, mine, or group	Location	Owner (Name, address)	Geology	Remarks and references
79	Carrizo Gorge deposit	SE¼SE¼ sec. 18(?), T17S, R8E, SBM; about 4½ miles north of Jacumba, in Carrizo Canyon. (Exact location not determined).	Undetermined (1958)	A small, but prominent outcrop of wollastonite a few tens of ft. west of the tracks of the San Diego and Arizona Eastern railroad.	Undeveloped. (B. W. Troxel, California Div. of Mines, personal communication, 1957).
	Pine Valley	See "remarks"	Guy Hogan, Pine Valley, and and David McMahon, 62 Marion Ave., Pasadena (1944)		"One mile from Pine Valley on Highway". An unsubstantiated occurrence. (W.B. Tucker, California Div. of Mines field notebook dated 1944).
30	Unnamed	Sec. 26, T13S, R4E, SBM; about 5½ miles southeast of Julian.	Undetermined (1955)	Dark colored wollastonite in lenses of highly silicated limestone in Julian schist.	Deposit explored by single 4-ft. pit. Quality and quantity not determined. (Stewart 58:38).

e accompanying tabulated list). Wollastonite also is mmon in the Mary Jane crystalline limestone deposit ar Dos Cabezas, and may be a minor constituent in her crystalline limestone deposits in the county. The neral is also common as a minor accessory mineral in veral tactite bodies that have been explored for tungsten nerals.

NC

Sphalerite (zinc sulfide) is a minor constituent of the dar Creek and Bradbury Deposits that have been ospected for lead (see herein under "Lead"). Probably occurs also in the county as a very minor constituent some quartz vein deposits that have been mined for ld. Production of zinc in the county has been recorded ly for 1926 (see Table 1).

RCONIUM

Zircon (zirconium silicate) has been reported from a cality near Ramona by Patton (1934, p. 116).

ANNOTATED BIBLIOGRAPHIES

Two types of bibliographies are provided herein for the convenience of the reader. First is a collective bibliography in which entries on geology and mining that pertain to the county are listed alphabetically by author. The second type consists of eight bibliographies, each on a separate subject or topic of geology, mining or a related field. A list of the eight subjects is provided following the heading for that section.

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COUNTY REPORT 3

Mines and Mineral Resources of San Diego County

List of Mines, Mineral Deposits, Prospects, and Mills Shown on Plate 1

California Division of Mines and Geology

Map Number	Name	Section	Township	Range**
	ABRASIVES			
1	Bird Rock deposit (site)	2 or 3	16	4W
	ARSENIC			
2	Black Mountain deposit	5	14	2W
	BERYLLIUM			
3a	Hogerman (Mountain Bell) property	8, 9	11	3W*
3b	Ruby group	2, 11	17	7E
	BORON			
4	Unnamed		11	8E*
5	Unnamed		9	6, 7E*
	CALCITE (OPTICAL)			
6	Hilton deposit	14, 15	10	8E
	CLAY			
7	Clay prospect	30	8	6W
8	Dorothy and Pearl claims (Pearl and Dorothy claims, Pearl and Dorothy Ann claims)	4	13	3W
9	El Cajon Kaolin deposit	36	14	1E*
10	General Petroleum Company mine Mosto Ranch deposit; Mosto Otaylite deposit; Hamberger Co.; Dinero Ranch Clay deposit)	29, 30	18	1W
11	Gladding, McBean and Company mine	7	13	3W
12	Huchting Ranch deposit	25	13	4W*
13	Kelley Ranch mine	14	12	4W†
14	La Jolla Clay Products Company	24	15	4W†
15	Linda Vista deposit	9	15	3W
16	Merrick Kaolin deposit	36	14	1E
17	Morris Clay deposit	18	12	2W
18	National Brick Company	National City		
19	Pacific Clay Products Company (Kelley No. 1) mine	15	12	4W†
20	Robert Charles and Thomas Hewitt claims	4	13	3W
21	Schier Clay deposit	23	10	4W
22	Sorrento Brick and Clay Products Inc. mine	5	15	3W†
23	Standard Oil (Filtrol) Company mine	17, 18	18	1W
24	Union Brick Company mine, East Pit (Union Brick and Tile Co.)	6	16	3W†
25	Union Brick Company mine, North Pit (San Diego Brick and Tile Company, Sunnyside Brick and Tile Company)	30	15	3W†
26	Union Brick Company mine, West Pit (Rose Canyon Brick Company, Hicatt Brick and Tile Company, Hubbard Brick Company, San Diego Vitrified Brick and Clay Products Company, and San Diego Brick and Clay Products Company)	6	16	3W†
27	Vitrified Products Co. mine (Vitrified Clay Products Co.; Wiro Mines)	7	13	3W†
	COPPER			
8	American Girl prospect	1	8	6W†
9	Beehive (Copper King (?)) prospect	1	8	6W†
0	Clark prospect	1	8	6W†
31	Daley (Barona) mine	11	14	1E†
32	Encinitas (Danes Lea) mine	32, 33 4, 5	12 13	3W 3W
33	Silver Shine prospect	31(?)	7	5W†
34	Undetermined	32	12	3W
	FELDSPAR			
35	Bear deposit	35	11	1W
36	Black Canyon deposit	19, 20	12	2E
37	Buckthorn (Flynt Silica and Spar Company, State Lease) deposit	16	16	6E
38	Carlsbad deposit	26	9	4E
39	Crestline and Gem Spar claims	21	16	6E
40	Hoover (Lakeside, Turner) deposit	35	15	1E
41	Laguna Junction (Benton Ranch) deposits	36 1 6	15 16 16	4E; 4E 5E
42	Langer deposit	26	11	1W
43	Lookout prospect	25(?)	9	3E*
44	Marden deposit	25, 36	17	8E
45	McGinty Mountain (Dehesa Cornwall Stone) deposit	27	16	1E
46	Mesa Grande deposit	26(?)	11	1E*†
47	Moore deposit	36 1	17 18	8E 8E
48	Mykrantz (San Vicente) deposit	3(?)	14	1E*
49	Overlook deposit	27	17	8E
50a	Pacific mine (Arthur Clay Spar No. 1, Campo, Pacific Sanitary Porcelain Co., Standard Sanitary, Stell) (mine)	25	17	4E
50b	(mill)	10	18	5E
51	Pearson deposit	23	9	3E
52	Pilz deposit	28(?)	18	3E*
53	Powers group	19(?), 24(?)	11	2E*
54	Quality (Orion, Osborne) deposit	21	18	5E
55	Spanish Bayonet deposit	35	14	3E†
56	Ward and Williams deposit	15	17	7E
57	White Rose deposit	17	17	5E
	GEM MINERALS			
58	A.B.C. mine	8	13	2E
59	Alvarado prospect	23	9S	2W
60	Anita claim	24	9	2W
61	Big Slope prospect	23	9	2W
62	Black Panther prospect	8	13	2E
63	Blanket prospects	23	9	2W
64	Blue Bell deposit (Blue Tourmaline claim, San Diego group)	12, 13	9	3E
65	Buttercup prospect	24	9	2W
66	Butterfly prospect	23	9	2W
67	Calac prospect	19	10	1E
68	Canyon King prospect	14	9	2W
69	Center Drive prospect	24	9	2W
70	Clark Extension prospect	36	10	1W
71	Clark mine	36	10	1W
72	Cliff prospects	24	9	2W
73	Cota mine	19	11	2E
74	Crystal Gem mine	11	11	7E
75	Crystal King prospects	23	9	2W
76	Douglass Extension prospect	23	9	2W
77	Douglass mine	23	9	2W
78	East Knickerbocker prospect	13	9	2W
79	Ed Fletcher, Jr. (Ed Fletcher) mine	15	9	2W
80	El Molino mine	25	9	2W
81	Elder Canyon deposits	2	9	4E

Map Number	Name	Section	Township	Range**
	GEM MINERALS—Continued			
82	Emeralite No. 2 (Gem Mine No. 1, Mountain Lily, Ware) mine	3	10	2E
83	Esmeralda mine	13 18	11 11	1E 2E
84	Fargo (Fargo et al.) mine	25	9	2W
85	Fraction claim	8	13	2E
86	French Pete (Elinor) deposit	35	9	3E
87	Gem Star (Gem Lepidolite, Loughbaugh) mine	23	9	2W
88	Goddess prospect	13, 14	9	2W
89	Green Cabin mine	14	9	2W
90	Green Ledge mine	19	11	2E
91	Happy Hooligan prospect	22	9	2W
92	Hazel W. prospect	14	9	2W
93	Hercules prospect	8	13	2W
94	Himalaya mine	17	11	2E
95	Hiriart (Heriart, Heriot, Hiriart prospects) mine	23, 24, 25	9	2W
96	Homestake (Home Stake) prospect	14	9	2W
97	Imperial Beach		18	2W
98	Jackpot Tunnel (Butterfly) prospect	24	9	2W
99	K. C. Naylor mine	24 19	9 9	2W 1W
100	Katerina (Ashley, Caterina, Catherina, Katrina) mine	24, 25	9	2W
101	Knickerbocker (East Knickerbocker, West Knickerbocker) claim	13, 14, 23, 24	9	2W
102	Little Chief prospects	24	9	2W
103	Little Three mine	8	13	2E
104	Little Three Extension prospect	8	13	2E
105	Lookout prospect	8	13	3E
106	Lost Valley tourmaline prospects	28	9	4E
107	Lost Valley Truck Trail prospect	14	10	3E
108	Mack mine	25	10	1W
109	Maple Lode mine	10	10	2E
110	Margarita mine	23	9	2W
111	Mason Valley Gem claim	3	13	5E*
112	Maude prospects	22	9	2W
113	McFall mine	5	14	2E
114	Mesa Grande mine	20	11	2E
115	Mission mine	23	9	2W
116	Moonlight Beach		13	4W
117	New A.B.C. prospect	8	13	2E
118	North Douglass prospect	23	9	2W
119	North Star mine	23	9	2W
120	Ocean View claim	13, 14	9	2W
121	Olla prospect	23	9	2W
122	Pala Chief mine	14	9	2W
123	Pala Douglass mine	23	9	2W
124	Pala King (Spring Bank, Wedge) prospect	14	9	2W
125	Pala View (Sholder-Trotter) mine	22	9	2W
126	Pasture prospect	23	9	2W
127	Payne mine	19	11	2E
128	Prospect prospect	5	13	2E
129	Redlands King prospect	23	9	2W
130	Redwing (Redlands, Redwings) prospect	24	9	2W
131	San Diego mine	20	11	2E
132	San Pedro mine	24	9	2W
133	Senpe (Sempe, Senpa) mine	24	9	2W
134	Sonny Boy claim (site)	8	13	2E
135	Stewart Extension prospect	23	9	2W
136	Surprise mine	9	13	2E
137	Tourmaline King (Schuyler, Wilke) mine	15	9	2W
138	Tourmaline Queen mine	14, 15	9	2W
139	Trail mine	18	11	2E
140	Trask mine	17	11	2E
141	Unnamed	33	16	8E
142	Vanderburg (Naylor-Vanderburg) mine	24	9	2W
143	Verdant View (Anita) prospect	24	9	2W
144	Victor (Big Buck) mine	36	10	1W
145	Vista Chief (Moosa Canyon) deposit	26, 27	10	3W*
146	West Canyon (Freak) prospect	15	9	2W
147	West Knickerbocker prospect	23	9	2W
148	White Cloud (Buster Brown) mine	15	9	2W
149	White Queen prospect	24	9	2W
	GOLD			
150	Abbie group	8, 9	15	5E
151	Aftermath claim	10	14	5E
152	Anchor prospect	17 or 20	15	5E
153	Andes prospect	12, 13	18	5E
154	Ballena Placer deposits	17, 18, 19, 20 21	13	2E
155	Banner Horseshoe prospect	10	13	4E
156	Banner Queen prospect	7 or 12 (?)	13	5E*
157	Barbara Worth (Bengal) group	18, 19	15	5E
158	Barber Mountain (Gold Star, Hetty Green) mine	19	17	3E†
159	Bill Hills prospect	9	18	5E
160	Black Eagle mine	22	11	2E*
161	Boulder Creek group	9, 10	14	3E
162	Brier claim	21	15	5E*
163	Brown group	8	15	5E
164	C. B. mine (consists of Ben Johnson claim, formerly Gold Ray; and Cold Beef claim, formerly Gold Reef)	14, 23	13	4E
165	Cash Entry group	30, 31	14	5E*
166	Challenger prospect	2	13	4E
167	Chieftain mine	31	12	4E
168	Cimarron (Cimmeron) prospect	20	15	5E
169	Cincinnati Belle (Cincinnati) mine	3	13	4E
170	Cleveland-Pacific (Escondido) mine	26	12	2W†
171	Coarse Gold prospect	2(?)	14	3E*
172	Coleman Creek (Anthony Ranch) Placer deposits	35, 36	12	3E
173	Cravath mine (site)	23	12	2W†
174	Decker prospect	16	15	4E
175	Descanso (Descanso Mining Company, Ellis, Magdalena) mine	24	15	3E
176	Donohoe (Artery Consolidated, Comet, Donahue, Golden Artery) mine	16, 21, 27	18	2E
177	Doolittle group	16	18	2E
178	Eagle mine	31, 32	12	4E
179	Eagle Nest (Fargo) mine	25	16	4E†
180	El Dorado claim	32, 33	12	4E
181	Elevada and Aquajito group	1, 2, 11, 12	13	4E
182	Elk and Landslide deposit	3	14	3E
183	Ella (Old Ella) mine	33	12	4E
184	Ester group	32	14	5E
185	Eureka group	14, 23	13	4E
186	Expansion group	31	14	5E
187	Frances group	8	15	5E
188	Gold Cross No. 2 (Cable) claim	10	13	4E
189	Gold Crown group	1, 12	14	3E
190	Gold King group	15	13	4E
190a	Gold King claim workings			
190b	Gold Queen claim workings			
191a	Gold Standard prospect	10	13	4E
191b	Gold Standard group (Gold Standard and North Star mines)	12	15	4E
192	Golden Chariot mine (includes Chariot North and Golden Chariot claims)	14	13	4E
193	Golden Duke (Encino?) group	4, 5, 8, 9	9	3E
194	Golden Ella prospect	14	13	4E
195	Golden Gem group (Big Blue, Blue Hill, Gardiner, Gardner, Gem mine)	33 4	12 13	4E 4E
196	Golden Rule prospect	4	13	4E
197	Good Hope prospect	15	13	4E
198	Grand Central Quartz (Grand Central Quarry) mine	23	15	3E
199	Granite Mountain mine	21	13	5E

Map Number	Name	Section	Township	Range**
	GOLD—Continued			
200	Grapevine Star (Dewey group, Ready Relief) mine	36	11	4E
201	Group Mining claims	13(?)	15	4E*
202	Harper Ranch (E. A. Harper, Harper's) mine	24(?)	14	4E*
203	Helvetia mine	4, 5	13	4E
204	High Peak mine	31, 32	12	4E
205	Home Builders prospect	11	13	4E
206	Janet mine	31	12	4E
207	Johnston's mine	16	18	2E†
208	Jolly Boy mine	7	13	3W
209	Jumper mine	4	13	4E
210	Kentuck group	3, 10	13	4E
210a	Contact claim workings			
210b	Gold Cross No. 1 (Fraction) claim workings			
210c	Hidden Treasure claim workings			
210d	Kentuck S claim workings			
211	Kitty Kay group	17, 18	16	5E
212	Kulinis (Whaley) mine	28	8	4W
213	Last Chance mine	4	14	3E
214	Long Valley Placer deposits	25	16	4E
215	Lookout group	10	14	3E
216	Lost Peg Leg claim	34	16	1E
217	Lucky Baldwin (Margaret, Marguritc, Margaret and Lucky Baldwin) group	31	14	5E
218	Lucky Chuck (Free Coinage, Hawke's) mine	12	15	4E
219	Lucky Strike group (includes Lucky Strike, Dam Fino, Pocket, and Long-Time-No-See prospects)	14	14	3E†
220	Lucky Strike mine (Grand Strike group)	14	13	4E
221	Madden group (Antelope mine)	3, 4	13	4E
221a	Curry claim workings			
221b	Gopher (Antelope) claim workings			
221c	Old Madden (Madden) claim workings			
222	Majestic group	32, 33	12	4E
223	Maude E claim	13	13	3E
224	Melba group	4, 5, 8, 9	15	5E
225	Mercedes group	4	15	5E
226	Mine Canyon	16, 21, 18	18	2E
227	Mineral Hill group	10	14	3E
228	Montana group	7, 8, 17	14	4E
229	Montezuma mine	10	11	4E
230	Narrows mine	13	12	6E
231	Noble group (Noble Mines, Noble's Mines, Pine Valley Mines)	7, 8, 17	15	5E
232	Nona group (Nona and Coarse Gold prospects)	5	14	3E
233	North Star (Duplex and Apex, North Star) group	31	14	5E*
234	North Star mine	12	13	4E
235	Oak Canyon (Cascade, You Bet group) mine	31	14	5E
236	Ora group	9	13	4E
237	Oriflamme (Oroflamme) mine	6	14	4E
		1	14	5E
238	Oro Fino (El Diablo) mine	26	12	2W†
239	Owens (Old Owens, New Owens) mine	31	12	4E
240	O.X. group	6	14	5E
241	Padlock claim	3, 4	13	4E
242	Parsons (Orange Blossom) mine (site)	23(?)	16	1W*
243	Penny prospect	11	14	3E†
244	Phillips (Chase Ranch) mine	13	16	1W
245	Pine Tree prospect	4	13	4E
246	Pioneer group	9, 10	14	3E
247	Pride of the West (Pride of Julian) mine	36	12	3E
248	Prosperity prospect	3	14	3E
249	Ranchito mine	11	13	4E
250	Ready Relief group (Bailey Brothers mine)	3, 10, 11	13	4E
250a	North Hubbard (Hubbard) claim workings			
250b	Ready Relief claim workings			
250c	Redman claim workings			
250d	South Hubbard claim workings			
251	Redrock group (Coyote)	1	13	3W
252	Reed group	3, 10, 11	13	4E
252a	Homestake (Wilcox) claim workings			
252b	Treasure Hill claim workings			
252c	Poorman claim workings			
253	Rose Quartz group (Hoar group of mines, Mahood prospect)	7	16	5E
254	Ruby claim	3, 4	13	4E
255	San Diego mine	32	12	4E
		5	13	4E
256	San Felipe mine	2	13	4E
257	San Vicente Valley placer deposits	25	13	1E
		30, 31	13	2E†
258	Saratoga prospect	4, 5	13	4E
259	Sawday Ranch placer deposit	16	13	2E
260	Schley group	1, 12	15	4E
261	Shenandoah mine	23	11	2E
262	Silent King prospect	26(?)	15	4E*
263	Silver King group	2, 3	14	3E*
264	Stoner prospect	28	8	4W
265	Stonewall (Stonewall Jackson) mine	3, 4	14	4E†
266	Telluride (Triluride) group	31	14	5E
267	Tom Scott mine	31	12	4E
268	Tres Amigos mine	7	16	5E
269	Undetermined	29	13	6E
270	Undetermined	24	13	5E
271	Van Wert (Van Wirt) mine	31	12	4E
272	Victoria group	5	15	5E
273	Viejas Mt. prospect	19	15	3E
274	Warlock group	33	12	4E
		4	13	4E
275	Washington (George Washington) mine	31	12	4E
276	West California claim	32, 33	12	4E
277	Wettleson prospect	14	16	2E
278	Willhite group	17	17	5E
279	Winatonia and Morning Glory claims (site)	16	16	6E
	GRAPHITE			
280	Mary Jane (Kane, Leebrick, Leibuck) deposit	10	14	5E
281	Seyer deposit	3(?)	14	5E*
282	Unnamed	10	14	5E
	GYPSUM			
283	National Gypsum Co. deposit (Blanc and Kipp claims)	25, 36	13	8E
		(San Diego Co.)		
		31	13	9E
		6	14	9E
		(Imperial Co.)		
284	Undetermined	24	13	8E
		(San Diego Co.)		
		19, 31	13	9E
		(Imperial Co.)		
	IRON			
285	Companion No. 1 (Campo) deposit	22(?)	18	4E*
286	Iron Master (Cornelius, El Cajon) deposit	25, 26	15	1E†
287	Lakeview deposit	1	15	1E
288	Mammoth deposit	6	8	5W†
		(San Diego Co.)		
		31	7	5W
		36	7	6W†
		(Riverside Co.)		
	KYANITE, ANDALUSITE, SILLIMANITE, DUMORTIERITE, AND TOPAZ			
289	Dehesa dumortierite deposit	9	16	2E
	LEAD			
290	Bradbury (Surprise) prospect	1	11	2W
291	Cedar Creek (Lost Spanish) mine	12, 13	18	1E†

Map Number	Name	Section	Township	Range**
	LIMESTONE-DOLOMITE			
292	Coyote Mountain deposit	3	10	6E
293	Deer Park (Glacier) deposit	1	15	4E
294	Elliot deposit	26, 27 34, 35	15	8E
295	Golden State (Dos Cabezas Marble Placer) deposit	23	16	8E
296	Heathman (Dos Cabezas, Heathman Quarry, Mamie-Heathman) deposit	27	16	8E
297	Jamul Ranch deposit (Jamul Portland Cement Co.)	27	17	1E†
298	Kuebler Ranch (McCarthy Ranch) deposit	29	18	1E†
299	Lakeside (Lakeside Lime and Marl, Lime) deposit	1, 2, 11	15	1W†
300	Mary Jane (Marie) deposit	27	16	8E
301	Santa Rosa Mountains deposits		9	7, 8E
302	Sentenac deposit	11	11	4E
303	Unnamed (Lime)	27	16	8E
304	Verruga (Verruga Marble) deposit	10	11	4E
305	White Cap (Blockman) deposit	11	18	8E
306	White Peak claim (Volk deposit)	10	11	4E
	LITHIUM COMPOUNDS			
307	Royal (Pandora) deposit	13	13	4E
308	Stewart mine (American Lithia Co.)	23	9	2W
	MAGNESIUM COMPOUNDS			
309	Mineral Products Div., Food Machinery and Chemical Corp. (California Chemical Corp., Westvaco Chemical Div., Westvaco Chlorine Products Corp.)	16	18	2W
	MANGANESE			
310	Clark prospects	7, 18	9	2W*
311a	Jacumba deposits	1, 12	18	7E
311b		6, 7	18	8E
312	Machado prospect	6	9	2W*
313	Schmiddmitt prospect	34	13	5E
314	Sherry Ann prospect	1	18	7E
315	Sunrise deposit	10	13	5E
316	Tule Mountain deposit	11 or 14	17	7E*
317	Turner prospect	31	14	5E*
318	Undetermined	25	15	7E
	MICA			
319a	Mica Gem group (Jacumba No. 1, Marden) Deposit	25	17	8E
319b	Mill	35	17	8E
	MOLYBDENUM			
320	Bour deposit (Molybdenum Syndicate Ltd., Santa Maria Mining and Milling Co.)	10, 11	13	1W
321	Dillbeck deposit	16	18	5E
322	Fernbrook (Woolsey) deposit	7	14	1E
323	Harvey Ranch deposit	19	15	2E*
324	Judson Ranch deposit	1	13	1W
325	Lippner (Aiken, Aitken, Campo Molybdenum Mines (Midway)) deposit	16	18	5E
	NICKEL			
326	Friday deposit	15	13	4E
327	Old Ironsides prospect	6	12	2E
328	Red Hill and Copper Butte claims	15	13	4E
	ORBICULAR GABBRO			
329	Dehesa deposit	15	16	1E
330	Lawson Peak deposit	6	17	3E
331a	Sheephead Truck Trail deposits	16, 21	16S	5E
331b				
	PEAT			
332	San Luis Rey deposit	33	10	4W
	PERLITE			
333	Harborlite Corp. mill	Escondido		
	PHOSPHATES			
334	Linda Vista deposits	13	14	4W
	PYROPHYLLITE			
335	Four-Gee (Golem deposit)	19	13	2W
336	Harris deposit	23	13	3W
337	Palagonite deposit	3	13	3W
338	Pioneer deposit	23	13	3W
339	Unnamed	30	13	2W
	QUARTZ AND QUARTZITE			
340	Ajax deposit	2	16	3E†
341	Fanning (Gladding, McBean deposit)	4	18	7E
342	Featherstone deposit	26	14	1E
343	Gibson deposit	3	18	7E
344	Haldredge deposit	23	11	1W*
345	Lowrey deposit	34	15	3E
346	Risley (Burroughs) deposit	8	18	7E
347	Rose Quartz mine	24	11	1E
		19	11	2E
348	Round Mountain (Delphos) deposits	9, 16	18	7E
349	Round Portrero deposit	25, 36	17	3E
350	Sweetman(?) deposit	6	18	7E*
351	Unnamed-1	7, 18	15	5E
352	Unnamed-2	24	17	3E
353	Unnamed-3	16	18	7E
354a	Unnamed-4	16	18	7E
354b	Unnamed-5	23	17	4E
355	Walker deposit	32	17	7E
356	White Butte deposit (American Encaustic Tiling Company)	33, 34	17	7E
	SALT			
357a	California Salt Company (sites)		12	4W
357b				
358	Chollas Valley Salt Company (site)		17	2W†
359	Portuguese Flat (site)		16	3W†
360	Sweetwater Creek (site)		17	2W†
361	Western Salt Company	9, 16, 17, 18, 19, 20, 21	18	2W†
	SAND AND GRAVEL, AND CRUSHED AND BROKEN STONE (D.G. = Decomposed Granite)			
362	Acme Truck Co. (D.G.)			
362a	Pit No. 1	35	15	2W†
362b	Pit No. 2	27	15	1W†
363	Bryant, D.G. (D.G.)	23	11	3W
364	Calavera quarry (crushed stone)	34	11	4W
		3	12	4W†
365	California, State of; Div. of Highways (D.G.)	28, 21	16	1W
366	Camp Pendleton (sand and gravel)	5	17	6W
367	Carlsbad Rock and Sand Co. (sand, D.G.)			
367a	Sand operation	13	11	5W
367b	Decomposed granite pit	33	10	4W
368	Carmean quarry (crushed stone)	10	13	3W
369	Caudell and Johnson (sand and gravel, D.G.)			
369a	Mission Valley operation (sand and gravel)	13	16	3W†
369b	Mission Valley operation (sand)	24	16	3W†
369c	Carroll Canyon operation (gravel)	1, 2	15	3W
		6	15	2W
369d	Poway operation (sand and gravel)	21, 22	14	2W
369e	San Diego Cement Co. operation (D.G.)	36	16	1W†
370	Coston Construction Co. (D.G.)	23	15	1W†
371	Cowdrey, E. E. (D.G.)	25, 26	11	4W
372	Daley Corporation (gravel)	5, 8	16	2W†
373	Dennis, V. R. (sand and gravel, crushed stone)			
373a	Canyon Rock Co. (plant)	3	16	2W†

Map Number	Name	Section	Township	Range**
	SAND AND GRAVEL, AND CRUSHED AND BROKEN STONE—Continued			
373b	Canyon Rock Co. (crushed stone quarry)	3	16	2W†
373c	Canyon Rock Co. (sand pit)	3, 4	16	2W†
373d	Santee Materials (sand)	22	15	1W†
374	Denton Sand and Gravel Co. (sand)			
374a	American Sand Co.	8	16	2W†
374b	Dehesa operation	15, 16	16	1E
375	Dulzura deposit (broken stone)	22	18	2E
376	Einer Brothers (D.G.)			
376a	San Pasqual pit	30	12	1W
376b	San Marcos pit	11	12	3W†
376c	Poway pit	14	15	1W†
377	El Cajon Sand and Gravel Co.	23	15	1W†
378	El Capitan quarry (broken stone)	1	15	1E
379	Escondido Sand and Gravel Works (sand and gravel, D.G.)			
379a	Plant	21	12	2W†
379b	Sand pit	35	10	3W
379c	San Pasqual pit (D.G.)	30	12	1W
379d	Los Penasquitos Canyon deposit	26	14	2W
380	Evans Point deposit (broken stone)	15	12	4W
381	Fenton, H. G. Material Co. (sand and gravel)			
381a	Mission Valley operation (plant)	18	16	2W†
381b	Mission Valley operation (source of sand and gravel)	18	16	2W†
381c	Mission Valley operation (source of sand)	18	16	2W†
381d	Murray Canyon operation (sand and gravel)	14	16	3W†
381e	Carroll Canyon operation (sand and gravel)	2	15	3W
381f	Otay operation (No. 1) (plant)	22	18	2W
381g	Otay operation (No. 1) (source of sand and gravel)	19	18	1W
381h	Monarch Materials Co. (plant)	25	15	2W†
381i	Monarch Materials Co. (source of sand and gravel)	20	15	1W†
381j	Monarch Materials Co. (source of sand)	30	15	1W†
382	Fletcher Quarries (broken stone, D.G.)			
382a	Broken Stone quarries	35	15	2W†
382b	D.G. pit	15	14	2W
383	Foster quarry (crushed stone)	35	12	3E
384	Golden, Kenneth H., Co., Inc. (crushed stone)	35	15	2W†
385	Goodman and Son (D.G.)	31	15	1E
386	Greenstone quarry (crushed stone)	11	13	3W
387	Gross Sand Co.	13	15	1W†
388	Grove, C. B. (D.G.)			
388a	Pit No. 1	24	16	1W
388b	Pit No. 2	10	14	2W†
389	Hatfield Creek quarry (crushed stone)	7	13	2E
390	Hester's Granite pit (D.G.)	21	16	1E
391	Hillside Materials (D.G.)	31	16	1E
392	Independent Stone Co.			
392a	Spring Valley quarry (site)	30	16	1W
392b	Sand operation (site)	36	14	1W†
393	Jamacha Sand Plant (sand and gravel)	31	16	1W
394	Knox, John (D.G.)	19	11	3W
395	Marron quarry (broken stone)	33	11	4W†
396	McGrath, C. W. (D.G.)			
396a	Pit No. 1	24	16	1W
396b	Pit No. 2 (Tunnel Hill pit)	31	15	1E
397	McGuffie Foundation deposit	4	18	8E
398	Meadowlark Ranch quarry	29	12	3W
399	Nelson and Sloan (sand and gravel)			
399a	Otay operation (plant)	22	18	2W
399b	Otay operation (source of sand and gravel)	21, 22	18	1W†
399c	Otay operation (source of sand and gravel)	9	19	2W
399d	Otay operation (source of sand)	35	18	2W
		2	19	2W
399e	No. 5 (San Clemente Canyon) operation (sand and gravel)	19	15	2W†
399f	Mission Sand Co. (sand)	17	16	2W†
400	Patterson Trucking Co. (D.G.)	26	15	1W†
401	Peters, W. H. (D.G.)	Vista		
402	Ponto Beach (Abizaid) deposit (gravel)	Ponto		
403	Rohl, H. W., Co. (sand and gravel)	23	11	5W
404	San Diego Stone Co. (Sweetwater) quarry (broken stone)	17	17	1W
405	Sierra Sand Plant	23	15	1W
406	Smith Construction Co.	28, 33	13	3W†
407	Sorrento Sand Co.	25	14	4W
408	Sweetwater Sand Co.	27	17	2E†
409	Weaver deposit (crushed stone)	35	17	8E
410	Woodward Sand Co.			
410a	Mission Valley operation	19	16	3W†
410b	San Pasqual operation	34	12	1W
411	Zinniger Sand Plant	32	13	3W
	SPECIALTY SANDS			
412	Clark Lake deposits		9	7E
413	Crystal Silica Co.	20	11	4W
414	San Diego Molding Sand Co. deposit (site)	35	16	3W
	DIMENSION STONE (Granite)			
415	American Marble and Granite Works (Jose Covas) quarry	26	15	1W†
416	Bly Stone Co. quarry	10	11	2W†
417	California Wire Sawyer Corp. (Plant)	35	14	1W
418	Cameron-Deering (Simpson-Pirnie) quarries	35	14	1W
419	Clemens Granite Co. quarry	4	16	1E
420	Ebony Black Diamond Granite Co. (Stockdale Granite quarry)	30	12	3W
421	Escondido Quarries, Inc. (Pacific Cut Stone and Granite Co.)	30	12	2W
422	Fellows and Clutter quarry	22	11	3W
423	Galbraith quarry	14	11	3W
424	Magee quarry	19	9	1W
425	Matson, Pete (Matson and Kouns, Matson and McDonald) quarry	23	11	3W
426	McGilvray, Raymond Corp. quarries	2	15	2W†
427	McKoon (Deering and McDonald, A. I. Lodge, Matson and Deering, Mission Silver-Gray Granite Co.) quarry	10	15	1W
428	Merriam quarry	23	11	3W
429	Meyer, W. A. (Eucalyptus Ranch) quarries			
429a	Meyer quarry	1	15	1W†
429b	Quarry No. 2	2	15	1W†
430	National Blue Granite quarry	10	11	3W
431	National Quarries (Johnson Brothers)	35	14	1W
432	Pomona Granite Co. quarries	10	11	3W
433	Potts, Don quarry	30	12	2W
434	Simpson-Pirnie Granite Company (site)	27	15	1W†
435	Southern California Granite Co. (Rossi) quarry	35	14	1W
436	Stridsberg, John quarries			
436a	Superior Black quarry	31	12	2W
436b	Crystal Black quarry	30	12	2W
437	Texas Quarries quarry	15	11	3W
438	Valley Granite Co. quarries	30	12	2W
439	(W. E.) Van Deventer (Daley Corporation quarry	10(?)	13	2W*
440	Vista Black Granite quarry	22	11	3W
441	Waterman Granite Co. quarry	35, 36	14	1W
		1	15	1W†
	DIMENSION STONE (Quartzite)			
442	Red Rose quarry	35	15	1E

Map Number	Name	Section	Township	Range**
	STRONTIUM			
443	Roberts and Peeler (Peler and Roberts, Roberts Celestite) deposit	13 (San Diego Co.)	13	8E
		18 (Imperial Co.)	13	9E
	TIN			
444	Katherine prospect	5(?)	10	5E*
	TUNGSTEN			
445	Bartling and Nelson deposit	14	10	3E*
446	Best Yet deposit	18, 19	14	5E
447	Blackstone prospect	16, 17, 20, 21	16	6E
448	Carrizo Canyon deposit	19	17	8E
449	Crown Point mine	8, 9, 17	16	6E
450	Dyche Valley (Hagee) mine	19	10	2E
451	Easy group (Little Goffee(?) prospect)	5	9	3E
452	Feldon deposit	26	13	5E
453a	Henderson deposit	20	14	5E
453b	Henderson mill	7	18	8E
454	Last Dollar prospect	21, 28	16	6E
455	Little Randsburg prospect	25	17	8E
456	Live Oak group	17	14	5E
457	Long deposit	2	12	4E
458	Los Coyotes prospect	24	10	4E
459	Metal Mountain mine	9, 16	16	6E
460	Pawnee (Carr, Oak Grove) mine			
460a		31 (Riverside Co.)	8	3E
460b		6 (San Diego Co.)	9	3E
461	Payoff mine	6	11	5E
462	Rys deposit	1	12	4E
463	Smitty prospect	22	12	5E
464	Sundown mine	33	14	5E
465	Teuscher prospect (Beauty Mountain Tungsten Mines)	5, 6	9	3E
466	Undetermined-1	6	11	4E
467	Undetermined-2	8	14	5E
468a	Undetermined-3	25	13	4E
468b	Undetermined-4	27	7	5W
469	Unnamed	11	17	7E
470	White Cloud deposit	21	17	8E
	UNDETERMINED			
471	Carmelita claim	26 or 35	9	3E*
	URANIUM AND THORIUM			
472	Allanite (Keeney) prospect	9	14	2E
473	Atomic Flat group		17	8E
474	Bird Rock deposit	1, 2	17	2E
475	Fletcher deposit	26	15	1E†
476	Olswick prospect	32	15	1W†
	VERMICULITE			
477	Circle Group deposit	16, 21	17	8E
	VOLCANIC ASH			
478	Pompai Group deposit	23, 24	9	5E
	WOLLASTONITE			
479	Carrizo Gorge deposit	18(?)	17	8E*
480	Unnamed	26	13	4E

* Deposit was not located accurately during present investigation, or occurrence was not substantiated.
** Township and range are based on San Bernardino Base and Meridian; all townships are south.
† Projected.

11 MAPS

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17-6996

34914—650 11-64 3,500

printed in CALIFORNIA OFFICE OF STATE PRINTING

1 Southwick, 1928 (unpublished).
2 Smith, Morse & Woodford, ca 1925 (unpublished)●
3 California Division Water Resources, 1956
4 Jones, 1958 (unpublished)●
5 Larsen, 1948
6 Larsen, 1948●
7 Johns, 1954; Weber, F.H. (unpublished reconnaissance mapping, 1958)
8 Merriam, R. (unpublished mapping, 1953)
9 Johns & Wright, 1951; Johns, 1954 a/●
10 Johns, 1954 b/●
11 Hanley, 1951
12 Johns, 1954 a/●
13 Merriam, 1946 (in part revised by Merriam, 1946-1959.)
14 Weber, F.H., (unpublished reconnaissance mapping, 1961)
15 Hanley, J., (unpublished)
16 Weber, F.H. (unpublished reconnaissance mapping 1957)
17 Hanna, 1926; Hertlein & Grant, 1954
18 Moore, 1957
19 Goldsfein, 1956 (unpublished)
20 Hertlein & Grant 1954, Johns, 1954 b/, Weber (unpublished reconnaissance mapping, 1958)
21 Cleveland, 1960
22 Merriam, 1959
23 Weber, F.H. (unpublished reconnaissance mapping 1958)
24 Merriam, 1959●
25 Everhardt, 1951●
26 Merriam, 1955 (unpublished)
27 Everhardt, 1951
28 Merriam, 1955 (unpublished)
29 Weber, F.H. (unpublished, very general reconnaissance, 1957)
30 Ver Planck, 1952
31 Dibblee, 1954 (modified slightly by Dibblee from unpublished data, 1959)
32 Weber, F.H., (unpublished reconnaissance mapping 1957)
33 Brooks & Roberts, 1954●
34 California Division Water Resources, 1956

● Modified slightly for this map by Weber, 1957, 1958, or 1959.

(Dashed lines indicate approximate boundaries)

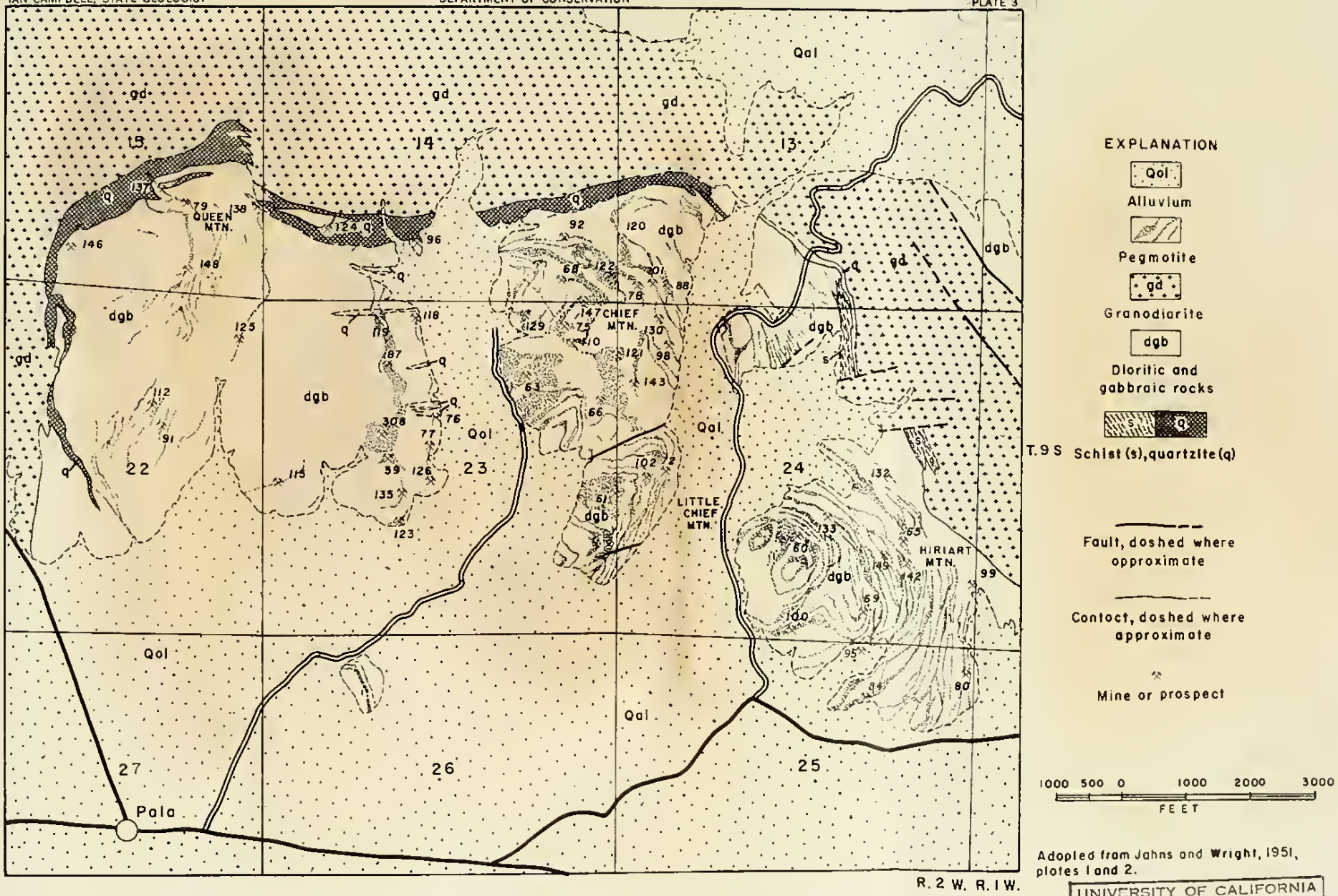
NOTE For titles of references used as sources of geology for compilation of map, see bibliography in back of text of report. For additional coverage of county, see Division of Mines Special Report 52

MAP OF SAN DIEGO COUNTY SHOWING TOPOGRAPHIC MAP COVERAGE AND GEOLOGIC MAPPING
ADAPTED FOR PLATE 1

DIVISION OF MINES AND GEOLOGY
IAN CAMPBELL, STATE GEOLOGIST

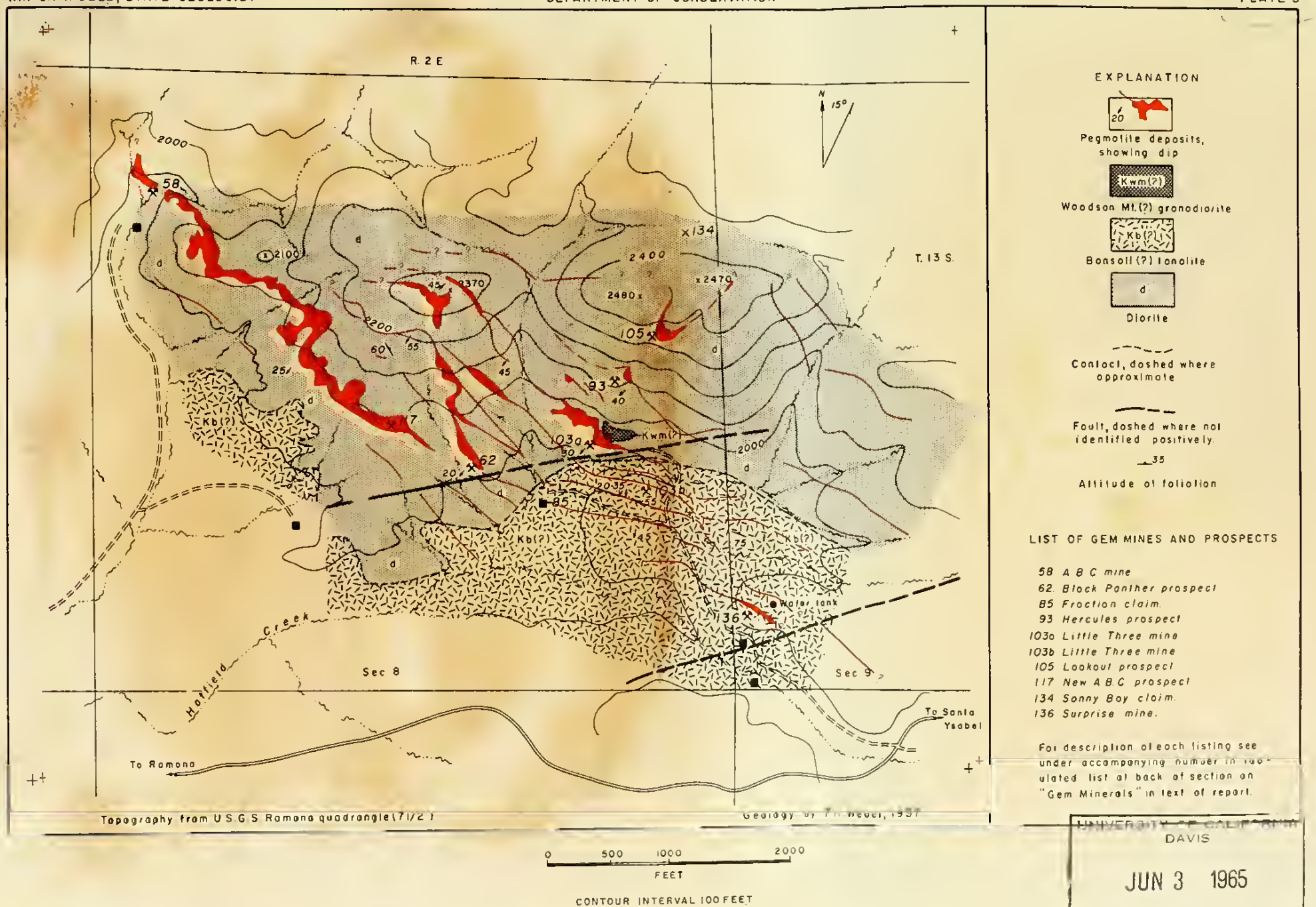
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF CONSERVATION

COUNTY REPORT 3
PLATE 3

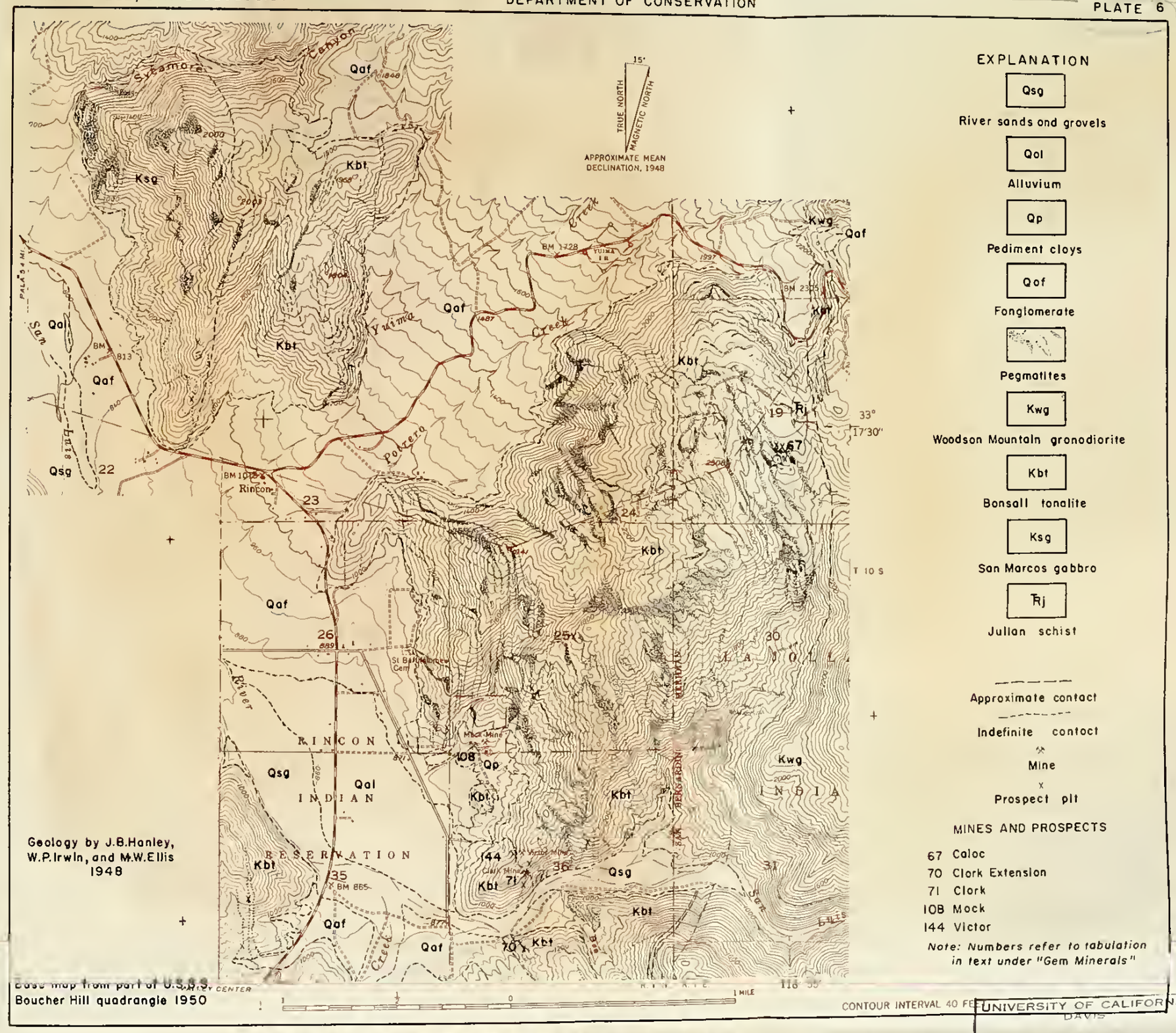


Adapted from Jahns and Wright, 1951, plates 1 and 2.

GEOLOGY AND MINERAL DEPOSITS OF THE PALA DISTRICT, SAN DIEGO COUNTY, CALIFORNIA



GEOLOGY AND GEM MINERAL DEPOSITS OF THE PRINCIPAL PART OF THE RAMONA DISTRICT, SAN DIEGO COUNTY, CALIFORNIA

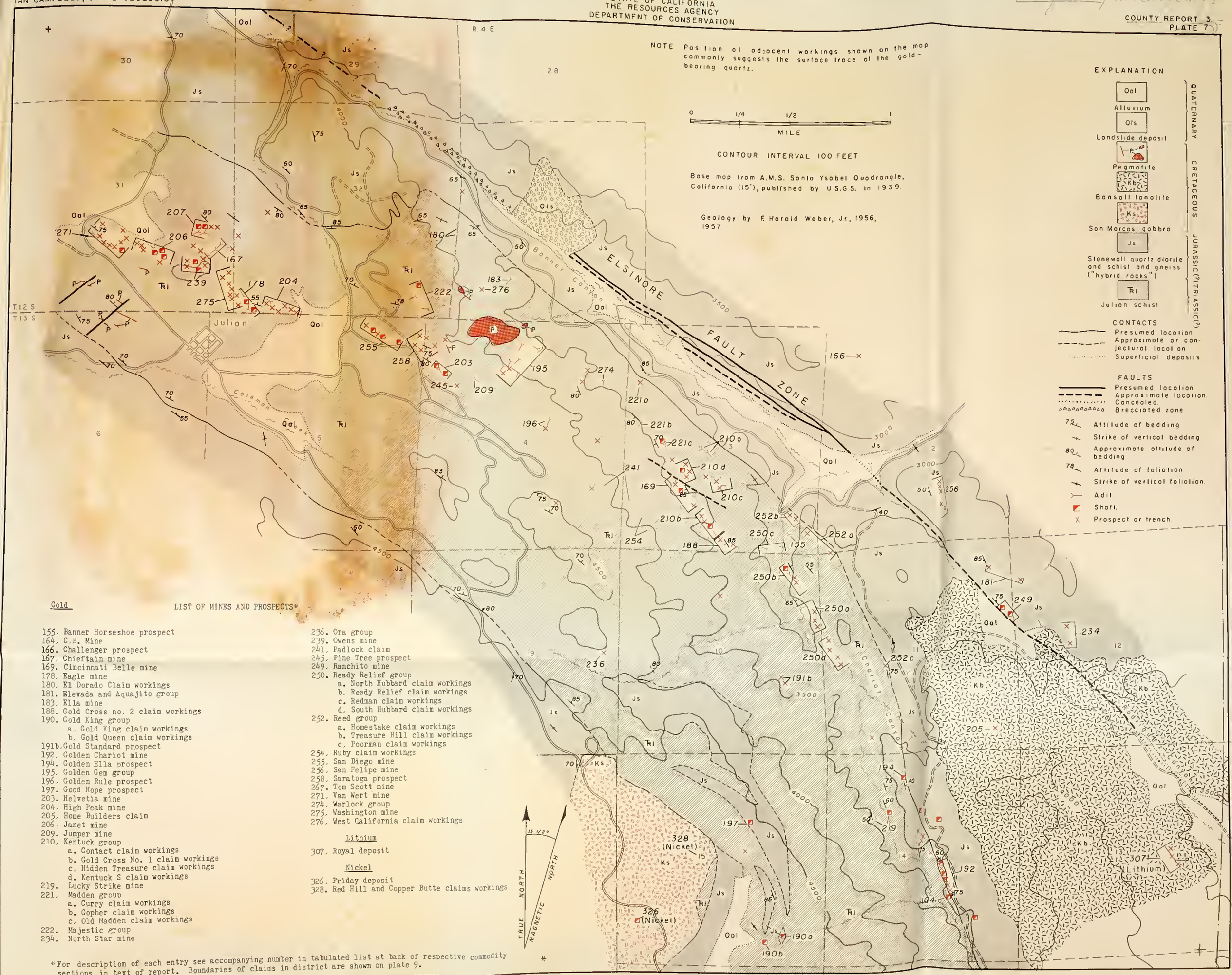


GEOLOGIC MAP OF THE RINCON DISTRICT SHOWING MINES AND PROSPECTS
SAN DIEGO COUNTY, CALIFORNIA

DIVISION OF MINES AND GEOLOGY
IAN CAMPBELL, STATE GEOLOGIST

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF CONSERVATION

COUNTY REPORT 3
PLATE 7



Gold

LIST OF MINES AND PROSPECTS*

155. Banner Horseshoe prospect
164. C.B. Mine
166. Challenger prospect
167. Chieftain mine
169. Cincinnati Belle mine
178. Eagle mine
180. El Dorado Claim workings
181. Elevada and Aquajito group
183. Ella mine
188. Gold Cross no. 2 claim workings
190. Gold King group
  a. Gold King claim workings
  b. Gold Queen claim workings
191b. Gold Standard prospect
192. Golden Chariot mine
194. Golden Ella prospect
195. Golden Gem group
196. Golden Rule prospect
197. Good Hope prospect
203. Helvetia mine
204. High Peak mine
205. Home Builders claim
206. Janet mine
209. Jumper mine
210. Kentuck group
  a. Contact claim workings
  b. Gold Cross No. 1 claim workings
  c. Hidden Treasure claim workings
  d. Kentuck S claim workings
219. Lucky Strike mine
221. Madden group
  a. Curry claim workings
  b. Gopher claim workings
  c. Old Madden claim workings
222. Majestic group
234. North Star mine
236. Ora group
239. Owens mine
241. Padlock claim
245. Pine Tree prospect
249. Ranchito mine
250. Ready Relief group
  a. North Hubbard claim workings
  b. Ready Relief claim workings
  c. Redman claim workings
  d. South Hubbard claim workings
252. Reed group
  a. Homestake claim workings
  b. Treasure Hill claim workings
  c. Poorman claim workings
254. Ruby claim workings
255. San Diego mine
256. San Felipe mine
258. Saratoga prospect
267. Tom Scott mine
271. Van Wert mine
274. Warlock group
275. Washington mine
276. West California claim workings

Lithium

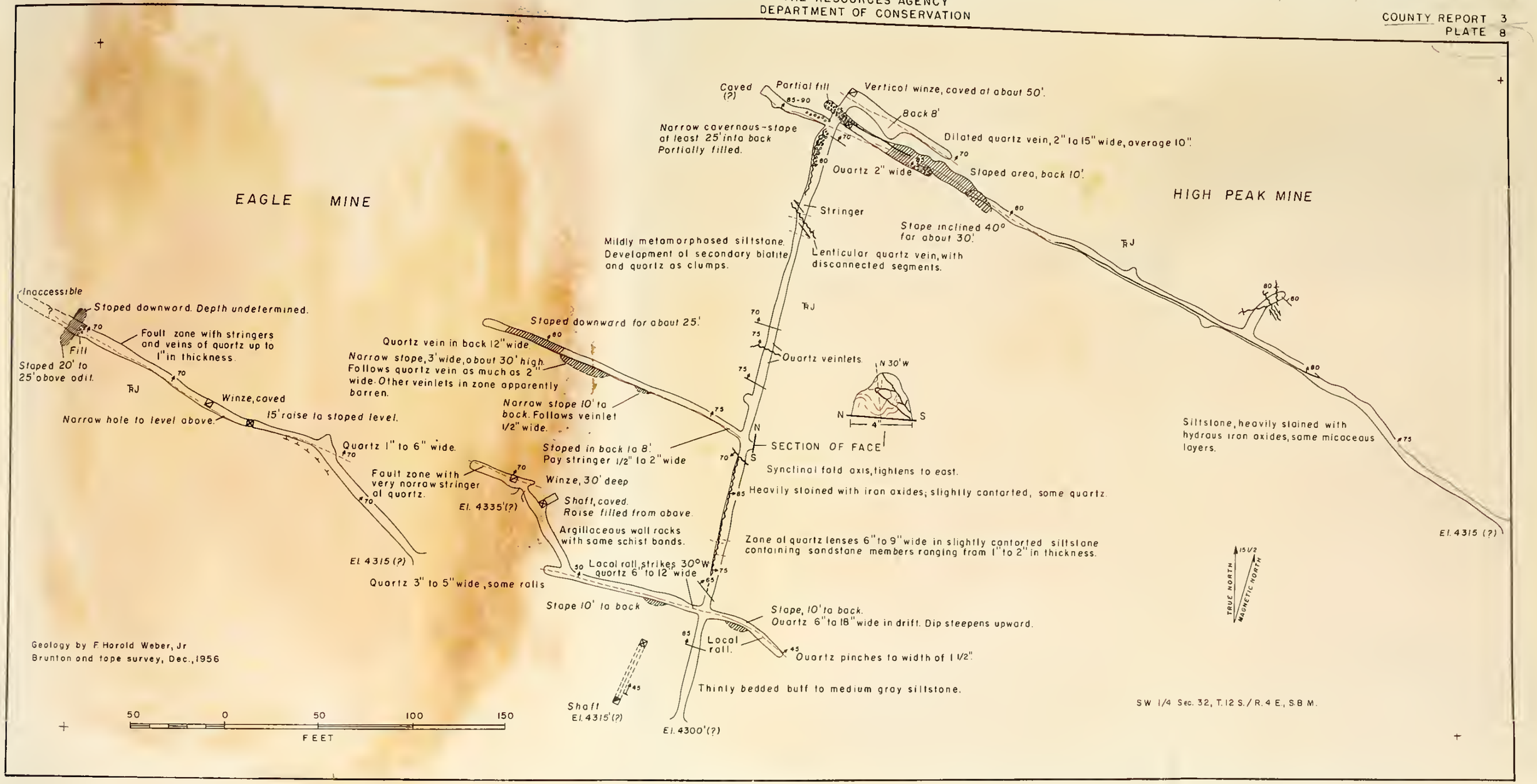
307. Royal deposit

Nickel

326. Friday deposit
328. Red Hill and Copper Butte claims workings

*For description of each entry see accompanying number in tabulated list at back of respective commodity sections in text of report. Boundaries of claims in district are shown on plate 9.

GEOLOGY AND MINERAL DEPOSITS OF THE JULIAN DISTRICT, SAN DIEGO COUNTY, CALIFORNIA



EXPLANATION

Quartz vein

CRETACEOUS OR YOUNGER

Julian Schist

TRIASSIC (?)

Dip and strike of bedding

Post-mineral fault, showing dip

Vertical post-mineral fault

Pre-mineral fault, unmineralized

Mineralized fault zone, showing dip; solid where mined, dashed where not mined, (and assumed very low grade or barren).

MAP OF UNDERGROUND WORKINGS OF THE EAGLE AND HIGH PEAK MINES SHOWING GEOLOGY AND TYPICAL VEIN SYSTEM OF THE JULIAN DISTRICT, SAN DIEGO COUNTY, CALIFORNIA

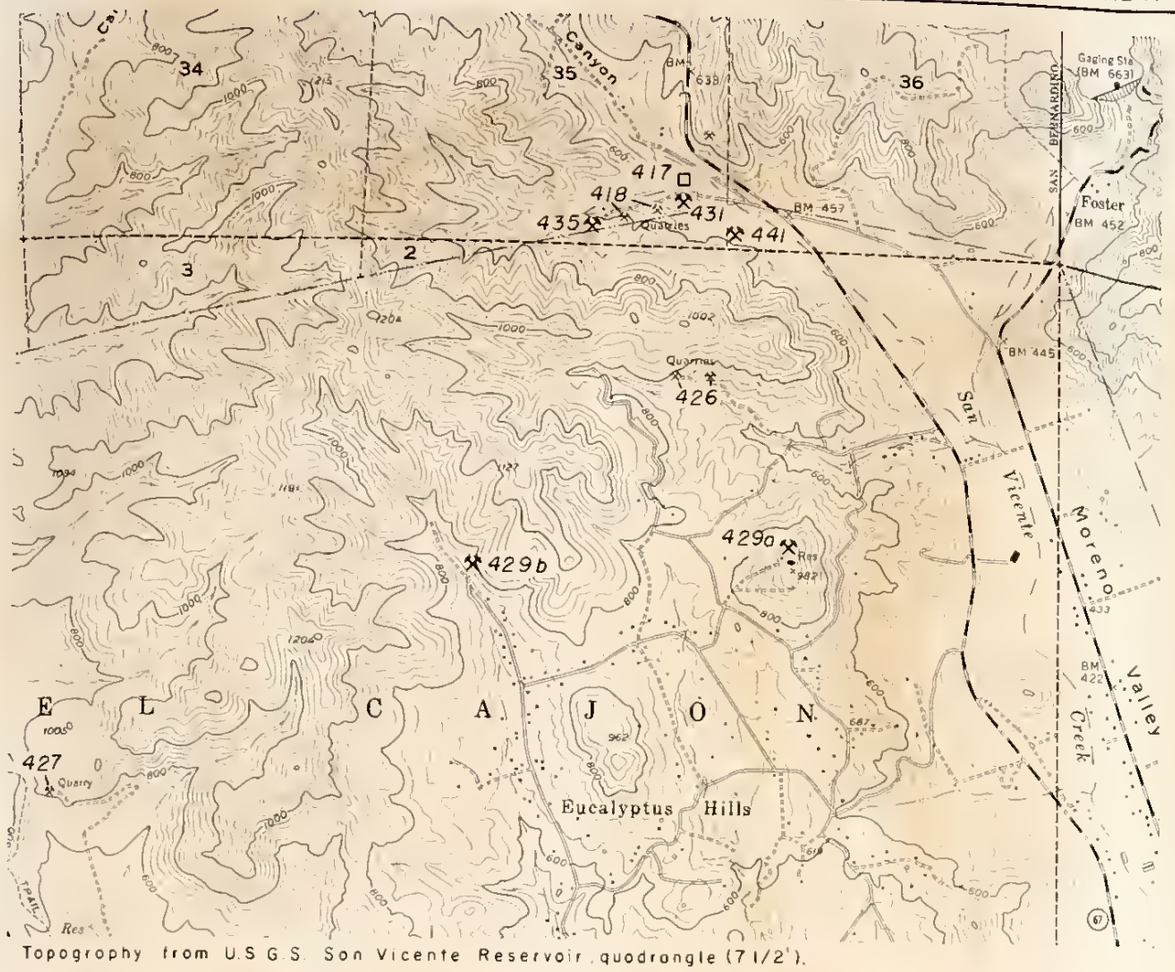
MAP OF JULIAN AND VICINITY SHOWING LOCATION OF MINING CLAIMS, SAN DIEGO COUNTY, CALIFORNIA

0 500 1000 2000 3000 4000 5000 6000
FEET

Compiled by J E Morrison, 1932, modified by F H Weber, Jr, 1957 For description of claims see tabulated list

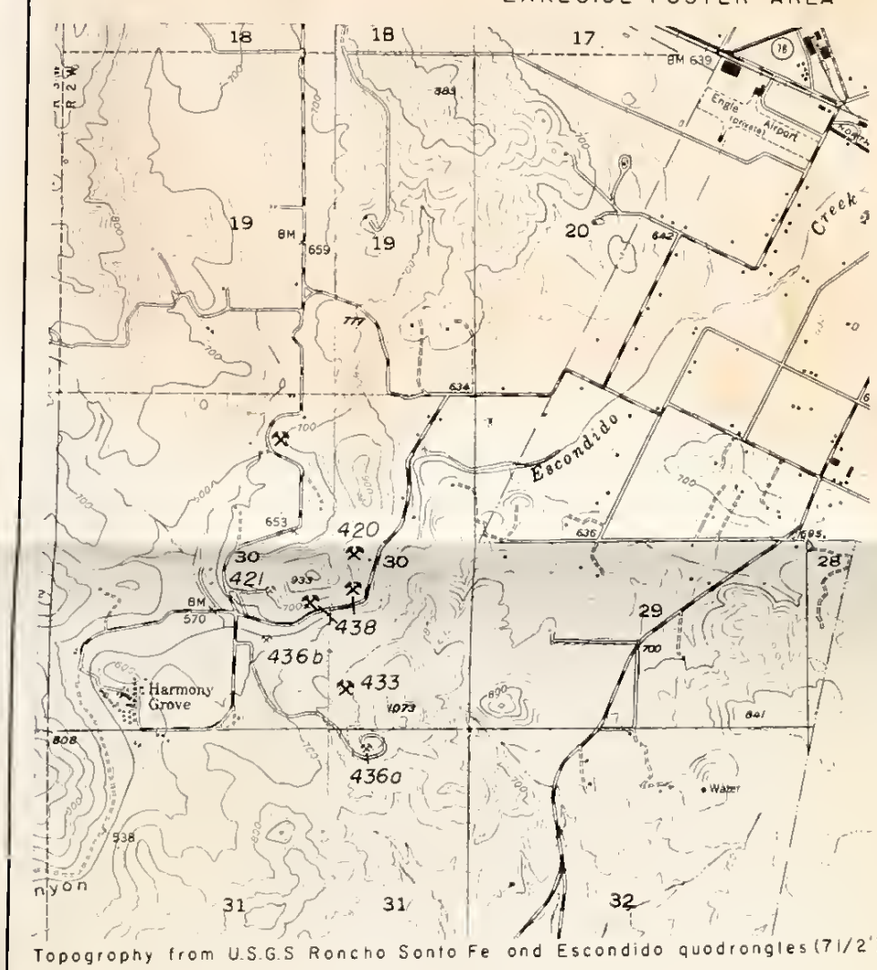
EXPLANATION

- Owens — Patented claims
- Jumper — Unpatented claims
- Hermon — Claims that have been adjudicated out
- Patented non-mineral land
- Five acre tract land
- Land believed to be in part open for prospecting, as of 1957



Topography from U.S.G.S. San Vicente Reservoir quadrangle (7 1/2').

LAKESIDE-FOSTER AREA



Topography from U.S.G.S. Rancho Santa Fe and Escondido quadrangles (7 1/2').

ESCONDIDO AREA

LIST OF QUARRIES*

Lakeside-Foster area

417. California Wire Sawyer Corp. (finishing plant)
418. Cameron-Deering quarries
426. McGilvray-Raymond Corp. quarries
427. McKoon quarry
429. W. A. Meyer quarries (a,b)
431. National Quarries quarry
435. Southern California Granite Co. quarry
441. Waterman quarry

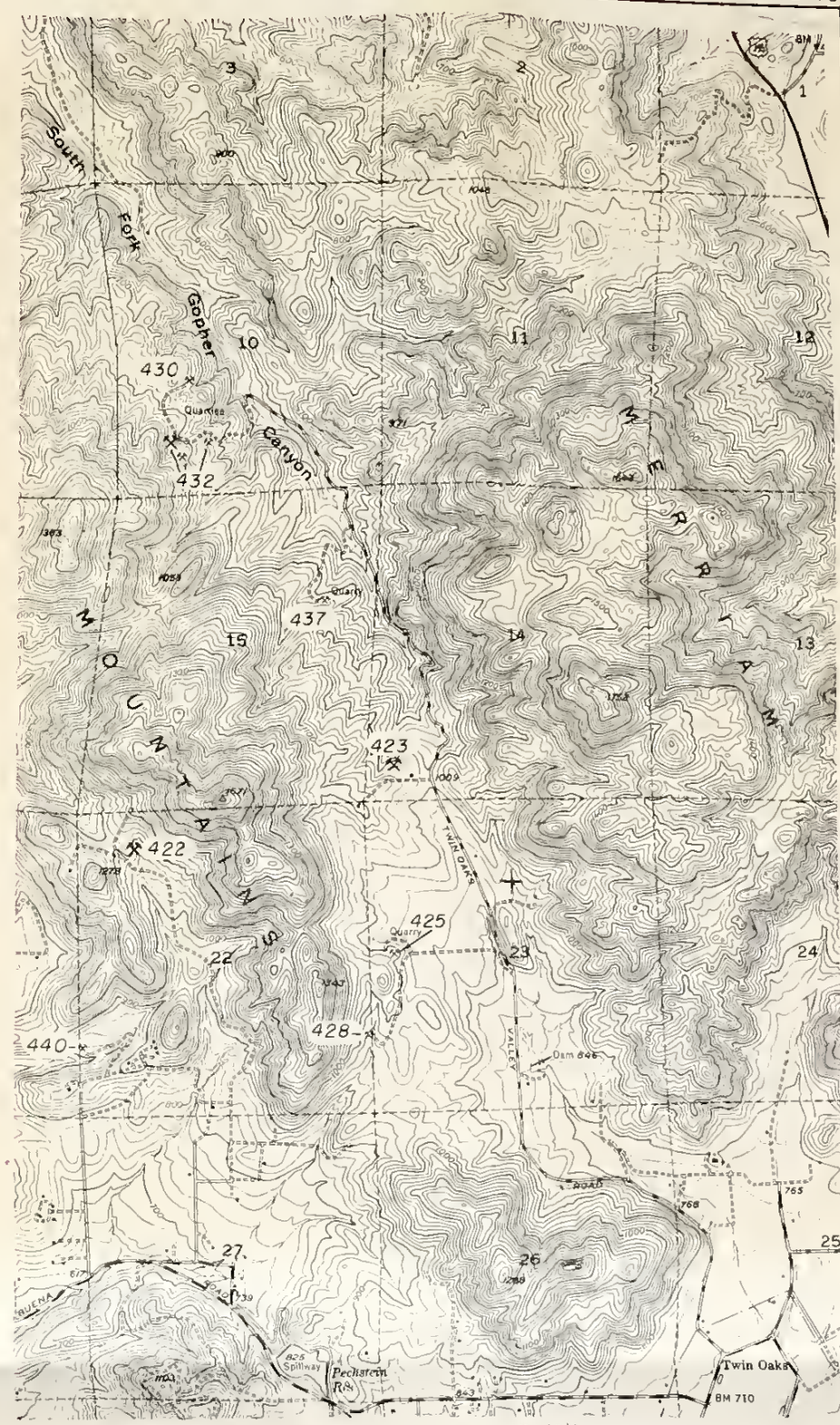
Escondido area

420. Ebony Black Diamond Granite Co. quarry
421. Escondido Quarries, Inc.
433. Don Potts quarry
436a. Stridsberg (Superior Black) quarry
436b. Stridsberg (Crystal Black) quarry
438. Valley Granite Co. quarry

Vista area

422. Fellows and Clutter quarry
423. Galbraith quarry
425. Pete Matson quarry
428. Merriam quarry
430. National Blue Granite quarry
432. Pomona Granite Co. quarries
437. Texas Quarries quarry
440. Vista Black Granite quarry

*For description of each entry see tabulated list under "Dimension Stone" in text of report.

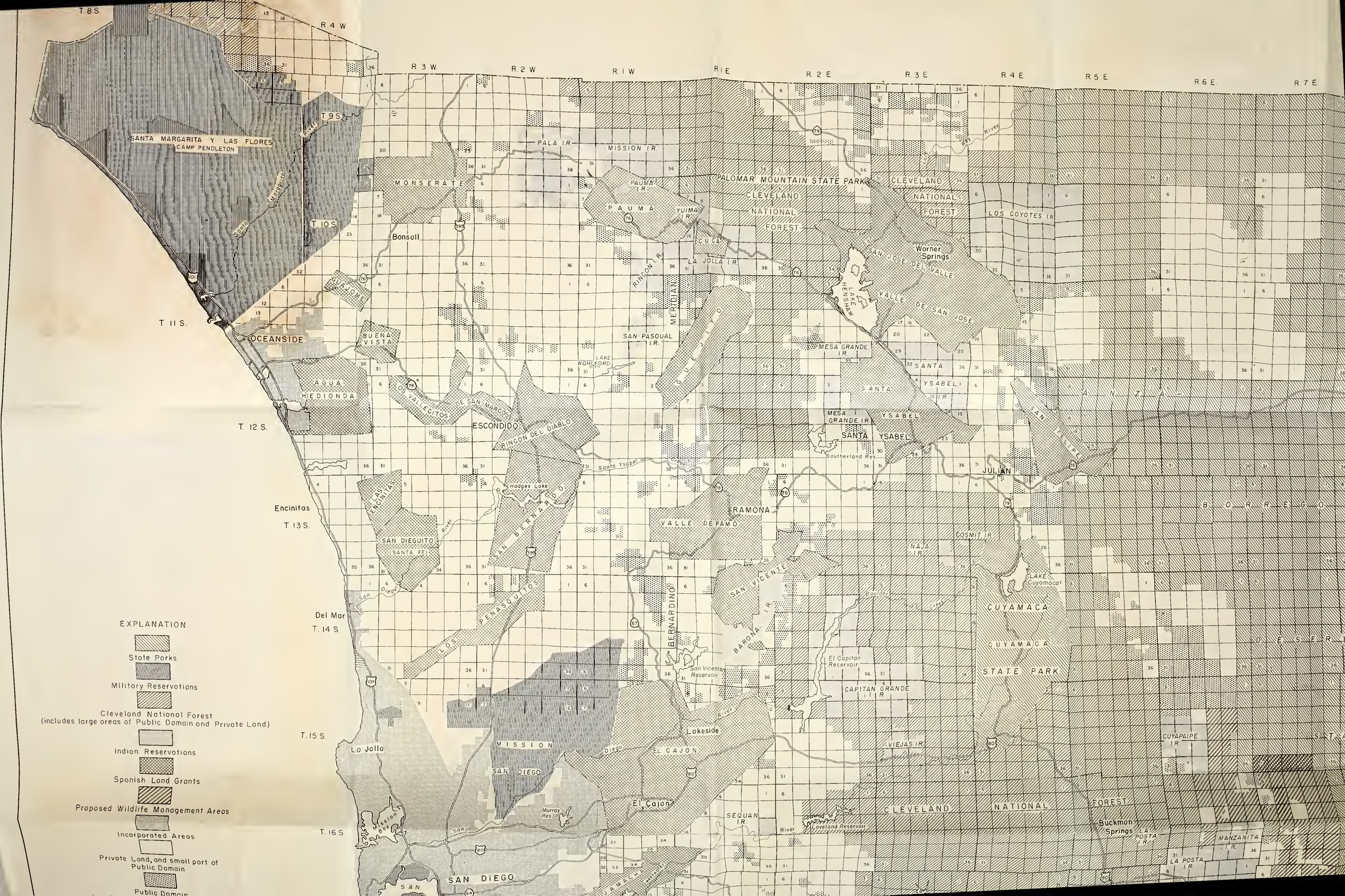


Topography from U.S.G.S. San Marcos quadrangle (7 1/2')

VISTA AREA

1 1/2 0
MILE

GRANITE QUARRIES IN THE LAKESIDE-FOSTER, ESCONDIDO, AND VISTA AREAS, SAN DIEGO COUNTY, CALIFORNIA


T 8 S.
R 4 W
R 3 W.
R 2 W
R 1 W
R 1 E
R 2 E
R 3 E
R 4 E
R 5 E
R 6 E.
R 7 E.
T 9 S.
T 10 S.
T 11 S.
T. 12 S.
T. 13 S.
T. 14 S.
T. 15 S.
T. 16 S
SANTA MARGARITA Y LAS FLORES
CAMP PENDLETON
Santa Margarita River
MONSERATE
Bonsall
PALA I.R.
MISSION I.R.
PAUMA I.R.
PAUMA
YUIMA I.R.
CUCA
PALOMAR MOUNTAIN STATE PARK
CLEVELAND NATIONAL FOREST
LOS COYOTES I.R.
Worner Springs
SAN JOSE DEL VALLE
VALLE DE SAN JOSE
LAKE HENSHAW
RINCON I.R.
LA JOLLA I.R.
SAN PASQUAL I.R.
LAKE WOHLFORD
GUEJITO
MESA GRANDE I.R.
SANTA YSABEL I.R.
SANTA YSABEL
Southerland Res.
JULIAN
SAN PEDRO
A N Z A -
B O R R E G O
D E S E R T
S T A
OCEANSIDE
BUENA VISTA
AGUA HEDIONDA
EQUAJONE
LOS VALLECITOS DE SAN MARCOS
ESCONDIDO
RINCON DEL DIABLO
Santa Ysabel Creek
Hodges Lake
SAN BERNARDO
RAMONA
VALLE DE PAMO
Encinitas
LAS ENCINITAS
SAN DIEGUITO (SANTA FE)
San Dieguito River
LOS PENASQUITOS
Del Mar
SAN VICENTE
BARONA I.R.
BERNARDINO
MERIDIAN
NAJA I.R.
COSMIT I.R.
LAKE Cuyamaca
Boulder Creek
CUYAMACA
CUYAMACA STATE PARK
El Capitan Reservoir
CAPITAN GRANDE I.R.
San Vicente Reservoir
Lakeside
EL CAJON
VIEJAS I.R.
CUYAPAIPE I.R.
Lo Jolla
MISSION
SAN DIEGO
Murray Res.
El Cajon
SEQUAN I.R.
Loveland Reservoir
Buckman Springs
LA POSTA I.R.
MANZANITA I.R.
Mission Bay
SAN DIEGO
EXPLANATION
State Parks
Military Reservations
Cleveland National Forest
(includes large areas of Public Domain and Private Land)
Indian Reservations
Spanish Land Grants
Proposed Wildlife Management Areas
Incorporated Areas
Private Land, and small part of Public Domain
Public Domain


R. 1 E.
R. 2 E.
R. 3 E.
R. 4 E.
R. 5 E.
R. 6 E.
R. 7 E.
R. 8 E.
T. 9 S.
T. 10 S.
T. 11 S.
T. 12 S.
T. 13 S.
T. 14 S.
T. 15 S.
T. 16 S.
PALOMAR MOUNTAIN STATE PARK
CLEVELAND NATIONAL FOREST
CLEVELAND NATIONAL FOREST
LOS COYOTES I.R.
Warner Springs
SAN JOSE DEL VALLE
VALLE DE SAN JOSE
LAKE HENSHAW
MESA GRANDE I.R.
SANTA YSABEL I.R.
SANTA YSABEL
MESA GRANDE I.R.
SANTA YSABEL
Southerland Res.
SAN FELIPE
A N Z A
Ocotillo
JULIAN
B O R R E G O
RAMONA
COSMIT I.R.
INAJA I.R.
SAN VICENTE I.R.
BARONA I.R.
LAKE Cuyamaca
Boulder Creek
CUYAMACA
CUYAMACA STATE PARK
D E S E R T
El Capitan Reservoir
CAPITAN GRANDE I.R.
VIEJAS I.R.
CUYAPAIPE I.R.
S T A T E
CLEVELAND NATIONAL FOREST
SEQUAN I.R.
Loveland Reservoir
Buckman Springs
LA POSTA I.R.
MANZANITA I.R.
LA POSTA I.R.
P A R K
BARRETT LAKE
MORENA LAKE

Proposed Wildlife Management Areas

Incorporated Areas

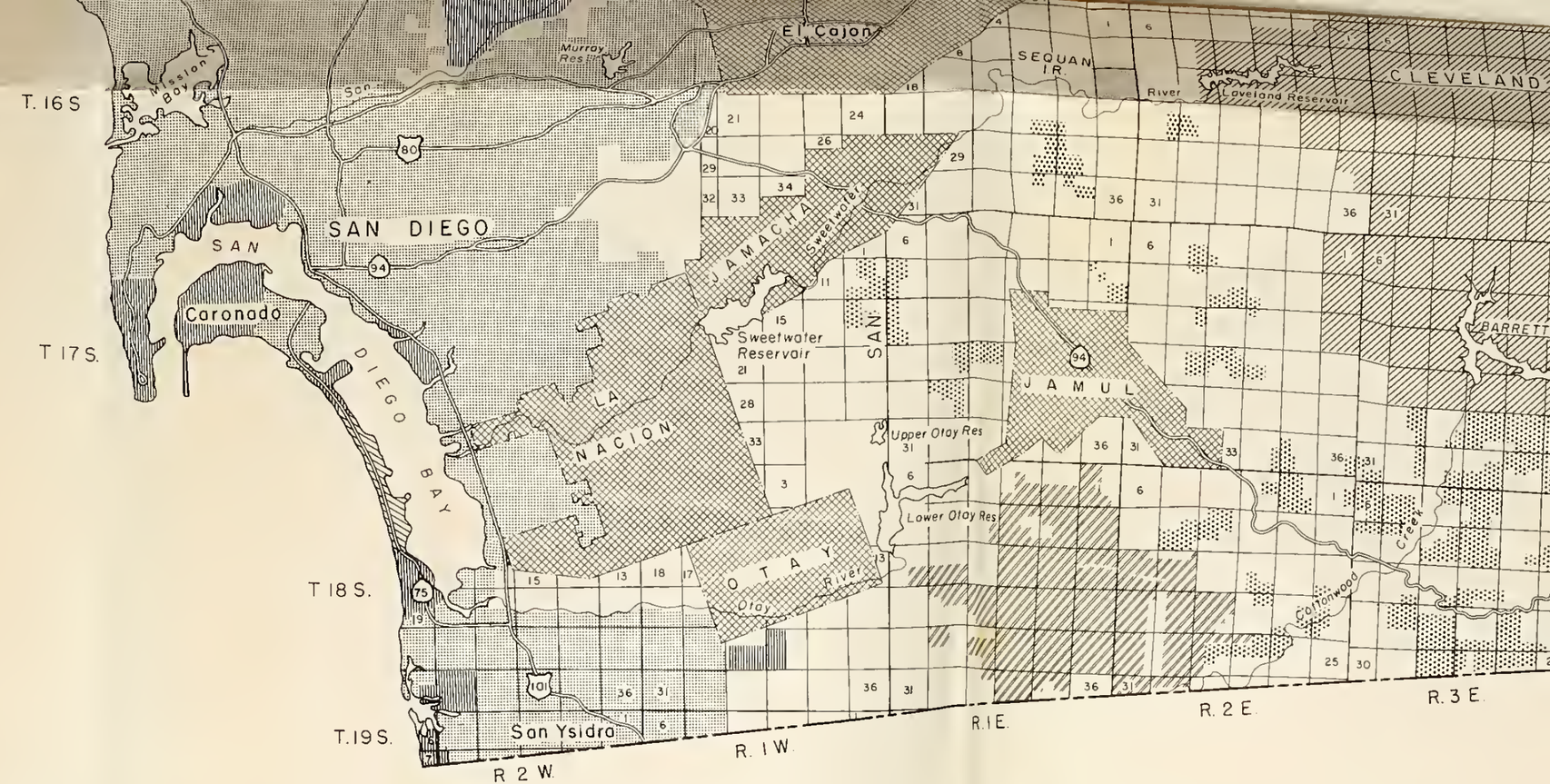
Private Land, and small part of Public Domain

Public Domain
(as of 1955; individual parcels of less than 120 acres not shown).

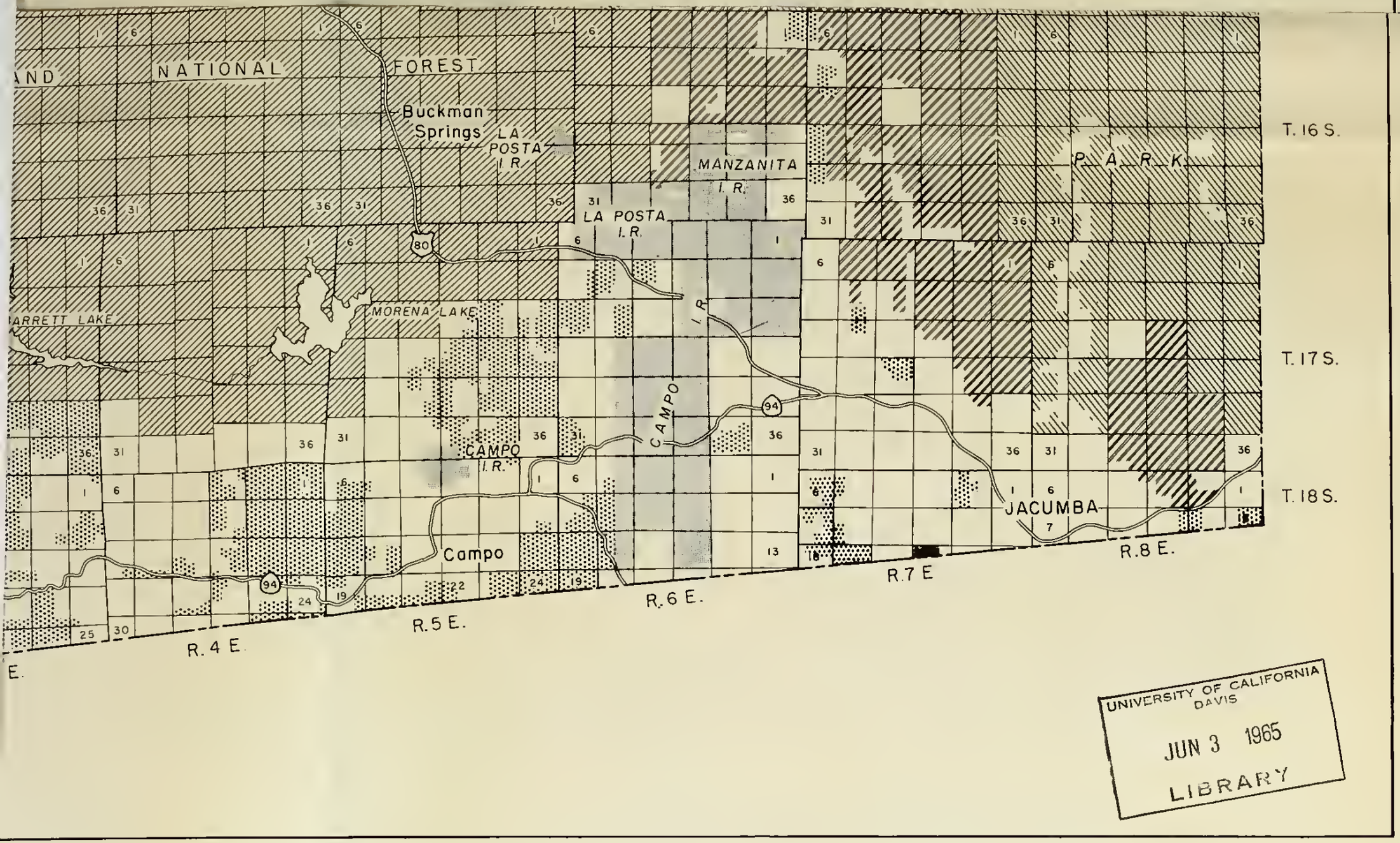
Compiled in 1959 by Barbara E. Biewener, of San Diego County Division of Natural Resources, and F. H. Weber, Jr., chiefly from maps and data of the San Diego County Assessor. Other sources of data were the United States Forest Service, California Division of Beaches and Parks, and Federal Register.

Base map, San Diego County Assessor's map, 1955.

0 1 2 3 4 5 6 7 8
MILES



STATUS OF OWNERSHIP AND ADMINISTRATION OF LAND IN SAN DIE



N DIEGO COUNTY, CALIFORNIA