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SANTA CLARA COUNTY.

By E. Huguenin and W. O. Castello.

(Field work in 1919.)

Santa Clara County, created February 18, 1850, lies south of San Francisco Bay and has an area of 1328 square miles. Alameda County bounds it on the north, Stanislaus and Merced on the east, San Benito and Santa Cruz, on the south, and Santa Cruz and San Mateo counties are on the west. Its assessed valuation in 1918 was about $95,000,000.

San Jose, the county seat, is the business center of the fertile Santa Clara Valley. It is 47 miles south of San Francisco on the main line of the Southern Pacific Railroad. The towns of Santa Clara and Palo Alto are next in importance, each having a population of approximately 7000. The former adjoins San Jose to the west and is the seat of the University of Santa Clara, one of the largest Catholic Universities in the west. In the year 1777 the Franciscan Fathers here founded the mission after which the county takes its name. Palo Alto is situated in the northern part of the Santa Clara Valley on the border line of San Mateo County. It lies 28 miles south of San Francisco, and owes its foundation to the establishment there of the Leland Stanford Jr. University, the most richly endowed university in the world. Gilroy, with a population of about 4000, is located near the southern border of the county and is the commercial center of the southern end of the Santa Clara Valley.

TRANSPORTATION.

The coast line of the Southern Pacific Railroad traverses the county throughout its length almost centrally, affording easy access to San Francisco and Oakland. A branch line runs from San Jose, via Los Gatos, to Santa Cruz. The Peninsula Railroad Company operates an electric system between San Jose and Palo Alto, via Los Altos, connecting with Los Gatos and Saratoga, and giving access to several small towns in the northwestern portion of the county. The new State Highway, over which many auto stages are operated, runs parallel to the main line of the railroad. The eastern portion of the county, particularly that mountainous region east of the Mount Hamilton Range, is very inaccessible, being traversed only by a few mountainous roads. That mineralized area in the northeastern portion of the county is at present reached only by road from Livermore. Easier access to this region from the railroad may be gained upon completion of the Patterson and Western Railroad, which is now being constructed. This road follows the Arroyo del Puerto from Patterson into the western border of Stanislaus County, the terminus of which will be not over a few miles from Red Mountain.

TOPOGRAPHY AND GEOLOGY.

The chief topographic feature of the county is the great central valley, comprising nearly one-half of the entire county, inclosed by the two parallel mountain chains which are part of the Coast Range Mountains. The westerly group, known as the Santa Cruz Mountains,

separates the Santa Clara Valley from the sea, and is a series of abrupt ridges whose peaks range in elevation from 2000 to 3000 feet. It is in general well timbered with oak, pine and redwood. The easterly group, which separates the smaller valley from the San Joaquin Valley, consists of several parallel ridges, between which are located small but fertile valleys. The highest of these ridges culminates in Mount Hamilton, whose elevation is 4209 feet above sea-level. These ridges contain only a scattered growth of oak, which is also the condition of the main valley.

The oldest geological formation found within the limits of the country is the Franciscan group. Its age has not been positively determined, but it is generally accepted as Jurassic.[1] It comprises the metamorphosed sandstones, cherts, and serpentines, which make up practically the entire eastern mountain group and the low foothills bordering the west side of the valley. A limited area of marine sandstones and shales which have been identified as Cretaceous overlies the Franciscan group southeast of San Jose. In the western part of the county, the Franciscan formation is overlain by heavy bedded sandstones of the Miocene, which produces the comparatively rugged topography of the bold ridge which separates Santa Clara and Santa Cruz counties. The quaternary formation is represented by the unconsolidated sands, gravels and clays (detritus of the older formations) which fill the valley bottom. Very few eruptive rocks are found in the county. Rhyolite occurs in the vicinity of the New Almaden Mine, southeast of San Jose. Its occurrence was first described by Mr. Becker of the United States Geological Survey.[2] A few narrow basalt dykes are exposed along Coyote Creek east of Madrone Station.

DRAINAGE AND WATER SUPPLY.

There are very few important streams in the county. The chief drainage system is that of the Coyote Creek, which rises in the mountains near the eastern boundary in the center of the county and flows southerly until it breaks through one range of hills south of Gilroy Hot Springs; thence northerly to a point about 3 miles east of Madrone Station, whence it cuts through another range of hills and enters the Santa Clara Valley, flowing northwestward to San Francisco Bay. Second in importance is the Los Gatos Creek, which rises in the Santa Cruz Mountains and flows northeastward, joining the Capitancillos or Guadaloupe Creek at San Jose, whence it also flows northward to the bay. The Los Gatos Creek and its tributaries form the main water supply for San Jose and Santa Clara. The northeastern part of the county is drained by the Alameda Creek and its tributaries, which enters the bay below Niles. The Pajaro River and its branches, the Arroyo de las Llegas, the Uvas Creek, and the San Felipe Creek, drain the southern part of the county. The numerous wells sunk throughout the length of the valley supply ample water for local use.

MINERAL RESOURCES.

Santa Clara County, essentially an agricultural county, was for many years the largest producer of quicksilver in the State, but is now second

[1] Andrew C. Lawson, U. S. G. S. Geological Folio No. 193.
[2] Monograph XIII, The Quicksilver Deposits of the Pacific Coast.

to San Benito County. The mining of magnesite is becoming one of the important mineral industries of the county, and during the past few years there has been a great increase in its production. The minerals produced in order of their value are quicksilver; brick; sandstone; crushed rock, sand, and gravel (combined under the head of stone industry); mineral water; petroleum; magnesite; natural gas; and grouped under miscellaneous and unapportioned, asphalt and bituminous rock, chrome, granite, lime and manganese.

ASPHALT AND BITUMINOUS ROCK.

The asphalt and bituminous rock deposits of Santa Clara County have been fully described in previous reports of this bureau from which the following brief description is extracted:

[3]"The bituminous deposits and springs in the southwest corner of Santa Clara County occur in the foothills forming the eastern slope of the Santa Cruz Mountains. They are principally developed upon the Sargent Ranch, about 3 miles from Sargent Station, on the Southern Pacific Railroad. They are more or less distributed over about sixty acres, although the principal outcrop of the bitumen-soaked strata are confined to an area of a few acres, within which most of the tar springs occur. At this point the shales are light in color when not stained with bitumen, and resemble those in the foothills upon the western side of the Santa Cruz Mountains. A tunnel has been run for a short distance in this formation, but is now caved in. The shales are overlaid by sandstone. About 150 feet down the mountain, and distant perhaps half a mile, are several tar springs exuding from a serpentine formation."

There has been a small production from the above deposits, but not in recent years as this natural asphalt could not compete with that produced as a by-product in the oil refineries.

Bibl.: Reports VII, p. 93; VIII, p. 548; X, pp. 607-609; XIII, p. 43.

BRICK.

The **Peterson-Kartschoke Brick Company,** established over 25 years ago, owns and operates a brick yard at Third and Keyes streets, San Jose. The clay is mined at the company's clay bank one mile east of the yard along the east bank of Coyote Creek. The clay bed is 18′ thick and covers many acres. It is mined by steam shovel and hauled by auto trucks to the yard. Capacity of trucks, four cubic yards each. The clay is shoveled into a hopper and conveyed on a belt to a set of rolls that breaks up any lumps, and feeds directly to a Pug Mill for tempering and then to a Monarch soft-mud machine. The bricks are burned in two Hoffman continuous kilns, each of 41,000 capacity. The plant is equipped with a large steam heated drying room in case of inclement weather. Electric power is used to operate the presses. The products are common brick and floor tile. An average of 40 men are employed during 9 months of the year. G. Kartschoke is president and manager; Maynard Wright is secretary.

The **San Jose Brick Company** owns a clay bank and brickyard 1 mile west of San Jose on the Los Gatos branch of the Southern Pacific Railroad. The company was organized in 1884 and the present plant

[3]Report X, pp. 607–608.

erected in 1893. This property covers 50 acres. The clay bed, of unknown depth, is now mined to a depth of 33 feet by steam shovel, which loads directly into cars of 6 yd. capacity, which are hauled to the brick presses over a cable railway, 1040 ft. long. The plant is equipped with four Monarch soft-mud brick presses, capacity 40,000 each daily; two Hoffman type continuous kilns of 40,000 and 30,000 capacity respectively; one 160-h.p. steam engine for operating plant, two 80-h.p. oil burning boilers. The capacity of the plant is 20,000,000 bricks yearly. However, it has not been run at full capacity for several years. About 40 men are employed. Louis Dossee is superintendent at the plant. In August, 1919, the company was being reorganized; A. M. Anthony, auditor.

CHROMITE.

Chromite occurs in small irregular kidneys and seams in serpentine areas of Franciscan rocks in the Red Mountain District in the extreme northeastern part of the county; in the hills above Alum Rock Park; and in the district 8 miles southeast of Los Gatos. The occurrences are rather limited and the ore is generally too thinly disseminated, or too low-grade to be of commercial value. It is stated that some ore was shipped from the district southeast of Los Gatos over thirty years ago.

Kilday Ranch Deposit. Several small lenses of chromite have been developed on this property which lies along the top of a ridge, probably 1000 feet in elevation above Guadalupe Cañon and 8 miles southeast of Los Gatos. The ridge here is capped with a decomposed serpentine, and chromite has been found at several different places, but thus far no large deposit has been uncovered, and there is very little ore now exposed. About eighty tons of the ore was shipped out by the Farish Company, Insurance Exchange Building, San Francisco, during 1916, but no work has been done since. M. J. Kilday of Los Gatos is the owner.

Laurel Lake Ranch Deposit. J. A. Ferbrache of Gilroy developed a deposit of high grade black chromite on his property 7 miles northwest of Gilroy. The serpentine in which the chrome ore occurs outcrops prominently along the ridge south of Uvas Creek. Associated with the serpentine is a peridotite, thin sections of which have been examined microscopically and show phases high in olivine, and also approaching augite piorite. Although still retaining its original outlines, much of the olivine is seen to be altered to serpentine. One large boulder was uncovered in the loose soil capping and a tunnel is being driven to cut some leaders which occur in the serpentine above. There have been some shipments since the property was visited.

Winship Properties. K. D. Winship, 350 Post street, San Francisco, owner; C. W. Rose and M. J. Gates, lessees, 211 Pacific street, Santa Cruz. Chromite occurs on section 11, T. 6 S., R. 4 E., and on SW. ¼ of section 7, T. 6 S., R. 5 E., M. D. M. Holbrook and McGuire, as sublessees in the summer of 1917, shipped several carloads of high-grade chromite from this property. In the latter part of 1918 T. S. O'Brien et al., 75 Fremont street, San Francisco, leased section 11, and built a 50-ton concentrating mill.

Several test runs were made during the first part of Feb., 1919, and about 25 tons of concentrates were produced, averaging 50% Cr_2O_3. The mill was closed down after this owing to market conditions. It is claimed that there is several thousand tons of milling ore here, which will run around 10% Cr_2O_3.

CLAY.

Garden City Pottery, H. M. Stammer, president; Gustav Nelson, secretary. The pottery is located at 560 North Sixth street, San Jose, and the company manufactures flower pots and stoneware. The clay from which the flower pots are made is purchased from the city of San Jose and hauled from Coyote Creek, about 1 mile east of the plant, while the clay for the stoneware is obtained from Lincoln, Placer County, and Carbondale, Amador County. The pottery is equipped with four oil burning kilns, two muffle and two down-draft moulds, presses, etc. Fifteen men are employed throughout the year. The plant has been in operation since 1904.

Pacific Coast Pottery and Terra Cotta Company, F. Eberhart, president; E. C. Hamlin, manager and secretary. The plant of this company at Fifth and Kayes streets, adjoins that of the Peterson-Kartschoke Company, to the east, the Southern Pacific Railroad forming the dividing line between the two. This company manufactures sewer pipe and terra cotta, importing most of the clay used from Amador County. The low-grade clay with which the higher-grade material is mixed is hauled from the company's clay bank along Coyote Creek 1 mile east of the yard. The plant is equipped with four down-draft kilns, machine presses, etc. The plant is operated by steam power using crude oil for fuel.

COPPER.

Hooker Creek Mine. Located 7 miles south of Los Gatos and 1 mile from the station of Eva on the main line of the Southern Pacific Railroad. It is near the line between Santa Clara and Santa Cruz counties. This property is owned by H. E. and J. E. Casey and G. W. Stollery of San Mateo, who began development in 1917. There are two tunnels, one about 300 feet, and the second about 185 feet in length. The ore is chalcopyrite, azurite and malachite, and some of it is said to run very high in copper. It also contains some gold and silver values.

No ore has been sold, although some negotiations were made with the Mountain Copper Company.

From three to four men were employed for several months, but it has been closed down since the latter part of 1918, on account of labor and market conditions. Fifteen men are employed throughout the year.

LIMESTONE AND LIME.

Limestone of a good commercial grade occurs at several places in the mountains bordering the west side of the Santa Clara Valley, the most important deposits being those in the vicinity of Black Mountain, and in the range extending southeastward from Los Gatos to the Guadaloupe mine. As early as 1864, kilns were constructed above the Guadaloupe mine, and a large tonnage of the limestone was burned; however, this

property has been idle since the early nineties. Another quarry was opened 2 miles southeast of Los Gatos, from which the limestone was hauled to kilns at Los Gatos. This, too, has not been worked for many years, and no lime is at present produced in the county.

The Black Mountain deposits outcrop over a considerable area. The rock is a very high grade limestone, and as such is suitable for either sugar refining (for which purpose a large tonnage was formerly quarried by the sugar company mentioned below), or for the manufacture of cement. It is fine-grained and hard, varying in color from yellowish-blue to black. The following analysis is of an average sample of the limestone taken by W. W. Bradley of this Bureau from croppings on the southwest flank of the mountain, in SW. ¼ of section 13, T. 7 S., R. 3 W., owned by **K. D. Winship**, 354 Pine street, San Francisco.

(Analyst, Sidney A. Tibbetts, Berkeley.)

Silica (SiO_2)	1.56%
Aluminum oxide (Al_2O_3)	0.47%
Iron oxide (Fe_2O_3)	0.22%
Manganese oxide (Mn_3O_4)	0.05%
Phosphoric oxide (P_2O_5)	0.06%
Calcium carbonate ($CaCO_3$)	97.20%
Magnesium carbonate ($MgCO_3$)	0.43%
Total	99.99%

These deposits suffer the disadvantage of being over 9 miles from the railroad, but they are accessible by wagon road. A railroad, however, could easily be built up the cañon of the South Fork of Permanente Creek to the foot of Black Mountain.

Bibl.: Repts. VIII, pp. 543-546; X, p. 619; XII, p. 394; XIII, p 630. Bull. 38, pp. 82-83.

The **Alameda Sugar Company**, with offices at 310 Sansome street, San Francisco, formerly operated a quarry on Black Mountain, 9 miles by road from Mountain View, on the Southern Pacific Railroad. The limestone was hauled to Mountain View and shipped to their sugar factory at Alviso where it was burned into quicklime and used for refining sugar. This quarry has been idle for the past few years.

Bibl.: Bull. 38, p. 82.

Bernal's California Marl Fertilizer Company, Pedro A. Bernal, president and manager; office 404 South Market street, San Jose. This company owns and operates a limestone quarry on the east slope of the Santa Teresa Mountains, 3 miles by road southwest of Edenvale. The limestone bed covers over 100 acres and is about 200 feet thick. It is irregular in character, grading from a fine-grained hard bluish-gray limestone to a calcareous marl, containing an abundance of shells. The analysis of the marl is given as follows:

(Authority, advertising matter.)

Silica	2.50%
Alumina	11.24%
Iron oxide	2.90%
Magnesia	1.55%
Calcium carbonate	80.81%

This marl pulverizes readily, and is said to be an excellent fertilizer, for which use it is quarried. As this material is very soft, it is easily dug out with pick and shovel, only occasional drilling and blasting being necessary. The marl is pulverized in a Williams Patent Crusher and Pulverizer, which has a capacity of 2 tons per hour, and is operated by a small electric motor. This crusher is a very efficient machine as it does not become clogged when the material is slightly moist. The product is sacked at the quarry and hauled by team to Edenvale, from where it is shipped to the consumers. This industry, established in 1915, has a promising future, as the demand for the fertilizer is steadily increasing. Eight men are employed during the dry season.

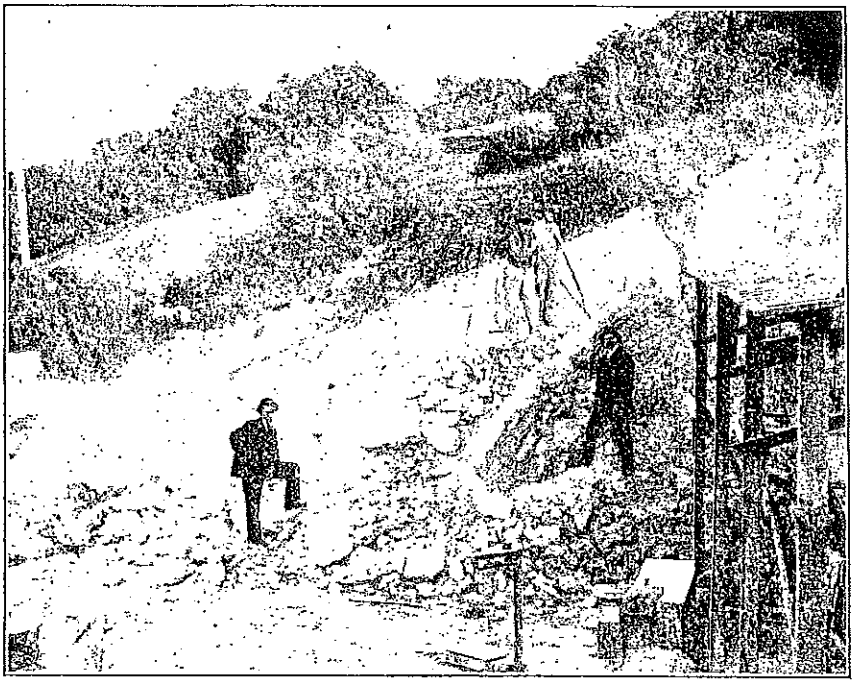

Photo No. 14. Quarry of Bernal's California Marl Fertilizer Company, nine miles south of San Jose.

A few years ago, several thousand tons of the hard gray crystalline limestone was quarried under lease by the Spreckels Sugar Company, for use at their refinery, but none of this material is at present quarried.

MAGNESITE.

Magnesite deposits occur in many serpentine areas in the eastern part of the county, the largest and best grade deposits thus far uncovered being those at Red Mountain, in the northeastern corner of the county, now being mined by the Standard Magnesite Company and the Western Magnesite Development Company. These deposits have long been known, and many attempts made to develop them, but their great distance from the railroad and the uncertainty of a market delayed their

exploitation; and it is only within the past decade that they have been put upon a producing basis.

A number of outcrops of magnesite occur at irregular intervals in a belt of soft impure serpentine along the low range of hills bordering the east side of the Santa Clara Valley, extending from east of Coyote Station to Gilroy. These outcrops are small and the magnesite is in general less pure than the Red Mountain deposits. It varies in color from white to buff. Pieces of float may be found in many places along that range. Some development work was done in 1916 at several localities, and some very promising prospects were opened. These deposits have the advantage of being within easy access of the railroad.

Bradford Ranch Deposit. Magnesite occurs in small veins in serpentine 4 miles southeast of Edenvale, along the top of an open rolling ridge. There was some production from the property several years ago, and during 1917 it was worked to some extent by Harry McLaughlin of San Jose, who shipped out several car loads. Work ceased in September.

A dump on the hillside above the Bradford ranch house marks the location of the most extensive underground work, now caved. The country rock is light-brown serpentine with many films of magnesite. Besides this caved entry, there is an open cut now partly caved. Above it a 125-ft. tunnel driven S. 30° W. found no ore. Over this is a tunnel with a cross drift or double entry which followed a vein from 2″ to 10″ thick, and it probably produced a few tons of ore, but there is none in sight now. On the east side of the hill near the top, a cut and tunnel 80 feet long found no ore, although there is a suggestion at this face that it may be approaching a deposit. On the southeast side of this hill, at about the same elevation as other developments, there is a cut 40 feet long which leads into a curving tunnel (length unknown) following a nearly vertical vein of magnesite which apparently varies from a few inches to two feet thick. The footwall is a slip fault, and the hanging wall has many magnesite veinlets or fractures in brownish serpentine. Crosscuts from the tunnel disclosed no ore, and a winze in the floor reaches the bottom of the lens at a depth of eight feet. There is practically no ore in sight in the tunnel, but a trench just above appears, however, to show the top of a 5-foot vein. A few tons of second grade ore are on the dump.

Any further production means considerable dead work to undercut the veins in these workings. Herbert S. Bradford of San Jose, is the owner.

Burnett Ranch Deposit. A deposit of magnesite was developed on this ranch several years ago. Now owned by Michael Righetti. Veins and boulders of good quality occur in an impure serpentine near the top of a ridge one-quarter mile north of the Metcalf road, and three miles northeast of Coyote Station. A vein which varied from 4′ to 10′ wide was mined by an open cut 100′ long. A tunnel was driven on this vein 10′ below floor of cut, but it is now caved. About 75′ northwest of this working, a 10′ tunnel shows a lens of white magnesite several feet in diameter and up to one foot thick. There are about ten tons on the dump. A small cut 300′ to the northwest found a little impure magnesite, and 700′ northwest of the original location a cut on a vein striking N. 45° W. and dipping 45° SW., took out a lens 60′ long.

These are now caved and the deposit is worked out. Walter Arnstein has a lease on the mineral rights here, but the property is idle.

Bibl.: U. S. Geol. Surv. Bull. 355, p. 31.

Jackson Ranch Deposit (formerly known as the **Cochrane Ranch Deposit**), is 4½ miles east of Madrone Station, and 1½ miles south of the junction of Coyote and San Filipe creeks. It is reported that some work was done on the deposit in 1897, and that several carloads of magnesite were shipped. During 1916, Harry C. Warwick, Hearst Building, San Francisco, worked it, taking out several hundred tons. The rock, an impure buff-colored magnesite, outcrops near the top of the ridge west of Coyote Creek. The serpentine is decomposed, and numerous boulders of magnesite have been taken in the open cuts. There is no well-defined ledge and the magnesite appears to be deposited as large blocks or boulders. It is said to contain 4% iron, to which it owes its buff color. No estimate of tonnage can be made, but undoubtedly a small output can be kept up indefinitely. Two men are working, using hand drills, picks and shovels. The ore is hauled down the steep hillside to the floor of the cañon in a sled, then shoveled into wagons and hauled by four-horse teams to Madrone. Alfred Jackson, Jr., is the owner.

Bibl.: Rept. XIII, p. 505. Bull. 38, p. 331; Manuscript of Bull. 79, "Magnesite in California."

Pacific Magnesite Company, Russ Building, San Francisco. This company operated on ten claims on Red Mountain adjoining the property of the Western Magnesite Development Company on the south, 33 miles southeast of Livermore. The claims were located in 1915, and some development work done the following year. In 1917 the property was tied up due to litigation over the ownership, and since then it has, by order of the court, reverted to the Western Magnesite Company.

Two tunnels were driven at elevations of about 50 and 100 feet below a large cropping of magnesite near the top of the ridge. The lower tunnel, 400 feet long, cuts the ledge, exposing an ore body of almost pure white magnesite. A gravity tramway 1200 feet long, with a drop of 400 feet, connects the lower tunnel with an ore bin above the road. A 65-h.p. gas engine and Giant air compressor were installed to supply the necessary air for the machine drills.

The Hoff-Price Company, Monadnock Building, San Francisco, had a lease on several claims of the Pacific Magnesite Company, from which they shipped a few carloads of magnesite in the spring of 1917. Work ceased here when that company began operations at the Sampson magnesite mine in San Benito County.

The **Standard Magnesite Company**, for several months during the first part of 1918, operated a magnesite property in the Red Mountain district about 33 miles southeast of Livermore, in section 18, T. 6 S., R. 5 E. Operations were discontinued in September, 1918. The company owns several claims, only one of which has been developed. There are two tunnels, one of which is 200 feet long, and the other about 75 feet. Considerable ore was hauled to Livermore, and shipped in 1918.

An average of 12 men were employed. There is considerable quipment at the property, consisting of an air compressor, drills, track, cars, etc. H. C. Haecke is president: home office 244 California street, San Francisco.

Weber Ranch Deposits. The Bay Cities Water Company, Coyote, California, owner. The deposits are located on an open ridge, about three miles in an air line northeast of Madrone. On the west slope of the hills near the top a deposit was developed under lease by H. C. Warwick of San Francisco. A large open cut shows a ledge of white to buff-colored magnesite which appears to be quite extensive. Several hundred tons have already been produced from this ore deposit.

On the east slope considerable float has been found and several large cuts were made in the hope of striking the ore in place. The magnesite occurs here in bunch-like or kidney deposits, and it was evidently not deposited in a vein or lode, but as a general alteration of the serpentine with which it is closely associated. As the slopes of the ridge are covered with an adobe soil, and the serpentine very much decomposed, it is impossible to determine without further development work, whether these deposits are in place. The kidneys or boulders are white and evidently quite pure. Several tons had been gathered and were lying on the dump ready for shipment, when visited. A few carloads were shipped by H. Sherlock during 1915 to Berkeley for the manufacture of carbon dioxide, and during 1916 some further development work was done by the owner under the management of H. L. Haehl, Humboldt Bank Building, San Francisco, but the deposits found were too small to warrant exploitation, and work ceased.

Bibl.: Cal. State Min. Bur. Bull. 38, p. 331. U. S. Geol. Surv. Bull. 355, p. 32.

Western Magnesite Development Company, Charles H. Spinks, president, 704 Thomas Clunie Building, San Francisco. This company, organized in 1912, owns and operates the magnesite mine on Red Mountain formerly owned by the American Magnesite Company. During 1917-1918 it was operated by Langdon E. Boyle, 519 California Street, San Francisco, as receiver appointed by the Federal Court on account of litigation between conflicting factions in the company. The property consists of ten claims, four of which are patented, and has been a producer since 1905. It is understood that C. S. Maltby has leased this property for five years and intends to install new machinery and make many improvements. (August, 1919.)

The magnesite outcrops in bold white ledges on the southern and western slopes of the mountain, several hundred feet above the floor of the valley. The following description of these deposits is quoted from the report of Hoyt S. Gale of the United States Geological Survey, who made a thorough study of them.

"The general area containing the magnesite outcrops is occupied by serpentine without evidence of much variation in character or of inclusions of other rocks. The serpentine is bordered on the west by sedimentary sandstones and shales, which form a distinctly different topography. The other limits of the mass of serpentine rock have not been defined. The original country rock from which the serpentine is

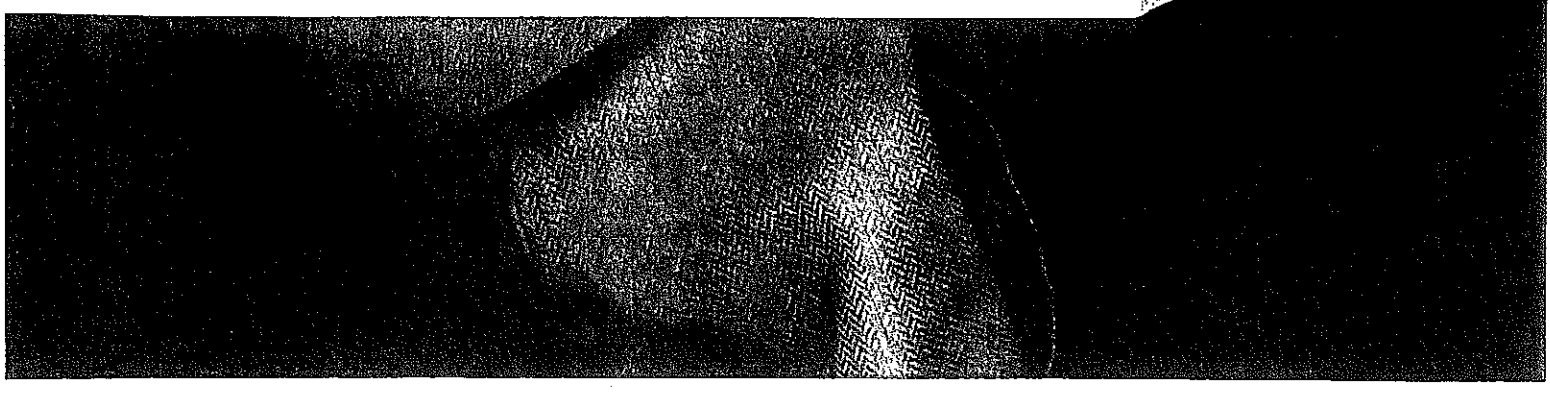

Photo No. 15. Open cut of Western Magnesite Development Company. Note lack of outcrop of this large body of magnesite. Ground surface is showing in upper right half of picture. Photo by Walter W. Bradley.

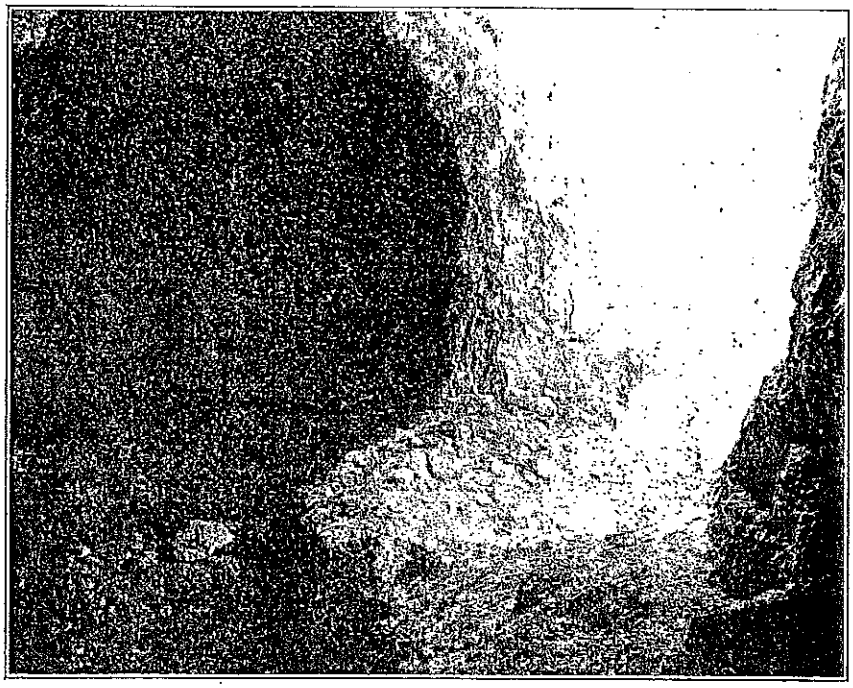

Photo No. 16. Stope in mine of Western Magnesite Development Company, showing magnesite over 30 feet in width. Photo by Walter W. Bradley.

derived is described by Hess as lherzolite and peridotite and is composed essentially of the minerals olivine, diopside, and an orthorhombic pyroxene. The mineral serpentine is a natural alteration product from such rocks. The original country rocks are composed principally of silicates of magnesia (silica, 40 per cent; magnesia, 25 to 40 per cent; alumina and iron variable, usually 5 per cent or more; and a small percentage of alkalies). It is natural to assume that magnesite might be derived by the decomposition or alteration of these silicates being deposited as veins along fissured zones or by replacing the country rock. As a whole, however, the serpentine of this area does not show the

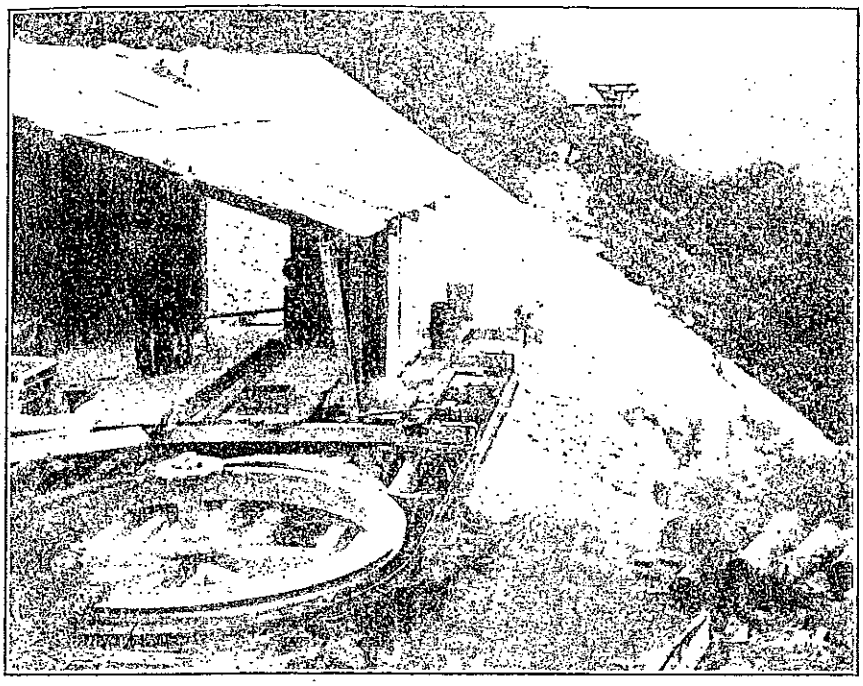

Photo No. 17. Tramway terminal and mine dump of the Western Magnesite Development Company.

excessive amount of shearing to be seen at many of the other magnesite localities.

"Throughout the dark red soil that covers the area of serpentine country rock, especially in the zones that contain the magnesite veins, silica is present in various forms. It occurs, in part, as a white and rosy opal, scattered fragments of which are strewn about on the surface, or it may be observed as chalcedonic veins or coatings in the joints of the country rocks. The silica associated with the purer mass of magnesite in the larger pit is in the form of a pale-greenish granular quartz.

"The magnesite veins are very irregularly distributed and appear to trend in all directions. The larger developed masses are of most unusual size, and even the great bodies that have been removed by mining have been taken out in large open caves or chambers, so as to

give little evidence of the real extent or size of the deposits underground, beyond that which has been taken out."

The principal workings consist of an open cut and several tunnels which have been driven at different levels, exposing a huge ore body, from which many thousand tons have already been mined. The two main tunnels are connected by a large stope or chamber which is over thirty feet in height. The vein at the surface, about 20' in width, was mined by an open cut over a hundred feet in length. There are numerous other prospect shafts, tunnels, and cuts on the many outcrops, but present work is confined to the main workings. The magnesite is in general very pure; however, towards the border of the large bodies it becomes mixed with the soft serpentinized country rock, having a yellowish color, so that there is no well defined boundary of the magnesite bodies. The high grade ore is said to average 98% magnesium carbonate.

An aerial tramway 2400 feet long connects the main workings with the furnaces, situated in the camp below the mine. The equipment consists of two 10-ft. vertical kilns, two single-burner kilns, steam plant, warehouse, and the usual camp buildings. Crude oil is used for fuel. Sixty to seventy men are employed during nine months of the year, producing about 30 tons per 24 hours. The coarse ore is calcined before shipping, while the fines are shipped without treatment. The ore is hauled 32 miles to Livermore, by auto trucks, the contract price being $4.50 per ton.

Bibl.: Repts. XI, p. 374; XII, p. 328; XIII, p. 505. Bull. 38, pp. 330-331; U. S. G. S. Bull. 540, pp. 498-501.

MANGANESE.

Manganese ores occur in that mountainous region in the extreme northeast corner of the county, bordering Alameda, San Joaquin, and Stanislaus Counties. They occur in the form of oxides in the jasper lenses of the Franciscan formation. This formation, consisting of heavy bedded sandstone, shale and conglomerate, more or less metamorphosed, is intruded by many different igneous rocks. The manganese deposits are very irregular, varying in size from stains and small veins in the chert to comparatively large pockets. The ore varies from soft and powdery to hard and massive. In discussing the origin of these manganese deposits, E. C. Harder writes as follows:

"The manganese ores in the Franciscan jaspers in their present form are clearly secondary concentrations, as is shown by their replacement of jasper and by the intimate association of manganese oxide and quartz veins, suggesting their contemporaneous deposition. That the jasper itself is the source of the ore is shown by the facts that it is invariably associated with the ore deposits throughout the Coast Ranges, and that ores do not occur in the sandstones and shales of the formation."

This theory, however, is now regarded by many as erroneous and the manganese beds are believed to have been deposited with the chert, and to have been altered, in place, from the carbonate of silicate, to the oxide, by the action of water and other agents.

Comparatively little ore was shipped from the different deposits, prior to 1916. The high price of this metal during the war period led

to some renewed activity, but at present none of the properties are being developed.

A huge boulder of manganese lies on Penitencia Creek, just below Alum Rock Park. This boulder labelled "meteorite," was at one time thought to be the outcrop of a large vein. The main ledge from which it came has never been discovered and is probably in that mountainous region at the head of the cañon.

The **Ala Mountain Mine** is 26 miles southeast of Livermore in section 28, T. 5 S, R. 4 E., M. D. M. A vein of manganese ore about four feet wide was exposed by an open cut and a tunnel, and some ore hauled to Livermore several years ago. No work has been done recently. The Merchant Estate of Livermore is the owner.

Black Bear Mine, 25 miles southeast of Livermore, is in section 34, T. 5 S,. R. 4 E., near the summit of the west slope of the Arroyo Mocho Valley, at an elevation of 3100 feet. Interbedded lenses of manganese ore occur in the jasper, some of them are 3′ in thickness and fairly extensive. Development consists of several open cuts and tunnels. Idle. D. P. Doak, Rialto Building, San Francisco, is the owner.

Black Bird Prospect is in the center of section 28, T. 6 S., R 5 E., and is owned by the Mineral Products Company. Some small pits were sunk, but no production was made.

The **Black Wonder Properties** comprise the Jones Group in the NW. ¼ of NE. ¼ of section 27; the Black Wonder in the SE.¼ of SE. ¼ of section 27; and the Mexican Prospect, in SW. ¼ of SE. ¼ of section 27, T. 6 S., R. 5 E., near the Stanislaus County boundary. It was formerly the property of the California Manganese Mining Company, of which Howard A. Broughton was President, and is now owned by the Mineral Products Company, with offices at 334 Rialto Building, San Francisco. This company, organized in 1915, is developing the property in connection with its deposits of chrome in Stanislaus County. A narrow gauge steam railroad, called the "Patterson and Western," was constructed from Patterson 23 miles up the Cañon del Puerto to the foot of Red Mountain, where Camp Jones has been established. Here it connects with a 2-ft. gauge gasoline tramway, five miles in length, which runs to the Jones Mine near the top of the ridge at an elevation of 2750 ft., almost 1000 ft. above the terminus of the Patterson and Western Railroad.

The company erected a factory at Patterson for the manufacture of manganese dioxide from the ores mined at this group.

These manganese deposits are the most important ones thus far discovered in the county, and their occurrence has been described in Harder's report[1] as follows:

"The southern part of the area covered by the claims is greenish-gray sandstone of the Franciscan formation; the northern part is a mixture of jasper and fine shale interbedded. This jasper area is part of a larger area extending in a general east-west direction for 3 or 4 miles between the sandstone on the south and a large area of serpentine on

[1] *Op. cit.*, pp. 162-163.

the north. Where the principal manganese ore deposits occur the jasper-shale belt is about a mile wide. The manganese ores extend as discontinuous deposits along the jasper belt for more than a mile in a general northwest-southeast direction, the principal deposits being to the southeast and very near the sandstone contact.

"The jasper-shale formation consists of beds and lenses of jasper interbedded with fine shale. The jasper may be thin bedded or very heavy bedded, in the last case forming prominent outcrops. The beds generally strike in the direction of the main jasper belt, but the dips are exceedingly irregular.

"The manganese ore occurs along heavy jasper beds as large masses replacing it, as veins, or merely as stains and partial replacements along cracks. The principal deposits, that is, those at the southeast end, are found along two or three prominent jasper beds 300 to 500 yards long, which are nearly parallel and 50 to 200 feet apart, separated by thin bedded jasper and shale. Of these, the deposits in the bed farthest south are most prominent."

Development consists of two tunnels and several open cuts. In both tunnels are exposed ore bodies varying from 5 to 8 feet. The ore is bluish black and more or less mixed with the country rock. Occasional pockets of soft and powdery ore of high grade occur in the ore body.

At the time visited, October, 1916, no development work was being done at this group, but it was expected to start operations upon completion of the road to the property. The company's officers are: A. F. Judd, of Honolulu, president; C. G. Bokus, secretary; H. G. Ginaca, of San Francisco, general manager.

Bibl.: U. S. G. S. Bull. 427, pp. 162-163.

Camp Bessie Mine. (See Fable Manganese Mine.)

Davenport Prospect is on the Winship properties near the center of the north line of section 27, T. 5 S., R. 4 E., ½ mile east of the Arroyo Mocho Road and 25½ miles from Livermore. Rather siliceous manganese oxide occurs in chert which strikes N. 70° W., and dips 65° S. When visited only one prospect hole five feet deep had been sunk.

Davenport and Smith Prospect is on the Winship properties in the NE. ¼ of section 27, T. 5 S., R. 4 E., ½ mile from the Arroyo Mocho road and 25 miles from Livermore. At the extreme northwest end of the claim an inclined shaft follows the ore on its dip southwest for 25 feet. Southeast of this, ore is exposed in trenches. Ninety feet southeast of the shaft there is a drift running nearly northwest along the strike of the ore body. Southeast still farther more trenching has been done, and finally, at the extreme southeast end, 300 feet from the shaft, a short tunnel exposes as much as five feet of massive siliceous manganese oxide striking N. 50° W., and dipping 25° to 75° SW. This body is considerably broken by minor shearing, and varies in width, averaging possibly two and one-half feet.

Doak Mine No. 2 is in the Red Mountain district 25 miles southeast of Livermore on the Camp Bessie Road, in sections 22-27, T. 5 S., R. 4 E., M. D. M. A few open cuts and short tunnels have been driven on some heavy croppings of manganese stained jasper, developing a vein

of manganese said to be 4 feet in width. Considerable ore has been produced from this deposit, but it is now idle. D. P. Doak, of San Francisco, is the owner.

Bibl.: Bull. 38, p. 337.

Fable Manganese Mine, in SW. ¼ of NE. ¼ of section 34, T. 5 S., R. 4 E., is in a small cañon tributary to the Arroyo Mocho, about 26 miles southeast of Livermore. The ore, a soft black oxide is deposited in an irregular layer varying from 6″ to several feet thick, interbedded in greenish-gray jasper, which has a strike a little west of north, and a dip of 45° to the west. Developments consist of a series of open cuts along the outcrop and a 100-foot tunnel driven on the vein showing 6 feet of ore. An incline shaft located near mouth of tunnel was sunk on vein to a depth of 18 feet, but it is now filled up. Idle. Thomas Green, of Dublin, California, is the owner.

Bibl.: Bull. 38, p. 337, U. S. G. S. Bull. 427, p. 162.

Keller Brothers have a slightly developed prospect of manganese in section 13, T. 6 S., R. 4 E., in San Antone Valley. No ore had been developed when the property was last visited.

Mammoth Prospect is owned by H. H. Ballantine and leased to John Plattner. The claim is in section 13, T. 6 S., R. 4 E., ¾ of a mile east of a point which is 32 miles from Livermore on the Arroyo Mocho Road. Several open cuts expose three to six feet of massive, rather siliceous manganese oxide in chert. No production is reported.

Mineral Products Company owns two unnamed prospects ½ mile east of the Black Bird Prospect, near the east line of section 28, T. 6 S., R. 5 E. Large, angular blocks of oxides of manganese occur here. A little work has been done. In the NE. ¼ of the same section a trench 60 yards long has been made and a small amount of oxide ore is exposed. No recent work has been done here.

Mateos Ranch Deposit. It is in section 8, T. 6 S., R. 2 E., eight miles by road east of Milpitas, in Alum Rock Cañon, about two miles beyond the park. There is no road connecting with the terminus of the electric railway at the park, so that at present, the ore has to be hauled over a mountainous road eight miles to the railroad station at Milpitas. A connection with the Alum Rock Cañon road could be made by constructing one-half mile of road.

The manganese ore occurs in seams and pockets in the jasper beds. Considerable high grade float is found in the cañon and a few large boulders aggregating several tons in weight, are lying in a small ravine near junctions with the main cañon. The ore, however, is intermixed with the jasper, and consequently low grade.

A tunnel was driven forty years ago in the jasper beds, and it is reported that some high grade ore was shipped. It is now caved and inaccessible. About 200 ft. west of the tunnel and at the same elevation, an open cut was made last year and about 40 tons of ore was shipped. The face of the cut is caved, so that no ore is at present exposed. Judging from the amount of float found in the cañon and

the extent of the manganese stained croppings, the property appears favorable for further development. It is idle. John D. Mateos, 165 North Fifteenth street, San Jose, California, is the owner.

Newhall Mine ("Great Expectations" Claim), E. P. Newhall, box 354, Livermore, owner; Horace B. Chase, 57 Post street, San Francisco, lessee. It is in section 36, T. 5 S., R. 4 E., on the headwaters of Colorado Creek, a branch of Black Bird Valley 29 miles southeast of Livermore. Some development work has been done by the owner; but he has recently (November, 1917) leased the property. The lessee has some ore out ready to ship showing both carbonate and oxide and said to analyze 42% manganese. The mine is three miles by wagon road from the main Arroyo Mocho road leading to Livermore. The ore is reported to show three feet in width.

Pennsylvania Manganese Mine. The property comprising two unpatented claims is in SE. ¼ of section 12, T. 7 S., R. 4 E., 35 miles southeast of Livermore via the Arroyo Mocho road. The jasper beds with interbedded lenses of manganese ores outcrop for about 500 ft. along the strike, which is northwest, in places showing high grade ore. Development work consists only of a few trenches along the outcrop. About 100 tons of ore, which appears to run high in silica, is lying on the several dumps. The property is worked for assessment only, and the owner is willing to lease on a royalty basis. Sufficient work has not been done to justify an opinion as to its importance. Morgan M. O'Day, 58 N. Fifteenth street, San Jose, is the owner. The Noble Electric Steel Company leased this property but discontinued work after shipping some ore.

On the **Wallace Ranch**, in section 8, T. 6 S., R. 2 E., 6½ miles by road east of Milpitas, a small cropping of high grade manganese ore was observed. This deposit adjoins that of the Mateos Ranch, to the northwest, and is evidently a continuation of the same beds. The jasper here outcrops prominently in bold ledges over large areas, but for the most part it is free from manganese stainings. The only ore observed in place was that exposed for a width of 12″ in a small cut, about 100 ft. in elevation above the old tunnel on the Mateos Ranch. Ore taken from this deposit is reported to have assayed 50.8% metallic manganese. It is undeveloped. Mrs. Grace P. Wallace, 164 East San Carlos street, San Jose, is the owner.

Winship Properties. K. D. Winship, 350 Post street, San Francisco, owner. In the northeast corner of Santa Clara County, in the upper part of the Arroyo Mocho, these properties include the following sections containing manganese prospects: section 27 and section 35, T. 5 S., R. 4 E., M. D. M.

In the SW. ¼ of section 27, on the west side of the Red Mountain-Livermore road, at a point well above and easily accessible to the road is a series of manganese veins covering a width of about 50′. These croppings are traceable for a distance of at least a couple hundred yards long, running west of north. It could probably be followed much farther, but the chamise brush is very thick at this point. A little work was done some years ago around these outcroppings, and it is stated a few tons of high grade ore hauled out. Material from there

could be easily handled by a gravity tram to a loading point on the Arroyo Mocho road.

On the NE. ¼ of this same section 27, is a good prospect of manganese ore. Some work was done a few years ago, said to have been by the same parties who worked on the SW. ¼. A short tunnel, now caved, is stated to have cut through a 4′ vein of high grade ore. The surface indications are that it is at least that wide. The strike is west of north. There are other exposures on this same lead, to the south for about 200′-300′. This deposit is on the east side of the Arroyo Mocho road in an ideal location for a gravity tram to handle the ore to bunkers. In April, 1916, E. A. Wiltsee took a lease on these deposits on section 27 and did a little preliminary development work, but nothing further. Holbrook & McGuire, as sub-lessees, shipped a couple carloads of manganese ore from this section in 1917, but none since.

MINERAL WATERS.

The numerous mineral springs of Santa Clara County are not confined to any particular locality or zone, but occur in the mountain ranges along both sides of the valley. They are all easily accessible and attractively located, and at the more important ones, recreation parks or health resorts have been established, while at others, the waters are bottled for medicinal and table uses.

Most of the springs are carbonated and of small flow, a few are essentially sulphur springs, but the best known is a hot spring of large flow, Gilroy Hot Springs, which has been famous as a health resort for many years.

Dr. Winslow Anderson in his valuable book "Mineral Springs and Health Resorts of California" calls attention to the medicinal value of several of the springs, comparing them favorably to the famous waters of Europe, and in writing of the California springs, in general, states that "all that is needed to make them as serviceable in the restoration and maintenance of health as their famous sister springs in the East and in Europe is their further development, their chemical analysis, and the scientific administration and application of their waters."

Alma Soda Spring. A small carbonated spring issues from a clay bank in a ravine one mile from Alma Station, in the Santa Cruz Mountains. The water, containing principally magnesia, soda and iron is bottled and distributed locally for table uses, by C. Wood, 315 Willow street, San Jose. The San Jose Water Company is the owner.

Alum Rock Park Springs. A group of mineral springs issue from the banks along the sides of Alum Rock Cañon, 7 miles northeast of San Jose. The country rock here is thin bedded sandstone and shales highly tilted and folded. The springs are all of small flow and slightly sulphureted. They vary greatly in their chemical characteristics, as will be seen by referring to the analyses below, extracted from U. S. G. S. Water Supply Paper No. 338. Most of the springs have been improved by cement basins to form drinking pools, and water from several of them is piped to the baths.

Analyses of Water from Alum Rock Park Springs, Santa Clara County, California.

(Constituents are in parts per million.)

	1		2		3		4		5		6		7		8	
Properties of reaction:																
Primary salinity		38		38		69		36		28		25		39		42
Secondary salinity		0		0		14		0		0		0		0		0
Tertiary salinity		0		0		0		0		0		0		0		0
Primary alkalinity		48		49		0		53		60		39		28		33
Secondary alkalinity		14		18		17		11		12		36		33		25
Tertiary alkalinity		104		91		10		80		61		2		2		42
Constituents	By weight	Reacting values	By weight	Reacting values	By weight	Reacting values	By weight	Reacting values	By weight	Reacting values	By weight	Reacting values	By weight	Reacting values	By weight	Reacting values
Sodium (Na)	1,320	57.40	872	38.22	1,751	76.16	2,110	91.77	1,652	71.80	583	25.35	657	28.50	856	37.24
Potassium (K)	25	.64	24	.61	45	1.16	77	1.96	25	.64	15	.39	13	.34	15	.38
Lithium (Li)	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace
Ammonium (NH_4)									0	.00	0	.00	0	.00	0	.00
Calcium (Ca)	142	7.11	101	5.02	423	21.10	164	8.16	127	6.33	198	9.86	161	8.02	152	7.60
Magnesium (Mg)	24	2.14	59	5.18	100	13.19	39	3.18	[illegible]	3.05	58	4.78	73	6.02	63	5.21
Iron (Fe) / Aluminum (Al)	5.9	.21	3.5	.13	6.9	.25	4.2	.15	.6	.02	1.9	.07	30	1.06	5.4	.19
Manganese (Mn)									0	.00	0	.00	0	.00	0	.00
Sulphate (SO_4)	197	4.10	205	4.28	2,418	50.34	10	.21	18	.38	305	6.36	390	8.11	290	6.04
Nitrate (NO_3)									0	.00	0	.00	0	.00	0	.00
Chloride (Cl)	765	21.63	404	11.39	1,522	42.96	1,323	37.35	800	22.58	133	3.75	308	8.68	534	15.06
Bromide (Br)									0	.00	0	.00	0	.00	0	.00
Iodide (I)									Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace
Carbonate (CO_3)	1,836	61.20	934	31.12	546	18.21	1,995	65.51	689	22.96	908	30.27	785	26.18	880	29.34
Metaborate (BO_3)	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	0	.00	0	.00	Trace	Trace
Arsenate (AsO_4)									0	.00	0	.00	0	.00	0	.00

Phosphate (PO_4)	12	.39	10	.32	3.4	.11	32	1.01	Trace.	Trace	0	.00	Trace	Trace	0	.00
Silica (SiO_2)	20	.66	22	.73	60	1.99	21	.70	31	1.03	26	.85	26	.87	25	.82
	3,746.9		2,621.5		6,035.3		5,775.2		3,370.6		2,227.9		2,443		2,820.4	
Carbon dioxide (CO_2)	1,483	67.41	583	38.69	192	8.73	1,835	83.41	1,033	46.86	16	.87	0	.00	447	20.34
Hydrogen sulphide (H_2S)	87	2.17	68	3.99					0	.00	10	.59	13	.77	13	.76

1. Blue Sulphur Spring. Analyst, William Irelan, Jr. Authority, advertising matter.
2. White Sulphur (Sulphur tunnel No. 1). Analyst, William Irelan, Jr. Authority, advertising matter.
3. Salt-Condiment Spring. Analyst, William Irelan, Jr. Authority, advertising matter.
4. Soda Spring. Analyst, William Irelan, Jr. Authority, advertising matter.
5. Soda Spring (on west side of creek, 100 yards north of baths). Analyst and authority, W. D. Forbes (1910). Possibly the same spring as that represented by the preceding analysis.
6. Sulphur Spring (75 yards northwest of tea garden). Analyst and authority, W. D. Forbes (1910).
7. Blackwater Spring (west of tea garden.) Analyst and authority, W. D. Forbes (1910).
8. Southernmost of three springs at Blackwater Spring house. Analyst and authority, W. D. Forbes (1910).

This property, owned by the city of San Jose, is conducted as a recreation park and is equipped with a swimming pool, tub baths, cafe, and numerous concessions. The Peninsular Railway operates an electric line to the park.

Bibl.: Repts. XII, p. 345; XIII, p. 518. U. S. G. S. Water Supply Paper No. 338, pp. 208-210. Mineral Springs and Health Resorts of California, by Dr. Winslow Anderson, pp. 78-80.

Azule Mineral Spring[1] is situated in a ravine a mile northward across a divide from Congress Springs. It was first known as Mills Seltzer Spring, but the name was early changed to Azule, from the blue appearance of the mountains to the southwest. The water was formerly bottled for table use, but it has not been on the market since about 1890. The property has, however, been improved as a picnic resort.

The spring rises in a small concrete house, from a crevice in dark-colored sandstone. Water also issues beside the spring house, apparently from the same crevice as that within the house, and the combined flow of the two streams is perhaps a quarter of a gallon a minute. The water is strongly carbonated and also tastes slightly of hydrogen sulphide. A very small deposit of Epsom salt was noticed beside the

Analyses of Water from Azule Mineral Spring and Congress Springs, Santa Clara County, California.

(Constituents are in parts per million.)

	1		2		3	
Temperature	16°C. (60°F.)				10°C. (50°F.)	
Properties of reaction:						
Primary salinity	39		42		43	
Secondary salinity						
Tertiary salinity						
Primary alkalinity	13		11		36	
Secondary alkalinity	48		47		21	
Tertiary alkalinity	140		136		42	
Constituents	By weight	Reacting values	By weight	Reacting values	By weight	Reacting values
Sodium (Na)	972	42.25	990	43.03	1,746	75.90
Potassium (K)	126	3.21	117	2.98	20	.51
Calcium (Ca)	69	3.44	62	3.08	181	9.05
Magnesium (Mg)	462	38.02	462	37.99	144	11.87
Iron (Fe)					115	4.10
Aluminum (Al)					41	4.52
Sulphate (SO_4)					378	7.87
Chloride (Cl)	1,212	34.17	1,280	36.10	1,201	33.89
Carbonate (CO_3)	1,582	52.75	1,526	50.86	1,790	59.67
Silica (SiO_2)	55	1.82			68	2.26
	4,478		4,487		5,684	
Carbon dioxide (CO_2)	2,632	119.64	2,606	118.46	756	34.36

1. Azule Mineral Spring: analyst and authority, Winslow Anderson (1888).
2. Azule Mineral Spring (bottled water): analyst, James Howden; authority, U. S. Geol. Survey, Bull. 32.
3. Upper Spring, Congress Springs: analyst and authority, Winslow Anderson (1888.)

[1]Gerald A. Waring, Springs of California, U. S. G. S. Water Supply Paper 338, pp. 212–213.

spring, and the channel is iron stained for a few yards below it. There are small deposits of lime carbonate farther downstream.

Although the spring issues from sandstone, serpentine that appears to form a dike not much more than 10 yards thick is exposed on the slope immediately above it. This dike may determine the position of the spring at this point, and the considerable amount of magnesia in the water that is shown by the following analyses, tabulated with one from Congress Springs, is probably explained by the presence of the serpentine. The water may be classed as secondary alkaline and primary saline, but the unusually large content of magnesium is noteworthy.

Bibl.: Rept. XIII, p. 518. Dr. Winslow Anderson's Report (1888), pp. 90-91.

Blodgett Magic Spring is located seven miles west of Gilroy in Bodfish Cañon. [1] "The water issues in a board-curbed and inclosed pool near camp grounds, at the base of the cañon side 25 yards east of the stream. It is not strongly mineralized, but tastes slightly saline and is mildly sulphureted and carbonated. * * * The analysis shows a primary and secondary alkaline water with notable tertiary alkalinity and primary salinity. In former years it was bottled and sold locally to a small extent. The water issues from soft white sandstone.

"A spring that is known as the **Blodgett Mineral Spring**, or Magnesia Spring, is situated on the hillside above a branch of Bodfish Creek and several miles north of Blodgett Magic Spring. It issues from ser-

Analyses of Water from Blodgett Mineral Spring and Blodgett Magic Spring, Santa Clara County, California.

(Analyst and authority, Winslow Anderson, 1889; constituents are in parts per million.)

	Mineral		Magic	
Properties of reaction:				
Primary salinity		45		28
Secondary salinity		16		
Tertiary salinity				
Primary alkalinity				21
Secondary alkalinity		39		51
Tertiary alkalinity		57		50
Constituents	By weight	Reacting values	By weight	Reacting values
Sodium (Na)	111	4.83	129	5.61
Potassium (K)	34	.38	4.7	.12
Calcium (Ca)	30	1.48	61	3.05
Magnesium (Mg)	68	5.62	37	3.03
Iron (Fe)	Trace	Trace	Trace	Trace
Aluminum (Al)	Trace	Trace	37	4.15
Sulphate (SO_4)	222	4.63	42	.88
Chloride (Cl)	112	3.15	85	2.40
Iodide (I)	Trace	Trace		
Carbonate (CO_3)	151	5.03	256	8.53
Metaborate (BO_2)	Trace	Trace	Trace	Trace
Silica (SiO_2)	93	3.08	70	2.33
	821		721.7	
Carbon dioxide (CO_2)	32	1.45	79	3.58
Hydrogen sulphide (H_2S)	48	2.81	Trace	Trace

[1] G. A. Waring op. at pp. 273–274.

pentine and its water is piped from a small covered and rock-walled basin 1 mile eastward to a tank near a farmhouse. The following analysis of the water shows that besides containing a large proportion of magnesia, the water of the mineral spring is primary and secondary saline in character."

Coes Spring. A carbonated spring rises in a creek bed on the east slope of Pine Mountain, 11 miles east of Madrone. It is not utilized commercially. An analysis of the water is given with that of Madrone Spring following.

Bibl.: Rept. XIII, p. 518. U. S. G. S. Water Supply Paper 338, pp. 214-215.

Congress Springs, formerly known as the **Pacific Congress Springs,** are in Campbell Creek Cañon, at the base of the Santa Cruz Mountains, 12 miles southwest of San Jose. A group of three springs, two of which are strongly carbonated, flows from the bank of the creek. Considerable gas escapes from the largest of the springs, the waters of which were formerly piped to a bottling plant below the springs. The gas was collected in a tank placed over the spring and utilized in charging the water, 5000 gallons of which were annually bottled and sold for table use. This property, before the burning down of the hotel in 1904, was a popular health and pleasure resort, but is now used only as an outing or recreation park. It is owned by the Peninsular Railway Company. The analysis given in the table with the Azule Springs is of the main spring.

Bibl.: Repts. XII, p. 345; XIII, p. 519. Water Supply Paper 338, p. 212. Winslow Anderson's Report, pp. 213-214.

Gilroy Hot Spring is situated 13 miles northeast of Gilroy on a hillside above Coyote Creek at an elevation of 1240 feet. There is one large mineralized spring here, which flows from a bank in a small ravine at a temperature of 112° F. It is housed in a bottomless concrete tank, from which the water is piped to tub baths and plunges. The flow is approximately 15 gals. per minute. The water is said to be efficacious in the alleviation of rheumatism, kidney, liver, stomach, skin, and blood diseases. Besides its uses for bathing, it is used for drinking, and it was formerly carbonated and bottled at Gilroy. The health resort established at this property in 1865 is one of the best known in California. There are hotel and cottage accommodations for 150 guests, and it is open throughout the year. A daily auto stage service from Gilroy to the springs is maintained throughout the summer. W. J. McDonald is the proprietor.

Bibl.: Rept. XIII, p. 518. Water Supply Paper 338, pp. 81-82. Winslow Anderson's Report, pp. 156-158.

Analysis of Water from Gilroy Hot Springs, Santa Clara County, California.

(Analyst and authority, Winslow Anderson, 1888; constituents are in parts per million.)

Temperature	43° C. (110°F.)
Properties of reaction:	
Primary salinity	60
Secondary salinity	31
Tertiary salinity	0
Primary alkalinity	0
Secondary alkalinity	9
Tertiary alkalinity	62

Constituents	By weight	Reacting values
Sodium (Na)	228	9.93
Potassium (K)	17	.42
Calcium (Ca)	66	3.30
Magnesium (Mg)	43	3.57
Iron (Fe)	2.1	.075
Sulphate (SO_4)	185	3.85
Chloride (Cl)	422	11.91
Iodide (I)	Trace	Trace
Carbonate (CO_3)	46	1.53
Arsenate (AsO_4)	Trace	Trace
Silica (SiO_2)	57	1.88
	1,066.1	
Carbon dioxide (CO_2)	114	5.16
Hydrogen sulphide (H_2S)	61	3.58

Grant Spring is situated in Alum Rock Cañon, 5 miles above the park. It is a slightly mineralized spring of small flow, whose waters contain principally sodium and magnesium carbonates. The water is bottled at the spring and distributed locally for table and medicinal uses by J. W. Shannon, 343 South Eighth street, San Jose, who has it under lease. J. D. Grant is the owner.

Bibl.: Water Supply Paper 338, p. 212.

Hillydale Sulphur Spring.[1] A small sulphur spring is situated on property known as Hillydale, about 4½ miles south of the reduction works of the New Almaden quicksilver mine, or 20 miles by road southward from San Jose. The spring is on the western bank of a stream, 200 yards from the house on the place, and yields about one-half gallon a minute of moderately sulphureted water. The following analysis indicates a primary-saline, secondary-alkaline water whose total mineral content is small.

[1] Water Supply Paper 338, pp 271–272.

Analysis of Water from Hillydale Sulphur Spring, Santa Clara County, California.

(Analyst, F. T. Green, 1904; authority, owner of spring; constituents are in parts per million.)

Properties of reaction:	
Primary salinity	57
Secondary salinity	0
Tertiary salinity	0
Primary alkalinity	6
Secondary alkalinity	37
Tertiary alkalinity	6

Constituents	By weight	Reacting values
Sodium (Na)	95	4.12
Calcium (Ca)	32	1.60
Magnesium (Mg)	9.5	.78
Iron (Fe) / Aluminum (Al)	1.0	.04
Sulphate (SO_4)	39	.81
Chloride (Cl)	104	2.93
Carbonate (CO_3)	83	2.76
Silica (SiO_2)	11	.37
	374.5	
Hydrogen sulphide (H_2S)	Present	Present

The water is used locally for drinking and is considered useful medicinally.

The spring is situated at the base of a basaltic slope, in an area of sedimentary rocks that may belong to the Franciscan formation. The rock near the spring contains much calcite and is stained with metallic sulphides, from which the sulphide constituents of the water are possibly derived.

Madrone Spring is situated 14 miles east of Madrone Station, and about 5 miles north of Gilroy Hot Springs, on a tributary of Coyote Creek. The spring issues at edge of creek, and the water, which is strongly carbonated, is caught in a cement basin. It was formerly hauled in barrels to San Jose and bottled, but is now used only for drinking purposes about the place. There are several other springs which are only slightly mineralized on the property. A resort was established here over thirty years ago, and it is open each year from May 1 to November 1. There are hotel and cottage accommodations for about 50 guests. Owners, J. D. Arnold, et al., Madrone, California.

Bibl.: Rept. XIII, pp. 518-519. Water Supply Paper 338, p. 214. Winslow Anderson's Report, p. 191.

Analyses of Water from Madrone and Coes Springs, Santa Clara County, California.

(Authority, 13th California; constituents are in parts per million.)

	1		2	
Properties of reaction:				
Primary salinity		1		3
Secondary salinity				
Tertiary salinity				
Primary alkalinity		29		8
Secondary alkalinity		70		89
Tertiary alkalinity		12		18
Constituents	By weight	Reacting values	By weight	Reacting values
Sodium (Na)	217	9.45	50	2.15
Potassium (K)	7.5	.19		
Lithium (Li)	Trace	Trace		
Barium (Ba)	1.2	.02		
Strontium (Sr)	Trace	Trace		
Calcium (Ca)	380	18.94	90	4.47
Magnesium (Mg)	37	3.04	182	14.94
Iron (Fe)	4.7	.17	21	.71
Aluminum (Al)			Trace	Trace
Manganese (Mn)	.8	.03		
Sulphate (SO_4)			27	.57
Chloride (Cl)	34	.40	6.4	.18
Carbonate (CO_3)	940	31.34	649	21.63
Metaborate (BO_2)	Trace	Trace		
Phosphate (PO_4)	3.2	.10	7.0	.22
Silica (SiO_2)	108	3.60	97	3.21
	1,713.3		1,135.4	
Carbon dioxide (CO_2)	Present	Present	Present	Present

1. Madrone Spring: analyst, G E Colby.
2. Coes Spring: analyst, M. E. Jaffa.

The **Santa Teresa Springs** are located on the east slope of the Santa Teresa Mountains overlooking the Santa Clara Valley, 3 miles south of Edenvale. The water, which is very slightly mineralized, issues from seams in a formation of hard gray sandstone, flowing over 20 gallons per minute. It is caught in a large concrete reservoir, from which the water is piped to the ranch house below, where it is bottled and distributed for drinking purposes to houses and offices in San Jose. Pedro A. Bernal, 404 S. Market street, San Jose, is manager. Mrs. Ygnacio Bernal, of Edenvale, is the owner.

Analysis of the Santa Teresa Spring Water.

(Constituents are in grains per gallon; analyst, Dr. H. Kleinhans; authority, advertising matter.)

Silica	5
Aluminum and Iron Oxide	1
Calcium Carbonate	8
Magnesium Carbonate	3
Magnesium Sulphate	2
Sodium Sulphate	4
Sodium Chloride	1
Total solids	24

There are several sulphur springs along Bodfish Creek, none of which are utilized commercially. One, larger than the rest, situated about 7 miles west of Gilroy, close to the wagon road, is used for drinking purposes by campers and teamsters.

NATURAL GAS AND PETROLEUM.

Natural gas and petroleum have been produced in the county at two localities, namely, in Moody's Gulch, south of Alma Station, and on the Sargent Ranch, near the southern boundary of the county. A number of wells were drilled at both of these localities, yielding some natural gas and oil. The first well was drilled in Moody's Gulch in 1878, and oil prospecting has been carried on there spasmodically to date. The Sargent field has been a producer only since 1900 (although wells were drilled there as early as 1886), yielding a few thousand barrels annually. Drilling has also been done northeast of Los Gatos, but no commercial production has resulted.

QUICKSILVER.*

The first known occurrence of quicksilver within the area of the United States, was that found at the New Almaden mine in Santa Clara County in 1824 by Antonio Suñol and Louis Chaboya. Though some occurrences had apparently been earlier noted in Mexico, the New Almaden was the first producing quicksilver mine in North America. Suñol and Chaboya built a mill nearby and endeavored to extract silver from the cinnabar. Late in 1845, the ore was shown to Andreas Castillero,[1] a Mexican officer, who identified it as cinnabar, and under whose direction development work was immediately begun. Gun barrels were utilized as their first retorts. The output was small, however, until after California became part of the United States, since which time more than a million flasks have been produced in this county, as may be noted from the tabulation herewith, the greater portion of which came from the New Almaden mine.

The quicksilver deposits of Santa Clara County are confined, with one exception, to what is known as the New Almaden district (see Plate II). This district lies east of south from San Jose, extending from the northeasterly foothills of the Gabilan Range on the west to the low foothills that lie between Coyote and Dry Creeks on the east. It also embraces the Santa Teresa Hills, a low spur ridge which lies between and in general parallel to the other two. The principal deposits are 8 to 13 miles from San Jose, on the ridge which forms the southwestern boundary of the Santa Clara Valley at this place, having a general NW.-SE. direction, and locally called the New Almaden Ridge.

The geology of this district and particularly of the New Almaden Ridge and its ore bodies has been described in considerable detail by various writers, especially by Becker[2] and by Forstner,[3] the latter of whom says:

*Much of this report on the quicksilver resources of Santa Clara County, particularly that with reference to plant equipment, is taken from Bull. No. 78, California State Mining Bureau, "Quicksilver Resources of California," by W. W. Bradley.

[1]Black's Supreme Court Reporter: The United States vs. Andreas Castillero: vol. 2, 1862. Also U. S. G. S., Mon. XIII, pp. 8–10, 1888.

[2]Becker, G. F., Geology of the quicksilver deposits of the Pacific Slope: U. S. Geol. Surv., Mon. XIII, pp. 310-330, 467, 1888.

[3]Forstner, Wm., Quicksilver resources of California: Cal. State Min. Bur., Bull. 27, pp. 168-171, 1903.

"The three ridges in which the deposits occur are to a great extent formed by serpentine, especially the two first named. The serpentine is associated with metamorphic sandstone and jaspilites. Large bodies of croppings can be found in each of these ridges, having also a general northwestern trend, but not coinciding with the backbone of the ridges.

"In the New Almaden ridge the most extensive orebodies have been found in and close to Mine Hill, the highest peak of the ridge, lying in its southeastern part. From this point going northwestward the croppings, while not continuous, can be traced along the ridge into the territory of the Guadalupe mine, a distance of about 3½ miles. At the surface the serpentine shows in large detached bodies surrounded by the sandstones and shales of the Franciscan series and having a general northwestern trend. This general direction of the serpentine exposures is important in connection with its occurrence underground, proven in the New Almaden mine. The line of ore croppings runs from Mine Hill to the American shaft, passing about 600 feet southwest of the Randol shaft. The underground workings in this territory have shown that the fissures wherein the orebodies have formed have invariably a serpentine footwall; hence the serpentine must be considered to occur underground in a continuous body through this entire territory and to be in places covered by overlying sandstones and shales. Southwest of Capitancillos Creek lies another parallel exposure of serpentine, contiguous to which the outcrops of the Costello mines are found. The Santa Teresa and Bernal mines are located in the serpentine of the Santa Teresa hills, and the North Almaden or Silver Creek mine close to those of the most northern ridge. In the latter a great part of the serpentine is very highly altered by silification, as also the sandstones, a great portion of the rocks being jaspilites. The western slope of the adjoining Mount Diablo range is nearly exclusively formed of shales.

"In this district the occurrence of cinnabar-carrying orebodies is clearly closely allied to that of serpentine, and as the New Almaden was the first extensively worked quicksilver mine in California, this association explains the reason why, for a considerable lapse of time, cinnabar ores were, in the opinion of most quicksilver miners, considered related to this rock formation. The croppings consist of a more or less weathered material having usually an ochreous color from the oxidation products of the iron sulphides, and traversed by a network of quartz seams, from a knife blade to quarter of an inch wide. Overlying the orebodies is almost invariably found a body of clay, generally black, and containing more or less inclusions of a dark-gray sandstone. As this clay overlies the ore bodies it has received the name of 'alta' (Spanish for 'high' or 'upper'). At the surface of this 'alta' crops as a light-gray material, resembling disintegrated sandstone, traversed by a network of very thin, yellowish-brown seams, often very much like a bunch of very fine roots. In places the same material can be found in the New Almaden mine several hundred feet below the surface, forming part of the 'alta.' * * * The rocks of the Franciscan series in this region show a great amount of silification. The chert beds are, however, almost entirely unrepresented.

"To the west of the New Almaden ridge a belt of bedded sandstone is exposed. The beds are from 3 to 5 feet thick and interbedded with thinner beds of shale. * * * The country west of the New Almaden ridge and south of Capitancillos Creek, belonging to the Gabilan mountain system, consists almost exclusively of the sandstones and shales of the Franciscan series with occasionally some jaspilites. * * * West of the serpentine belt which lies west of the New Almaden ridge, south of Costello's house, a small exposure of glaucophane schist was found. A body of rhyolite lies in the northern part of the New Almaden ridge, having a nearly east and west strike and being about two miles long."

The alta, or so-called clay referred to above, is not a substance of definite composition, though it is usually a dark or black mass, readily distinguishable even in hand specimens from the country rock. It is simply an attrition product of the country rock and varies in composition with the material from which it has been produced. Its black color is in part due to the presence of manganese.

With reference to the age of the formations in the New Almaden district, Becker[1] summarizes his observations in the following:

"Upon highly metamorphosed rocks lie Miocene sandstones, which were sharply folded at the Post-Miocene upheaval. They are not conformable with the lower series and contain pebbles from these older beds. In the older rocks near New Almaden Mr. Gabb found *Aucella*, proving the presence of the Knoxville series.

"In this district is the only mass of rhyolite thus far found in the Coast Ranges. It forms a dike nearly parallel to the line connecting the New Almaden and the Guadalupe. It is almost continuous, and I have followed it for a distance of several miles. It is certainly Post-Miocene and probably Post-Pliocene.

"The New Almaden is a very extensive mine * * *. The ore is cinnabar, with occasional traces of native quicksilver, accompanied by pyrite and marcasite, with rare

[1] *Op. cit.*, p. 467.

crystals of chalcopyrite. The gangue is quartz, calcite, dolomite, and magnesite. These materials were deposited in shattered masses of pseudodiabase, pseudodiorite, serpentine, and sandstone. * * *

"The other mines of the district contain similar ores in similar rocks. The Guadalupe was the most productive. * * *

"All the deposits of the district appear to occur along a rather simple fissure system. The main fissure is nearly parallel to the rhyolite dike at the Guadalupe. It follows the direction of the hills, the axis of which curves gradually away from the dike for a certain distance. Passing through or near the San Antonio and Enriquita, it seems to break across the ridge at the America and enters the Almaden on the strike of its two great fissures. It is near this fissure that new orebodies are most likely to be found. The Washington seems to be on a branch of the main fissure.

"This was probably formed at the time of the rhyolite eruption, to which also I ascribe the genesis of the ore."

Also:[1]

"This dike not only proves the former existence of volcanic activity in this district, but emphasizes a fundamental structural axis. The character of the metamorphic rocks shows that the line along which compression and upheaval took place in the early Cretaceous was about west by north, east by south. The folding of the Tertiary rocks shows that compression was repeated in the same direction at the close of the Miocene. The position of the rhyolite dike proves that the dislocation which opened a passage for this lava again followed a similar course."

Also:[2]

"Ore deposition followed the eruption of lava. The minerals deposited and the manner of their deposition are such as in the more northerly quicksilver districts were induced by volcanic springs. Though there are now no indubitable remnants of the volcanic activity which certainly prevailed here since the beginnng of the Pliocene, the analogies of the deposit, together with the presence of lava of approximately the same age as the ore, make any theory of deposition excepting from hot sulphur springs improbable."

There have been but two mines of consequence developed in this district, the New Almaden and Guadalupe, though there are a number of small properties which have at times produced a few flasks of quick-

[1] *Idem*, p. 314.
[2] *Idem*, p. 328.

crystals of chalcopyrite. The gangue is quartz, calcite, dolomite, and magnesite. These materials were deposited in shattered masses of pseudodiabase, pseudodiorite, serpentine, and sandstone. * * *

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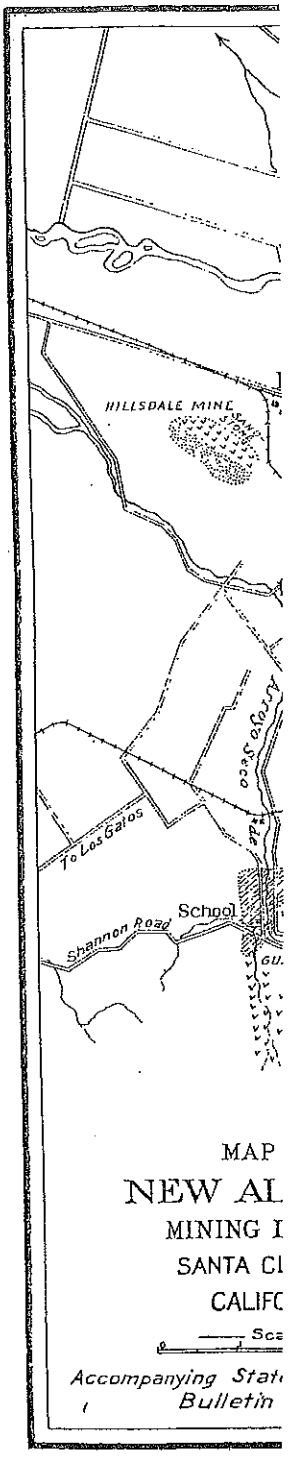
[1] *Idem*, p. 314.
[2] *Idem*, p. 328.



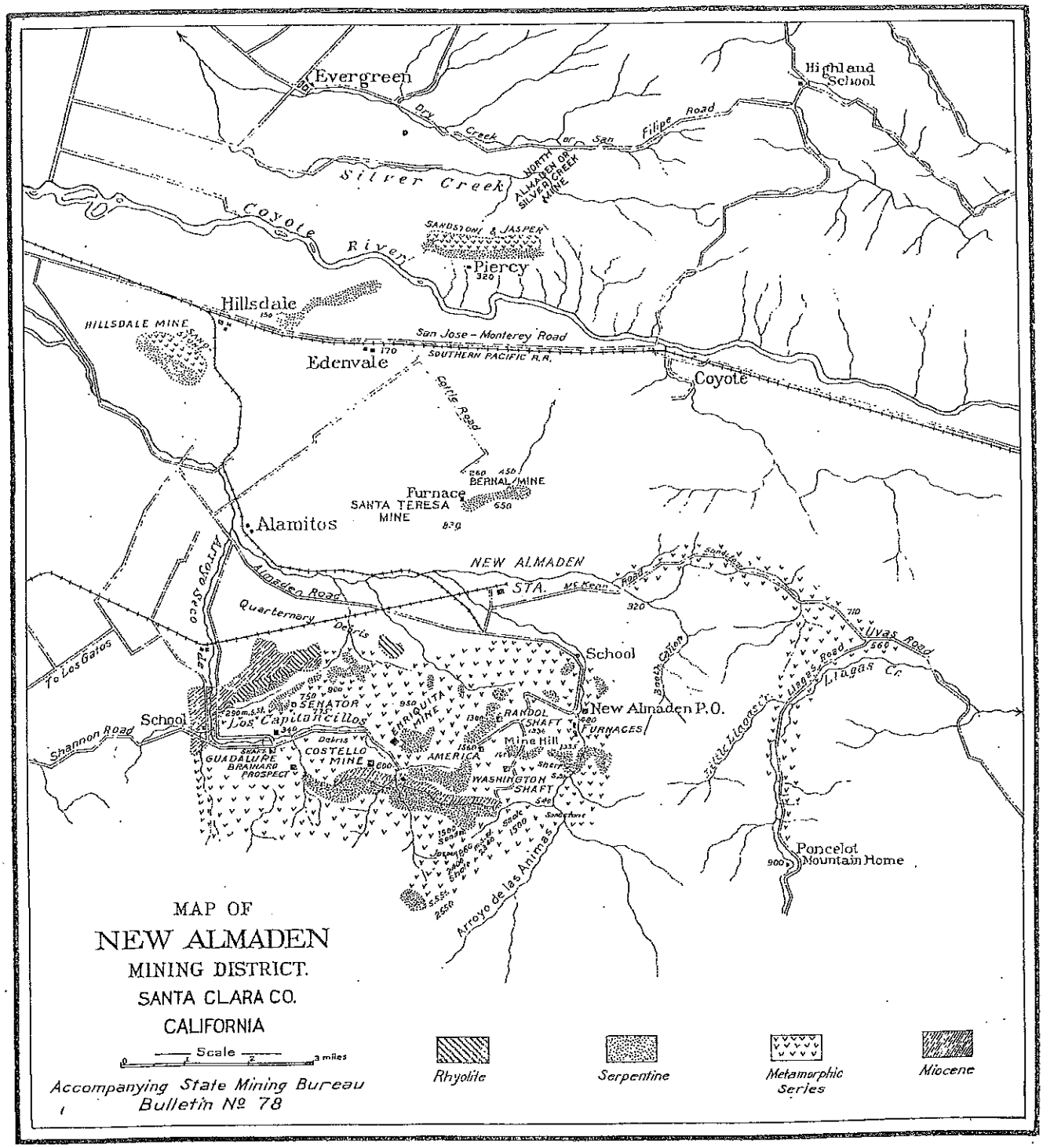


Plate II. Map of New Almaden Mining District.

Table of Mineral Production of Santa Clara County—1850 to 1918, Inclusive.

Year	Quicksilver		Mineral water		Petroleum		Brick		Clay		Sandstone		Limestone		Stone industry Value	Magnesite		Miscellaneous and unapportioned	Value
	Flasks	Value	Gallons	Value	Barrels	Value	M	Value	Tons	Value	Cubic feet	Value	Tons	Value		Tons	Value		
1850	7,723	$765,052																	
1851	24,579	1,850,248																	
1852	10,901	827,500																	
1853	22,284	1,735,618																	
1854	30,004	1,003,722																	
1855	20,147	1,540,351																	
1856	27,125	1,401,078																	
1857	26,304	1,374,251																	
1858	25,761	1,232,149																	
1859	1,394	81,000																	
1860	7,461	376,117																	
1861	24,452	1,447,789																	
1862	23,871	1,442,041																	
1863	22,563	1,350,350																	
1864	42,281	1,550,245																	
1865	47,194	2,100,265																	
1866	33,150	1,857,519																	
1867	24,491	1,132,760																	
1868	20,693	1,170,393																	
1869	10,896	570,588																	
1870	14,423	827,592																	
1871	15,368	1,151,641																	
1872	18,671	1,121,781																	
1873	11,042	857,964																	
1874	9,654	805,455																	
"	24,403	1,468,000																	
1875	16,980	1,425,817																	
1876	27,000	1,225,920																	
1877	20,547	1,157,240																	
1878	24,921	820,000																	
1879	30,054	1,070,212																	
1880	20,186	964,185																	
1881	21,284	823,821																	
1882	20,208	851,648																	
1883	29,451	836,765																	
1884	20,000	910,000																	
1885	21,400	852,000																	
1886	18,000	630,000																	
1887	20,000	837,000																	
1888	18,000	765,000																	
1889	13,100	589,500																	
1890	12,000	636,000																	
1891	8,890	371,165																	
1892	6,503	226,470																Natural gas $9,000 cu. ft.	$4,072
1893	6,014	259,054																	
1894	7,225	232,159	5,000	$1,250	2,500	$3,250	22,725	$119,250			24,000	$5,292						Natural gas 800,000 cu. ft.	12,000
1895	7,000	253,500	20,000	4,000	4,000	10,000	24,750	121,550							$32,000				
1896	6,222	211,570	44,000	13,800	900	1,145	15,000	80,000					500	$800	5,000			Natural gas	1,200
1897	4,700	169,200	39,500	17,600	4,000	10,000	19,000	105,000											
1898	6,876	235,000	25,968	11,358	3,050	6,000	18,695	65,490	200	$2,500					12,000				
1899	4,835	188,370	76,000	19,150	1,500	3,000	20,741	170,455					1,800	3,000	8,000	100	$1,250	32 tons asphalt	640
1900	5,145	241,077	30,000	8,000			20,000	138,000	2,000	6,000	120,000	100,000	8,000	8,000		38	950	5 tons manganese	75
1901	5,220	238,608	55,000	8,500			21,850	94,670			80,000	80,000			617	50	800	17 tons asphalt	255
1902	6,869	284,290	21,900	5,500			22,952	178,092			35,000	31,500						2,000 cu. ft. kranite	1,200
																		21 tons bituminous rock	47
1903	5,003	282,130	50,000	12,500	4,605	3,966	25,000	185,284			112,560	225,000	7,000	7,000	100			11 tons asphalt	182
1904	3,889	148,103	50,000	12,500	42,000	13,230	24,500	178,581							12,000				
1905	2,698	95,908	5,000	1,200	41,000	14,575	26,482	201,357	700	1,050	100,000	150,000			2,000				
1906	2,693	94,808	5,000	1,250	7,000	2,800	23,597	163,076	1,000	1,500			10,000	15,000					
1907	2,715	96,025	21,874	2,187	22,100	5,525	20,038	253,423			3,500	3,500	9,450	16,921					
1908	2,450	102,954	271,625	29,695	35,400	17,700	15,060	93,618					671	1,417	45,142			10,017 bbls. lime	10,017
																		1,400 bbls. lime	1,050
1909	3,747	168,490	373,367	40,784	63,780	76,536	6,000	30,000					2,321	4,150	75,918	800	3,000	Unapportioned 1900-1909	32,254
1910	4,038	182,710	182,500	11,250	36,080	30,838	12,000	36,000	12,000	66,000			4,984	8,451	63,765	7,563	51,987		
1911	7,583	346,593	165,750	10,000	12,252	5,507	6,000	30,000					2,417	3,918	97,596				
1912	8,595	365,538	152,500	10,250	14,092	8,276	15,000	105,000					3,374	4,120	43,228	609	6,000	13,508 bbls. lime	10,154
																		18,107 bbls. lime	9,780
1913	9,760	149,213	101,000	10,750	20,000	12,000	12,000	65,000					3,569	4,200	29,377	70	630	Natural gas 2,000 cu. ft.	500
1914	2,407	118,063	22,000	10,750	10,000	5,800	15,000	72,500							89,093	1,425	14,250		
1915	4,886	276,319	23,400	10,770	16,617	11,037	10,020	67,784							93,942	7,623	74,697	Other minerals	240
1916	4,016	375,496	50,000	11,250	16,363	10,901	18,199	82,500	2,024	2,228					111,974	23,207	239,155	Other minerals (b)	25,028
1917	5,921	632,594	16,230	1,023	18,535	28,152		80,000	6,014	4,929					111,504	9,963	99,997	Other minerals (c)	28,251
1918	3,277	476,524	13,025	1,578	20,499	14,843		62,000							111,280	9,748	121,872	Other minerals (d)	248,763
1919	3,012	371,762			18,724	23,606	7,250	65,000	2,332	2,222					73,387	10,912	129,024	Other minerals (e)	480,721
Totals	142,283	$54,049,803	1,929,014	$290,285	425,515	$354,010	467,352	$2,907,701	26,470	$86,504	474,860	$593,292	51,276	$69,560	$950,750	60,985	$605,592		$1,595,773

TOTALS

Brick	$2,907,701
Clay	86,504
Limestone	69,557
Magnesite	734,496
Mineral water	290,285
Petroleum	354,010
Quicksilver	54,049,803
Sandstone	593,292
Stone industry	950,750
Miscellaneous and unapportioned	1,616,645
	$61,656,676

(b) Chromite, limestone and manganese.

(c) Chromite, manganese, tile and limestone.

(d) Chromite, manganese, clay, tile, potash.

(e) Manganese, limestone, mineral water and potash.

silver. The total recorded output of quicksilver from this county is given in the following tabluation:

Quicksilver Production of Santa Clara County.

Year	Flasks	Value	Year	Flasks	Value
1850	7,723	$763,052	1886	18,000	639,000
1851	27,779	1,859,248	1887	20,000	847,6 0
1852	15,901	927,5.5	1888	18,000	765,000
1853	22,284	1,235,618	1889	13,100	589,500
1854	30,604	1,663,722	1890	12,000	630,000
1855	29,142	1,560,554	1891	8,200	371,105
1856	27,138	1,401,675	1892	5,563	226,470
1857	28,204	1,374,331	1893	6,614	248,054
1858	25,761	1,232,146	1894	7,235	222,169
1859	1,294	81,690	1895	7,050	253,800
1860	7,061	378,117	1896	6,222	211,570
1861	34,429	1,447,739	1897	4,700	169,200
1862	39,677	1,442,041	1898	5,875	235,000
1863	32,803	1.380,351	1899	4,485	186,270
1864	42,489	1,950,245	1900	5,145	241,073
1865	47,194	2,166,205	1901	5,220	236,608
1866	35,150	1,867,516	1902	5,869	254,260
1867	24,461	1,122,760	1903	5,602	223,130
1868	25,628	1,176,825	1904	†3,589	148,103
1869	16,898	775,618	1905	2,693	95,968
1870	14,423	827,592	1906	2,592	94,608
1871	18,565	1,171,641	1907	2,518	96,086
1872	18,574	1,224,584	1908	2,460	103,954
1873	11,042	887,004	1909	3,747	158,400
1874	9,084	995,455	1910	4,038	182,719
	*20,000	*1,098.000	1911	7,523	316,593
1875	16,980	1,428,867	1912	8,695	365,538
1876	27,930	1,228,920	1913	3,709	149,213
1877	30,237	1,127,840	1914	2,407	118,063
1878	24,924	820,000	1915	4,386	376,319
1879	36,054	1,076,212	1916	4,016	375,496
1880	30,135	934,185	1917	5,921	639,594
1881	31,288	933,321	1918	3,977	478,524
1882	29,208	824,542	1919	3,012	271,702
1883	29,084	836,165			
1884	20,000	610,000	Totals	748,283	$54,049,803
1885	21,400	$658,050			

*Estimated production of Guadalupe Mine previous to 1875.
†Flasks of 75 pounds since June, 1904; of 76½ pounds previously.

Bernal Mine. Mrs. Ygnacio Bernal, owner, Edenvale. It is 10 miles southeast of San Jose, on the east slope of the Santa Teresa hills, at an elevation of about 450 feet. A tunnel, over 200′ long, was driven along a clay gouge and serpentine contact, many years ago; but failed to encounter any important ore body, so it was abandoned. No work has been done in recent years.

Bibl.: Cal. State Min. Bur. Bull. 27, p. 171; Bull. 78, p. 157.

Bowie Prospect, New Almedan district. Circle B. Mining Company, owner, Prospect only. Idle.

Brainard Prospect. This is on patented property owned by Mrs. M. D. Brainard et al. of San Jose, situated south of the Guadalupe mine, and west of the northern end of the New Almaden lands. There is an old adit in which it is stated some cinnabar-bearing material was cut, but there has been no work done in recent years.

Comstock Mine. T. H. French, owner, Lone Tree via Hollister. It is in the extreme southeastern corner of Santa Clara County, in section 19, T. 11 S., R. 7 E., M. D. M., and in the Stayton district most of which lies in San Benito County. The Comstock mine is located on the only surface exposure of serpentine found in the Stayton district. Abandoned some years ago.

Bibl.: Cal. State Min. Bur. Report XII, p. 367; Bull. 27, p. 172; Bull. 78, p. 157. Mineral Resources West of Rocky Mountains, 1875, p. 14.

Costello Mine. M. Costello, owner, New Almedan. It is about 1½ miles by road southeast of the Guadalupe mine, on the hillside above Los Capitancillos Creek at an elevation of about 1000′. It is a prospect only and no ore was found in place. It has been idle for a number of years.

Bibl.: Cal. State Min. Bur. Bull. 27, p. 172; Bull. 78, p. 157.

Guadalupe Mine. New Guadalupe Mining Company, owner; Hugh C. Davey, president; John L. Stubbs, vice president; Chas. W. Aby, treasurer; route A, Los Gatos. This property, covering a territory of 2500 acres, is situated 10 miles south of San Jose on the west slope of New Almaden Ridge, and adjoins the land of the New Almaden Company on the northwest. The mine was discovered in the early 50's and is said to have produced 20,000 flasks of quicksilver up to

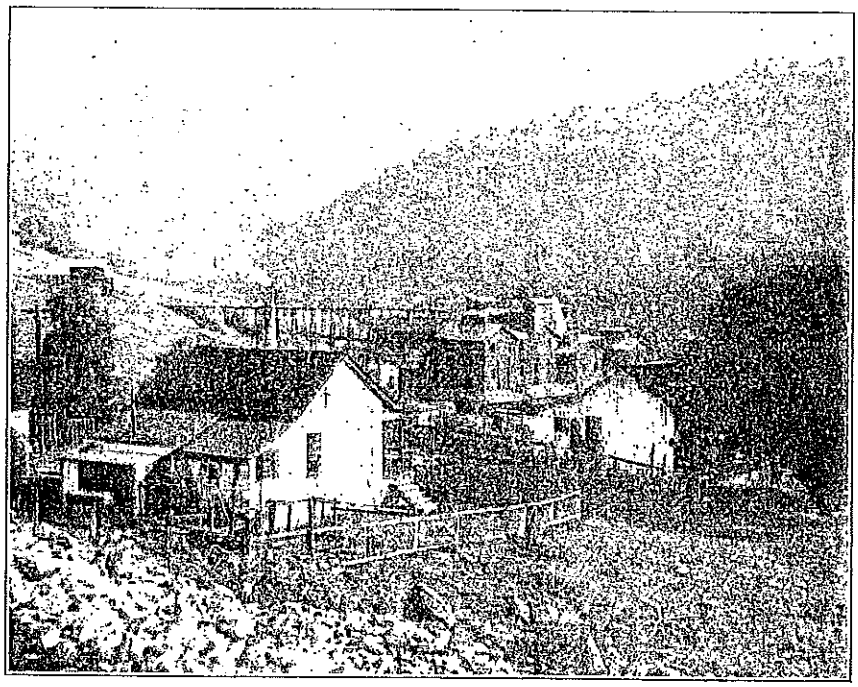


Photo No. 18. Reduction plant at the Guadalupe Mine, looking southwestward from dump shown in Photo No. 20.

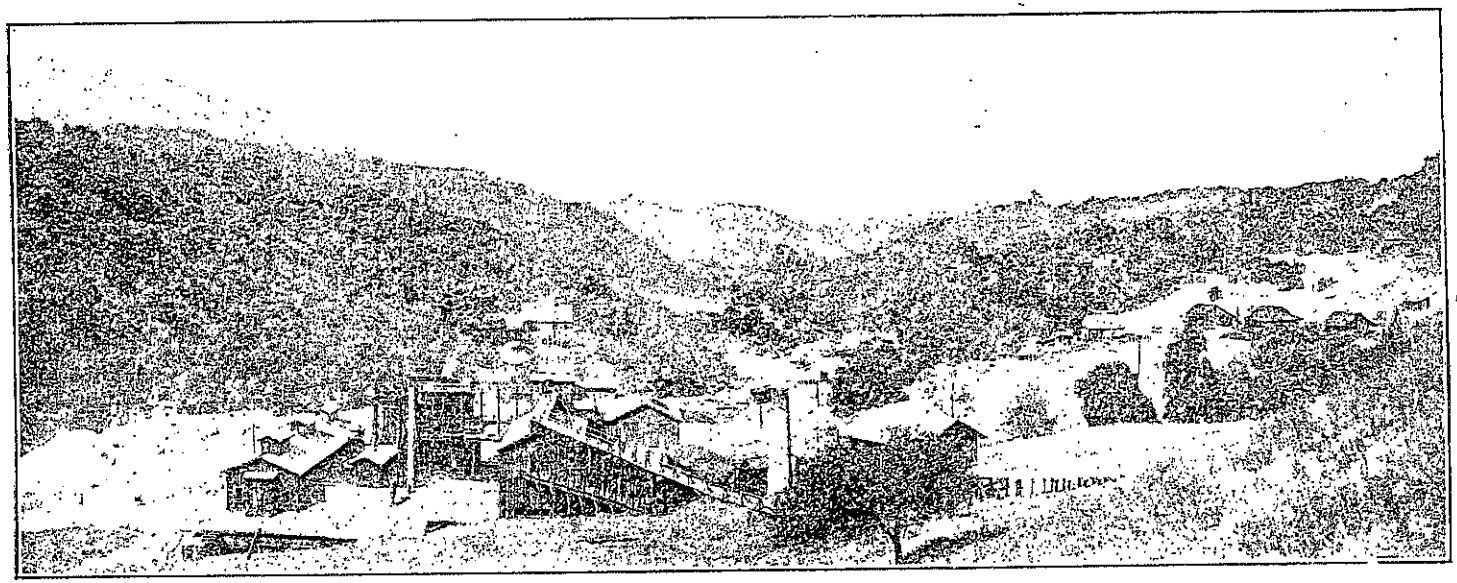


Photo No. 19. Guadalupe Mine, Santa Clara County. Furnaces in foreground; old vertical-shaft house in middle distance; main working incline shaft at extreme right. Photo by W. W. Bradley.

1875, when it became the property of the Guadalupe Mining Company. This company erected furnaces and made many surface improvements. In 1886 the mine was shut down due to litigation, remaining idle until 1900 when H. C. Davey, one of the present owners, organized the Century Mining Company. The old furnaces were remodeled, the mine unwatered, and operations resumed, since which time it has been an important and continuous producer.

The mine was first worked by a vertical shaft, 625′ deep, sunk on the south side of, and near the bottom of Capitancillos or Guadalupe Creek. It was very difficult to keep the surface water out of this shaft during the wet seasons, and it was finally abandoned. A 700 foot incline, which is now the main working shaft, was then sunk on the opposite side of the creek on the dip of the vein. It has three compartments down to 180′ on the incline (where it connects with No. 1 Tunnel, whose portal is just above the creek bed), and two compartments below that. There are many miles of underground workings in the Guadalupe. Several shallow shafts and drifts have been driven on different outcrops about the property, but mining in recent years has been confined to the main workings.

From the plan of the old workings, it appears that the ore body developed by the vertical shaft on the south side of the creek had a northwest strike and southwest dip. The second level, 300′ below the collar of the vertical shaft, connects with the incline shaft on the opposite bank of the creek. From the sixth level (625′) of the vertical shaft an incline winze was sunk from which the seventh, eighth and ninth levels were driven; but ore was developed only on the seventh and eighth levels. The ore of the Guadalupe mine is similar in appearance to that of the north-end New Almaden ground, being in part at least a silicified serpentine with cinnabar. There is some associated pyrite. In the latter part of 1917, the bed of the creek was replaced by a concrete flume, 740′ long and 55′ wide, with side walls 9′ high, to carry the stream over the portions of the old mine beneath. There is a 1′ high cross-wall every 100′ to hold the gravel and protect the flume floor from excessive wear. With this improvement in service, the mine was unwatered later. Electric power is used.

Equipment includes electric hoists, air compressors and machine drills. The reduction plant consists of two coarse-ore furnaces of 18 tons capacity each and two fine-ore furnaces of 30 tons capacity each, all oil-burning, and modeled after the Davey patents. The ore is broken to cobble size and sorted by hand in the mine, the waste being partly used to fill old stopes. At the surface, the ore is screened and then trammed by mule-drawn trains to the fine and coarse-ore furnaces respectively. The fine ore is passed through a rotary drier, 29′ long x 28″ diam. lined with one row of fire-brick, and driven by a 4-h.p. electric motor at 2 r.p.m. The discharge is directly into the feed end of the fine-ore furnace, in a sealed compartment to prevent escape of any mercury vapors that might be present.

A concentrating plant of 50 tons daily capacity was built, and started operating in February, 1917, handling material from the old mine dumps. Crushing is done in a ball mill with 20-mesh screen. After classification, the fine pulp goes to a Deister table, and the sand to two Wilfleys. The plant is driven by a 25-h.p. Semi-Diesel oil engine. The concentrates are said to assay 8%-10% mercury, and

are reduced in the fine-ore furnaces. In September, 1917, there were 75 men employed, 25 of whom were underground. Due to the "after the war" slump, the mine was closed down and has not been in recent operation. (June, 1919.)

Bibl.: Cal. State Min. Bur. Repts. VIII, p. 542; XIII, p. 600. Bull. 27, p. 173; Bull. 78, pp. 157-160. Mineral Resources West of Rocky Mountains, 1885, p. 13; 1876, p. 20. U. S. Geological Survey, Mon. XIII, p. 236.

Hillsdale or San Juan Bautista Mine (one time called **Chapman**; also **Chaboya**). Elizabeth Kohrs, owner; Hillsdale, via San Jose, R. F. D. It is about 2 miles southeast of San Jose on the east slope of the San Juan Bautista Hills, and within one-half mile of a street car line. These hills, an isolated group, composed of metamorphic rocks, largely serpentine, rise to a height of only a few hundred feet above the valley, and are a northward continuation of the Santa Teresa Range.

The mine is said to have been discovered in 1847 and worked to 1861 by Mexicans, subsequently becoming the property of a Mr. Chapman, who worked it up to 1874. In the spring of 1871, production was at the rate of 30-40 flasks of quicksilver per month. It lay idle from 1874 until 1892, when it was reopened by R. H. Harper, of San Jose, and worked spasmodically in a small way up to 1907. In 1915, under the name of New Discovery Quicksilver Company, a lease and bond was taken and a few flasks of quicksilver produced; but little work was done underground, and the lease forfeited. There are said to be over 4000 feet of underground workings, but most of the tunnels are now inaccessible, being caved. The reduction plant consists of two 12-pipe retorts, evidently built in later years, as they are in good condition.

Bibl.: Cal. State Min. Bur. Rept. XIII, p. 600; Bull. 27, p. 174. Geol. Surv. of Cal. Geol., Vol. 2, pp. 112-113.

New Almaden Mine (originally **Chaboy**, then **Santa Clara**). The Quicksilver Mining Company, owner; New Almaden Company, Incorporated, lessee; Geo. H. Sexton, president, 45 Broadway, New York; Chas. A. Frank, secretary and treasurer; Edmund Juessen, general manager, 57 Post street, San Francisco. This property, covering over 8000 acres, lies from 8 to 13 miles east of south from San Jose along the New Almaden Ridge, and was at one time second only in production to the famous Almaden mine in Spain, after which it was named. This property is the oldest known quicksilver mine in the United States, being first worked in 1824 by Antonio Suñol and Luis Chaboya. In 1845, Andreas Castillero, a Mexican army officer, "denounced" (located) it under the name of Santa Clara. After the admission of California into the Union, Castillero and associates leased the mine to Barron Forbes and Company, who changed the name to New Almaden. It has been worked continuously since 1845, but the greatest surface improvements were made after it became the property of The Quicksilver Mining Company in 1864.

Many important practices and appliances in the metallurgy of quicksilver had their beginning here, including the development of the Hüttner-Scott fine-ore furnace in 1875-1876. The present operating company took over the property under a lease and bond in 1915. The total production has been surpassed by only one mine in the world (Almaden mine, Spain) during the period in which New Almaden has been operating. Published records show that this total, however, has been exceeded by the Indria mine, Austria, and the Santa Barbara mine, Huancavelica, Peru, the bulk of whose production was made prior to 1850; in fact, Huancavelica has yielded but little quicksilver since 1800.

GEOLOGY AND MINE WORKINGS.

The New Almaden property really contains three mines, all of which are located on the same mineral belt: the great New Almaden mine proper, the Enriquita, and the Senator or El Senador, as the Mexicans named it (also referred to as the North Line mine). A distance of nearly 4 miles separates the first and the last named. The workings of the main New Almaden mine, cover a territory of about 2½ square miles, which is exclusive of the Enriquita and Senator; and their greatest depth is 2450 feet below the top of Mine Hill, which is the datum point for all underground workings. The elevation of Mine Hill is 1600′ above sea-level. In this territory 18 shafts have been sunk, and there are nearly 100 miles of underground excavations, much of which is at present inaccessible. Forstner[1] states that in 1903, the Victoria shaft, a short distance to the southwest of the Randol shaft, and the Harry shaft, on the southeast slope of Mine Hill were the only two shafts then in operation. The deepest workings then being followed were on the 1000′ level, as below 1300′ the mine was filled with water. Since that time, most of the work has been done through the Harry shaft and the Day tunnel, and more recently at the Senator mine.

Geology.

The geology of the New Almaden mine has been studied and described in considerable detail by a number of authors, the most important of whom was Becker. He states:[2]

"The ores * * * are composed of the usual association of minerals: cinnabar (sometimes accompanied by a little native mercury), pyrite, quartz, calcite, and dolomite, and more or less closely associated masses of bituminous matter. Accompanying the deposits is a small amount of chalcedony or opal, usually black in color, but this substance is much less abundant here than in the greater part of the northern mines. Dolomite is more prevalent as a gangue mineral here than in most quicksilver districts * * *.

"The rocks associated with cinnabar in this district include every variety of the metamorphic series. Where the rock happens to be a permeable sandstone, impregnations have resulted. Elsewhere the ore seems to occur exclusively in crevices in the rock * * *. I was unable to perceive any indication that ore had been deposited by substitution or that the rock had influenced the deposition of ore by its chemical properties. Ore is found with nearly equal frequency in contact with various rocks and the existence of fissures appears to have been the necessary and sufficient condition for the deposition of cinnabar and gangue minerals. * * *

"The ore in the New Almaden mine seems never to occur except close to evidences of faulting. This evidence consists in the presence of layers of attrition products, so-called clays, full of slickensides and of fragments of rocks more or less rounded by attrition. These layers of clay usually occur on the hanging sides of deposits and are known to the miners as atlas, the Spanish term for hanging-walls. The clays are impermeable to solutions and the ore usually forms on their lower side, as if the cinnabar had ascended and been arrested by the atlas. * * *

[1]Forstner, Wm., Quicksilver Resources of California: Cal. State Min. Bur. Bull. 27, p. 175, 1903.

[2]Becker, G. F., Quicksilver Deposits of the Pacific Slope: U. S. Geol. Surv. Mon. XIII, pp. 314 et seq., 1888.

"While the evidence of the existence of a fissure system is, if possible, more abundant in the New Almaden mine than in most quicksilver deposits of the Pacific Slope, the deposits themselves are of various types. The commonest is the reticulated mass, or stockworks, consisting of irregular bodies of broken rock into which solutions of cinnabar and gangue minerals have filtered, cementing the fragments together with ore. Where the disturbance has been less extensive and irregular, clean-cut fissures may sometimes be seen filled with ore, and these can only be classified as veins, though they are not persistent. * * *

"Certain features must be common to the ore bodies taken singly and to the ore-bearing ground as a whole. It would be impossible to suppose that each stockwork has an independent fissure system, and a mere glance at the mine map shows that a connection between them exists. It is also a historical fact that the thin seams of ore * * * have led from one ore chamber to another. * * *

"The distribution of serpentine, the average strike of the metamorphic strata, the compression of the Miocene beds, the position of the rhyolite dike, and the trend of the range, in short the whole structural geology of the region shows that the fundamental axis of disturbance must have a direction which is approximately northwest and southeast."

Also:[1]

"Considered in detail, the orebodies are stockworks; but they are arranged along definite fissures and the deposits as a whole have a vein-like character and answer to the 'chambered veins' defined in a subsequent paragraph. The workings have developed two main fissures. One of these dips from the surface at a high angle and in a nearly straight line. The other strikes in nearly the same direction as the first, dips steeply from the surface, then flattens and approaches the first fissure rapidly, again becomes very steep, and in the lowest workings almost coincides with the first. In vertical cross-section the two fissures form a figure resembling a V. The great ore bodies are distributed along these two fissures, making irregularly into the walls. The wedge between the fissures also contains ore bodies."

Mine Hill Workings.

The surface and workings of the New Almaden mine have been minutely surveyed and the data carefully preserved by the officers of the Quicksilver Mining Company in the form of a large, detailed, colored map which hangs in a specially constructed fireproof draughting room, adjoining the office at the Hacienda. An excellent reproduction of this map, up to the date of its publication, 1888, accompanies Becker's report.[2] The map herewith (Plate III) was compiled from the company's records and is reproduced herewith by courtesy of Mr. Edmund Juessen, general manager. The principal dumps are shown in brown with the surface contour lines. The principal ore bodies extracted since Becker's publication of the map, are indicated by: 1. The N.-S. line of stopes to the west of and nearest the Harry shaft. 2. The line of stopes lying approximately at right angles across the northwestern end of the older stopes, and extending southwesterly from the "mouth of Randol tunnel." 3. Portions of the stopes south of the Cora Blanca shaft.

The ore deposits are limited on their hanging wall side by the alta, which being an impermeable layer prevented the passage of water circulation. According to Forstner,[3] the footwall side is persistently serpentine, from which it is concluded that the serpentine, or rather the intrusive peridotite which has altered to serpentine, is the cause of the fracturing of the other rock strata.

"The fracturing has taken place on both sides of the serpentine, which apparently can not be considered otherwise than as an intrusive body having uplifted the rocks of the Franciscan series.

The orebodies form principally in those parts of the zones where the dip of the 'alta' is very flat * * *. The contact of the alta with the underlying vein filling,

[1] *Op. cit.*, p. 467.
[2] *Op. cit.*, Atlas Sheet IX.
[3] *Op. cit.*, p. 178.

and where this is missing with the serpentine, is very tortuous in both directions, vertically and horizontally, so that in the gangways, which * * * follow this contact, it is an exception to find a straight line of any length. The stopes are locally called 'labores.' The material which fills the zones of fracturing and wherein in places cinnabar forms, is generally rather hard and siliceous, traversed by a network of seams of quartz and dolomite, showing repeated fissuring and filling containing some inclusions of serpentine, the cinnabar forming principally in connection with the seams. In places the vein-filling has more of an ochreous character, the matrix being more or less leached out, leaving only the network of seams intact. * * *

"The general character of the vein-filling indicates that, as in most of the other quicksilver deposits in the State, the deposition of cinnabar has been associated with the process of silicification, which characterizes the alteration of the rocks of the Franciscan series.

"The general direction of the seams in the vein-filling is not parallel to the line of contact with the alta. * * * In the upper workings the part nearest to the alta is seldom the richest, the cinnabar forming more plentifully at from 5′ to 8′ below the alta, while in the lower workings the richest ore is invariably close to the alta.

"The contact between the alta and the vein-filling is very sharply marked, but there is a gradual change of the above-described vein-filling into the material of the serpentine footwall, the vein material gradually carrying more serpentine, until it has entirely changed into the latter. The hanging-wall is a shale, judging from surface exposures. Underground, no crosscut through the alta to the hanging-wall was seen."

Recent Work.

In the latter part of 1917, some ore was broken in stopes connected with the Day tunnel, which was burned in the coarse-ore furnaces at the Hacienda. A connection was made later on the 800 level, from the Santa Rosa drift near the main shaft, to Deep Gulch Tunnel. This permits of tramming around the hill to the Hacienda furnaces, a distance of about ½ mile, or about one-half that previously traveled for delivery from the Day tunnel. Equipment at the mouth of the Day tunnel includes an Ingersoll-Rand duplex compressor, 16″x14″ and 10″x14″, driven by a 100-h.p. electric motor.

Senator Workings.

The principal ore extraction of recent months has been from the Senator workings, which are, as already stated in a preceding paragraph, nearly 4 miles distant from Mine Hill. This ground adjoins that of the Guadalupe mine, they being on opposite sides of the same ridge. A new 'shaft' (winze) is being sunk, on a 60° incline, starting at 1300′ in from the portal of the main adit. The collar of the old winze is at 1150′ in. An electric hoist with 75-h.p. motor is used. The tunnel level is designated as the 260′ level, and levels down to ♯5 have been established in the winze, with sinking nearing ♯6 level. Only a little sorting is done in the stopes underground. The ore going to the furnaces is stated to vary from 0.2% to 1.0% mercury. The formations and orebodies in the Senator and Enriquita mines are in general similar to those at the southern end of the New Almaden belt, but no bonanza shoots have been found like the massive cinnabar bodies worked in the upper levels of Mine Hill. The Enriquita mine was opened up in 1859, and up to January 1, 1865, had yielded 10,571 flasks of quicksilver. It has not been worked in recent years.

REDUCTION EQUIPMENT.

A study of the development of practices and appliances in the metallurgy of quicksilver during the past 60 years shows the intimate relations of such developments to the history of operations at New Almaden. In the earlier operations, the intermittent form of furnace was utilized. These furnaces and their *modus operandi* are described in detail by Goodyear,[1] who observed them working in 1871 at New

[1]Goodyear, W. A., Examination of the Quicksilver Mines of California: Geol. Surv. of Cal., Geol., vol. II, pp. 106, 119, 131–132, 1882.

Almaden, Knoxville, and New Idria. The most important item for which credit is due to the staff of the New Almaden mine was the development in 1875–1876, of the Hüttner-Scott fine-ore furnace (now generally referred to as the Scott), by H. J. Hüttner, Robert Scott, and J. B. Randol.

For some years, the furnace equipment at the Hacienda (the name given to the community grouped about the reduction plant) included

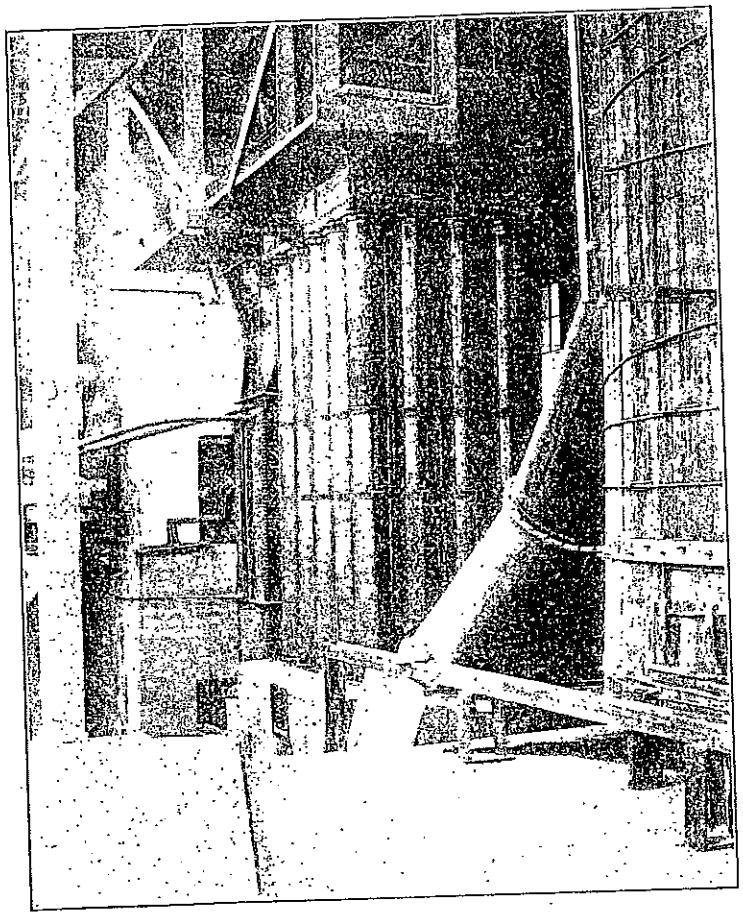


Photo No. 20. Cottrell Dust Precipitator, or 'Hot Treater' (concrete chamber at left), and condensers connected with Herreschoff Furnace, at Senator Mine of New Almaden Company, Santa Clara County. Photo by W. W. Bradley.

two Exeli coarse-ore furnaces of 12 tons capacity each; two Scott furnaces for 'granzita' (medium ore) of 36 tons and 18 tons capacity, respectively; and two Scott furnaces for 'tierras' (fine ore) of 36 tons and 24 tons capacity. In the latter part of 1917, these were all torn down, except the Exelis, and treated for their absorbed quicksilver. The soil and gravel under the site of the old intermittent furnaces and

of the Scotts was excavated to bedrock, a depth of 30 feet, and run through a washing plant for recovery of the metallic quicksilver contained. An important yield of metal was obtained from this material.

At the Senator mine, in 1917, a Herreschoff multiple-hearth furnace, mechanically rabbled, was handling the ore. (See Photo No. 21.) It was installed early in 1916, by the then manager, W. H. Landers, who also, in connection with this installation, patented certain features of the condenser system. This furnace is 14 feet inside diameter and

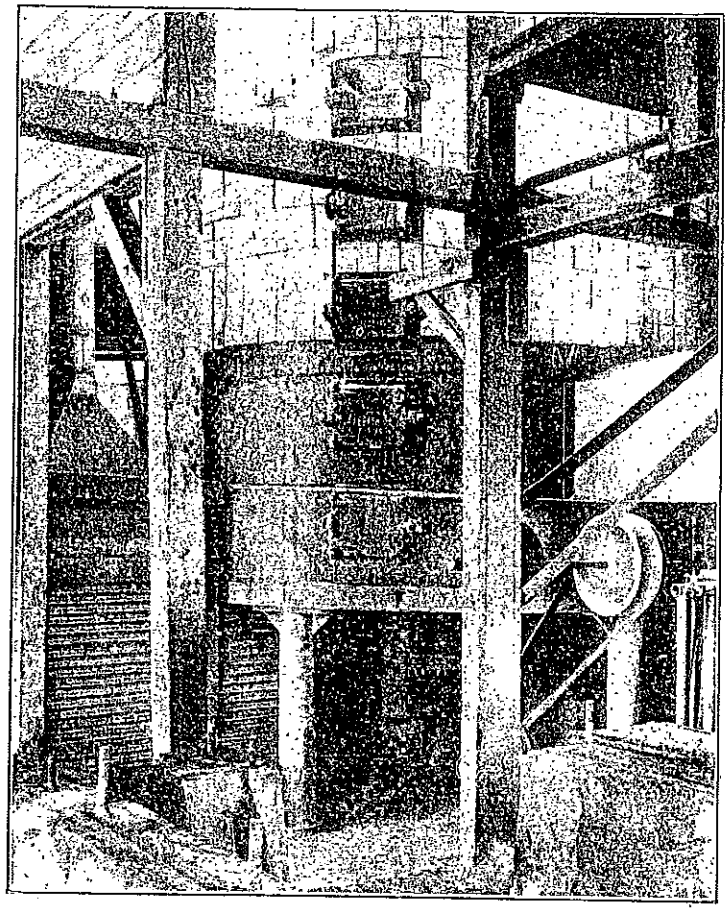


Photo No. 21. Herreschoff Multiple-hearth Furnace at Senator Mine of New Almaden Company, Santa Clara County. Photo by W. W. Bradley.

has 6 hearths, plus a drying floor on the top (see Photo No. 22). There are two fire-boxes on #5 hearth (next to bottom) level, set opposite to each other. On #2 hearth level, about one-third of the way around from the top exit-pipe, a third fire-box has been added in order to keep the temperature of the gases above 600° F. while going through the Cottrell dust precipitator which follows. The central column and the rabble arms are air-cooled, the resulting hot air being utilized for concentrate drying and other purposes. A Brown recording pyrometer

is connected in at the furnace exit to enable regulation of the fume temperature.

This furnace is stated not to work economically on material coarser than $\frac{3}{4}$ inch. Up to 58 tons have been treated in 24 hours; but it seems to do its best work at between 40 and 50 tons. Feeding and discharging are both automatic. The feed hopper is shown in Photo No. 22, while the housing for the discharge may be seen in the lower left-hand corner of Photo No. 23. A steel ore-car is kept under the discharge chute, and when filled is trammed out by hand to the dump.

By reason of the dust raised and thrown into the fume circulation as the ore is mechanically scraped from one hearth to the next, a bother-

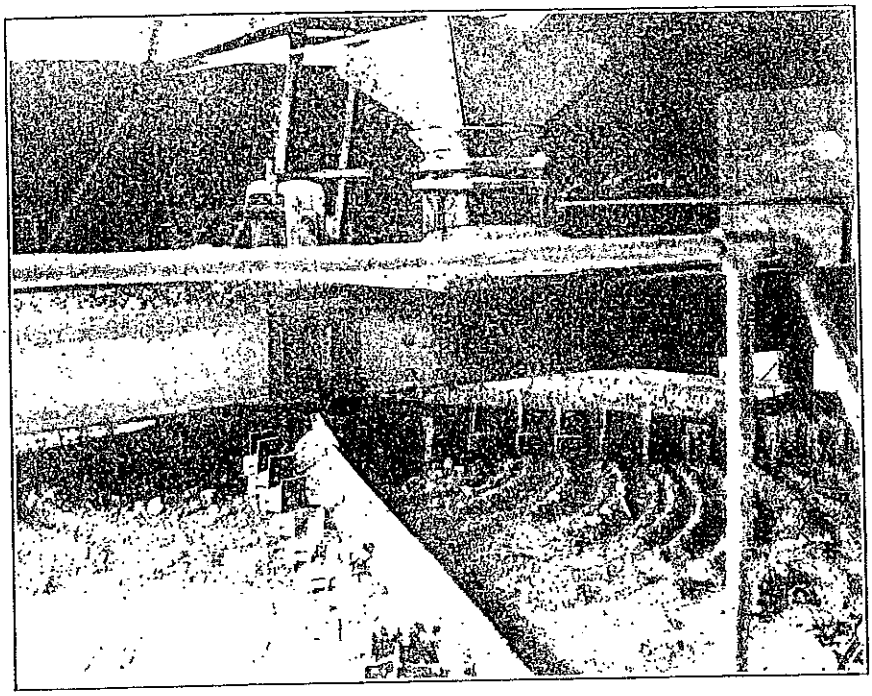


Photo No. 22. Top, or Drying-hearth, of Herreschoff Furnace. Feed hopper is seen in upper part. Photo by W. W. Bradley.

some accumulation of dust was at first obtained in the condensers. To correct this and keep the dust from passing into the condensers, a Cottrell fume precipitator, called the 'hot treater' was installed between the furnace and the first condenser. (See Photo No. 20.) To prevent the mercury from condensing in this treater, the temperature of the gases (as already mentioned) is kept above 600° F. on leaving the furnace. As a precaution to recover any quicksilver which might have condensed in case of irregularities occurring in the furnace operation, the hot-treater dust is run into a settling tank before being discharged to the dump. Following the last condensing chamber is a second Cottrell precipitator (Photo No. 23), called the 'cold treater,' to throw down any remaining mercury 'mist' in the fumes. It is stated that a little quicksilver is obtained in this cold treater. The incoming electric

current of 440 volts is transformed to 50,000 volts for the 'hot treater' and 100,000 volts for the 'cold treater.'

The fuel consumption of this furnace is stated to have proven rather high, being approximately 8 gallons of oil per ton of ore treated, as against 5-6 gallons per ton for a 50-ton Scott furnace. The installation cost of the multiple-hearth type of furnace is much less than it is with the Scott, being stated to be about $20,000 for a 100-ton plant, or $200 per ton-day capacity (1916; but for 1917 nearly double that).

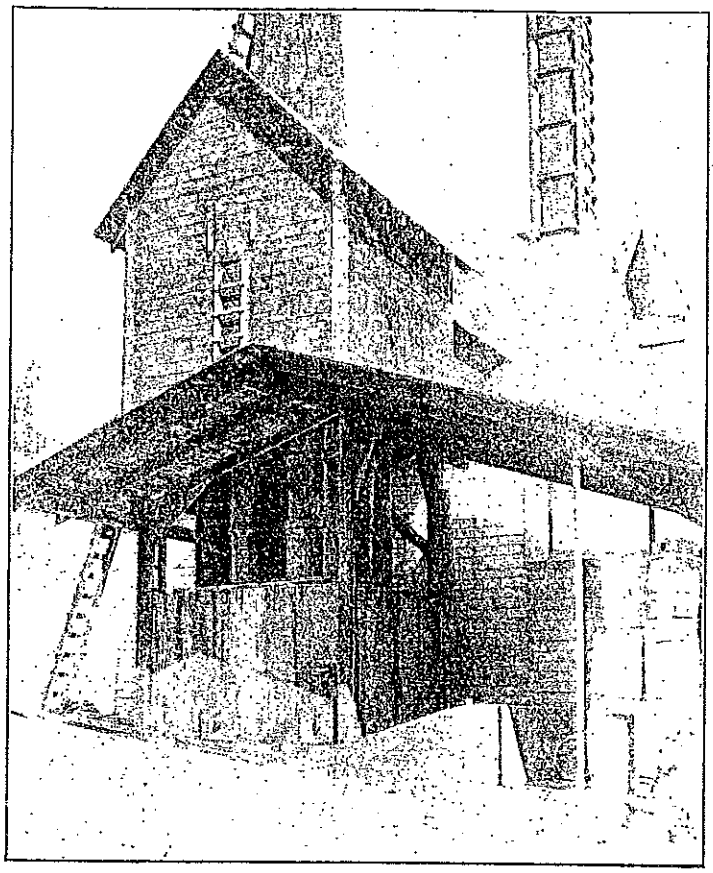


Photo No. 23. Cottrell Precipitator, or 'Cold Treater,' at Senator Mine.
Photo by W. W. Bradley.

The cheapest operation of this type of furnace is obtained with the larger units or with several units under a single roof, as a single machinist can attend to the mechanical features of several units. To repair the rabble arms or other parts of the interior mechanism, the furnace must be shut down and cooled off. This is apt to occur oftener than interior repairs are required in a Scott furnace, though Herreschoff units have been in operation on copper ores for more than two years without such repairs. It is stated that an 82% recovery of the assay value of the feed was obtained with the Herreschoff furnace for

the 4 months ending with July, 1917. The heads assayed approximately 0.9% mercury, and contained from 3 to 5 tons, daily, of concentrates assaying up to 4%, which were mixed with the mine-run ore.

As the furnace does not work economically on material coarser than ¾", the ore after preliminary breaking in a gyratory crusher, is passed over a shaking screen of ¾" mesh, and the oversize re-crushed in a jaw breaker. A bucket elevator is included in the equipment, and electric power is used. The first condenser consists of 20 iron pipes 12" diam. x 12' long, an arrangement patented by Landers[1] in 1916, then manager of the New Alamaden Company. Condensers #2, #3, and #4 are redwood-stave tanks, 12' diam. x 16' high. No. 2 can be seen at the right of the photograph. These tanks are cleaned out one a week.

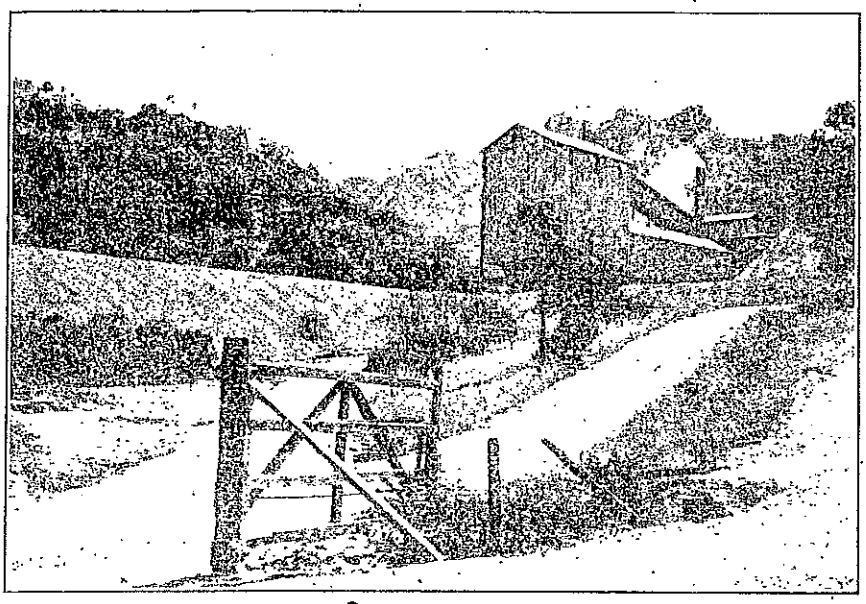


Photo No. 24. New 90-ton Scott furnace at Senator Mine of New Alamaden Company. Photo by W. W. Bradley.

A 90-ton double Scott fine-ore furnace was built in the early part of 1918. It has 4 fireboxes and handles a minimum of 75 tons per day, though it has treated up to 96 tons per 24 hours. It is thus the largest Scott furnace at present in operation. The ore is crushed to pass a 2-inch ring; and is transported from the crusher bins, by an inclined belt-conveyor, discharging directly into the top of the furnace. The side walls of the furnace are built up several feet above the level of the throat, thus giving an auxiliary ore-bin and providing an automatic furnace-feed.

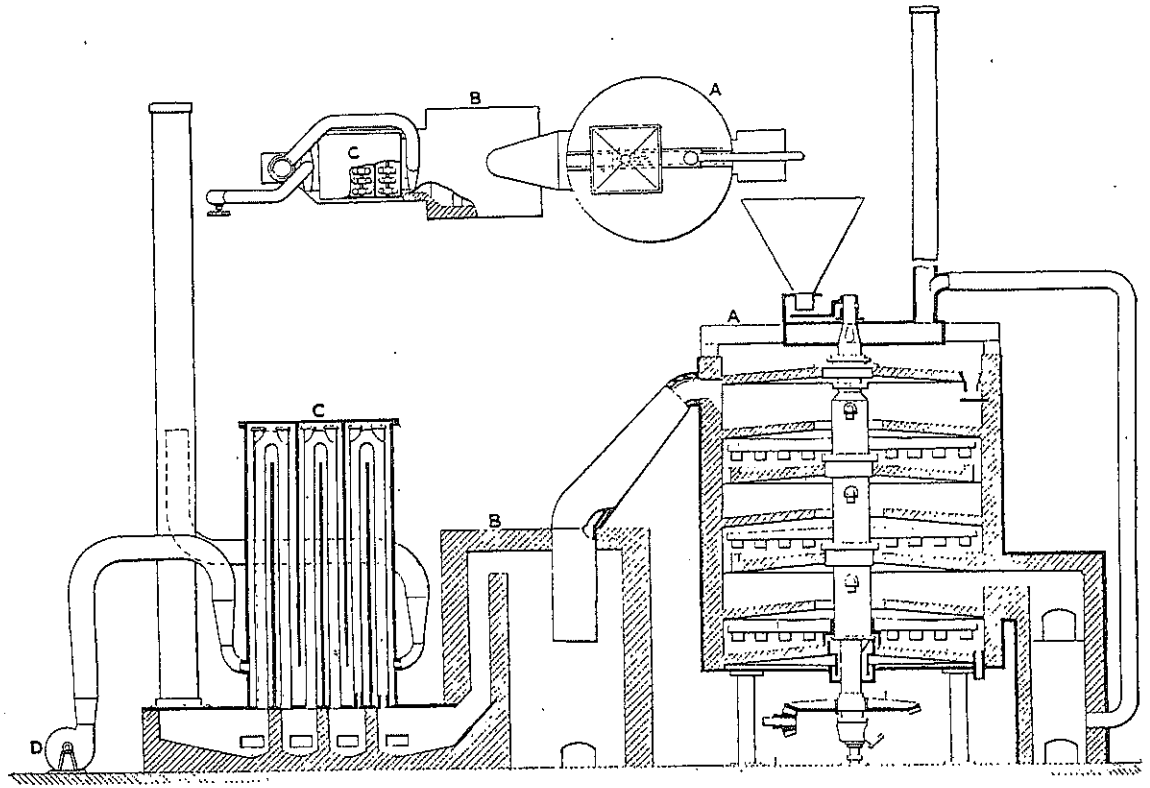
There are eight new condensing chambers connected with this furnace, arranged in a double row. The first chamber in each row is of concrete, and the other three are of tongue and groove redwood, built rectangular. A 3-foot redwood-stave flue connects the last of this series of condensers to the first circular wooden condenser of the Herreschoff series. Crude oil is used for fuel.

Concentration.

Both table concentration and flotation were tried in 1916-1917, but were discontinued in September, 1917. In June, 1916, a concentration

[1]Landers, W. H., The smelting of mercury ores: Eng. & Min. Jour., vol. 102, p. 634, Oct. 7, 1916.

PLATE III.



Plan and Sectional Views of the "Landers Mercury-Smelting Furnace."

plant consisting of a ball-mill and a Deister-Overstrom table was in operation at the old Randol dump, but later moved to another part of the property, as the quicksilver values in the dump material were spotted and too low for commercial work. On June 15th, with the plant running smoothly and apparently doing good work, samples taken every half-hour for 5 hours assayed as follows: Heads 0.03% mercury; tails 0.015%; middlings 0.03%; concentrates 1.16%. The ore treated in the 5 hours amounted to 20 cars of 15½ cu. ft. each. There was occasionally a very little native quicksilver, which was caught by amalgamation on a piece of tin at the concentrate-discharge end of the table.

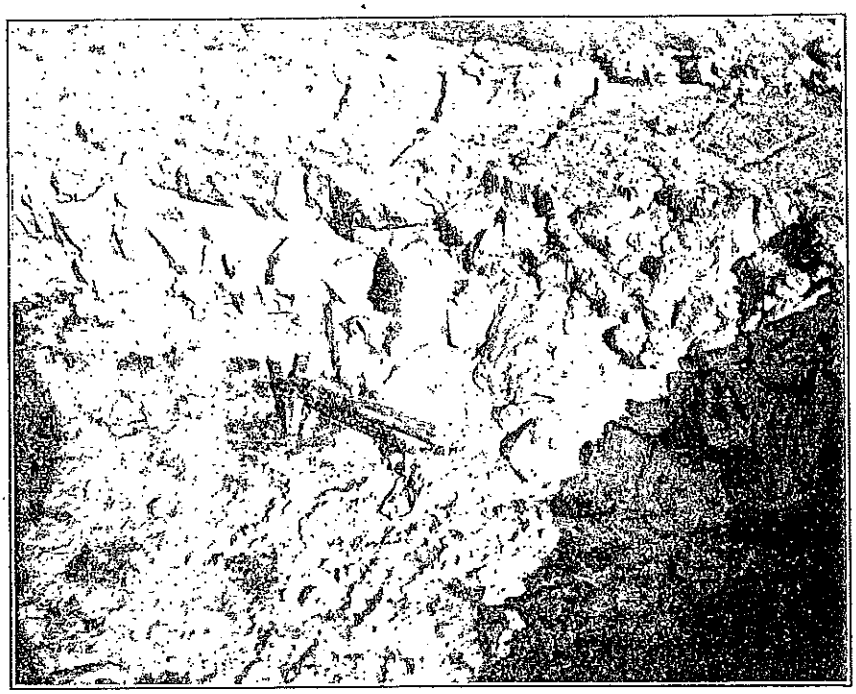


Photo No. 25. Flotation Concentrates drying in the sun, at the Senator Mine of New Almaden Company, Santa Clara County. Photo by W. W. Bradley.

Following that, concentration plants were placed in operation at the Day tunnel and at the Senator mine which is at the north end of the New Almaden property. These plants consisted of crushers, ball-mills and Deister-Overstrom tables. The concentrates were roasted and mixed with ore, in the Herreschoff furnace installed at the Senator. Electric motors furnished the power. In the Day tunnel mill, below the jaw crusher was a 6′ x 5′ Allis-Chalmers ball-mill in closed circuit with a Dorr Simplex classifier. The grinding was regulated so that approximately 87% of the pulp passed 60 mesh. The overflow from the classifier passed through 4 Callow flotation cells, and then to 1 double-deck Deister-Overstrom table. The table was not only crowded (120 tons per 24 hr.) but was compelled to handle an unclassified feed. A 12′ diam. x 6′ high, Dorr settler dewatered the concentrates, followed

by a 6′ diam. x 4′ Oliver filter. The concentrates were handled by motor truck to the Herreschoff furnace. It is stated that the heads sample averaged 0.23% mercury; that the tailings could have been brought down to 0.03% mercury by finer grinding; that the equipment and practice could have been improved so that an extraction of over 80% could have been obtained; but that it cost from $80-$85 per flask (including furnace reduction of the concentrates) to produce the metal, as against $45-$50 per flask by careful sorting and regulation of the ore feeding direct to the furnace. Fine grinding was the expensive part of the process. The ore being largely a hard and tough, silicified serpentine, the steel-liner and ball consumption was high.

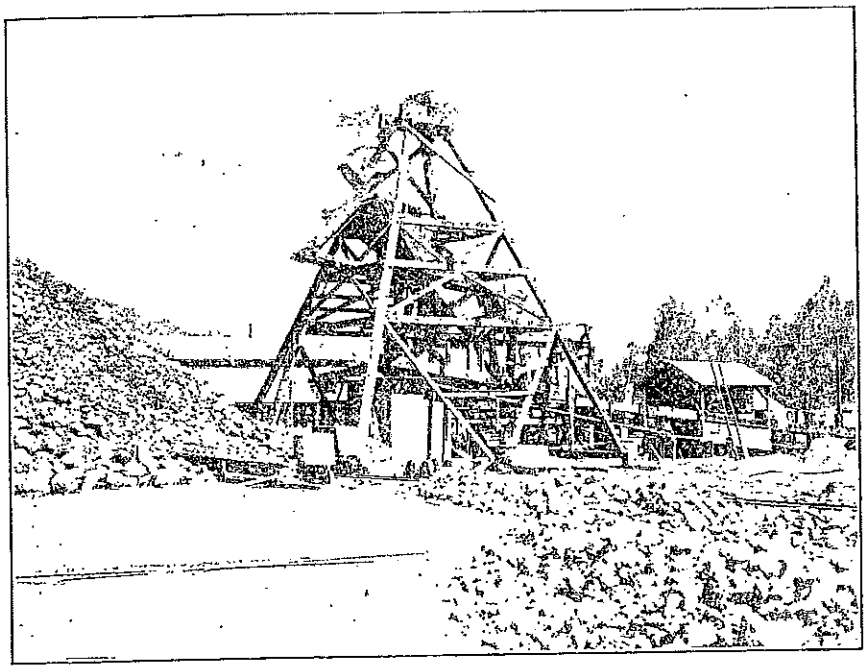


Photo No. 26. Gravel-washing plant for recovering metallic quicksilver from material excavated from old furnace sites, at Hacienda of New Almaden Company, Santa Clara County. Photo by W. W. Bradley.

There is no ochre in the ore, but considerable slime from the serpentine. Screen analyses showed cinnabar in the flotation tailings on the — 80 and — 100-mesh 'chats'.

The flotation plant at the Senator had 3 Callow cells and a Deister-Overstrom table; and at first used two 4′ x 4′ ball-mills. These latter were replaced by a 4½′ x 6′ Marcy mill. The flotation concentrates proved to be messy stuff to handle, and not the easiest thing to dry for convenient feeding to the furnace. According to R. S. Lewis[1] others have found the handling of flotation concentrates far from being an 'unalloyed pleasure.' After passing through the flotation cell, the pulp passed directly to the tables without further classification or

[1]Lewis, R. S., The disposal of flotation products: Min. and Sci. Press, Vol. 114, pp. 473–484, April 7, 1917.

dewatering. Some experiments were tried with dewatering at the Senator plant, but with only slight success, it is stated.

As mentioned above the ground underneath the site of the old intermittent adobe furnaces, and of two of the older Scott furnaces and their condensers, was excavated to bedrock, a depth of 25′ to 30′. This earth, sand and gravel was well-sprinkled and disseminated globules of quicksilver, which had worked their way down from the furnaces during the years of operation here. The material is hoisted and transported by an Alaska-carrier cable, having a bucket of 1 ton capacity. From 50 to 100 buckets per day are hoisted, the men working on a bonus system. The bucket dumps into a bin (see Photo 26) from which the material is fed to a revolving screen with ¾-inch round holes. The —¾″ material then passes to a 'log washer' (having a screw conveyor); then, successively, through a riffled launder; a Richards pulsator-riffle (Hungarian riffles with a pulsator compartment); and finally through another riffled launder. This has proved to be quite an effective plant for the material being handled. Even the bin at the head had to be made mercury tight with provision for drawing it off as considerable quicksilver settles out there when the bucket is dumped. The larger boulders are handsorted out, in the pit, and dumped to one side of the washing plant.

Timber, Labor, etc.

There is little or no mining timber available in the vicinity of these mines. Sawed timber is brought in by the railroad from outside points. Fuel oil is used at the furnaces. In September, 1917, a total of 105 men were employed, including 60 underground, and 6 at the Senator furnace plant.

Bibl.: [Note—The New Almaden mine and plant have been described by so many writers, that only the principal references are here given. Others will be found in the Bibliography in Part III, of this bulletin.] Cal. State Min. Bur. Repts. 1, pp. 26, 27; IV, pp. 336 et al; VIII, pp. 541–542; X, pp. 604–606; XI, pp. 374–375; XII, pp. 367–370; XIII, pp. 600–601; Bull. 27, pp. 174–186; Bull. 78, pp. 160 et al. U. S. G. S., Mon. XIII, pp. 8, 310–330, 467; Bull. 78, pp. 80–83; Min. Res. 1883–1915 inc. Mining Resources West of Rocky Mountains, 1867, pp. 170-178; 1874, pp. 33, 380, 540; 1875, p. 13; 1876, pp. 4–18, 20. Min. and Sci. Press, vol. 84, pp. 393–404, 1902; vol. 87, p. 201, 1903; vol. 100, pp. 15–16, 446–447; Feb. 16, 1916, pp. 282–284. Eng. and Min. Jour., Vol. 34, pp. 185–186, 334, 1882; Vol. 91, p. 85, 1911; vol. 102, p. 630, 1916. Geol. Surv. of Cal., Geol. Vol. I, p. 68; vol. II, pp. 91–110, 122.

Santa Teresa Mine. Enos Fontis, of Edenvale, owner. This property is 8 miles southeast of San Jose on the east slope of the Santa Teresa Hills. It was developed by the Santa Teresa Quicksilver Mining Company, of which R. H. Harper of San Jose was superintendent. A 40-ton Scott furnace was erected, and several tunnels driven into the hill to cut the vein. The country rock is serpentine, and the ledge matter an alteration product of serpentine through silicification, carrying a low percentage of cinnabar. After working a few years, without

encountering any orebodies of sufficient size or richness to warrant their further exploitation, the mine was abandoned; and is still idle.

Bibl.: Cal. State Min. Bur. Bull. 27, p. 186; Chapter Rept. Bien. period, 1917–1918, in preparation.

Silver Creek Mine (North Almaden). A. R. Bradford et al., owners, 770 East St. John street, San Jose. This property, formerly known as the North Almaden mine, is 12 miles by road southeast of San Jose, on the east side of Silver Creek. A large body of serpentine containing cinnabar was found in Silver Creek gulch, overlying Knoxville gravels. This detached body was evidently due to a great landslide which is plainly visible about the works. It was approximately 1000′ in length, 300′ wide, 60′ in thickness, and was exhausted in a few years, producing about $60,000 worth of quicksilver. Occasional prospecting has been carried on since, but no important ledge has been found in place. The property is equipped with a 20-ton Scott furnace and a pipe retort.

Bibl.: Cal. State Min. Bur. Repts. XII, p. 367; XIII, p. 600; Bull. 27, pp. 187, 235, 238; Chapter Rept. Bien. period, 1917–1918, in preparation.

Wright Mine. Mrs. A. Rodgers, owner, San Francisco. It is 3 miles south of the New Almaden Hacienda, on Llagas Creek, and is said to have produced some high-grade ore many years ago. It is hardly more than a prospect, and has had but little development work done on it. Idle.

Bibl.: Cal. State Min. Bur. Repts. XII, p. 370; XIII, p. 600; Bull. 27, p. 187; Chapter Rept. Bien. period, 1917–1918, in preparation.

SANDSTONE.

An extensive body of hard buff-colored sandstone, which is deposited in beds varying from a few inches to several feet in thickness, occurs at Graystone Station, 9 miles south of San Jose, on the Almaden branch of the Southern Pacific Railroad. This stone was formerly quarried for building purposes in San Francisco, San Jose and other towns, and it was used for the construction of the buildings of Stanford University. There has been no stone cut from this deposit for several years, and the only sandstone quarries now operated in the county are those producing crushed rock, described under the heading, "Stone Industry."

Bibl.: Repts. VIII, p. 547; X, p. 618; XII, p. 399; XIII, p. 637; Bull. 38, pp. 133–138.

STONE INDUSTRY.

Alum Rock Quarry. A deposit of siliceous shale occurs in Alum Rock Cañon a few hundred yards above the end of the car line. This rock is occasionally quarried for local road uses by the City of San Jose. The quarry was idle at the time visited.

Bibl.: Bull. 38, p. 223.

Campbell Gravel Plant. The E. B. and A. L. Stone Company, Rialto Building, San Francisco, owns a bed of gravel and sand in Los Gatos Creek, 1 mile south of Campbell, alongside of the Peninsula Railroad.

The plant was erected in 1912, and was in continuous operation up to the first part of 1919, when it was closed down, due to lack of construction work. The deposit is said to be at least 80 feet in depth and is inexhaustible, as the pits dug in the bed during the year are refilled with gravel and sand in the wet seasons by the swollen creek. The material is mined by a slack line scraper which hauls it to the plant alongside of the creek. Here it is dumped onto a grizzly, the over-size going to a Sturtevant mill, while the under-size is passed through a series of revolving screens and washed. The washed and sized products are then stored in bins, from which they are loaded directly onto trucks, or railroad cars. The water for washing purposes is obtained from a well at the property, and as there is a scarcity, after washing it is returned to settling tanks and re-used. The plant is operated by electric power supplied by the Pacific Gas and Electric Company. The daily capacity of the plant is 300 tons. E. U. Leh, district superintendent for the company, is in charge of this and the Coyote plant.

Coyote Gravel Plant. This plant, erected by the E. B. and A. L. Stone Company, in 1913, is on Coyote Creek, ½ mile south of Coyote Station. A spur track of the Southern Pacific Railroad is laid to the property, which covers 15 acres. The gravel bed here is a few hundred feet wide and about 12 feet thick. It is mined by a 70-ton oil burning Bucyrus steam shovel and hauled to the plant by an electric motor train operated by a 3d rail conductor. The plant, equipped with a gyratory crusher, trommels, elevators, washing vats, etc., has a daily capacity of 1000 tons, and is operated by electric power. Sufficient water for all purposes is supplied by a well sunk in the creek. Sixteen men are employed when the plant is operated at full capacity. For several months (last part of 1918 and first part of 1919) the plant has been operating at only part capacity.

Hillsdale Quarry, also known as the **Gay Quarry,** is near Hillsdale Station, 3 miles south of San Jose, at the northern end of the San Juan Hills. The rock is a fine-grained, hard, metamorphosed sandstone, fractured and traversed by clay seams and was formerly quarried for macadam and concrete uses. The machinery has been removed and the land is now used as pasture. Formerly owned by the Security Savings Bank of San Jose, but recently sold to John E. Anderson.

Bibl.: Repts. XII, p. 399; XIII, p. 626; Bull. 38, p. 324.

Quality Sand and Rock Company, formerly known as the **Saratoga Crushed Rock Company.** G. W. C. Baker, president; Wm. T. Macdonald, secretary; office 903 First National Bank Building, San Jose. This company owns and operates a quarry situated in Campbell Creek Cañon, one mile west of Saratoga, just below Congress Springs. The rock is a hard, gray, metamorphosed sandstone, approaching a quartzite, which has been greatly shattered, so that it breaks up readily in small angular fragments. The deposit is approximately 700 feet thick and covers many acres. A bench is now being quarried 300 feet above the road. The rock is loosened by blasting and then quarried by steam shovel, which loads into cars hauled by electric power to the crushing plant. Here it is passed through the usual equipment, consisting of a gyratory crusher, trommels, belt conveyors, washing vats, etc. The crushed and washed products are then conveyed to the storage dump

below the plant. Two concrete lined tunnels 387′ and 115′ in length, respectively, have been driven into the hill under the dump and above the loading bins that are placed alongside of a spur track of the Peninsula Railroad. These are equipped with belt conveyors, and steel doors placed at intervals along the tops of the tunnels, through which the crushed rock is drawn and conveyed to the loading bins. Besides crushed rock, a siliceous sand is produced which is said to be excellent for concrete and plaster use. The entire plant is operated by electric power supplied by the Pacific Gas and Electric Company. Twenty men are employed, producing 450 cu. yds. of crushed rock daily. Chas. C. Bell is superintendent at the plant, which has been in operation since 1908.

Stanfield and Knowles Quarry. This quarry adjoins that of the Saratoga Crushed Rock Company, 1 mile west of Saratoga, on a precipitous hillside, being a continuation of the same hard metamorphosed sandstone. The rock is loosened by blasting, and hauled to the plant alongside of the road by a drag line scraper. Here the rock is crushed, sized and stored in the loading bins, from which it may be drawn into cars or trucks. Electric power is used. The quarry has been worked for the past twelve years. Three men are employed. Owners, Jim Stanfield and Dr. Knowles, of Los Gatos.

Stanford Quarry. A deposit of basalt which outcrops on the Stanford Estate, one mile back of the university, is quarried to supply crushed rock for macadam and building purposes about the university. Some of the rock is sold to contractors, principally for road use, the balance being used locally at the university. The basalt flow covers many acres, and the quarry is a circular cut, a couple of hundred feet in diameter with a face 100 feet in height. It is equipped with a crushing plant, consisting of a No. 5 gyratory crusher, trommel, bucket elevator, small jaw crusher. Two electric motors of 40-h.p. and 20-h.p., respectively, are used to operate the plant. Twenty-five men are employed. J. E. Hewsted is general superintendent, and F. Capperman is in charge of the quarry, which is operated by the university authorities.