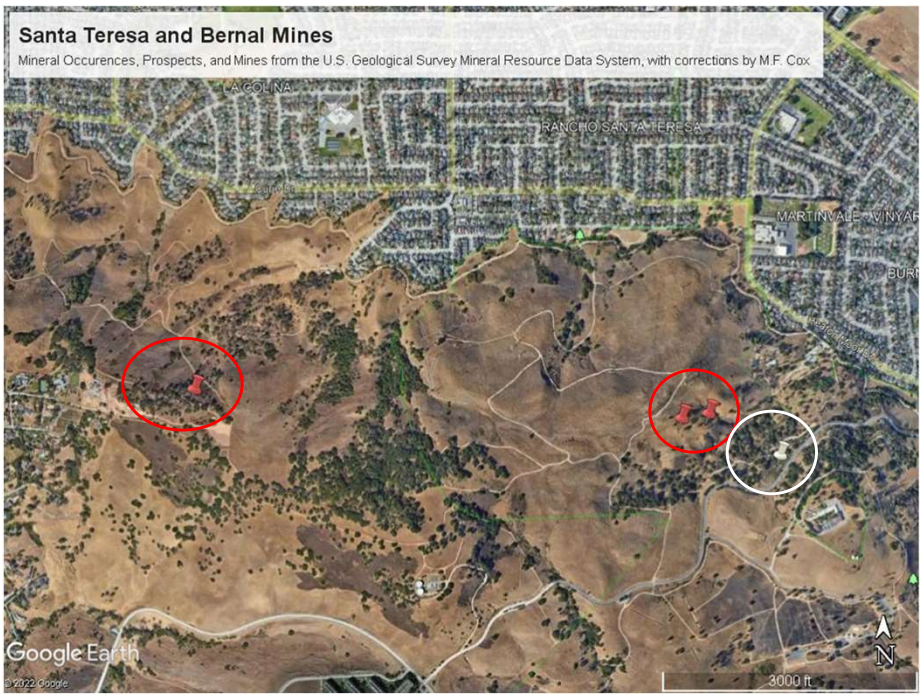
Santa Teresa Mine and Bernal Mine Yesterday and Today Santa Clara County, California

Michael Cox and Mike Boulland

August 2022

Thank you for attending our talk, Mike B. hopefully you all know, a historian and significant contributor to many important parks, park associations, and other worthy causes. I am Michael Cox, a person who has been obsessed with New Almaden and mercury mining since moving to California in 1974 at the age of 16. I've been lucky enough to help lots of good people with many projects and to have done many interesting geology things – including investigating the Santa Teresa mine. The Bernal mine I have not studied in depth, so I am glad Mike B. is here to help. The history has too many threads to cover today, but this presentation with notes will be posted to the FOST web page so folks can read some of the details we will have to gloss over during this talk.



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These are the mining locations in Google Earth™. To the left is the Santa Teresa mine circled in red and to the right is the Bernal mine. The red circle is the mercury and the white circle is the lime quarry. Decomposed limestone, called marl, was quarried and roasted to make lime for a variety of uses. The company doing the mining was called the Bernal Fertilizer Company. Like most mines, both are in hilly terrain where the bed rock is exposed. The valley is filled with sediment washed down from the hills. Any mineral deposits in the bedrock under the alluvium remain hidden.

Themes

1. Historical Context
2. Physical Overview
3. Operational History
4. Geological Setting
5. Summary

These are five themes we'll touch on in this talk.

1. Historical Context

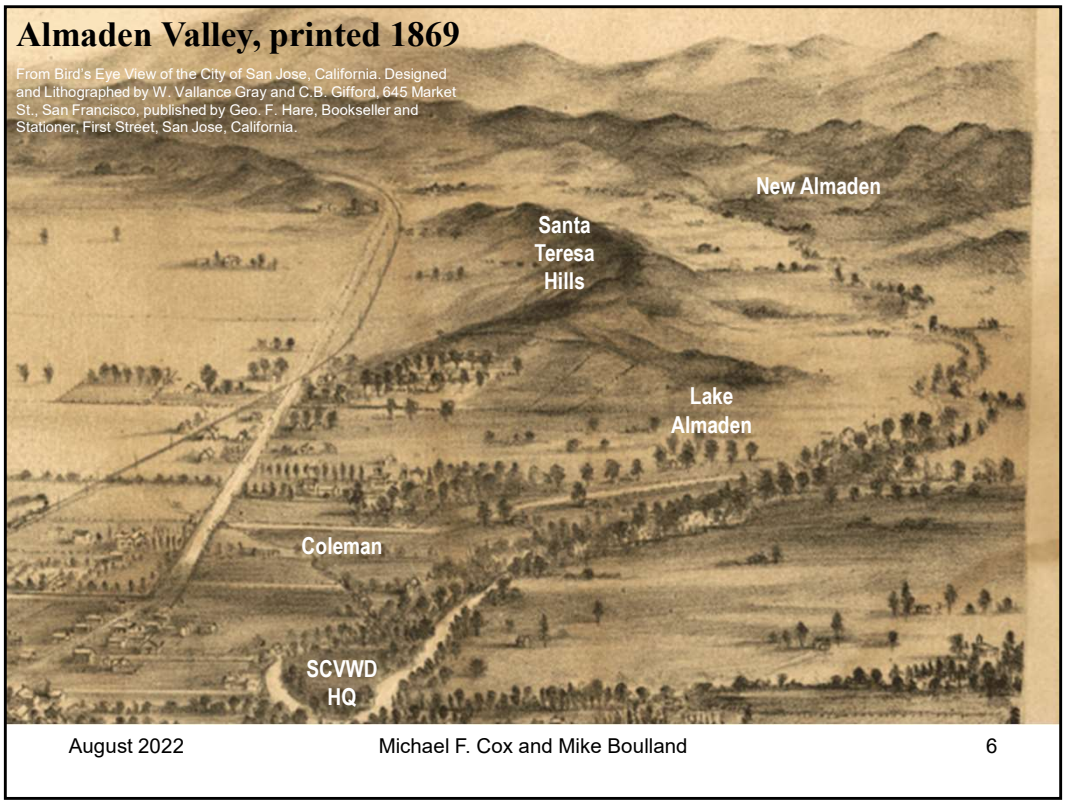
- Principle human activities
- Land ownership and use
- The mining cycle and mercury

Self-explanatory.

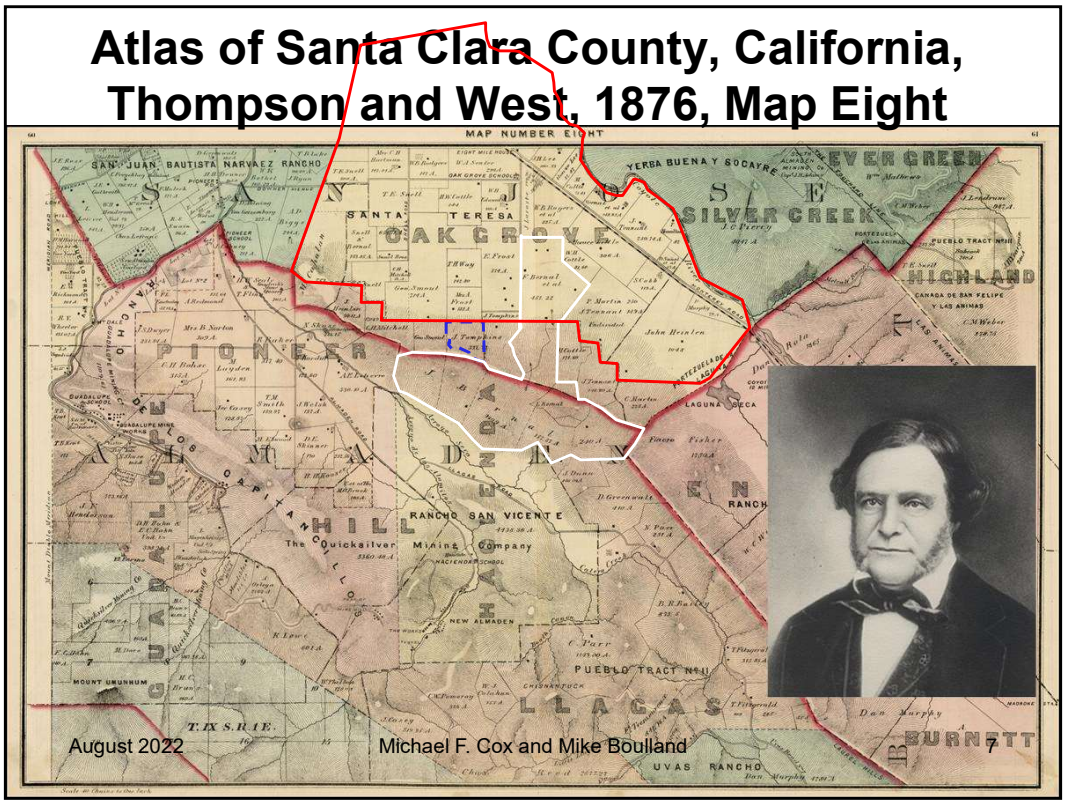
Principle Human Activities

- Pre-mission era: indigenous people living off the land for unknown thousands of years
- Mission era to gold-rush: missions, forts, and cattle ranching
- Post gold-rush: ranches and farms, but industry on the rise. Refrigerated railcars (ca. 1880s) cause a great rise in fruit farming.
- Post-WW-II: industry, commerce, and housing. Electronic-allied industry and services rise to domination.

Self-explanatory, but an interesting side note is that water pumping from the Santa Clara Valley has caused the land to subside as much as 30 feet in some places, and the subsidence continues to this day, a nightmare for map makers and surveyors.



Keep in mind that nothing about this place would look very familiar to us if we were transported back to 1869, when this perspective drawing was made. It is detail from a larger drawing of San Jose and the entire south Santa Clara valley. The main feature in the view is the Almaden Valley. These lands were once part of huge land grants and common pueblo lands. In 1869, the agricultural explosion has not yet happened. San Jose is a sleepy pueblo town trying to emerge as a boastful city. The New Almaden mercury mining district was the single-owner industrial gorilla of the Bay Area, a position it took from about 1854 until about 1890. Cattle ranching for meat and leather was the other huge industry in the valley, divided up among hundreds of ranches and owners. In the hills, logging and lumber making were big business. Something largely unrecorded was the degree to which the landscape was influenced by the indigenous peoples. It is possible they used fire to keep the land productive and accessible, and to a degree that is now being appreciated on account of the severe fires in unmaintained wildlands.



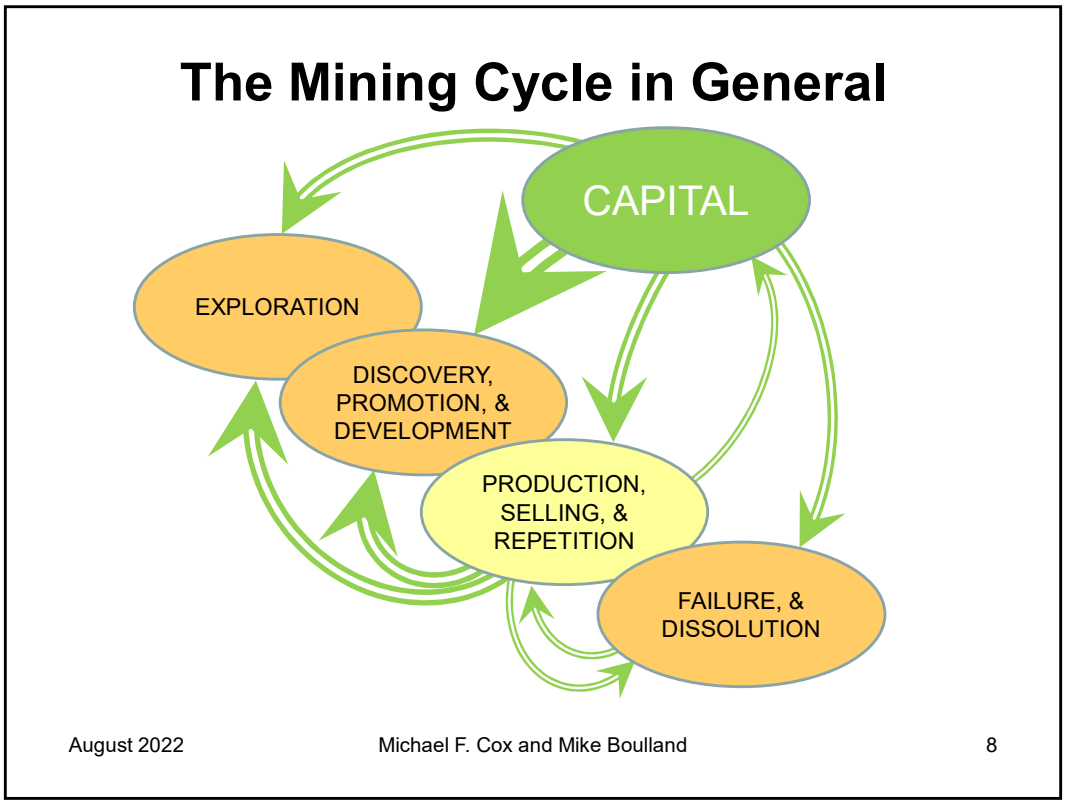
This Thompson and West 1874 map of land parcels and ownership has the modern Santa Teresa property outlined in blue and the then existing Bernal family holdings outlined in white. In red is the approximate outline of the original rancho. The ranch comprised 9,647 acres (39.04 km2) when patented March 8, 1867. The rancho was settled in 1826 by 64-year-old Jose Joaquin Bernal and was awarded to Bernal in 1834, by Governor José Figueroa. Don Bruno Bernal, his son, pictured, ran Rancho Santa Teresa after the 1837 death of José Bernal. Bernal was a rancher and produced meat and leather, branding as many as 2000 calves each spring. Accordingly, the ranch is mostly flat valley land.

Pedro A. Bernal, his grandson, eventually inherited the ranch after time and pressure greatly reconfigured the family holdings, as shown in white. Pedro owned a portion comprising 374 acres. Pedro died September 6, 1935 of a heart attack while in his house. The rancho was originally 10,000 acres, but through the years portions had to be sold off, mainly to pay for legal bills in defense of the title to the land and other claims. One interesting episode involved Pedro A. Bernal being accused of lewd conduct and held in the San Jose Jail for 17 months until his attorney was able to convince the Governor of California to pardon Bernal on June 7, 1919. Many influential people felt Bernal was falsely accused.

The rancheros did not use the hills as much as the valley lands, so the hills were typically owned by the Pueblo de San Jose at this time. By 1874, the rancho Santa Teresa de Avila is much shrunk compared to the 1850s. It has been subdivided into smaller ranching and farming properties, as are most of the other Ranchos and the old pueblo lands of San Jose. The valley land became too valuable to resist selling the land to cover a myriad of expenses falling on the heads of the old families. Much of this subdivision was to pay legal fees and increased costs associated with the change from ranching to concentrated agriculture, as well as a greatly increased urban population.

The family has clearly retreated south, into the less valuable hilly terrain. In 1874, the ranch is reportedly one

of only two in the State still owned by the original family granted the land and is the largest. The Bernal family connection to the Bernal mines is now clear, but the Santa Teresa mine remains on lands owned by others. The record appears to be one of separate land ownership and no direct Bernal family involvement in the Santa Teresa mine, although I am not 100% sure of this. The ownership and boundaries over time are open questions needing more research.



Capital is money put to productive use, meaning the profits invested to make more money. Money is made by taking something and turning it into something desired by people and industry. Mining requires a large capital investment before one is able to turn ore into product. Large is an understatement in today's world. Permitting and litigation delays can cost hundreds of millions even before a single piece of the infrastructure has been built. When pushed to the wall, capital scales up and small players are squeezed out. Bigger cash flow can outcompete smaller cash flow.

Because it can take a decade or more to bring a large deposit online, a company needs to have a portfolio of deposits ready for development. Experience and technology are called into service to solve real problems when natural systems reach inherent limitations. Mine management must be extremely experienced and skillful to be competent at knowing what to invest in and when.

On the other hand, unscrupulous individuals often find mining ripe for promoting lackluster prospects and using other people's money to pursue mining ventures while living the good life. I have met many in my time. We geologists politely refer to them as "promoters," but a more pejorative term is "OPM addicts." None of this matters much to mercury. Mercury is a nearly dead commodity, as the next slide will show. The million pounds or so involved in commerce each year are small compared to other commodities. Consider glyphosate. Global sales in 2022 are about 1.6 billion pounds, sixteen hundred times larger.

Death of an Industry - U.S. Hg Consumption 1970-1997

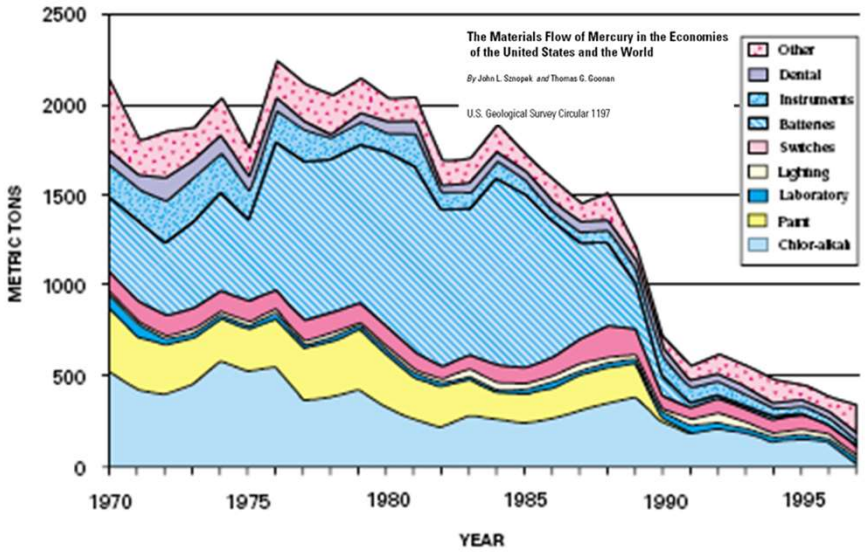


Figure 3. U.S. industrial reported consumption of mercury (1970–1997).

Due primarily to environmental problems and concerns, the global mercury industry collapsed. Restrictions came into play starting in the 1970s. Commercial demand hung on until about 1989. This lag is partly due to the time needed for end-users to discover, qualify, and embrace substitutes, especially for batteries and chlor-alkali (chlorine and caustic soda) production. All but a few mines closed by 1990, and all mines were closed by 2005. Today, few would advocate the use of mercury, but due to price increases for illicit small scale gold mining, as well as some some essential uses, mercury mines have reopened in Mexico, Kyrgyzstan, Russia, and China. Their mercury mainly ends up in the hands of small-scale gold miners around the world, but mainly in Africa, South America, and Indonesia.

So that's the historical context. What it means is the Bernal and Santa Teresa mercury mines will not be opening anytime soon, unless someone wants to invest in creating some underground space for visitors to look at. Let's look at some details regarding these two old and long-abandoned mines.

2. Physical Overview

- Mine Features
  - Bernal Mine
  - Santa Teresa Mine

Self-explanatory section divider. Section 2 will review physical features at the sites and section 3 will provide some operational details, first for the Bernal mine and then for the Santa Teresa mine. This will cause some awkward repetition, but I felt its necessary to see what was there prior to discussing the operational history.

Bernal Mercury Mine Features

William Forstner, E.M., 1903 and Bailey, E.H. and Everhart, D.E., 1964

- 1903, owned by Ygnacio Bernal, No. 207 Balbach Street, San José, CA.
- 2 shafts, 65 and 20 feet deep, and a 215-foot adit driven nearly 200 feet below.
- Adit extended in 1946 to 10 feet below the shallower shaft; retort was installed at its portal.
- Thin nearly vertical lens of silica-carbonate rock which is crossed by several north-trending 1-inch veins of quartz and dolomite.
- Some showy but scant patches of cinnabar in the veins.
- Further development is probably not worth while.

Descriptions with edits, from Geology and Quicksilver Deposits of the New Almaden District, Santa Clara County, California, U.S. Geological Survey Professional Paper 360, p. 169.

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Here are the features plotted on Google Earth™ as best I could from memory and with the help of Mike Boulland. I have not been to the mine since the 1980s. My first introduction to it was through James Delgado, who worked at the New Almaden museum as a docent when I first came to the museum in 1976 to volunteer as well.

Entrance to the Bernal Mine

Pedro A. Bernal photo collection, downloaded July 2022 from:
http://digitalcollections.sjlibrary.org/cdm/ref/collection/sjplbernal/id/26

The mine was opened by Pedro Alcantar Bernal in a failed attempt to mine quicksilver. No ore body was found.

Retort Ruins

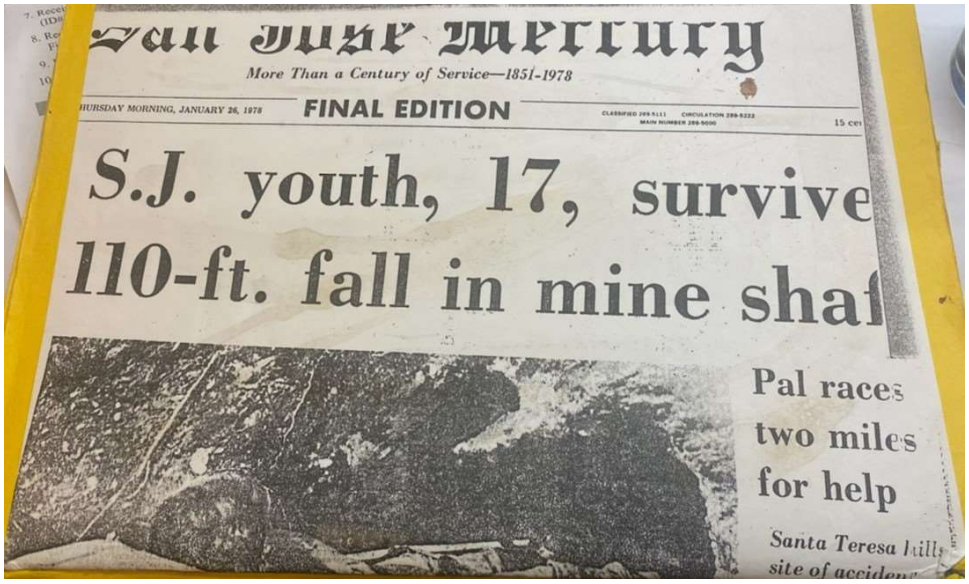
Labeled "Dilapidated structure at the Bernal Marl Fertilizer Company."

Bernal Family photo collection, downloaded July 2022 from:
http://digitalcollections.sjlibrary.org/cdm/ref/collection/sjplbernal/id/40

This is an undated photo of the WW-II vintage two tube retort near the main tunnel that Bailey and Everhart (1964) report as being installed in 1946. Retorts are devices, typically inclined 12-inch to 14-inch metal tubes, in which ore is placed for roasting. HgS (cinnabar) + heat and oxygen - - -> Hg vapor + SO2 (sulfur dioxide) gas. The tubes are sealed with the ore inside and heated from the outside, using wood, coal, fuel oil, or flammable gas like butane. The sealed tubes each have a smaller iron condenser tube attached. This is the condenser tube, and typically terminates in a basin to catch the condensed mercury. Some condensers have water jackets to help keep the tube cool.

This retort was not used much, as the burnt ore pile below it is very small. Note the poison oak growing on and around the structure. Poison oak seems to proliferate on disturbed land and dilapidated structures. There are mining tunnel sites in New Almaden where the poison oak is so thick one cannot get to or even see the former tunnel entrance. The Randol tunnel at New Almaden is an example, where there are poison oak plants with trunks like small trees, yet the tunnel was rehabilitated in 1945, clearing all the land around it, and used extensively until 1946, when it was left to time and weather.

Mine Accident


San Jose Mercury
More Than a Century of Service—1851-1978
FINAL EDITION
S.J. youth, 17, survive
110-ft. fall in mine shaf
Pal races two miles for help
Santa Teresa hills

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January 25, 1978 a youth drinking with friends in the mine fell down an internal shaft inside the Bernal mine adit. The shaft was somewhat inclined, so the youth survived, albeit with severe head injuries. The Sheriff's office responded. The tunnel entrance was blown up some years later by the bomb squad leader, Sheriff Leonard Anderson. Mike Boulland was teaching at a nearby school and reports he and the students heard and felt the explosion, initially thinking it was an earthquake.

When the accident happened in 1978, park ranger and later Deputy Sheriff Michael Quane was living on Mine Hill in New Almaden and became greatly concerned about kids going into the old mine workings. My brother and I were venturing underground at New Almaden, and Quane certainly increased his efforts to catch us. We never were caught, but it needs to be said that we were very aware of the hazards, how to identify them, and techniques for staying out of danger. Our purpose was photographing the mines with a light touch and reverence for the labores (large rooms) hand-dug by the miners. We certainly never drank. We had not gotten around to exploring and photographing the Bernal workings, so they are lost to me.

The Bernal Marl Fertilizer Company Quarry

- Open pit mining on decomposed fossiliferous limestone
- Active 1915 to 1938 according to State Mining Bureau, but we know this is wrong based on advertisements in 1880s
- Large crusher and screening plant
- Crushed and screened calcium carbonate put into sacks and sold directly to consumers

Pedro Alcantar Bernal, who was the grandson of Bruno Bernal, took over ownership of Rancho Santa Teresa after the death of his father Ygnacio Bernal, and started, or continued a businesses selling marl (a decomposed fossiliferous limestone) mined from the ranch. I have not researched this enterprise thoroughly, but there are indications that the mining took place at intervals and perhaps by different firms as leaseholders paying royalties to the Bernal landowners. Most of the activity does seem to be in the time interval reported by the State.

NATURE HAS PROVIDED THIS RESERVE FOR THE MAINTENANCE OF YOUR SOIL'S FERTILITY

The Great Natural Shell Deposit on the Bernal Rancho Near San Jose Is Now Available For the Farms, Orchards and Vineyards of California.

BERNAL MARL Was Prepared in Nature's Laboratory, Where Its Caustic Properties Were Removed, and Where It Was Made Instantly Available for Combination With the Soil Elements for the Uses of the Plants and Trees.

Lime, in the Form of Marl, Stands Foremost as a Soil Ingredient, and May Be Said to be the Basis of Civilization.—E. W. Hilgard, University of California.
BERNAL MARL is This Carbonate of Marl.

WHAT BERNAL MARL IS

BERNAL MARL IS a soil sweetener and adjuster.

BERNAL MARL IS Nature's restorative for depleted soils.

BERNAL MARL IS a natural product from a deposit containing Carbonic Acid Gas, Potash, Phosphoric matter and Carbonate of Lime, soluble in soil moisture.

BERNAL MARL IS a fresh water shell marl, identical in its composition with those used in Germany and Holland, where the greatest agricultural results are obtained.

BERNAL MARL IS a mellow, powdery Carbonate of Lime Marl, Richly Decomposed, free from caustic properties, and instantly available for combination with soil elements.

WHAT BERNAL IS NOT

BERNAL MARL is NOT A CAUSTIC.

BERNAL MARL is NOT waste from a kiln.

BERNAL MARL is NOT a by-product.

BERNAL MARL is NOT a manufactured product.

BERNAL MARL is NOT an irritant, not unpleasant to handle.

BERNAL MARL is NOT a mixture of impurities that will injure the soil.

WHAT BERNAL MARL WILL DO

BERNAL MARL WILL sweeten acid soil.
BERNAL MARL WILL break up hard pan.
BERNAL MARL WILL check the wastage of nitrogen.
BERNAL MARL WILL aid in the prevention of insect injury.
BERNAL MARL WILL restore the depleted elements.
BERNAL MARL WILL increase the yield and improve the flavor, color and quality of the fruit.
BERNAL MARL WILL enable the soil to utilize the natural and applied fertilizers.
BERNAL MARL WILL mellow heavy soils, adding to the ease of cultivation, improving both light and heavy soils for air and moisture benefits.
BERNAL MARL WILL enrich the fruit bloom and heighten the color and fragrance of flowers.

BERNAL MARL is so named because the deposit was discovered upon land comprising a portion of the great Santa Teresa grant to Ygnacio Bernal in the seventeenth century by King Carlos of Spain.

Five years ago, while on a tour of Europe, Pedro A. Bernal, a descendant of the original grantee, made the discovery that the mountain of yellowish substance on his property near San Jose was identical with Marl deposits in England and Germany, which have been mined for ages and applied to the land.

Upon returning home he caused tests to be made, with the result that the deposit was found to be rich in lime, potash and phosphate. He began development of the deposit and its use upon orchard land in the Santa Clara Valley demonstrated it to be the most valuable soil corrective and fertilizer known. Tests made by the State Experiment Stations have shown that its use will increase the crop yield enormously.

The Bernal Marl Fertilizer Company was organized and a reduction works erected at the deposit, costing over $100,000. The deposit was opened to great depth and the plant is now in operation, yielding a heavy daily tonnage that is being distributed upon the orchards and ranches throughout California. The discovery and development of this deposit is welcomed by agriculturists as a great boon to the state. Its value to the growers is inestimable.

Telephone or Address Orders to

THE BERNAL MARL FERTILIZER CO.
207 South First Street, San Jose, Cal.

Telephone San Jose 1654

Lloyd W. Stetson, Director of Sales

SIGN AND MAIL TODAY

Bernal Marl Fertilizer Company,
207 South First St., San Jose, Cal.

Send Literature and Price on your Bernal Marl to

Name .....
Address .....
Phone .....

Bernal Fertilizer Ad

Pacific Rural Press, October 29, 1921

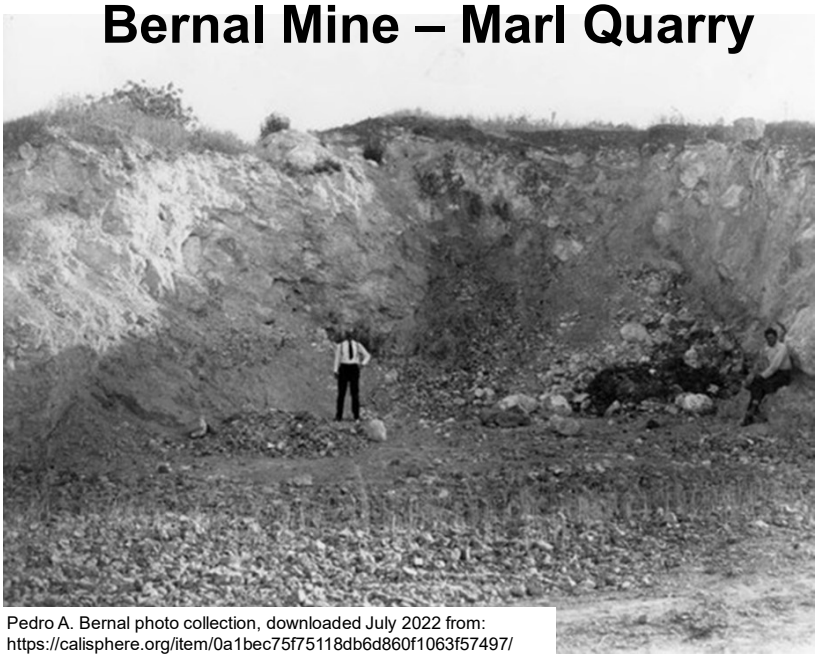
This advert is from the Pedro A. Bernal's peak of mining activities. Bernal was essentially leasing the land to a 3rd-party mining outfit backed by a venture capitalist named A.J. Ginoux, of Oakland, CA, a person said to have invested $85,000 in building the mill and with extensive interests in Bay area agriculture (Modesto Morning Herald, 03Nov1921, page 6.).

The Bernal Marl Fertilizer Company Quarry

Pedro A. Bernal photo collection, downloaded July 2022 from:
http://digitalcollections.sjlibrary.org/cdm/ref/collection/sjplbernal/id/21

The California History Room at the City of San Jose main library (Martin Luther King Jr. branch) has Berrnal family photographs and has posted them online, but sadly few have dates and significant descriptions. This one is simply described as “rocky outcrops” of Bernal’s fertilizer company.

Bernal Mine – Marl Quarry



Pedro A. Bernal photo collection, downloaded July 2022 from:
https://calisphere.org/item/0a1bec75f75118db6d860f1063f57497/

This photo is labeled the Bernal Quicksilver mine, but it most likely the Bernal Marl (limestone) mine. The fellow in shirt and tie looks to be Pedro A. Bernal, so the photo is probably from the 1910-1920 interval. Some sort of powered excavator, possibly a steam-shovel, was used to dig up the marl.

Bernal Mine - Mortar

Pedro A. Bernal photo collection, downloaded July 2022 from:
http://digitalcollections.sjlibrary.org/cdm/search/searchterm/csj_BF-030

This photo is labeled "Bedrock mortar at the Bernal Marls Fertilizer Company." Mike Boulland is interested in the indigenous settlements of the area and there are many documents recording a significant settlement in the area, a topic addressed in detail in Santa Clara County Parks and Recreation documents regarding the Bernal-Gulnac-Joice ranch. Mike B. believes that the rancheros would deliberately locate their houses in the same area as the indigenous settlements, so that the peoples could work together. It is clear that the Bernal ranch was home to a significant population of indigenous peoples and there are many grinding stones and even petroglyphs in the area, as well as long stone walls that are somewhat mysterious as to who built them – perhaps the indigenous people working under the direction of the early rancheros piled up the dry-stone walls to keep farm animals in certain areas.

Bernal Mine – PAB Stamp

Pedro A. Bernal photo collection, downloaded July 2022 from:
http://digitalcollections.sjlibrary.org/cdm/singleitem/collection/sjplbernal/id/37/rec/1

This photo is labeled “Pedro Alcantar Bernal's initial stamp in concrete.” It looks like someone made up a bit of lime or plaster mortar and Pedro used a stamp of some sort to apply his initialed stamp, much like concrete companies do today. What I do not know is where this stamp was. The photo is undated and has no location information.

Bernal Mine – Marl Reducer

Pedro A. Bernal photo collection, downloaded July 2022 from:
http://digitalcollections.sjlibrary.org/cdm/singleitem/collection/sjplbernal/id/33/rec/1

This photo is labeled “The Marl works reducer site at the Bernal Marl Fertilizer Company limestone quarry at the Rancho Santa Teresa. The business was started and owned by Pedro Alcantar Bernal.” This is pretty far up the hill and the marl plant was adjacent to the valley floor as best one can tell from the scant photographs, so I think this might be the ore bin for the WW-II retort. Some field work is needed to look for these artifacts, if they still exist.

Interpretive Sign

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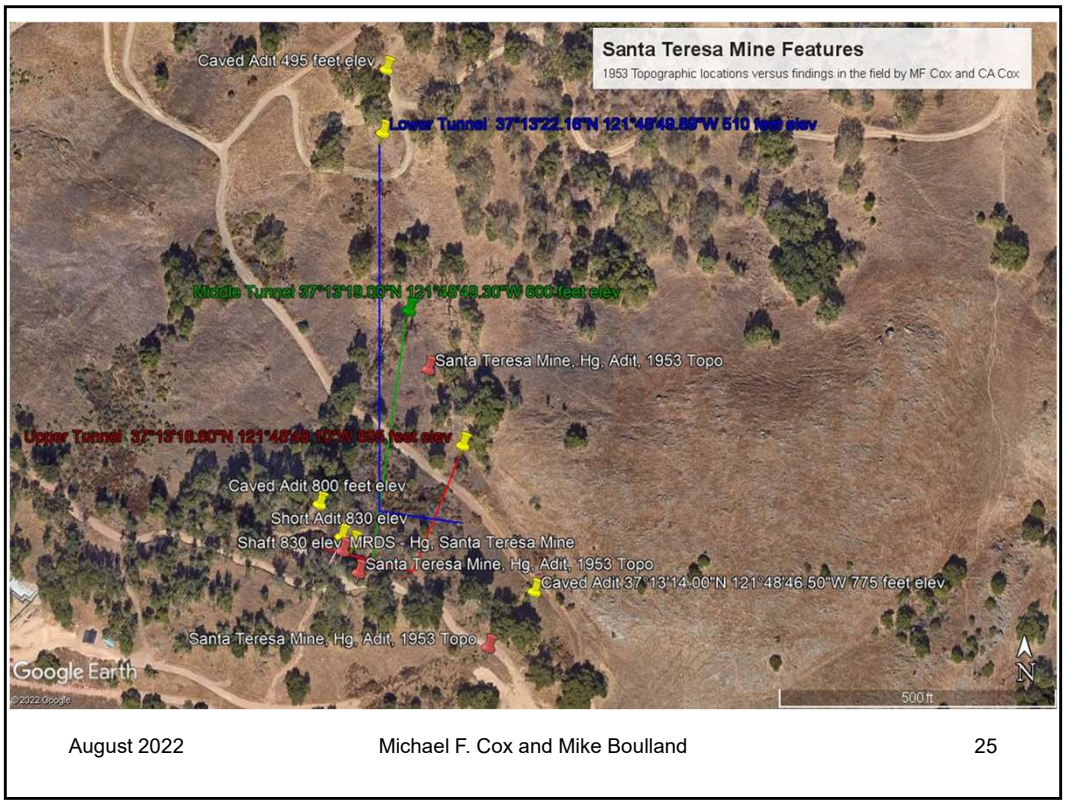
Ron Horii shares this photo he took of an interpretive sign at the park. It shows a very large plant at the valley floor. I hope this plant is the Bernal operation and not a photo of some other plant confused with the Bernal operation. The very high conveyor feed extending to the right seems more suited for a ship than railcar or truck, and there is the problem of historical accounts stating the sacked product was transported to the railroad as opposed to loaded onto railcars. Again, it's not something reviewed in detail for this presentation and more work is needed.

Santa Teresa Mine Features

From William Forstner, E.M., 1903

- Lowest tunnel, 700 feet long, vein 500 feet from portal, course is nearly south.
  - Turns left on the vein and extends under the two upper tunnels.
- Middle tunnel, 110 feet above the former, course S.8°W., 325 feet long.
  - Cuts the ledge 228 feet from the portal.
- Upper tunnel is 85 feet above the middle tunnel, course S.22°W.
  - Cuts the ledge 220 feet from the portal, turns right and runs 187 feet.
  - Winze, 50 feet from turn, connects with the middle tunnel about 90 feet from where the latter cuts into the ledge. Several drifts and crosscuts run in the ledge matter, which dips north.
  - Intermediate short level run from the shaft 37 feet above the middle tunnel.
  - Between the middle and upper tunnels, farther on, a raise goes from the upper level 110 feet up to the surface, all in ledge matter.
- Rocks contain many cavities and considerable ochreous material is found, probably due to the oxidation of iron.
- The country rock is all serpentine. The ledge matter varies greatly in character. Fissures have been filled by quartz and calcite [sic, dolomite and magnesite], silicification varying in different zones of the ledge.

These are the primary features of the mercury mine described in 1903 by Forstner, William, E.M., 1903, June, “Quicksilver Resources of California,” California State Mining Bureau Bulletin 27, pp. 186-187. This is the authoritative reference, because nothing happened after the turn-of-the-Century campaign.



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On this aerial photo from Google Earth™ I have overlain placemarks and lines showing the major workings of the Santa Teresa mine. There are three levels of workings, respectively shown in blue, green, and red from lowest to highest. I'll point them out for folks that cannot see the colors well. The total length of underground workings is about 1,200 feet, including vertical shafts.

3. Operational Summary

- Bernal Mine
- Santa Teresa Mine


Santa Teresa Quicksilver Company

SANTA CLARA COUNTY, CAL.

101 MILK STREET, BOSTON, MASS.

E.S. DeGolver, Pres.
John Joyce, Vice-Pres.
W.B. Holloway, Treas.
E.C. Grant, Secy.
R.B. Harper, Supt. Of Mines

This section will review the scant information regarding operations at these two mines. I do not have a photo of R.B. Harper. I can find little information regarding R.B. Harper. He was reportedly involved in the New Almaden mines and struck out on his own when those mines began to fail. He was in the major newspaper society pages on occasion, travelling to east coast cities to raise money for his mining ventures. The scant personal records and comparatively voluminous promotional material associated with the mining venture makes me suspicious that Harper was a seasoned mining promotor. Mining promoters are OPM addicts.

From: “British Columbia’s Geological Surveys, 1895 to 1995,” by Atholl Sutherland Brown, 1998, p. 30. “In 1877, Harper was an appointed “Inspector of Mines,” in British Columbia. From “Also in 1877 a Government Engineer, R.B. Harper, was appointed who wrote reports on lode deposits in the Cariboo and Howe Sound. He came from San Francisco highly recommended as skilled in quartz but was said by some to be ignorant of auriferous pyritic ores and was let go, not to be replaced.”

Bernal Hg Mine Operation Summary

From: Bailey, E.H. and Everhart, D.E., 1964, Geology and Quicksilver Deposits of the New Almaden District, Santa Clara County, California, U.S. Geological Survey Professional Paper 360, p. 169.

- Its production is not recorded, and its present ownership is not known.
- Probably a small amount of quicksilver was recovered from its ores by the early operations.
- In 1942, 4 drill holes, none of them more than 200 feet long, were put down from the surface into the ground below the shafts.
- In 1946 the shallower adit was extended to the area below the shaft, and a retort was installed at its portal.
- In 1947 the mine was idle, and no quicksilver appears to have been recovered in the retort.

Self-explanatory

Bernal's California Marl Fertilizer Company

State Mineralogist's Report XXVI, 1930, p. 9.

- Pedro A. Bernal, Edenvale, owner.
  - Leased by Consolidated Rock and Product Company of Los Angeles.
- Commenced 1921, ceased 1927.
- Fine-grained hard bluish-gray limestone to a calcareous marl with abundant shells.
- Most equipment removed
  - excavator, grizzly, screens, and mill for pulverizing the marl
- Product sacked, hauled to Edenvale, shipped by rail to consumers for fertilizer.

Self-explanatory. Again, there is variation in the dates of operation reported in the newspapers and mining bureaus and associations. Someone will need to clean all this up some day and prepare a concise timeline of who, what, when, why, and where.

Santa Teresa Operation Summary

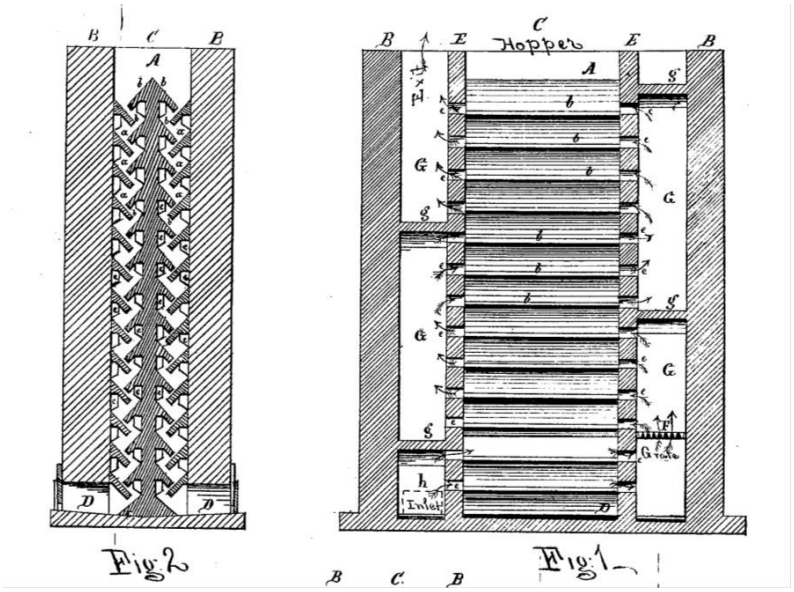
- Possibly early prospect dating to 1875
  - Explored silica-carbonate outcrops near ridge top
  - Reported litigation and disputes over title
- Mine operated for a few years
  - Incorporated January 1898 ($300,000; $50/share)
  - 1902-1903 re-organization, capitalization, opening
  - 1903-1904 mining & 40-ton Scott furnace, property acquisition, failure, merger with Hillsdale mine
  - 1908(?) dissolution of parent company
  - Doubtful the two-year operation cost more than $75,000, operators claim expenses of $250,000
- 9 flasks of production reported for 1903 - doubtful

Experienced mining men from New Almaden sought fortune in deposits located elsewhere. R.B. Harper, a mine engineer, supervised reopening the Santa Teresa mine in 1902. Harper and his east-coast partners raised capital to reopen the mine. Robert Scott, brick mason, was retained to build the ore processing furnace. Despite rapid development of the mine and furnace plant over a two-year period, there was insufficient mercury ore to sustain the operation. Harper over-promoted the mine, using language such as "workmen engaged in running a tunnel uncovered an ore bed probably sixty feet In width." He did not say ore sixty feet wide, he said the bed or bedrock, meaning rock that MIGHT contain ore. Investor beware! Oops, too late. ☺

Robert Scott – New Almaden Rifle Club ~1885

This is the late Robert Scott, a native of Canada, and a brick mason. Scott arrived in New Almaden in 1864. With James Hüttner, he developed an idea for a radical improvement in mercury furnace design. The idea was based on brick cereal-roasting furnaces being used in Michigan, something Huttner has worked on as a mechanical engineer, and Scott was building the same type of cereal roasters in London, Canada.

Hüttner-Scott Furnace



When first proposed in the late 1860s, mine management shrugged. The furnace idea languished until mining superintendent James B. Randol arrived in 1870 and funded experimentation to improve the furnace yard. Randol's interest in innovation, and his willingness to fund experimentation, emboldened greater risk-taking in the industry. Scott made an excellent living designing and building his namesake furnaces, including the 40-ton-per-day unit at the Santa Teresa mine.

The device is simple. Crushed ore fed in at the top rattles down over tile shelves. The shelves maintain a linear air space through which the combustion gasses can flow and heat the ore. The mercury is vaporized and drawn off to a brick condenser system. A photo will follow.

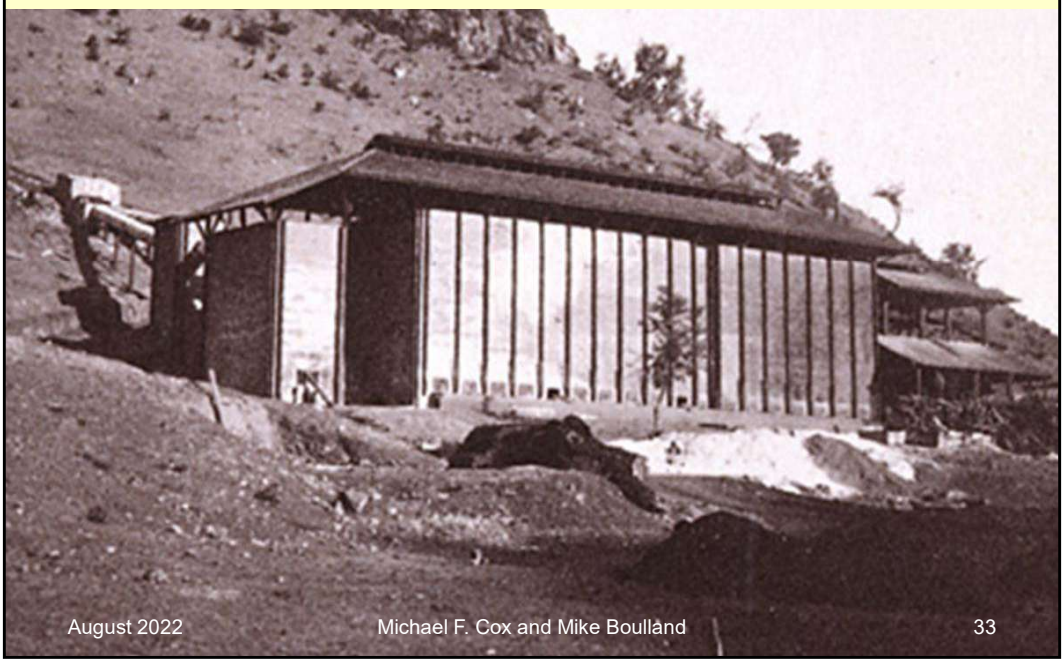
Hüttner-Scott Furnace – 1914

C.N. Schuette, *Quicksilver*

- 34 in operation in the U.S.
- 40-ton-per-day furnace, typically:
  - 140,000 common red brick; 25,000 fire brick
  - 3,000 custom fire brick & 360 tile fire bricks
  - 5 tons fire clay, 150 barrels lime, 10 barrels cement, 55 tons of sand, 8 tons of iron work
  - 75 days to build with 1 super, 1 blacksmith, 1 carpenter, 2 helpers, 2 hod carriers, and 5 masons
  - $20,000 cost ($550/ton capacity, or ~$500,000 in 2015 @3.1% infl.)
  - ~$0.80/ton/day to operate; other mining costs add ~$3.60/ton
  - Spot price of Hg in 1914 is $0.63/lb
  - Break-even ore grade is 7 lb./ton (0.35% recoverable Hg)

Building a Scott furnace was a big investment. Brick work was the essential ingredient, so Hüttner became a footnote to his invention. Perfected in 1875, the Scott furnace rapidly expanded across the world. Scott advertised his services to build the furnaces pursuant to the shared design and eventually he traveled the west and even the world building what would become known as “the Scott furnace.” Scott spent the rest of his life building these furnaes. In 1903, Scott supervised the construction of the furnace at the Santa Teresa mine.

What Santa Teresa furnace would have looked like, reverse of photo labeled: “93. New Almaden Works. Furnaces across the Creek .” Furnaces 1 & 2 at the New Almaden Mines, circa 1863. Source: “Lawrence & Houseworth Photography Albums: California Views,” Society of California Pioneers, URL: http://www.oac.cdlib.org/ark:/13030/kt7z09q3g1/?brand=oac4 .



The furnace plant at the Santa Teresa mine might have looked something like this. The furnace is to the right, under the split-roof building, and cannot be seen. To the left are the tall brick condenser stacks, each an empty plastered chamber in which mercury vapor condenses, falls to the floor, and runs out to a collection trough. To the far left are the expansion chambers to reduce potential mercury mist and fume losses before exhausting the gasses to a hillside chimney.

Later History

Holmes, George H., 1965, Mercury in California, in Mineral Potential of the United States, U.S. Bureau of Mines Staff, Information Circular 8252, Washington D.C., pages 130 & 135

- Bernal Mine
  - Work prior to 1918 comprised a 200-foot adit on a clay-serpentine contact. No significant cinnabar mineralization was encountered and no production made. The property has been inactive since 1918.
- Santa Teresa Mine
  - The property was explored about 1903. The work included driving several adits and drifts to develop mineralized silica-carbonate rock along a serpentine-sandstone contact. No commercial grade ore bodies were found. The mine has reportedly been abandoned.

Self-explanatory.

Pollution Cleanup

- 2017 The California Regional Water Quality Control Board – Region 2 – SF
  - Santa Teresa Mine, Investigation in progress under TMDL oversight. Ranked 12 of 17, 17 being the highest priority.
  - Bernal Mine Mercury Under Investigation Investigation in progress under TMDL oversight. Ranked 11 of 17.
- 2022 Status TBD

Both mines contain very little waste and are not much of a threat to water quality of human health. The Santa Teresa mine owners voluntarily removed a small pile of burnt ore below the site of the former Scott furnace, which was removed long ago for its bricks, leaving only the concrete base. When inspected by Mike Cox about ten years ago, there was no obvious trace of elemental mercury to be found at key places in the furnace base, nor was any significant ore found in any of the old tunnel dumps and rock exposures. A great deal of iron-oxides were present in places, including red hematite, easily mistaken for cinnabar by novices, but R.B. Harper, coming from New Almaden, surely knew the difference. Or did he?

4. Geological Setting

- Plate tectonics
- Ocean crust ages
- Geological blocks
- Mines, Prospects, Occurrences, & Faults
- Detailed Geology

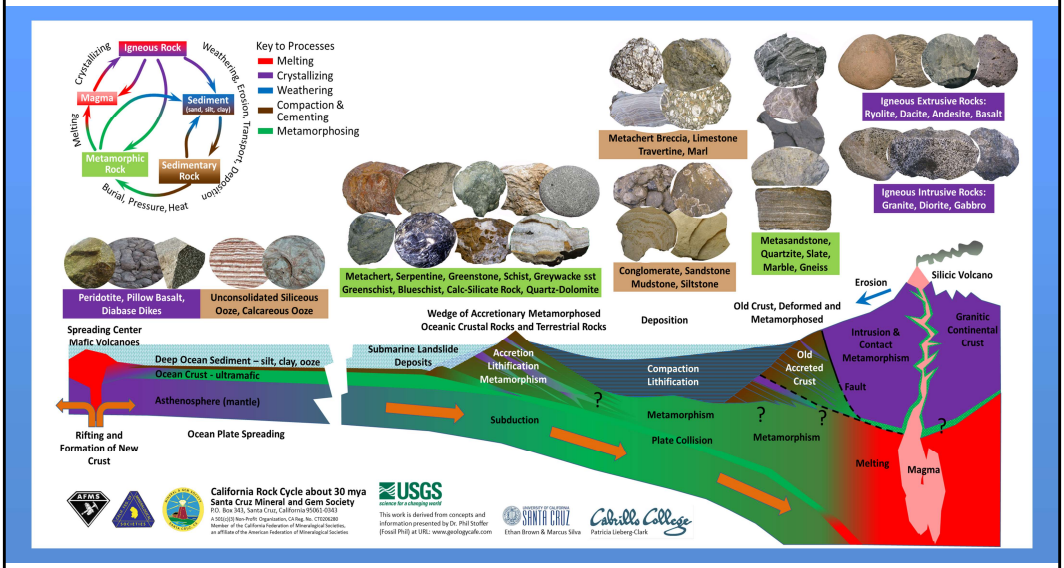
Self-explanatory. This geological overview will finish with some details and an explanation of why these deposits were not large paying mines.

Terminology

- Words one can look up on the Internet to learn more:
  - Plate Tectonics
    - Subduction zone
    - Convergent margin
    - Accretionary wedge
  - Faults:
    - Transform fault
    - San Andreas fault zone

Before we get into details, here is some terminology folks can look up later. I'll explain as we go.

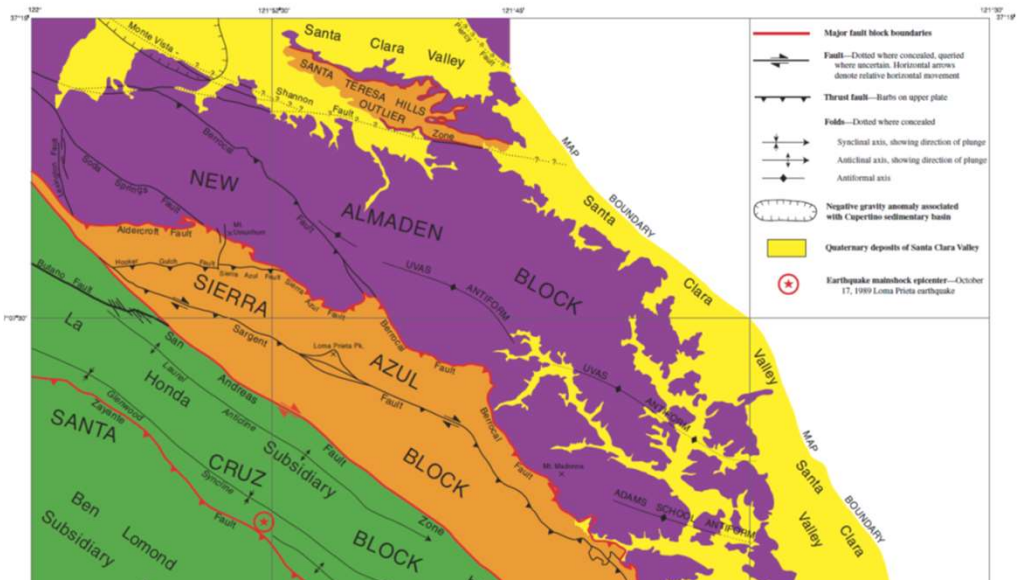
Plate Tectonics and Rocks



This is a cartoon representation of subduction occurring in the Bay Area region about 30 million years ago. Today the subduction has been replaced by the San Andreas fault, but subduction is still occurring north of Cape Mendocino, hence the active volcanoes like Shasta. Subduction occurs when plates move in response to currents in the molten rock of the deeper Earth. Subduction is driven by plate tectonics, formerly called continental drift. Ocean crust erupted at mid-ocean ridges spreads out and travels along on mantle material until it collides with lower-density continental crust. The denser water-rich oceanic crust is overrun and pushed down by the continental plate. Where the plates meet, rocks and sediments are scaped off the oceanic plate and accreted onto the edge of the continent. These are called accretionary wedges and in California they are mountainous piles of northwest-southeast trending slivers or blocks.

The velocity of the plates range from ~1 cm to ~8 cm a year, moving between about 60 and 500 miles in 10 million years. The recycling of ocean crust is so rapid that most of it is significantly younger than 280 million years. The ocean floor is recycled into the mantle, scraped off onto the continent, or melts and rises toward the surface. Mercury is a volatile metal. It forms a vapor even at room temperature. Its volatility means that it constantly cycles between the land, water, and air, and this property has caused it to accumulate along subduction zones around the world.

Major Geologic Blocks or Terranes



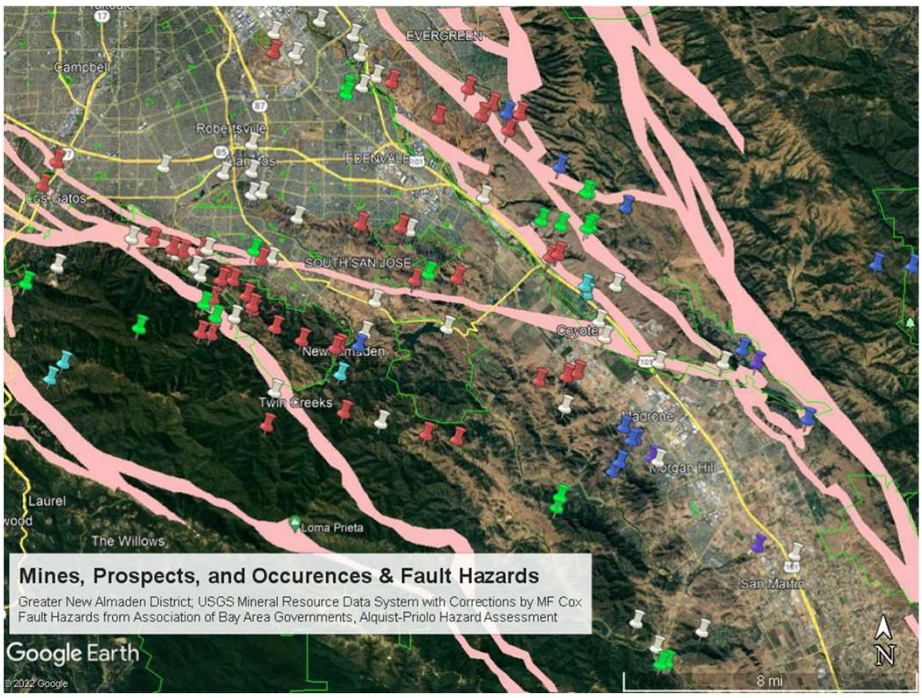
From: R.J. McLaughlin, J.C. Clark, E.E. Brabb, E.J. Helley, and C.J. Colón, Geologic Maps and Structure Sections of the Southwestern Santa Clara Valley and Southern Santa Cruz Mountains, Santa Clara and Santa Cruz Counties, California; U.S. Geological Survey Miscellaneous Field Studies Map MF–2373, Sheet 7 of 8, 1991

The Bay area is divided up into northwest-southeast trending slivers of rocks called blocks. The details of the rocks and their origins is very complex due to both subduction, the passage of one plate under another, and lateral faulting, the right-lateral San Andreas fault being the most well known. In this figure one might notice the New Almaden block is bounded by faults to the south and is covered by much younger alluvial deposits to the north. The Santa Teresa Hills are called an “outlier” by the geologists. An undulation in the thrust fault and crust, coupled with subsequent erosion, could lead to an erosional remnant of the Sierra Azul block that was thrust over the New Almaden block. The rocks are somewhat similar in type and origin, but the Sierra Azul block lacks significant mercury deposits.

For those that want a bit more detail, the following is a very general and somewhat inaccurate but good enough summary, largely based on McLaughlin et al. (2001). The New Almaden block is bounded to the southwest by the Berrocal and Aldercroft thrust faults (high-angle reverse faults) related to tectonic compression prior to the San Andreas system extending into the region about 4 to 5 million years ago. The older thrust faults are zones of weakness. Some have converted to motion related to the San Andreas fault system and some are now inactive. The faults have also allowed continued uplift driven by a slight buoyancy and ductility of serpentinite as well as local compression forcing up wedge-shaped slivers of crust, sometimes called “fault flowers.”

The rocks of the block are a complex mixture of ancient ocean crust and overlying sedimentary rocks deposited in a subduction-zone trench and on an ancient continental shelf. The rocks were accreted, piled up in wedge-shaped slices due to subduction. Accretion was accompanied by periods of exposure, erosion, subsidence relative to sea-level with new sedimentary deposition, and then further uplift and erosion. The oldest rocks are not exposed but are probably granitic rocks and ancient ocean crustal rocks dating back as much as 200 million years. The Sierra Azul block is similar in rocks and age but has been thrust over the Almaden block by compressional forces. The Santa Teresa Hills outlier is an erosional remnant of the Sierra Azul block. Structural and stratigraphic relations suggest that emplacement of the Sierra Azul-Santa Teresa

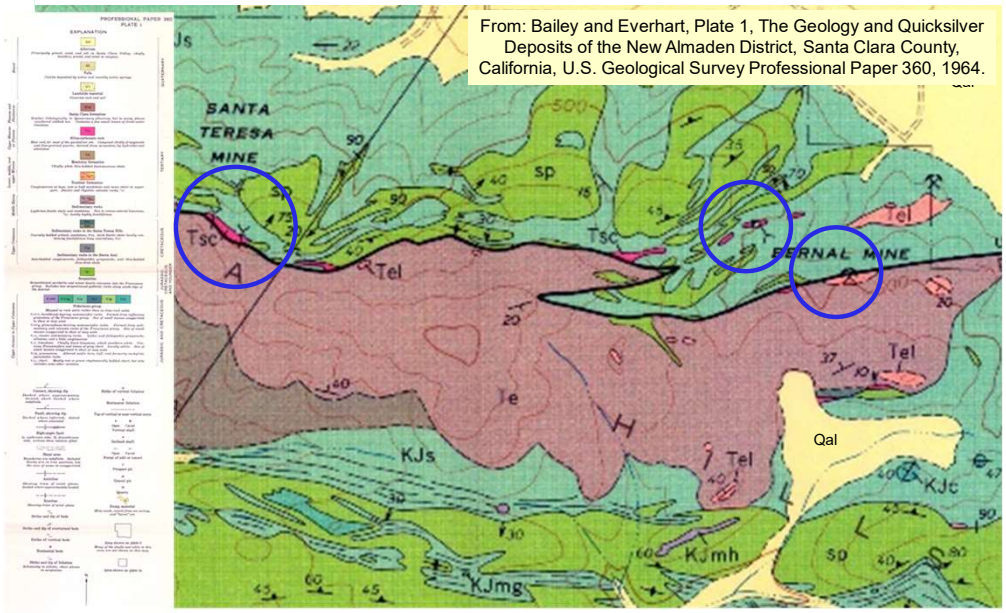
Hills block followed deposition of an Eocene (56 to 33.9 million years ago) marine section and preceded early Miocene (Saucesian, 23.7 to 16.6 million years ago) deposition of marine strata on the New Almaden block.



August 2022 Michael F. Cox and Mike Boulland 40

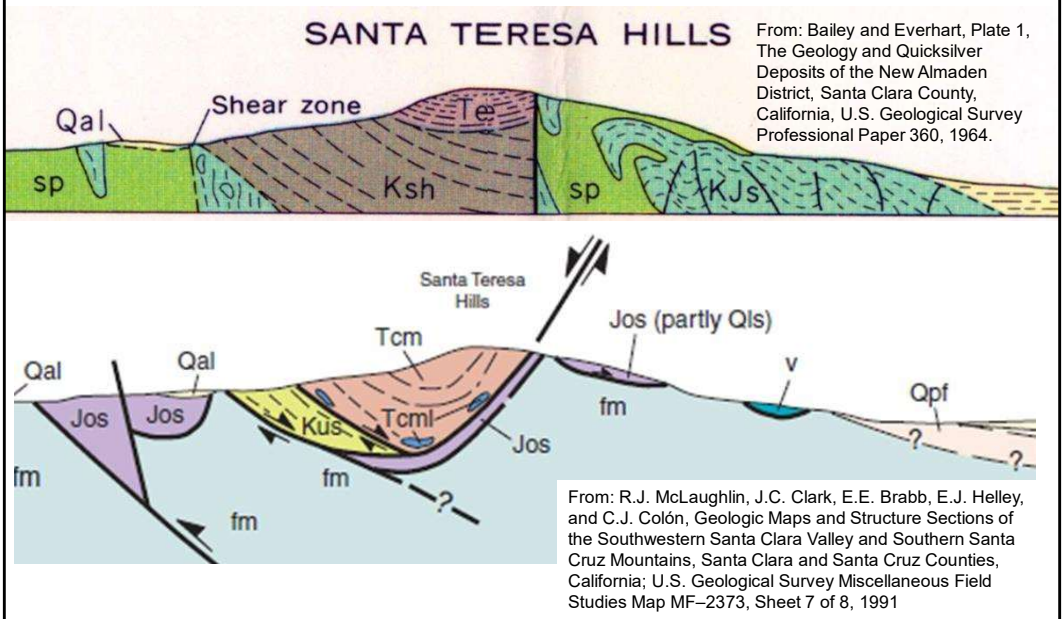
Faults are a major feature of the Bay area. The wide pink lines are faults considered to pose a hazard of slippage in our time. Mineral deposits typically are found along the faults. The pins representing mineral deposits are lineated and parallel major faults. Not shown are minor faults. Faults serve as pathways for migrating mineral-rich fluids, both hot and cold. White pins are rock, sand, and gravel operations, mainly surface quarries. Bright green pins represent chromium deposits and light-blue pins are copper. The darker blue pins are magnesium and manganese deposits. Hard to spot are a few purple pins representing lapidary material deposits, respectively silicified magnesite at Anderson Dam and poppy-jasper in the Morgan Hill area. Note the prevalence of building material quarries along the Santa Teresa Hills, with just a few mercury deposits and one chromium deposit. Most of the deposits were exploited during periods of high demand and therefore higher prices. For mercury this is the boom in gold mining in the 19th Century followed by the world wars and the technology boom of the 1950s to 1970s, when mercury mining collapsed due to international pollution concerns.

Surface Geology



Transform faulting via the San Andreas system, starting 30 million years ago, has and is continuing to bring complexity to the geology of the California Coast Ranges. This map is from seminal work done in the field from 1945 until 1956 and published in 1969. Qal = Quaternary alluvium; TSc = Upper Miocene silica-carbonate rock; Te and Tel = middle Eocene sedimentary rocks; Ksh and Kss = sedimentary rocks in the Santa Teresa Hills; sp = Jurassic-Cretaceous serpentinite; KJs = Jurassic and Cretaceous clastic sedimentary rocks of the Franciscan assemblage; KJc = Jurassic and Cretaceous chert of the Franciscan assemblage

Geology Sections- 1950s vs. 1980s



From: Bailey and Everhart, Plate 1, The Geology and Quicksilver Deposits of the New Almaden District, Santa Clara County, California, U.S. Geological Survey Professional Paper 360, 1964.

From: R.J. McLaughlin, J.C. Clark, E.E. Brabb, E.J. Helley, and C.J. Colón, Geologic Maps and Structure Sections of the Southwestern Santa Clara Valley and Southern Santa Cruz Mountains, Santa Clara and Santa Cruz Counties, California; U.S. Geological Survey Miscellaneous Field Studies Map MF–2373, Sheet 7 of 8, 1991

Two sections, drawn 40 years apart, illuminate how tectonics has influenced geologic interpretation. The 1964 interpretation at the top is based mainly on concepts from sedimentary geology. The bottom section incorporates seismic profiling and knowledge about the slices and wedges of rocks accumulated during subduction and further altered by San Andreas system faulting. The potential for economic ore is considerably less in the Santa Teresa Hills in the lower cross-section because the serpentinite-related rocks that host ore on the east side of the ridge are just thin surface exposures. Qal or Qpf = Quaternary alluvium;; Te and Tcm = middle Eocene sedimentary rocks; Ksh and Kss or Kus = sedimentary rocks in the Santa Teresa Hills; sp or Jos = Jurassic-Cretaceous serpentinite; KJs of fm = Jurassic and Cretaceous clastic sedimentary rocks of the Franciscan assemblage; Tcml = middle Eocene marl-limestone; v = basaltic rocks

Limestone in the area is old and often occurs as small blocks included in the Franciscan mélange (French, meaning pudding), the ground up and jumbled up rocks of the subduction zone, where continental and ocean plate collided. There are larger exposures, for example the Calera limestone discussed in a KQED article in 2011 (https://www.kqed.org/quest/19212/calera-limestone-a-gift-from-the-ancient-pacific). Some of the fossiliferous limestone outcrops are remnants of volcanic islands, called atolls, that rafted in on the ocean plate and became squished onto the continent. The atolls supported shell-rich coral reefs, just as they do today. An example is a bluish-white banded outcrop of limestone in a north-side road cut of Highway 17 just uphill from the Cats restaurant. I have not specifically looked at the exposures of the Bernal quarry, but the fact that they are small, discontinuous, and associated with peculiar tuffaceous volcanic rocks, leads me to believe that the Bernal marl is composed of coral-island limestone remnants.

Summary

- Bernal Mine
  - Early indigenous use (mortar rocks)
  - Old mercury prospect, small, little production
  - Old lime quarry, small, significant production
  - Ranchers trying to stay solvent?
- Santa Teresa Mine
  - Turn-of-Century mercury prospect
  - Flashy promotion
  - More music than gold?

Both mines are small. The Bernal reportedly made a flask of mercury and some tens of tons of marl for agricultural use. The mine reportedly burned the marl to reduce it to lime, but records do not indicate this. I characterize the operation as one lead by the Bernal family to supplement their ranch operating income. The Santa Teresa mine strikes me as pure promotion – having fun prospecting with OPM (other people's money.) There is also the possibility the Santa Teresa promotions were used to get money for additional work at the San Juan Bautista (later Hillsdale) mine, a mine that had been somewhat over promoted. "More Music than Gold" is a phrase used by the late Jimmie Schneider. It means more song and dance (promotion and excuses) than actual riches for the workers and investors. Sound familiar?

In 1976, this 18-year-old fellow did not yet know the mercury industry had no future. He was too busy studying and crawling around in the recently abandoned mercury mines. I am among a small group of people who have focused on mercury, but I also have had a very varied and wonderful career that includes a wide range of subjects, from basic geology to complicated business process management. This has made me an optimist and believer in the power of technology.