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PROFESSOR SILLIMAN'S REPORT

UPON THE

OIL PROPERTY

OF THE

Philadelphia and California

PETROLEUM COMPANY,

OF PHILADELPHIA,

SITUATED IN

Santa Barbara and Los Angeles Counties,

CALIFORNIA,

TO WHICH ARE ADDED

EXTRACTS FROM THE FIELD NOTES MADE ON A SURVEY AND
EXPLORATION FOR A RAIL ROAD, IN 1850 AND 1857,

BY

COL. J. WILLIAMSON,

CHIEF ENGINEER OF THE SURVEY.

PHILADELPHIA :

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REPORT.

To JOHN C. CRESSON, Esq.,

President of the Philadelphia and California Petroleum Company.

DEAR SIR:—The delivery of my Report on the Oil Lands of your Company, has been necessarily delayed for a short time, pending the arrival of the samples of crude oil therefrom, required for the chemical examinations. Permit me now to state the important facts in the case.

The discovery of Petroleum on a great scale in California is a fact now well established, and chiefly along or near the sea-shore, in the counties of San Luis Obispo, Santa Barbara and Los Angeles, where its occurrence in accessible positions and surrounded by arable lands and in a delightful climate, has led to the early incorporation of these lands in the hands of powerful Companies, based on the expectation of doing a large and permanent business. Among the most favored of all these localities, so far as they have fallen under my own observation, is the large estate amassed in Santa Barbara County by your own Company.

The lands owned in fee simple by the *Philadelphia and California Petroleum Company* comprise the whole of three large ranchos adjoining each other, and embracing collectively, nearly *two hundred thousand acres of land.*

These estates are,

1st. The Rancho Las Posas of	-	-	26,623.36	acres.
2d. The Rancho Simi,	-	-	113,009.21	"
3d. The Rancho San Francisco,	-	-	42,800.00	"
Total area,	-	-	<u>182,432.57</u>	"

This corresponds to about *two hundred and eighty-five square miles* of the finest agricultural and grazing lands in California, giving your estate an extremely high value irrespective of its oil outcrops.

This great territory is all within the geological limits where oil may be reasonably looked for and where (which is much more to the point,) it is found.

It falls within the boundaries of the Cretaceous and Tertiary beds of the Coast Range, and is traversed or bounded by ranges of mountains and hills forming lines of disturbance or upheaval along which, as I have elsewhere explained, the oil outcrops in California may, in most cases be reasonably looked for.

Between a range of low hills on the east and the Santa Susanna Mountains on the south-west and west, the main body of land in this estate forms an interior valley. This valley debouches to the sea by the western end of the Posas Rancho, where it is within about nine miles of the Pacific. From the sea to the diagonally-opposite extremity of the estate, is a distance of over thirty-six miles. This is called the Valley of Simi,—a well watered valley, capable of producing all the agricultural and pomological products of a climate rivaling Italy in its genial air, and exceeding it in its salubrious climate and brilliant skies. This fine region has been heretofore almost exclusively devoted to the herding of half-wild cattle or grazing of sheep, although the Tapo Vineyard has gained great celebrity for its wines and brandy.

Las Posas gains its name from its fine natural springs of water which are repeated upon Simi, whose vineyards are watered by one of these fountains, true natural artesian wells, some of which bring to the surface thin oil. Such is the case with the natural fountain or Laguna, which rises near the Mansion House of the Noriega family, on the Simi Estate. Carburetted hydrogen gas accompanies the escape of oil from these springs, just as in front of the Santa Barbara Coast, where both oil and gas escape constantly from the surface of the ocean.

This estate is on a line geologically continuous with the leading oil-producing areas of this portion of California. From what I

have myself seen, and from all I can learn from the observations of others, I have reason to believe that, as an oil estate, it is unsurpassed by any other in California, while in the incidental but not unimportant advantages of soil, superficial area and capacity of production for all the most valuable products of the soil, it is likewise unsurpassed.

NATURE OF THE CALIFORNIA OIL OUTCROPS.

It has been often remarked that in California most natural phenomena are on a scale of extent unlike what is seen upon the eastern side of the continent. The oil outcrops form no exception to this rule. Some of the natural wells of petroleum and tar are forty or more feet in diameter, troubled by the escape of gas, and surrounded sometimes by a quagmire of pitch in which wild and domestic animals become mired. Vallies or Canons are flowed with the escaping products to that degree that progress across them is impeded. Hill-sides are covered, often for hundreds of square acres, with hardened asphaltum, where in an earlier day oil springs, now no longer active, have found vent. These phenomena are all connected in California with the existence of naphtha, the smell of which is recognized in the fresh fracture of even its hardest products, and they are not to be confounded with the tarry bitumen of Barbadoes and the West Indies generally, in which there appears to be little volatile oil. The relation of the California asphalt to the thin oil is discussed under a subsequent head.

DISTRIBUTION AND CHARACTER OF THE OIL OUTCROPS ON YOUR ESTATE.

The accompanying map, prepared by Thomas Sprague, Surveyor of Santa Barbara County, exhibits the distribution of the oil outcrops on the lands of the Philadelphia and California Petroleum Company, as also the main physical features of the territory. The Santa Susanna Mountains rising on the southwest and continued across the southern boundary of the estate are largely composed of heavy bedded sand-stone, the upheaval of which has given a prevalence of northerly dips to the shales

along the western line, while near the springs marked 5 and 6, and some others, the strata stand nearly vertical. The Santa Susanna Pass is in this range of sand-stone mountains, where huge blocks of eroded sand-stone rising to a height of several hundred feet, form a wild and picturesque boundary between the Simi Rancho and the large territory of the Ex-Mission of San Fernando laying next south of it. There is a gradual rise in passing through your estate from the stage-station on the Las Posas Rancho, through the valley of the river to the Santa Susanna Pass, the valley being bounded by gentle grassy hills rising into mountains, as already stated to the west and south, and less remarkably on the east, in the line of the San Fernando Hills.

The oil outcrops occur along the strike of the rocks. These are indicated by numerals on the map, and are briefly described in their order.

No. 1, Is a slight outcrop of oil in a small valley, on the Simi Rancho.

No. 2, Is a fine outcrop of oil and tar, situated in a large valley. This outcrop is on the south side of a bluff running east and west about one hundred feet high. The oil comes out from the base about half way up the bluff, and for a distance of a half mile from the eastern to the western points of outcrop. Oil is also found in the valley in places some hundreds of yards from the main outcrop. The strata dip here to the north, at an angle of about fifty degrees.

No. 3, Is a large "Cienega," or spring of water in the Simi plain, already alluded to in the former part of this report.

On the surface of the water at times, much oil is found floating; at other times but little is seen.

No. 4, Oil here comes out in the bank and bed of the Arroyo de Simi, in small quantities, but of a very marked character, covering the surface of the water.

No. 5, Indicates a point where gas in large quantities escapes from the earth accompanied by a soft sulphurous mud.

This hole is about three feet in diameter and is constantly discharging gas, mud, and water. It is also intermittent, dis-

charging more at some times than at others. This discharge is situated on the side of a hill in a small valley, leading out of the "Canada de Tapo."

No. 6, Is a vein of asphaltum crossing a large valley, showing itself in the bed of the stream and running into and up the face of the mountains on the east and west sides. Where it crosses the stream it discharges a moderate amount of oil and tar. The strata here are nearly or quite perpendicular, and the apparent course of the vein about east and west. Its width cannot be correctly determined without laying bare the face of the mountain, but it is probably twenty feet wide.

No. 7. Two springs of pure water accompanied with gas.

No. 8, Is a succession of oil and tar springs in a valley or Canada, running into the Santa Clara River. They cross out for about three-fourths of a mile along the upper portions of the Canon.

The quantity thrown out is large. These are on the north side of the mountain, partly in the Simi, and appear to be of *first-rate quality and quantity.*

No. 9, Is a series of outcrops, situated at the northern edge of Simi Rancho, reaching over on to the adjoining San Francisco Rancho. This is a valuable outcrop of thin oil, standing in pools up and down the Arroyo.

No. 10, Indicates some large springs on the sides of the mountain, where the whole earth is saturated with oil, and from its own weight pushing forward and sliding down the mountain. The spring shown on the map, just inside the line of Simi, is a fine lime-water spring, coming out in a sag or depression of the mountain, about half a mile north of the creek. Masses of porous limestone, (*tufa*,) deposited in former times by this spring, are still plainly visible.

No. 11, Is the valley of an Arroyo, in its circuitous course cutting deep into the mountain. Near where the line of the two Ranchos crosses its course is a large spring of white sulphur water, very deep, and in which Mr. Sprague came very near losing one of his men and his horse in attempting to pass around it.

Nos. 12, 12, 12, 12, 12, Indicate outcrops in the heads of Canons; some of them are believed to be rich.

No. 13, On the wide bed of the Santa Clara River, are sloughs and springs of water just under the bank. This water is more or less covered with oil.

No. 14, Is a wide outcrop extending for more than a mile along the Canon.

No. 16, Is a very large oil spring, and the one from which the sample of five gallons was taken on which the chemical examination contained in this report was made. It throws out a stream of thin oil that runs down the Arroyo for a distance of about two miles.

Of these springs, Nos. 2, 6, 8, 9, 10, 14 and 16 are worthy of particular mention, both for their size and for the quality of the crude petroleum. No. 8 has more of the character of the asphaltum on Hills' Rancho, west of the Santa Barbara, than any deposit yet noticed in the country.

On the Rancho Las Posas, the same geological characters prevail, as on Simi and San Francisco, and there can be hardly a doubt that artificial wells may be bored with success at numerous points along the whole extent of the Arroyo de Simi, or at intervals for a distance on your estate of at least twenty miles from north to south.

This examination of oil outcrops is undoubtedly very far from expressing the whole truth or of conveying an adequate impression of the extent and importance of the oil outcrops on your estate. These are in fact much more numerous than the map records. Each little valley or Canon on the property will, beyond doubt, on more careful examination than has as yet been given to them, disclose new outpourings not now known.

OF THE CHEMICAL CHARACTERS OF THE OIL.

Of the chemical character of the California Petroleum, it is not possible in the present state of our experimental knowledge to speak as fully as it will be after the oil has been drawn fresh from the wells now about to be bored.

In a climate like that of California, evaporation takes place

with great rapidity during at least nine months of the year, and as a consequence the thin and more volatile portions of the Petroleum evaporate on exposure, leaving only the thicker and heavier oils, the further evaporation and oxydation of which leaves asphaltum, which has accumulated in considerable quantities in the vicinity of all the Californian oil outcrops.

The following experimental results obtained from the physical and chemical examination of a sample of thin oil from your estate, under my directions, in the Sheffield Laboratory of the Scientific School in New Haven, appear to me of much importance as establishing beyond all doubt the vital point of inquiry, that you possess a crude Petroleum in abundance on your estate, which even in its natural condition of escape to the surface, and after exposure to the air, proves itself to be of almost unequalled quality, and justifies the expectation that, when drawn fresh from the wells, it will rank among the very best samples of crude Petroleum produced in the world.

ITS PHYSICAL CHARACTER.

This sample of oil was collected from outcrop No. 16, before named.

This sample is of a dark brown color, thin and mobile as water, and of a decided naphtha odor. It shows two colors, (dichroism,) according to the angle of light. In a thin tube it has a yellow brown color by transmitted light. Its density is 861, or about 34.30° of the commercial standard.

It burns in its crude state in lamp with a chimney, (common lamp,) with quite a bright flame and strong light for a few moments, but after eight or ten minutes the wick commences to coal, and after about fifteen minutes it smokes, and finally dies out. You can readily repeat this experiment for your own satisfaction.

ITS CHEMICAL CHARACTER.

A preliminary trial showed me that a portion of this oil would distill at a very moderate temperature. Arrangements were made, therefore, to conduct the operation during the first

half of the distillation in glass, for the convenience of observing and regulating the process and noting the temperatures, expecting to complete the experiment in an iron retort. These arrangements were carried out with the following results:

One thousand measures (1,000 c. c.) were distilled in fractions of one hundred measures each, noting from time to time the changes in temperature by a mercurial thermometer, the bulb of which was continually in the fluid.

A vapor condensed in the void space at	-	140°	Farenheit.
The fluid began to simmer at	-	209°	"
" " " " boil at	-	221°	"
20 measures had distilled at	-	307°	"
40 " " " " "	-	338°	"
100 " " " " "	-	350°	"
140 " " " " "	-	374°	"
160 " " " " "	-	392°	"
200 " " " " "	-	419°	"
240 " " " " "	-	455°	"
260 " " " " "	-	463°	"
300 " " " " "	-	482°	"
360 " " " " "	-	511°	"
400 " " " " "	-	538°	"
450 " " " " "	-	568°	"
485 " " " " "	-	608°	"
500 " " " " "	(estimated,)	698°	"

The temperature rose very suddenly after 485 measures had passed over, and soon passed the boiling point of mercury.

The remaining 500 measures were distilled from an iron retort, and yielded about 460 measures of oil, a light carbonaceous residue (coke) being left in the retort.

The result of this experiment may be thus stated :

1,000 measures of crude oil yielded, on distillation

in glass,	-	-	-	-	-	-	500 measures.
In iron,	-	-	-	-	-	-	460 "
Total,	-	-	-	-	-	-	<u>960</u> "

Or, 96 per cent. of the crude product reappears in the fractional distillation as oil ; only a drop or two of water came over.*

The characters of the several portions of this fractional distillation are expressed in the following table, for each decimal portion :

		Decimal part.	Specific Grav.	Beaumé.	Explos. Test.	
1st,	-	-	100 c. c.	755	55.77	58° Fah.
2d,	-	-	100 c. c.	775	51.80	70° "
3d,	-	-	100 c. c.	793	47.62	100° "
4th,	-	-	100 c. c.	815	42.70	156° "
5th,	-	-	100 c. c.	838	37.83	196° "
6th,	-	-	100 c. c.	867	32.08	190° "
7th,	-	-	100 c. c.	872	31.13	190° "
8th,	-	-	100 c. c.	890	27.79	181° "
9th,	-	-	100 c. c.	900	26.00	171° "
10th,	-	-	100 c. c.	900	26.00	140° "

* Of unrectified products, the loss in rectification cannot be very well determined in the small way ; but appears to be on the lubricating oil, from 6 to 8 per cent. ; on the illuminating oil, not so much ; and on the light oil, not appreciable.

The color of these products varies from Nos. 1 and 2, which are quite colorless, through 3 to 7, which commencing in 3 as a faint pink becomes red in 6 and 7, while 8, 9 and 10 can hardly be distinguished in color from much of the better quality of crude oil flowing from the best wells, having the same change of color (dichorism) by reflected and transmitted light. The unrectified products would arrange themselves thus by color—

I.	1st,	2d,	3d	fractions.
II.	4th,	5th,	6th,	7th, “
III.	8th.	9th,	10th,	“

But in the actual conduct of the manufacture of this oil, I presume the practical oil distiller would make three divisions of

Light oil, including the 1st and 2d fractions.
Burning oil, “ “ 3 to 7 “
Lubricating oil, “ 8 to 10 “

The mean densities of these three classes would be :

1st class, 765 = about 53.5° commercial.
2d “ 837 = “ 38.5° “
3d “ 890 = “ 28.0° “

The relative percentage indicated by this division of the products of distillation, would be :

1st class, 20.00 parts	Light oil.
2d “ 46	“ Burning oil.
3d “ 30	“ Lubricating oil.

Carbon and loss being about 4 per cent.

It is very probable that in the large way, if deemed desirable, the proportion of burning oil could be raised to 60 per cent. ; but this is a practical question which can be much better decided by the experience of your manufacturer.

All these grades (10) are easily clarified and deodorized by the usual treatment with oil of vitriol and carbonate of soda. The first two decimals were both colorless, and free from any burnt or empyrumatic odor, fragrant and agreeable. No. 3, which was faintly pink, and very slightly unpleasant, became quite colorless, and perfectly agreeable smelling by the usual

treatment. The other fractions yield to similar treatment. Not one of them has by any means so disagreeable an odor in its unrectified state as many commercial samples of so-called refined oil possess. I send you the specimens, after rectification, grouped in three classes as indicated, that you may judge for yourself of their quality.

The Illuminating oil has an explosive test of 155° Fahrenheit, and burns beautifully in a lamp.

I have not proved the existence of aniline. It will be requisite to operate on large quantities before its absence from your crude petroleum can be safely affirmed.

You will observe under the column of Explosive Test a sudden fall in the degree at which explosion occurs after the 7th fraction, the 10th being not less than 50 degrees under the 7th. This anomaly is explained, I venture to suggest, on the ground that, as the temperature of distillation rises rapidly toward the close of the process, (see table,) some of the lighter oils are regenerated, in consequence of the breaking up of a portion of the oil into products of a lower boiling point, and also a portion of gas which escapes in a steady, but slow stream, during the distillation of the three last fractions. This curious fact is not without its useful suggestions, as affecting the application of the so-called "fire test," which at best is a very rude mode of testing.

In conclusion, permit me to congratulate you on the extremely satisfactory results of this first chemical examination of your crude oil. There is but little risk in predicting that the results in the large way used upon the freshly drawn oil will be even superior in the large way to those which I have now the power of presenting to your notice.

WHY THIN OIL MAY BE LOOKED FOR FROM THE ARTESIAN BORINGS.

That the fresh oil, as it will flow from the wells, will contain a larger proportion of light oil than most of the crude oil, does not admit of a doubt, in my judgment.

Nature, in fact, demonstrates this in her great experiment which is now going on along the Santa Barbara coast, where

the surface of the sea is, for many square miles, flooded with thin oil, escaping from the edges of the oil-bearing strata, beneath the waves.

This oil is so thin that it evaporates almost as soon as it reaches the surface, and the air is laden with the heavy odor of its volatilization.

I have elsewhere described this phenomenon, and take the liberty here to repeat my own language, as the phenomenon is not only very remarkable in itself considered, but of the highest interest in view of the future prosperity of your Company, in as much as it seems to quiet all doubts on the important question whether boring will reach oil in California.

"From the times of the earliest explorations and voyages in California, it has been known that near Santa Barbara there existed springs of oil flowing up over the surface of the sea.

"This remarkable phenomenon has appeared hitherto only to excite wonder and vague speculation as to its cause. To this day I find, on conversing with intelligent ship-masters, the idea prevails that the oil flow is the product of one, or of a very limited number of springs, and that it might possibly be controlled by pipes or otherwise. The absurdity of this notion will appear when the facts are described, and in view of the structure of the coast as already explained.

"Often for hundreds of acres square at one view, there was no part of the sea but was thus covered. The sea boils like effervescing soda water, with the escaping gas which accompanies the oil, and great globules of pure oil rising with the gas flash out on the surface of the water, tossing it up in jets, and then breaking into films of rainbow hues, changing at every instant like the tints of a dying dolphin. The effect is wonderfully beautiful and exciting, every fantastic form of animal plant and fish is reproduced on this marbled surface in thin films of fine oil.

"That vast quantities of oil are here daily lost, by evaporation from the surface of the sea, is perfectly obvious, and considering the unlimited time in which the flow has been going on over so large an area, it may be doubted if this waste does not equal all the oil which is saved from all the oil wells in the

United States. The origin of this escape is not doubtful, nor the explanation of the phenomenon difficult.

"It will be remembered that this lavish outpouring of thin oil upon the surface of the sea is directly in front of, and coextensive with the asphaltum deposits on the shores of the Las Golita and Las Positas Ranchos.

"A section of the cliffs, showing the actual position of the sandstone with reference to the sea and the asphaltum, might serve to render this subject more easy of comprehension. By inspecting such a section, the asphaltum is seen filling seams and fissurés in the sand-rocks, where formerly, beyond doubt, oil flowed.

"It has run down over the cliffs, forming on the surface heavy masses of hardened asphalt. In doing so all the rents have been sealed, as well in the cliffs as in the plain behind. But the pressure still continuing, the oil has found vent accompanied by gas along the edges of the out-cropping beds of sand-stone beneath the sea, where, being free from evaporation, no asphalt accumulates. Here rising with torrents of gas to the surface of the water, it spreads out and speedily evaporates, and is borne along by the tidal currents up or down the coast. It is not improbable, should a well be sunk to cut some of these veins of oil or the seams in the sand-rock through which they flow, that the escape now taking place into the sea may be diminished materially. It is an experimental question, depending for its solution on the relative heights of the hydrostatic column of two liquids of unequal densities.

"A question of the very highest economical interest seems, however, to be conclusively settled by the phenomenon here rehearsed, namely: Do the asphaltum deposits on the California coast justify the inference that they were derived from the evaporation of oil, and do they indicate the probable existence of oil in depth? The answer seems to be emphatically *affirmative*. Certainly nothing short of the absolute demonstration of an actual boring could be more satisfactory." *

* Copied from the author's MSS. description of the *Rincon Rancho*, on shores of Santa Barbara County.

AGRICULTURAL ADVANTAGES OF YOUR ESTATES.

It would be interesting to dwell briefly on the other elements of prosperity combined in your estate, superadded to the great value which it derives from its outcrops of oil. Especially should I wish to speak somewhat at large of the suitability of your property for wine growing, and the cultivation of those fruits capable of transportation to a distant market. But the full discussion of these topics, interesting as they are, and important in every view to your Company, and to the country at large, is reserved for another occasion. I limit myself at present to a few points only.

While in Southern California during the fruit season of the past year, being always interested in these departments of culture, I embraced the opportunity to glean such information as was accessible on these topics, and shall, if you desire it, take pleasure on another occasion in presenting for your consideration the results of my observations. Suffice it to say at present, that being in possession of a territory considerably larger in area than either of the Counties of Philadelphia or Delaware, and of greatly superior fertility, blessed with a salubrious and delightful climate, it becomes you to consider well the best plan for its colonization with a superior class of population, vine growers and other agriculturists.

You have already an example at hand in the Anaheim Colony, known as the "*Los Angeles Vineyard Society*," founded in 1857 on a small area of 4,000 acres of land, in Los Angeles County, where, from a vineyard of 400 acres, in a period of four years after the vines first became productive, they have this past season produced about two thousand five hundred pipes of wine, worth at wholesale about \$67.50 per pipe. The actual cash outlay on this property was \$2,400, and this comparatively trifling capital has returned this last season a gross revenue of one hundred and forty thousand dollars, a revenue which will continue to increase for several years to come.

In addition to this product, giving employment to a small community of industrious Germans, a considerable annual sum is realized from the lands used for farm purposes—producing

corn, barley, wheat, beans, &c., to the amount of \$8,000—exclusive of the maintenance of the requisite farm animals, and the household consumption of garden products.

Such facts as these give us a glimpse of the near future now opening upon Southern California, when the accession of capital and an intelligent, industrious population shall replace the semi-barbarous nomadic life which has heretofore held this fine country in great estates devoted to the widest species of grazing.

A series of providential events crowned by the discovery of oil in great quantities, has now opened these beautiful districts to a new population, and it remains for you and your associates to work out the problem, so full of varied interest and value, not only for the fortunate holders of the new oil region, but for the whole State of California in its general commercial prosperity.

Permit me to congratulate you on the possession of an estate so vast and productive in its varied natural resources, situated in the finest climate for human labor and health, conveniently near ocean transportation, and holding out every promise of a speedy return for all the labor and capital you may expend upon it.

Yours, with great regard,

B. SILLIMAN.

NEW HAVEN,

March 15, 1865.

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APPENDIX.

*To the President and Trustees
of the Philadelphia and California Petroleum Company.*

GENTLEMEN:—I herewith submit a report founded upon extracts from my field notes, made on a survey and exploration on the southwest coast of California, in 1850, 1851, 1852, and a re-survey in 1857 and 1858, for a railroad through the State of Texas to the Pacific ocean.

These notes and stations were taken from various lines run through the property known as Rancho Las Posas, Rancho Simi, and Rancho San Francisco. I find that the indications of oil and gas springs on these estates are as good as on the estate of Ojai, and it only remains for your Company to develop the rich gas springs, to secure a rich reward in the oil that lies beneath the soil of these Ranches.

Station 16, North by West, on Red Wood Tree, 16 feet West.

A hill of solid black shale rock, which is strongly and perceptibly charged with bitumen.

Station 21, West, on Rock Sand Stone.

A gully with water courses, have, no doubt, at some time; holes are cut in them; are numerous and deep; a greasy matter is constantly oozing out of the seams of the rock, and also quite a strong stream of gas comes out of one seam. On a light being

applied it will go off like a cannon, the report of which can be heard for a half mile up the gully.

Station 16, North by West, 85 feet, on Oak Stump.

Is a range of upheaval hills of solid black shale rock, which is strongly charged with bitumen.

Station 49, West by half North, 40 feet on Sand Stone.

In this gully the water courses have cut into the solid rock, and in all the opening crevices oileous substance.

Station 126, West, 36 feet North, on Stump of Red Wood.

Near the bottom of the valley a large number of gas springs appear just under the rock.

Station 141, West by South, on Oak Stump, 75 feet.

Are a large number of holes, where the Indians obtained their earthgrease, as they call it by name. It has a singular smell.

Station 176, North by West, on Sand Stone Rock.

At this station the Indians have a burning station, where they prepare their earthgrease for medical purposes. They rub it over their persons to keep away the insects.

Station 213, North line on Rock, West by South, 53 feet.

Singular geological formations; black shale rock. Sand and lime rock is the outcropping upheavings; has a singular appearance; ground shakey, when you jump on it. Run a rod into the ground, and upon pulling it out, gas will escape which will burn for some time.

Station 861, South by West, on Stone, 56 feet.

Carburetted hydrogen gas is found in great quantities all over this range of hills, and has been burning in some places for hours at a time.

Station 916, South by West, on Red Wood Stump, 15 feet.

Oleous substance is found all around this low spot of swamp land extending from the ground.

Station 1,064, West by South, 13 feet on Rock.

Salt springs of old date, large bones lying around.

Station 35, South Line West, 13 feet on Rock.

Sulphur springs abound all about this station, good to drink.

Station 39, South line West, 183 feet on Oak Tree.

Coal beds found here; thin veins of coal in black shale rock; a tarry substance is oozing out of the coal.

Station 71, South by West, 184 feet on Rock.

Deleterious gases oozing out of the ground.

Station 1,186, on Rock North line, 24 feet West by South.

A beautiful limpid oleous substance is oozing out of the rocks at the bottom of this range of upheavings, about 400 feet long.

Station 81, North by West, 61 feet on Rock.

We call this Lightening Camp, from the fine fireworks we had during the evening. The men stationed themselves at the different gas jettings, and touching them off, they would discharge themselves like fireworks.

Station 124, North by West, 14 feet on Rock.

Here we lighted the gas jettings to play our games—they gave us a fine light all night.

Station 264, North by West, 145 feet on Rock.

Is a fine Spring, very oleous, has a singular smell of bitumen.

Station 465, North by West, 416 feet on Rock.

Is a deep gully, 50 feet wide. At the bottom is a fine mineral spring, rather saltish, or inclined to soda.

Station 516, North by West, 513 feet on Rock.

Up this ravine gas is found in great abundance, with large quantities of bituminous tar, being of a greasy nature, or, as the Indians call it, "earthgrease;" the gas is constantly oozing out of the ground.

Station 121, West by South, 61 feet on Tree, Red Cedar.

Here is a fine burning spring.

Station 261, West by South, on Tree of Oak, Root $2\frac{1}{2}$ feet.

Is a mine called Madre de Jose. A great quantity of gas is coming out of the mouth of the shaft.

Station 416, West by South, 24 feet on Oak Tree.

Soil very black with bitumen. 16 feet West by North is a hot spring, very salt.

Station 576, West 33 feet on Rock.

Is a fine spring at the head of the ravine. On washing in it it emits a very peculiar smell. It is a very good washing water for the hands, making them feel soft and smooth.

Station 619, West, 10 feet on Rock.

Gas to a large extent is found at this station.

Station 716, West, 76 feet North on Rock.

Here is a fine old salt spring.

Station 784, West on Rock, 14 feet.

The bitumen found here is of a dark greasy nature, quite plenty.

Station 861, West on Rock.

Running North from this station is quite a range of hills. At the bottom of these hills is a large number of grease holes, where the grease of the Indians oozes through the clefts and apertures of the rocks. This grease is of a very beautiful amber color. In a fluid state it looks like a yellow water.

Station 971, West by North, 27 feet on Rock.

The asphaltum here has a brownish-yellow color, thick and greasy.

Station 1,010, West by North, on Rock.

At this station are great marks of disturbance of the rocky formation of these hills.

Station 1,116, West by North, 24 feet on Rock.

The rock is very porous and perforated, of a honeycomb order, where it has an upheaval appearance.

Station 1,206, North by West, 45 feet on Red Wood Tree.

A very beautiful hill or cone. It looks as if it came out of the ground like a loaf of sugar. Four feet from the surface of the ground is a coal seam, about one foot thick. I have a sample of this coal. It is of a semi-bituminous nature—burns free.

Station 1,300, West by North, on Rock.

* Hot sulphur springs. About 400 feet east is a hot soda spring. The rock is of a sandstone character.

Station 1,416, West by North, on Rock 16 feet.

At this station are quite a number of salt springs, with gas bubbling out like soap bubbles, quite bituminous in smell.

Station 1,500, West by North, on Rock.

All the fissures in the rock round this station are filled with a bituminous substance, which has hardened, and when taken from the rocks will burn beautifully. It has hardened into solid seams. The rock is of a calcarious nature.

Station 31, North in the Valley, on Rock.

At this station the natives were, no doubt, in the habit of getting their grease to burn in their lamps, (very rudely made.) Still it is miserable stuff to burn. It makes a great deal of smoke and soot, and has a bad smell.

Station 133, North, on Rock 26 feet.

Quite a lake of bitumen. The natives use it for the roofs of their houses—it is an excellent substitute for cement or mortar, and I cannot see what reason it cannot be sent to San Francisco, to roof the houses and pave the streets. It would be of vast importance if the inhabitants of San Francisco could be induced to use it. I think it is the same kind of material as is used in the Eastern cities, and found on the shores of the Dead sea.

Station 216, North, in the Valley on Rock.

Gas springs all around our camp. At this station had an attack of pain in my knees; used the Indian grease that came out of the ground in a hollow or swamp near the camp, which almost immediately relieved me of the pain.

Station 131, West, 186 feet South on Rock.

At this station is a very fine quarry of soapstone, equal to any I have seen in New York.

Station 172, West by South, 131 feet on Rock.

North is a fine pit of fire clay; the material is found in great abundance, and I would call the attention of the Company to it, as it can be made useful in the smelting of ores.

Station 191, West by South, 184 feet on Rock.

Is a fine lode in a crevice in the rocks, which promises to guarantee a rich return in gold-bearing quartz, when worked to a sufficient depth. About 500 feet east are two other lodes. The development is extensive, and of a character that leaves no doubt in the minds of those who view them that the ore is as rich as that taken from any lode yet discovered in the mining region of California.

Station 381, on Rock South by West, 14 feet.

Is a vein probably 100 feet in length, opening to view as fine a crevice of gold-bearing ore, one-half foot in width, as ever a miner could wish to see. The pyrites and decomposed quartz form together a crevice of five feet in width, the wall rock being solid and nearly perpendicular.

Station 714, West by South, 46 feet North on Rock.

Is an oleous spring of Indian grease. Just at the foot of a range of hills, about 300 feet west, is another large gaseous spring.

Station 471, North by West, 83 feet on Rock.

At this station salt springs abound, and all things about here indicate that it was once the spot where the Indians manufactured a large quantity of their grease, which they gathered near the gas pits here.

Station 171, North by West, 84 feet.

Is a station on rock of a former survey, is an extensive gas range of hills, and the oleous yellow matter is oozing out of the ground in great abundance. It is low bottom land, about 175 acres in extent.

Station 184, West by North, 814 feet West.

Here are strong indications that galena exists to considerable extent; some fine samples have been found, which were put in the sample trunk.

Station 414, West by South, 84 feet on Rock.

At this station fine magnetic iron ore appears in the primary rocks, such as gneiss, hornblendic gneiss, and pure hornblende. The bedding or situation of these rocks is in the main northeast and southwest, with a slight dip to the south. The masses of magnetic iron ore occur between these beds of gneiss, and in general conform to them.

Station 14, West by South, 174 feet.

Is a fine bed of graphite or plumbago. This mineral, so valuable for machinery alone, lies in a well defined vein, varying in width; on either side all trace of its existence is lost, but the boulders of this material upon the surface indicate that vast deposits exist beneath. The veins are regular veins, and will therefore increase in width and richness as you descend; this is very certain from their well defined course.

Station 814, West 84 feet, North on Rock.

Here the horizontal strata are piled one above another to the hill-tops, and more or less distributed, and give vent to a large quantity of gas, very illuminating at night, and an oleous, greasy matter is constantly oozing out of the crevices of the rock, and runs into the sand at the bottom. Sometimes the oleous matter is thrown some distance by the force of the gas.

Station 414, West by North, 14 feet on Rock.

Here are numerous small springs of water, and the oleous matter covers the water and gives it a most beautiful appearance in the morning, when the dew rises off the water.

Station 618, West by North, 814 feet on Rock.

Here are extensive salt and soda springs, and the water is very soft for washing the hands, on account of the oily matter that is mixed with it, and floating on the top. The Indians use this yellow greasy material for pains in the limbs, and we can all of

us recommend it for the same purpose, from practical experience of its efficacy.

Station 614, West by North, 84 feet on Rock.

Here the out-burst of gas and oily matter is enormous, and will well repay a visit by the curious, as it comes out of the ground beneath the spur of the rocks. Here we made our camp, so as to avail ourselves of the material for camp purposes and light. We called this "Camp Illumination," and the small mount just to the north, "Mount Houston." We remained at this camp thirty-four days, exploring all day and making up our notes at night.

Station 814, West, South Line 165 feet.

Here appears to be quite a fine bed of oleous matter combined with bitumen, and quite a number of salt springs in all directions; also a mass of fine clay, more or less mixed with Galena, and traces of gold in small scales are found through it.

Station 916, West by North, 84 feet.

Here are great upheavings, with coarse sand-stone, and then beds of conglomerate and soft coal, that burns well.

Station 23, West, on Rock 116 feet.

Here are found some fine specimens of cinnabar, and from the crevices of the rocks the material is found quite plenty in the deep gulches. There is, no doubt, a fine vein of cinnabar, probably very rich, and of great value, if properly explored and developed by an experienced miner.

Station 86, West, on Red-wood 14 feet.

At this Station is a fine soda spring, quite hot and oily.

Station 117, West by South, on Rock.

At this Station the vein of cinnabar is well developed, and traced from Station 23, showing that we are on the cinnabar looma or range.

Station 76, North by West, 7.50 feet.

Another vein I examined in a gulch was about 2 feet wide and at the bottom is composed of very rich appearing iron pyrites, which I was told brought a high price at the mill. So wide a vein with such rich ore is very rare in mines here, and indicates a strong vein of gold-bearing ore. These counties contain gold, silver, copper, iron, lead, antimony, cinnabar, in such quantities as will pay well to mine them.

Coal is found all along the base of the mountains or row of hills, and out into the valleys. The coal is very bright, rather soft, of a semi-bituminous character, and very full of gas; contains very little sulphur, burns exceedingly well, and makes a hot fire. With capital to work the coal beds extensively it would pay a fine interest, say 5 per cent. per month in gold, to lay a tramway to the mines from the coast. Capital alone is needed to develop all the vast mineral resources of California.

The crevices in the hills are full two feet broad, and become wider as you go down. The ore is soft and friable, and very easily mined.

I found some beautiful quartz here, containing pyrites of iron, the richest ore of these hills.

The ore taken out has been crushed at two different mills to test its richness, has proved equal to anything yet developed, and much richer than many lodes that are working at a large profit.

This property is sufficiently extensive for the purposes of a large Company, when placed under full working capacity.

During my survey I examined the different outcroppings, and found lodes or veins that run nearly parallel to, and within fifty feet of each other, and situated upon the Southern slope of the loomas, where I think that all the lodes that are opened will prove good.

In view, therefore, of the developed condition, and the attested richness of the ores found on this property, the moral certainty that there are still richer ores beneath, and the facilities for

securing wood and other supplies for milling and mining purposes, makes this a very valuable property.

With improved machinery, such as I am now sending to Peru, this mining property can be made to pay a good interest in gold upon one million dollars, within one year after it is in operation.

The property described is situated on your Ranches, and at times a considerable amount of gold has been washed from the surface diggings—the hidden source of this is on the hills and gulches on the Ranches now under the control of your Company.

I need not comment further upon the merit of this property, as an inducement for investment that will yield a large dividend when properly worked.

There are many things on this property that deserve a passing notice, which I cannot describe in detail. Its fine agricultural advantages stand pre-eminent; its farming lands are unsurpassed by any in Southern California; the hills can be cultivated to their tops, and some of the best wild grapes are found on these Ranches; the soil is very productive, and every seed put into the ground produces a thousand fold; cotton and tobacco will grow luxuriantly, and with profit to the husbandman.

I cannot refrain from the expression of my satisfaction upon finding that the extracts from my field notes, taken so many years since, no less than my general views of the character and value of the property in San Louis, Obispo and Santa Barbara Counties, in Southern California, are so completely in accordance with those contained in the full and valuable report of Professor Silliman, whose examinations and surveys the last year had nothing in common with mine but an entire coincidence in our views of the present condition and future destiny of this great oil region of California.

Samples of the various oils, asphaltum, bitumen, amber oil, rosin, coal, tar, liquid bitumen, chrystalized petroleum, coal, Indian grease, and other oleaginous substances taken from the fissures in the rock, and found on the surface of the soil, and gas

springs, can be seen at my office, on the arrival of the steamer on the 25th March, or 1st April, in New York.

Very respectfully,

J. WILLIAMSON,

Engineer-in-Chief of Survey and Exploration.

The following examination of the California oil, gathered from the surface springs, has been made by Professor J. M. Maisch, Sufficient time was not allowed him to purify and discolor the oil, or make the examination as full as he desired; it will, however, be continued, and the results communicated at some future day. It is quite satisfactory, as far as it has been carried, and entirely confirmatory of the examinations made of samples of the same oil at the laboratory in New Haven, under the direction of Professor Silliman.

Philadelphia, March 18, 1865.

JOHN C. CRESSON, ESQ.,

Pres't Philadelphia and Cal. Petroleum Co.

DEAR SIR:—I have examined the coal oil from California sent to me, and find it to have a specific gravity of .8629, and to be composed of

Benzine spec. grav. .756	$7\frac{8}{10}$	p. ct. by vol.
Illuminating oil, spec. grav. .8219	50	“ “
Lubricating oil,	$42\frac{2}{10}$	“ “

The lubricating oil is very dense, has a strong body, and is in this respect greatly superior to many of the lubricating coal oils in our market. It is of a dark brown color, and will answer well for heavy machinery.

With comparatively little trouble and outlay, a great portion of it may be purified so as to answer for light machinery.

The illuminating oil is very light in color, and is easily obtained, entirely colorless by treatment with acids.

What is commercially called "benzine," consists of hydrocarbons, rarely exceeding .740 in specific gravity; compounds of the specific gravity .756 are generally contained in the commercial coal oil used for illuminating, which would increase the quantity of illuminating oil from this sample to $57\frac{8}{10}$ p. ct.

Yours, very respectfully,

J. M. MAISCH.



ANALYSIS
OF THE
CRUDE PETROLEUM

FROM

The Philadelphia and California Petroleum Co.'s Estate

IN SAULEE, BARBARA COUNTY,

CALIFORNIA.

By C. M. WARREN, Esq.,

OF BOSTON.

Communicated in a Letter from the Author to PROF. SILLIMAN.



New Haven, April 1, 1865.

F. GRAFF, ESQ., *Sec'y.*

DEAR SIR:—It gives me pleasure to transmit to you herewith Mr. Warren's results of fractional condensation of the sample of oil from your estate, identical with that upon which I have already communicated to Mr. Cresson the analysis made here.

Mr. Warren is the author of a new and highly improved method of distillation, by which results of great accuracy are attained in the fractionalizing of hydro carbons. His experience as a chemist with petroleum is far greater than that of any other person in the United States, and his reputation for skill and accuracy unsurpassed. It is very satisfactory to me therefore to find how essentially similar his results are to those which I have already communicated to you. You will note that Mr. Warren's temperatures are given in degrees Centigrade, while mine are translated into Fahrenheit's degrees.

With reference to the crude petroleum, of which you have now three different analyses, it is to be remarked that when drawn fresh from an artesian boring, it will undoubtedly afford a larger proportion of light and of illuminating oil than the surface samples now accessible.

Yours, truly,

B. SILLIMAN.

MR. WARREN'S LETTER TO PROF. SILLIMAN.

Boston, March 31, 1865.

DEAR SIR:—The results of my examination of the Crude California Petroleum which you sent me through Messrs. Spear, Burke & Co., of this city, and which bore the seal of Messrs. Wyeth & Bro., are as follows:

Specific gravity at 17 c. $0.864=33^{\circ}$ Beaumé.

1250 cc. of the crude substance subjected to	} Specific gra- vity not taken.
my process of fractional condensation, gave—	
41 cc. of light oil between 93° and 100° c.	
43 “ “ “ “ 100° and 140° c.	
525 “ B. burning oil “ 140° and 310° c. sp. gr. $=44^{\circ}$ B.	

From this point the distillation was conducted in the ordinary manner from a common retort, no thermometer being employed.

270 cc. lubricating oil of sp. gr. $29\frac{1}{2}^{\circ}$ Beaumé.

293 “ “ “ “ 28° “

1172 cc. $=93.8$ per cent. of total product.

The residue left in the retort was dry coke. After treatment with sulphuric acid and alkali the light oil and the burning oil were nearly or quite colorless. The lubricating oil had a yellowish color. The odor of the burning oil was extremely agreeable, fully equal in this respect to the best Kerosene or refined Pennsylvania petroleum. The other products are also entirely free from disagreeable odor, and indeed the same may be said of the crude oil itself. In this respect it is readily distinguishable from the Pennsylvania petroleum.

The burning properties of the illuminating oil are not surpassed by any oil which I have seen.

What I have called *light oil* is not very volatile, and would not, I think, rank in the market as naphtha, at least not that taken between 100° and 140° c.; and it is my opinion that the burning oil would take the whole of the light oil, and still bear the commercial fire test. In that case some of the lighter of the lubricating oil probably might be run into the burning oil, so that the yield of the latter would be over 50 per cent.

Yours, truly,

C. M. WARREN.

PROF. B. SILLIMAN,

New Haven.



