

CALIFORNIA STATE MINING BUREAU.

HENRY G. HANKS, STATE MINERALOGIST.

FOURTH ANNUAL REPORT

OF THE

STATE MINERALOGIST

FOR THE YEAR ENDING MAY 15, 1884.



SACRAMENTO:

STATE OFFICE, JAMES J. AYERS, SUPT. STATE PRINTING.

1884.

The following is an analysis of a sample of maltha from the tar wells of Santa Barbara, made by J. M. Robertson:

Indorsed: Liquid mineral tar from Biggs' ranch, Carpenteria, Santa Barbara, Cal.

S. W. HOLLADAY,
302 Montgomery Street.

SAN FRANCISCO, July 1, 1884.

Nitrogen	2.25
Carbon	70.00
Hydrogen	10.00
Oxygen	8.50
Ash	9.00
Insoluble matter, whitish25
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Centesimally	100.00

Wholly soluble in ether. Partly soluble in alcohol.

J. M. ROBERTSON, Chemist.

SAN FRANCISCO, August 20, 1875.

The following lists comprise the countries and localities in which petroleum has been found in greater or less quantities:

UNITED STATES.

Alabama, California, Colorado, Georgia, Kentucky, Maryland, New York, Ohio, Oregon, Pennsylvania, Tennessee, Texas, Virginia, West Virginia, Wyoming.

CALIFORNIA.

So far as surface indications go, petroleum has a wide range in California, springs and pools of the fluid being encountered in nearly all the coast and also in some of the inland counties of the State. In the more southerly tier of counties it generally occurs in connection with extensive beds of asphaltum or *bréa*, this being also the region of the more productive oil wells. To the extent above denoted petroleum has been found in the following counties in this State, viz.: Alameda, Colusa, Contra Costa, Humboldt, Kern, Lake, Los Angeles, Mendocino, Napa, San Bernardino, San Luis Obispo, San Mateo, Santa Barbara, Santa Clara, Santa Cruz, Sonoma, Tulare, and Ventura.

FOREIGN COUNTRIES.

Argentine Republic, Burmah (Rangoon), Canada, Cuba, Germany, France, Italy, Mexico, New Zealand, Persia, Russia (Baku), Spain, Switzerland, Trinidad, United States of Colombia, and Venezuela.

HISTORY OF PETROLEUM IN CALIFORNIA.

Petroleum has been known to exist in California since the earliest settlement of the country. The black "maltha" oozing from the earth and standing in pools, or flowing from springs on the hillsides, was evidence of the fact; still no attempt was made toward utilizing this valuable material in a large way until 1857. About this date, as near as I can gather, Mr. Charles Morrell, a druggist in San Francisco, made the first attempt to produce coal oil from California crude materials. He commenced operations in Santa Barbara County, near the line of Ventura County, in the vicinity of Carpenteria. The

bluff on the seashore is about fifty feet above tide level, and from eight to ten feet below the surface there occurs a stratum of coarse sand, of a yellow color, two feet thick and lying horizontally, or nearly so, that is saturated with maltha, mineral tar, or liquid asphaltum. Mr. Morrell erected quite extensive works, well supplied with cast-iron retorts, furnaces, etc., in which the crude material was refined by distillation, and oil produced; but for some reason not now known, the enterprise was a failure.

In 1856 a San Francisco company commenced working at the Brea ranch, near Los Angeles, and tried to obtain refined oil; the particulars of their operations are not now obtainable.

Andreas Pico knew the locality now called Pico Cañon, Los Angeles County, for some years before Mr. Morrell established his refinery, and had made oil for the San Fernando Mission in a small way, in a copper still and worm. He was probably the pioneer coal oil manufacturer of the State.

In 1857, W. W. Jenkins, W. C. Wiley, and Sanford Lyon, visited Pico Cañon to look for mineral and oil. Francisco Lopez, former steward of the San Buenaventura Mission, and superintendent of the gold placers, had informed them that there was oil, which they found oozing from the ground in what are now called Pico, Hooper, Sespe, Casteca or Pine, and Piru Cañons. No further attempts to produce coal oil appear to have been made until 1864; when the Buena Vista Petroleum Company was incorporated, in February, but active operations were not begun by them until the following year, when they commenced work in Tulare County under the title of the Buena Vista and the First National Petroleum Companies.

April 8, 1865, Professor Silliman published a letter to the Hon. D. H. Harris, entitled, "California Oil not Asphaltum." This letter was afterwards printed in the *Mining and Scientific Press*. Silliman quoted Professor Brewer, to the effect that the oil at Humboldt was light enough to burn quite well in a chimney lamp without refining. Also, that one spring on Azuza (now Sespe) Mountain, behind San Buenaventura, furnished an oil so thin that Brewer had seen it in use in a common lamp without rectification. Professor Silliman wrote that he had obtained ninety-six per cent of good oil from a sample of it. The publication of this letter had great influence in stimulating the search for and study of California oils. None of the wells had at this time reached any considerable depth, but there was great activity in prospecting for oil.

About this time, J. C. Cherry came to California, having in contemplation the erection of an oil refinery. He visited and made a favorable report on the property of the Point Arenas Oil Company.

The San Fernando Petroleum and Mining District was located in June, 1865, with Mr. C. Leaming, Recorder, who still holds that office, and the San Fernando Petroleum and Mining Company incorporated.

During 1865 operations were commenced on Mattole Creek, Humboldt County, by the North Fork Oil Company, and on August third, at the Mattole well, a burst of oil and gas rose several feet above the opening. This action lasted for a few minutes only, but left the well full of oil. The next day it was pumped out, and the same action was repeated, as was the case on the fifth and sixth days. Thirty barrels of oil were shipped to San Francisco. "Six twenty-gallon casks of crude oil," by another statement, was the first shipment of oil received from the north.

The Bolinas Petroleum Company began operations at Bolinas Bay. The works were situated in the Arroyo Honda, on the Bolinas grant. The San Pablo Petroleum Company, located one mile from San Pablo, Contra Costa County.

At the Adams well, Mount Diablo, San Joaquin County, active operations were commenced. The Adams was the pioneer in that district.

Near Lexington, Santa Clara County, some Portuguese sunk an open shaft 135 feet deep; no results were obtained beyond indications; the prospect was for coal.

In Moody Gulch, Santa Clara County, the McLeran(?) well was sunk to a depth of 500 feet, and about one barrel of oil obtained per day. Moody Gulch was named from Moody's sawmill that once stood there.

Oil was discovered on Bell's ranch, 15 miles below Halfmoon Bay, San Mateo County, and at Purissima Creek.

The Pennsylvania Petroleum Company commenced operations near the seacoast, six miles south of Santa Cruz.

The Philadelphia and California Petroleum and Santa Barbara and California Petroleum Companies were incorporated.

Rowe and Fleeson sunk a well one mile below Simmons Spring, Sulphur Creek, Colusa County.

The Antelope Valley and the Pioneer Oil Company, Colusa County, commenced operations for the second time.

The Los Angeles Petroleum Oil Company began sinking a well by steam power, and on April twenty-eighth were down 130 feet.

The Paragon Petroleum Company commenced operations, and the Humboldt Oil Company was incorporated.

In May forty cases of crude oil were sent to San Francisco from the San Joaquin and Pacific Oil Companies of Tulare County, which was shipped east on the steamer of the eighteenth.

In this year there was published a tabular statement, naming the oil companies to the number of sixty-five. Nominal capital, \$45,000,000.

In 1866 Mr. Charles Stott began work on Santa Paula Creek, Ventura County, at the base of Sulphur Mountain, and erected a refinery on a small scale. He made several thousand gallons of illuminating oil, and then gave up the enterprise because it did not pay. October twenty-second, the San Francisco *Alta* published an article on petroleum and refineries, giving Charles Stott credit for refining the first oil in this State.

In this year there were two refineries established in San Francisco, one owned by Hayward & Coleman, the other by Stanford Bros. Neither of these establishments achieved any considerable success, and were eventually abandoned.

Mr. — Polhemus, also, had a refinery at Los Angeles. A portion of the crude oil which he refined was obtained from wells near the town of Los Angeles, and some was hauled by teams from Pico Cañon.

Mr. Hughes bored for oil in Pico Cañon, and struck a flowing well at 140 feet, but the tools became fast in the well and could not be extricated.

A well was sunk on the Potrero, in San Francisco, but the result was not satisfactory. There was considerable excitement about oil during this year.

The "Pioneer Petroleum and Refining Company," of San Fran-

cisco, was incorporated. Charles Stott, David Hunter, and H. P. Wakelee, Trustees.

In 1867 Lyon and Jenkins returned to the claims they had examined ten years before. Jenkins went to Sespe and Piru; Lyon remained at Pico. Lyon's Station was named from him; he died in 1883.

The " Fargo " well, sunk at Moody Gulch to a depth of 400 feet, yielded one barrel per day; and from a well at Griswold's place, two miles from Lexington, 500 feet deep, some oil and salt water were obtained.

In a well sunk in Colusa County the water in the well was seen to rise like a tide at 3 P. M. and at 6 A. M. At Antelope Valley, 18 miles north of Oil Center, in the same county, there is a salt pond, and salt water is found in the oil wells. At this time eight oil wells had been sunk in Colusa County.

On January twenty-eighth, twelve barrels of crude oil were shipped from Pico Cañon, Los Angeles County.

The following account of the operations of the Buena Vista Petroleum Company—whose oil claims, comprising some twelve to sixteen hundred acres, are situated in Kern County, west side of Tulare Valley—is of interest. The exact location is Township 30 south, Range 22 east, Sections 19, 20, and 29, and in Township 30 south, Range 21 east, Sections 12 and 13. Previous to 1866, Mr. Stephen Bond and Mr. E. Benoist commenced a well on the flat below the tar springs on the company's claims. At a depth of sixteen to eighteen feet, in raising the auger they turned it the wrong way and unscrewed and lost the bit, which accident stopped the work.

In 1866 the Buena Vista Company set a still with a daily capacity of 300 gallons near a large spring of good water, three miles from the oil springs. The company attempted to sink a well for water in a more convenient location but did not succeed in obtaining it. For thirty feet or more the formation was alternate layers of shale, sand, and asphaltum; below thirty feet was a three-foot stratum of asphaltum very difficult to penetrate, but no water. Two adobe buildings were erected, one for the refinery, the other for the workmen. The oil belt lies along a low range of hills for several miles north and south, on which sulphur springs are quite numerous. Most of the oil croppings are from 200 to 500 feet above the level of the valley. At the Buena Vista springs the oil has flowed out and covered several acres in the form of glossy black asphaltum. There are numerous bubbling tar springs on the flat, from which liquid asphalt or oil flows and gases emanate. Sometimes the imprisoned gases form a globular bubble in the thick oil a foot or more in diameter, which eventually bursts and the tarry liquid subsides again to its level. The asphalt stream extends half a mile or more over the sandstone and to the valley below. The crude oil for the refinery was taken from pits or shafts sunk from 16 to 18 feet deep. There were also several shallow pits or wells which soon filled with oil and water. At the bottom of the shafts a quicksand of oil, water, and sand was met with which could not be overcome by curbing, or otherwise controlled. An open cut was then made into the hill, but a solid formation of sandstone and thick beds of asphaltum were met with. The cut was 7 to 8 feet deep and 4 wide, from which some tarry asphaltum was obtained and distilled. At one time, from the shafts and cut, it was believed that from 5 to 8 barrels a day could be collected. Oil procured from the surface

marked 10 to 12 degrees Beaumé, at a depth of 10 feet in the shafts it marked 12 to 14 degrees, and at 20 to 30 feet in depth an oil was found as light as 21 degrees.

Three thousand to four thousand gallons of refined oil were produced. In the distillation the following results were obtained: First run five to seven per cent from forty-seven to forty-three degrees, forty per cent from forty to thirty degrees, thirty-five to forty per cent from twenty to sixteen degrees. The residue left in the still was soft asphaltum, which could be removed without difficulty. They generally ran off from eighty-five to ninety per cent from the charged still, when the residue would continue to run off from the tap while hot. Many difficulties met with by the company caused the work to be abandoned. Freight was high, \$60 to \$70 per ton to San Luis Obispo, and from \$15 to \$20 more to San Francisco. The nearest fuel or timber were the forests of the Santa Meta Mountains, lying thirty miles south. From the time the company discontinued work nothing has been done at this locality. Many bones of animals, thought to be fossil, were found in the vicinity. In this year Professor Silliman wrote his celebrated paper on California petroleum, which has called forth so much comment. It was published in *Silliman's Journal*, previous to its being read before the California Academy of Sciences, April 1, 1867, for which reason it was not published in the proceedings of that society. The following are extracts from a condensation of the paper, which appeared in the *Mining and Scientific Press*, April 6, 1867. The experiments were made on a sample of oil from Mattole Creek, Humboldt County, a thick viscid maltha, having a density of .980=31° B. By fractional distillation he obtained a series of light and heavy oils, ranging from .700 to .918 specific gravity. No paraffine was obtained by freezing with a mixture of ice and salt, from which he drew the conclusion that there was none of that substance in the California oils. The light oils obtained were 12.96, 14.56, and 18.96 per cent of the crude oil. It was his opinion that the oil of California could not compete with the oils of Pennsylvania at the prices then ruling, but he believed that our heavy oils would be extensively utilized as a fuel, in which prediction he has been sustained by history, has been shown.

Among the specimens from California, sent to the Paris Exposition of 1867, were petroleum from Mattole, Humboldt County; Joel's Flat, Noble Springs, Santa Barbara County; Wiley's Spring, San Fernando Mountain (Pico Cañon), Hughes' Spring, and Pico Spring, Los Angeles County; Hayward & Coleman's claim, Sulphur Mountain, Ventura County; Stanford Brothers' claim, same locality; from Canada Larga, Santa Barbara County; from Santa Cruz County; Bear Creek, Colusa County, and Charles Stott's claim, Santa Barbara County.

Experiments were made at Corral Hollow, San Joaquin County, to distil coal oil from shale, which did not prove a success.

In 1868 Mr. — Davis leased the Wiley Springs in the San Fernando Mountain. He collected all the oil he could and sent it to the Metropolitan Gas Works in San Francisco for about a year. Metropolitan Gas Company's office was at that time at 810 Montgomery Street, San Francisco.

In 1869, the first work was done at Pico Cañon, by Mr. Hughes, who put down a spring-pole well called the Pico Well. A similar well was sunk about the same time at Wiley Springs. Wiley Cañon is three miles northeast from Pico Cañon.

In 1871, petroleum was discovered on the Augmentation Ranch, Sequel, Santa Cruz County. Oil was also found in Livermore Valley, Alameda County.

In 1872, Charles Stott again worked the Sulphur Mountain property in Ventura County; this time with better success.

In 1873, the Star Oil Company, of Los Angeles, built their first still in San Francisco, and shipped it to Los Angeles County. The works were established at Lyons Station, under the superintendence of Captain William B. Smith, refiner. This was one mile from the present Newhall Station, and was the foundation of the present refinery at Pico. Wood was used as fuel. There were many different ideas as to the nature of the oil and the mode of purification. No satisfactory results were obtained at this time, and in 1876 the works were sold to Scott & Baker, who also failed to make them pay. Mr. Shoemaker succeeded them, but did not produce oil in sufficient quantity to be profitable. Mr. J. A. Scott then took the refinery, and met with fair success.

In 1874 Messrs. Temple, Moore, and Pico, worked in Pico Cañon. The oil they obtained was sent to the refinery at Lyons Station, which was subsequently removed to Pico. At this time there was considerable activity in the production of petroleum at Sulphur Mountain, Ventura County, so named from the numerous sulphur springs. Hayward's claim produced ten barrels daily of 32 gravity oil. Stanford's, six barrels daily; Santa Paula Oil Company, ten barrels daily; San Fernando Company, near Canulos, about ten barrels daily. All the oil was obtained from natural flows. Two hundred barrels per month was used by the Central Pacific Railroad for lubricating purposes, but beyond this there was no demand for the crude material. At this time there were also some new oil springs discovered at Sespe.

During the year 1876 the Star Oil Company was engaged in sinking wells in Pico Cañon. The yield of the district amounted to forty barrels per day.

In 1877, the California Star Oil Company, of Los Angeles County, under the management of J. A. Scott, produced twenty barrels of refined oil daily at the Pico refinery. The Ventura wells were then producing eighty barrels daily, and those of Pico Cañon from forty to fifty barrels. Work of development by steam machinery commenced at this locality.

In 1878, Chas. N. Felton and P. C. McPherson commenced work in Moody Gulch on the old Boyer well. At 700 feet a rush of oil and gas occurred which rose 100 feet above the mouth of the well and 100 barrels of oil were supposed to have been lost. For some time after 60 barrels of oil per day were pumped from this well, which had a gravity of from 46 to 47 degrees Beaumé. The oil was sent to the Pico refinery, near Newhall, Los Angeles County. In September of this year, in a communication to the *Mining and Scientific Press*, Mr. Edward Madden, an oil expert, stated that the oil of Ventura County was inferior to that of Pennsylvania as an illuminator, but superior as a lubricator.

In the same paper he gives the production of the Star Oil Works at 150 barrels per day, and the yearly consumption of California at 3,500,000 gallons, valued at \$1,000,000. His opinion, based on surface indications, was that the southern portion of Los Angeles County was full of oil.

October, 1879, the *San José Mercury* contained an account of the

successful prospecting for oil in Moody Gulch, Santa Clara County, Santa Cruz Mountains. Dall Brothers, employed by the Santa Clara Petroleum Company, at a depth of 600 feet struck a vein of oil which spouted 100 feet above the top of the well. Having no tanks, etc., 100 barrels or more of oil ran to waste. After a time the flow subsided but recurred again at intervals. This strike created a great excitement.

At this time, there were five wells at Pico from 200 to 600 feet deep; eight wells in Ventura County on ex-mission lands, from 100 to 200 feet deep, all yielding oil by pumping, in all, 20 barrels per day; and one well at Sespe 1,500 feet deep, yielding 100 barrels per day. September tenth, Pacific Coast Oil Company of San Francisco was incorporated.

In 1881, A. C. Dietz & Company established the Berkeley Lubricating Oil Works, for the manufacture of lubricating oils from California material brought from Ventura County. They turned out 100 barrels per day. In February, there were seven new wells being drilled in the State, and the product during the past year had doubled. The oil business in California was at this time of greater magnitude than was generally supposed. Citizens of Los Angeles, Ventura, and Santa Barbara Counties, signed a petition asking the U. S. Government to instruct Clarence King, Geologist, to make surveys of the oil districts; and to note the progress of development since 1865. They represented that a belt of oil shale extended for eighty miles in length, from the San Fernando district in Los Angeles, through the Sespe, Santa Paula, Ojai, and Sulphur mountains in Ventura County, and the Carpenteria and Santa Barbara districts, terminating in the Pacific Ocean at Goleta, in Santa Barbara County. That, although the indications were encouraging, yet the work had been done somewhat blindly, and without scientific guidance; much money had for this reason been lost, believed to be as much as \$1,000,000 with unsatisfactory results. Practical oil men, and capitalists, familiar with the subject, were of the opinion that the results of their work indicate that large quantities of petroleum of good quality exist, but that they fear to progress without scientific guidance. In consideration of the importance to the whole country of the vast interests involved, they felt they had a right to ask aid from the General Government.

This year (1884), Mr. Lyman Stewart, of the firm of Harrison & Stewart, informed the State Mineralogist that the Pennsylvania company of which he is a member has invested, in Pico Cañon and elsewhere in Los Angeles and other counties, \$130,000, a large portion of which is a loss. They sunk six wells in Pico Cañon and one at Santa Paula, all of which are "dry holes." Mr. Stewart is from Titusville, Pennsylvania. He brought out thirty men, all skilled workmen. Some of the wells sunk by them were very deep. He said that if he could obtain oil in one well, the company would soon make up the loss. They are now boring in Pico Cañon, near the Pico well.

PETROLEUM IN CALIFORNIA—LOS ANGELES COUNTY.

The Chandler Oil Mining Company, of Los Angeles, was incorporated February, 1884, George Chaffey, President, C. H. Howland, Secretary, B. Chandler, Superintendent. The company's wells are at Petrolia, Section 5, Township 3 south, Range 9 west. They commenced operations on Puente Ranch, Section 1, Township 3 south, Range 10 west, and obtained oil at from 100 to 300 feet, sp. gr.=15° to

30° B. One well produced 150 barrels, which sells for \$4 50 to \$12 per barrel. Mr. Chandler informed me that within two years 5,000 barrels had been produced at Petrolia, which I visited in May, 1884. Two wells were being sunk: Number one was 290 feet deep; number two was 240 feet deep. From number one quite a quantity of "black tar oil" (maltha) had been pumped. A tank, holding from seven to ten barrels, was standing full. Common bréa, which contains what seems to be ionite, is burned under the steam boiler, and is the only fuel used. (The presence of ionite was also observed at Sargent, Santa Clara County.) The wells at Petrolia are on small foothill elevations above Anaheim, direction or trend of the hills is about east by south. A small creek runs down south by west to the plains. On both sides bréa has run down and formed terraces, as at Sargent, and the "black tar" is similar. Of the bréa there are several varieties: Cellular, like volcanic scoria, and mixed with sand; several grades pure "black tar," and some brown and light, like ionite, which it seems to be. At Swallow Point the soft sandstones resemble those at Pico Cañon. In several directions from the oil wells may be seen extensive patches of bréa, which have flowed from the hillsides.

Mr. J. W. Snow's well is about a mile from Petrolia. It is 550 feet deep, but unfortunately for the owner it is a "dry hole." There are large fields of bréa contiguous containing much of what is thought to be ionite. The sides of the cañon in which the well lies are sandstones and conglomerates, with rather thick seams of selenite interstratified. The stratification is confused and broken so that no section could be found exposed. A shark's tooth described elsewhere was found at this point.

The well was first a square shaft, 44 feet deep, from the bottom of which a six-inch well was sunk through soft sandstone. At 250 feet and for 150 feet lower probably, sandstone was cut through. The sand is like that in the bréa. High up the cañon sandrocks were found seemingly in place, dip 32°, strike N.W. to W.N.W. The tertiary fossils found here are described elsewhere.

SITES OF THE MORE PRODUCTIVE WELLS—PICO CAÑON.

At this place, seven miles southeast from the town of Newhall, Los Angeles County, the Pacific Coast Oil Company have sunk a number of wells, 16 of which are producing more or less oil, some of them yielding as much as 75 barrels per day. Besides the wells already producing several others are being put down. The borings here reach to various depths, many of the wells being down over 1,000 feet. Several have been sunk from twelve to sixteen hundred feet, and one has reached a depth of 1,900 feet. Many pumps and derricks can be seen here in constant operation, the former lifting the crude oil from the wells that are already yielding, and the latter working the boring apparatus of those being put down. The oil at this locality is found on one side of an anticlinal fold or break, as it is called, and after being pumped to the surface is collected from the various wells and conveyed by a four-inch iron pipe to the large receiving tank, located centrally to the group, whence it is carried by a two-inch pipe to the company's refinery, near Newhall. Some of these wells, after flowing sparingly for a time, again yield more freely, these periods of partial intermission occurring without much regularity.

The characteristic sandstone and conglomerates appear here, sam-

ples of which were obtained for the State Museum. Bréa deposits were also noticed on the adjacent hillside. In the vicinity of the wells are located the workmen's quarters, shops, and other outbuildings of the company; the manager of these works is Mr. R. Craig.

The oil wells, refineries, and plant of the Pacific Coast Oil Company, of San Francisco, C. N. Felton, President, D. G. Scofield, Auditor, E. Wheaton, Secretary, are the most extensive and successful on the Pacific Coast. I addressed a letter to this company, asking certain questions, the answers to which I thought would be of interest to the people of the State. My questions, with the answers returned by the President of the company, are given below:

QUESTIONS.

- Question 1. When was the Pacific Coast Oil Company incorporated?
 Q. 2. When was work commenced in Pico Cañon, Los Angeles County?
 Q. 3. What was the cost of the two refineries?
 Q. 4. How much capital is invested?
 Q. 5. Is the table of production in Williams' "Mineral Resources" correct (1878 to 1882 inclusive, 197,484 barrels)?
 Q. 6. What has been the production since 1882?
 Q. 7. How much was produced before 1878?
 Q. 8. What is the daily average yield at Pico Cañon, Los Angeles County?
 Q. 9. What has been produced in Moody Gulch, Santa Clara County?
 Q. 10. To what extent has California oil decreased importation?
 Q. 11. Is any California oil exported, and where?
 Q. 12. What is the number of producing oil companies in the State?

ANSWERS.

- Answer 1. September 10, 1879.
 A. 2. Work was commenced in Pico Cañon in 1875, by the drilling of three shallow wells with spring pole, all of which yielded oil at depths of from ninety to two hundred and fifty feet. Actual work of development commenced with steam machinery in 1877.
 A. 3. Refinery at Alameda Point cost \$160,117 43; refinery at Newhall cost \$25,266 64.
 A. 4. Amount of capital invested, say, \$2,500,000.
 A. 5. Cannot say; have not seen table referred to.
 A. 6. 190,540 barrels.
 A. 7. See Journal of Commerce Annual for 1883.
 A. 8. 560 barrels.
 A. 9. About 24,000 barrels.
 A. 10. About 33½ per cent of all kinds.
 A. 11. Exported to British Columbia, Sandwich Islands, Mexico, and Society Islands.
 A. 12. Companies actually producing oil: Pacific Coast Oil Company, San Francisco Petroleum Company, California Star Oil Works Company, Mission Transfer Company, Santa Clara Petroleum Company. Numerous companies have been formed, some have drilled shallow wells, but the above are all that have successfully produced oil.

TUNITAS CREEK, SAN MATEO COUNTY.

This oil district visited April 21, 1884, is situated in San Mateo County, being in Township 6 south, Range 5 west, Section 25. Several wells have been sunk here, one named the Balmoral, to a depth of 586 feet, without obtaining oil. From another, not named, light green oil was being pumped from a depth of 550 feet. The following phenomena, as furnished me by Mr. H. W. Bodwell, in charge of the work, were observed in sinking the Balmoral well:

- From 100 feet to 140 feet showing of oil; best about 130 feet.
 Two hundred and thirty-five feet, abundant salt water.
 Two hundred and fifty-six feet to two hundred and eighty feet, showing of oil and gas.
 Three hundred and eighty-six feet, smells strongly of gas.
 Four hundred and thirty feet to bottom (586 feet), gas quite abundant.
 Four hundred and sixty feet, black soot appeared on water very abundantly.
 Four hundred and seventy feet, showing of oil.

Crude petroleum is used as a fuel under the boilers here, being applied in the usual manner with a jet of steam.

MOODY GULCH, SANTA CLARA COUNTY.

Visited this locality, which lies about two miles southeasterly from Alma, Santa Clara County, April 17, 1884. The deposits here are owned by the Santa Clara Petroleum Company, who have sunk two wells at the same level, but on opposite sides of the cañon, and about eighty-five feet apart, the elevation here being 970 feet above sea level. Each of these wells has been furnished with a hand windlass, steam engine, pump, etc. A tank, connected with the wells, has been put up here. From this tank a two-inch iron pipe extends to another and larger tank, located some distance down the cañon, and from which the oil is conveyed by a similar pipe, thence to the railroad, about one mile distant. These wells are named Moody Nos. 1 and 2, and though idle at the time of my visit, have produced considerable oil, judging from what could be seen and learned. The direction of the cañon changes at this point and continues towards the top of the hill, about W.N.W.

At a height of 1,040 feet another well, with derrick, engine, pump, etc., is encountered. But, as below, nothing here was being done, the machinery being partially dismantled and the whole place much neglected; though here, too, some oil had evidently been produced.

The next well, No. 7, was met with at an altitude of 1,120 feet. Here the engine was working and the water being bailed out, preparatory to further sinking. Though no oil in quantity had been produced here, I examined some brought up with the water, and found it to be thin and of a green color and good smell. There are signs of this well having at some time been on fire, though I was unable to learn much about its present condition or past history.

Ascending the cañon, the last well in this series was reached at a height of 1,160 feet, and about 200 feet below the summit of the hill. Here, some oil contained in a tank was examined and found to be fluid, and of good smell and color, quite unlike the tarry liquid seen at the Sargent Ranch. The power here is supplied by a steam engine of from eight to ten horse-power. From the main pulley, a belt extends to another near the mill. The pump is worked by a crank and beam, the machine being controlled by a friction pulley shifted by a lever. On the throttle of the engine there is fixed a small pulley, and a still smaller one near the pump where the fireman stands. A rope transfers the power from the larger to the smaller of these pulleys, enabling the fireman to shut off or turn on the steam at will, without moving from his station. The engine can also be reversed by the motion of a lever which changes the pitman from one eccentric to another. At the top of the derrick, standing over the well, there is placed a large iron pulley over which a rope passes, and running through a block near the floor extends to a winding pulley driven by the engine. There is also a heavier and shorter rope, and a hand-windlass, used in boring, drilling, etc. The oil is pumped first into local tanks, when it is carried by gravity to the collecting tank. Here the water having been drawn off, it is passed to the lower tank, and, finally, to the railroad.

REFINERIES.

The Pacific Coast Oil Company has erected works, for refining crude petroleum, at Pico, near the town of Newhall, Los Angeles County, and which were visited May 11, 1884, which is referred to in the "History of Petroleum in California." The offices of the company are located in the town of Newhall. The oil here treated is obtained from the wells in Pico Cañon, seven miles distant, whence it is conveyed through a two-inch iron pipe to a large iron tank or receiver. From this receiver it is again carried by gravity through iron pipes to the refinery. From the refinery the product and by-products are conducted to storage tanks. From these tanks pipes lead to the side-track of the railroad, these pipes being sufficiently elevated to discharge the oil into box cars, in each end of which there is a boiler iron tank of a capacity of 50 barrels—a carload consisting of 100 barrels of oil. The globe valves are reached from an elevated platform placed along the side-track. The stream of oil is guided into the manhole opening in the car tank by loose elbows and joints of pipe (practically a goose-neck). The manhole plates screw down. Elbows below are furnished with discharging cock, three inches in diameter, to which flexible tubes being attached the tanks are readily emptied of their contents.

Portions of the crude oil from this locality are sent to San Francisco, Los Angeles, Colton, Arizona, and elsewhere. It is used at Colton for burning lime, and at Los Angeles for fuel in electric light works and in burning brick. The refined oil is sold for local use in the southern portions of California and in Arizona. It is water white and burns freely in the mechanical lamp. Sp. gr. 797=46° B., which is rather heavy for a good burning fluid in the ordinary lamps. This Newhall refinery was erected before the extensive works at Alameda Point were put up. Though not protected by a building such is the mildness of the climate that no serious inconvenience has been experienced from this deficiency.

About four and a half years since, Mr. A. E. Edwards put up a refinery in the valley of the Santa Clara River, Ventura County, at which oil from the wells on the Little Sespe was treated. For the conveyance of the oil a pipe was laid down along the Little and the Big Sespe, connecting the wells with the refinery. The crude oil from these wells had a specific gravity of 42°. The refined was water white and burned well in lamps, according to an editorial statement in the Los Angeles *Commercial*. These wells lie in Section 6, Township 4 north, and Range 20 west, San Bernardino meridian.

May 5, 1884, I visited the refinery of the Pacific Coast Oil Works at Alameda Point, Woodstock Refinery, G. R. Miller, Superintendent. The works are contained in an area of 30 acres, in which there is ample room to increase the capacity of the works as occasion may require, which depends in a great measure on the supply of crude oil that can be obtained in the State.

The large retort now in use has a capacity of 850 barrels. The crude oil is forced in from the receiving tanks by steam pumps. The heat is generated under the still by burning jets of refuse petroleum, forced in by a jet of steam. The lighter oils first come over, and are conveyed through pipes laid in wooden boxes surrounded by water. The condenser is, in effect, a Liebig cooler on a very large scale.

The pipes extend for several hundred feet to the receiving house, from which the oil is conveyed to storage tanks of boiler iron placed in convenient localities.

The first distillation is not continued to dryness, but is discontinued when the residue is of a certain consistence, suitable for burning, when the still is allowed to cool to 300° or thereabout, after which the tarry residue is pumped into receiving tanks and used as fuel. Near the large retort, there is one of different construction, which is continuous in its action. It holds 80 barrels, but the daily capacity is 300 barrels.

There are two stills heated by steam, and used for fractional distillation of the first distillate. The products pass through the same cooler, and are received in the receiving room, and passed to the different tanks.

The fractional distillation is managed by means of an appliance, called "observation boxes," in which the operation can be seen. At the proper time the distillate, when it has attained a certain gravity, is diverted into different pipes leading to receiving tanks. The observation boxes are of plate glass.

There are fourteen receiving tanks of various sizes, one being devoted to the storage of oils from Santa Cruz County—others for the southern counties.

In one part of the inclosure are two elevated tanks, in which the oils are mixed with chemicals, by which they are refined. In octagonal buildings, with glass set in the roof and sides, there are two bleaching tanks; with a capacity of one thousand barrels each, in which the refined oils are exposed to the sunlight for a time, which is one operation in the process of refining.

In the boiler-house there are two large boilers, heated by refuse petroleum, blown in by a jet of steam and ignited. The consumption of carbon is so perfect that no smoke is seen to escape from the chimneys.

Mr. Miller made some experiments in the direction of burning brick by petroleum fuel, with only partial success; but the results of the experiments were such that he thinks the next will succeed, and that the cost of burning brick will be much abridged.

The Pacific Coast Oil Company have not succeeded in supplanting the eastern market, but have stopped the importation of lubricating oils, naphthas, and benzines to the extent of one third. From the fuel tanks a portion not required for burning, including "bottoms," is at intervals pumped into six stills, heated by open fires, from which a heavy lubricating oil is driven over, leaving in the still at pleasure either a pure asphalt or a coke. The coke has the appearance of the finest coke from the manufacture of coal gas, and the asphaltum is free from sand and suitable for many purposes, including the manufacture of varnish for the protection of iron. The lubricating oil is kept in a large cylindrical horizontal tank of boiler-iron partly imbedded in the ground.

The works are situated on the Southern Pacific Coast Railroad, from which a branch extends to the warehouses. The near proximity of the shores of the bay not only affords an escape for refuse, but gives facility for the approach of barges and sea-going vessels.

GEOLOGY OF THE CALIFORNIA OIL REGIONS.

My examination of the more important localities at which petroleum occurs in California was necessarily made with such haste that it would be premature attempting at this time to write much on the subject of their geology. It is to be hoped, however, that leisure and opportunity will be found to make more thorough examinations thereof in the future. Pico Cañon and Tunitas Creek offer special facilities for making geological sections, the rocks here lying in such positions that they could be readily measured.

As shown by the fossils collected, the localities visited belong to the tertiary age. The sedimentary rocks observed are highly interesting, and will hereafter be carefully studied. At Pico Cañon the sand rocks are stratified with much regularity, and are interstratified with plates or seams of gypsum (selenite), as seen also at Temple Street cut in the city of Los Angeles. There occur here, also, a black shale and a coarse conglomerate, but no fossils were noticed in the vicinity of the wells, though some are to be found at a short distance. There is evidence that this neighborhood has at some period been subjected to violent water action. That this happened at irregular intervals is shown by the unequal thickness of the various strata, and the material of which they are formed, some being quite thin and consisting of the finest river silt, while others are much thicker and composed wholly of coarse gravel. They were originally, no doubt, deposited on the bottom of a tertiary sea, and very likely at the mouth of some great "dead river." They were afterwards folded, and at a still later period, broken, as we now find them. In color this rock varies from gray to distinct yellow. Specimens were obtained and preserved for chemical and microscopic examination and study.

At the west end of the San Fernando tunnel, two miles south of Newhall, a sedimentary sandstone, similar to that noticed at San José, Los Angeles, and Pico Cañon, crops boldly, and can be seen in passing on the cars, extending for many miles. This sandstone abounds with fossils. They also appear plentifully in a cut made by a small creek near by, in the bed of which lie exposed boulders, gravel, fine sedimentary silt, and a coarse highly ferruginous conglomerate, which latter, in decomposing, has imparted much iron to the water. The rocks here have been stained a deep red color. Fossils are noticeable also at the south end of the San Fernando tunnel, which has a length of 7,678 feet. In this cañon a thin seam of lignite has been exposed. The surface of the water where, standing in stagnant pools long, is covered with a scum of oil.

This variety of sandstone underlies the city of Los Angeles, where, from time to time, petroleum in small quantities has been met with. The water obtained in a well being sunk for the soap and chemical works of Mr. E. C. Niedt, at the time I was in that city (May, 1884), was found to be mixed with oil. The sedimentary rocks, as seen at the Temple Street cut, dip 56° S.E. nearly, and strike nearly S.W. At another point they incline 58° to the S.S.E. They strike at right angles with the dip; the stratification being wonderfully regular, with seams of selenite, as at Pico Cañon and Petrolia. At Tunitas Creek, San Mateo County, near the oil wells, the road cuts through a stratum of loose, rounded boulders, full of fossils—*Pecten pabloensis*. The

creek near Lobitas Station has eroded a fine sedimentary silt formation, rich in fossils, and which, extending westward, terminates on the seashore in a bluff seventy-five feet high, where again this same class of organic remains appears.

There is at Moody Gulch, Santa Clara County, nothing in the surface geology to indicate the source of the petroleum found at that place. The formation consists mainly of sand, gravel, and fragments of a soft yellow sandstone, samples of which were taken for the Museum. This sandstone resembles some found on Russian and Telegraph Hills, in San Francisco. I was unable to obtain here any fossil remains, nor could I learn that any had ever been observed by others. On the road below the wells is a cropping of this rock, which here has evidently been much disturbed. In the hill, which rises some two hundred feet above the upper well, the sandstone is found only in broken pieces, though the workmen report a ledge on the other side of the summit. There is here, also, so far as my observation extended, an absence of fossils.

FOSSILS FOUND IN THE CALIFORNIA OIL REGIONS.

The following comprises the fossils observed in the examination of the California oil regions:

At Snow's Well, near Petrolia, Los Angeles County, broken tooth of shark, *Carcharodon* sp.; and (5651), *Lucina borealis*, Lin. Pliocene.

At Sargent's, Santa Clara County, with asphaltum (5650), *Crassatella collina*, Con. Miocene; (5649), *Arca microdonta*, Con. Miocene; and (5647), *Tapes stanleyi*, Gabb, Pliocene.

Lobitas Station and Bluff, on the seacoast, San Mateo County (5645), *Saxidomus gibbosus*, Gabb, Pliocene; (5649), *Arca microdonta*, Con. Miocene; (5648), *Pecten pabloensis*, Miocene.

Oil wells, Tunitas Creek, same county (5648), *Pecten pabloensis*, Miocene.

The fossils found near Newhall, Los Angeles County, have not yet been determined, though they belong, without much doubt, to the tertiary.

SAMPLES OF OILS AND ASPHALTUM.

Below is given tabular statement of oils and asphaltum gathered and placed in the State Museum:

Catalogue Number.	Specific Gravity.	Description.	Locality.	Township and Range.	Degrees Beaumé.	Proportion of Sand and Impurities.
5633	1.143	Maltha	Tar Creek, near Sargent's, Santa Clara Co.			
5634		Asphaltum	Tar Creek, near Sargent's, Santa Clara Co.			
5635		Asphaltum, refined	Tar Creek, near Sargent's, Santa Clara Co.			
5636		Asphaltum, refined	Tar Creek, near Sargent's, Santa Clara Co.			
5637	1.15	Asphaltum, pure	Tar Creek, near Sargent's, Santa Clara Co.			
5638		Bréa	Petrolia, near Anaheim, Los Angeles Co.	Sec. 5, T. 3 S., R. 9 W.		56.8 per ct.
5639	.969	Maltha	Petrolia, near Anaheim, Los Angeles Co.	Sec. 5, T. 3 S., R. 9 W.	15°	
5640	.920	Maltha	Puente, Los Angeles Co.	Sec. 1, T. 3 S., R. 10 W.	22°	
5641	.795	Petroleum Green Oil	Tunitas Creek, San Mateo Co.	Sec. 25, T. 6 S., R. 5 W.	46°	
5642	.830	Petroleum Green Oil	Pico Cañon, Los Angeles Co.		39°	
5643	.797	Petroleum Refined	Pico Cañon, Los Angeles Co.		46°	
	1.81	Petroleum, in sand	7 miles from Santa Cruz, Santa Cruz Co.			80.2 per ct.

The production of petroleum in California, from 1878 to date, in barrels of 42 gallons, is here given, the yield of the first five years being taken from *Mineral Resources of the United States*, Albert Williams, Washington, 1883:

1878	15,227
1879	19,858
1880	42,399
1881	50,000
1882	70,000
1883	190,540
1884	
Total	388,024

Cost of oil, 33° to 40° B., to the Los Angeles Electric Light Company, is \$2 50 per barrel.

Newhall light refined oil sells for 6 cents per gallon at refinery. At Los Angeles, Puente, and Petrolia, crude oil commands 10 to 25 cents per gallon.

We have been heavy importers of petroleum, home requirements in this line having always been large, while a great extent of outside territory has been supplied from San Francisco.

Receipts at this port from the Eastern States amounted last year to 304,785 cases, besides considerable quantities received overland at interior towns.

The distribution from this point has for many years past ranged from two to four million gallons per annum, the quantity sent out last year having exceeded the latter figure. The annual consumption of California, Oregon, and Washington Territory, may be set down at 4,000,000 gallons, the demand for these countries undergoing rapid enlargement. Our exports of petroleum go mostly to British Columbia, Asia, and Asiatic Russia, with a little to Tahiti, Mexico, South America, and other of our neighbors. We shall probably be able in the course of a year or two more to supply the product of our California wells to not only these countries, including all the islands of the Pacific, but to the entire coast, from Cape Horn to Behring's Strait, and eastward to the Rocky Mountains, nor can we see any reason why we should not in time command the markets of the Orient.

THE OUTLOOK.

Everything considered, the prospects of the petroleum business in California may be pronounced highly encouraging. Having met with some disappointments at first, our people, being then largely engaged in mining for the precious metals, dropped the oil business, and for a number of years gave it little or no attention. Returning to it now, they are embarking in this industry with their usual energy—a guarantee that our petroleum deposits will, after the manner of our gold and silver mines, be worked to their fullest extent.

107. PETZITE. Etym. *Petz*, the chemist who first analyzed it. See, also, Tellurium.

This mineral is a variety of Hessite (which see), being a telluride of silver and gold; the latter metal replacing part of the silver. It is of too rare occurrence in California to have any practical value aside from the gold it contains, and interesting only as being an associate of gold.

An analysis of a specimen from the Stanislaus mine, Calaveras County, afforded Kustel: