We thus have a standard to which the determinations by the bomb-calorimeter are referable and which shows them to be correct.

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PETROLEUM IN CALIFORNIA.

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WITHIN the last few years California has developed a new industry, that of petroleum. The knowledge that it existed is not new. Seepages occur in various parts of the State, and natural gas is found over a very large area. Immense deposits of asphaltum occur in the southern counties and were used by the early Mission Fathers. Attempts were made to distil the crude oil and in 1855, Pico erected a small refinery.

The discovery of oil in Pennsylvania produced great excitement, not only in the east but in California. Claims were located in all parts of the State and companies formed to work them. In 1865 there were sixty-five companies in existence with a nominal capital of $45,000,000. Oil properties were exploited in every county from Humboldt to San Diego, but there was no apparent success, owing to lack of prospecting, insufficient depth of wells, and to the opinion of eminent chemists and geologists that the oil would not be found in large quantities, and could not be refined.

Petroleum occurs in every part of the State, but as yet only the southern part yields any large quantity. Ventura, Los Angeles, Orange, Santa Barbara, Kern and Fresno Counties furnish practically all the oil that is produced, although in many other counties small yields have been obtained.

Los Angeles, in common with other districts, was exploited nearly forty years ago, but no oil was obtained. The wells were not bored deep enough. Nothing further was done for thirty years, until in 1892 a well 365 feet deep was sunk and yielded oil. In three years, more than 300 wells were drilled and most of them yielded oil. Other districts in the neighborhood were exploited, and hundreds of new wells located. The production of oil rapidly increased until in 1897 it had reached 1,400,000 barrels. The total amount of oil obtained from the Los Angeles district amounts to more than 9,000,000 barrels. About 1400 wells have been dug, none of them very deep. The oil sand averages about 60 feet in thickness. A second sand has been worked with profit, and it is believed that a third sand exists.

Other districts in Los Angeles County have been worked for oil, the principal ones being Whittier, Fullerton and Puento. This oil is usually light in gravity, so much so that the most of it is distilled and only the residuum used for fuel. In Ventura County there are more than 500 wells, over 300 of them being worked now; they are from 500 to 2000 feet deep. Practically all are owned by the Union Oil Company. In Santa Barbara County, oil seepages have long been known. In 1895 some wells were dug on the beach at Summerland, and oil was struck at the depth of only 125 feet. The deepest are only about 400 feet. Since then more than 300 wells have been bored, some on the beach and some on the ocean, 400 to 1200 feet from the shore. Some of the wells in other districts are 1000 or more feet deep. The oil is heavy, averaging about 14° Bé. The yield is between 8000 and 10,000 barrels a month but has been much more. The Fullerton and Brea districts in Orange County produced last year over 1,000,000 barrels. The oil varies greatly in gravity, from heavy, 14° Bé., to as light as 35° Bé.

North of the Tehachapi, the whole valley of the San Joaquin seems to be underlaid with oil, although as yet only a small area is worked. The principal fields are in Fresno and Kern counties. In Fresno County is the well-known Coalinga district. This field is limited in extent, extending over but a few sections, but in this area there are very many wells. Some are very deep, one being 2300 feet. The oil is of different qualities, some very heavy and black in color, others very much lighter, about 35° Bé. There are two pipe lines to transport the oil to the railroad, and a pipe line to the ocean is about to be commenced.

Another district in Fresno that has produced some oil is Kreyenhagen, 22 miles southeast of Coalinga. Like Coalinga, it produces two qualities: one green and light, 35° Bé., and one black and heavy, 14° Bé. Other districts have been prospected but they yield little or nothing.

In Kern County we come to the largest field that has yet been discovered. It has developed marvelously, over 600 wells have been dug and nearly all are producers. Some of them yield only a few barrels a day but most of them are about 50-barrel wells.

Some have produced much more: 200, 400 or even 600 barrels a day. None of them are flowing. The average depth of the wells is about 800 feet; some are less than 500 feet, and the deepest are less than 1100 feet. The oil is thick, black and heavy, ranging in gravity from 9° Bé to 22° Bé., usually being from 14° to 17° Bé. It usually carries much fine sand, from which it is freed by settling. The oil is sometimes previously thinned by heating with steam. The oil carries large amounts of asphaltum, from 10 to 40 per cent. The present well-defined producing area of the Kern River district measures about 5 miles long and 3 miles wide, the longer axis extending in a northwesterly direction, and the thickness of the oil sand varies from 50 to 400 feet, a large proportion being of the latter depth. The limits of the field have probably not been reached, and in time the producing area will probably be enlarged. 20,000 to 25,000 barrels a day are shipped from this district, and this yield could be increased many fold, if there was a sufficient demand. Owing to the lack of demand and consequent low price of oil, many of the wells are not pumped, the owners waiting for better prices. A pipe line is being constructed by the Standard Oil Company from Bakersfield to their refineries at Point Richmond on San Francisco Bay, a distance of 280 miles. The pipe is 8 inches in diameter, covered with asbestos and buried. The reason for this is that the oil is so viscous at ordinary temperatures that it cannot be pumped. It must be heated, and at every pumping station, which are 27 miles apart, a heating plant is installed. The company has also built 100 37,500-barrel storage tanks at Bakersfield and two 75,000-barrel cement reservoirs. The large area of the field and the great thickness of the oil sand indicate that the life of the wells will be very long. The Kern River field is the most important in California and produces more than half the entire yield of the State.

Another part of Kern County where petroleum is found is the McKittrick district. Here are large deposits of asphaltum that are worked by the Southern Pacific Railroad. They have built a branch 65 miles long, terminating at Asphalto. This district contains a few good wells, but many are useless. Some give very large amounts of water. The oil is light, about 33°, and the yield is about 50,000 barrels a month. A third district in Kern County is the Sunset. This has also been worked for asphaltum for nearly ten years. It has lately been developed for oil. Over fifty companies are operating; some have good wells, as much as 100 barrels a day, but most of them are barren. Nearly all are troubled with fine sand that caves in and chokes the wells and also remains in the oil. There is a great lack of water. What there is is usually salt or alkaline. Most of the oil is heavy, containing about 30 per cent. to 40 per cent. asphaltum of good quality. The asphaltum for a time was more valuable than the oil, owing to the lack of transportation. This has been remedied by the railroad building a branch line connecting at Bakersfield. The adjoining Midway district appears promising but as yet has not produced much.

The foregoing are the districts that produce practically all the oil in California. But it has been found in greater or less quantity in almost every county, and also in parts of Oregon, Washington, British Columbia and as far north as Alaska. Some of the counties in which prospecting has been carried on extensively are, all the southern counties and in San Benito, Monterey, Santa Clara, San Joaquin, San Mateo, San Francisco, Alameda, Contra Costa Napa, Sonoma, Colusa, Tehama, Mendocino, Humboldt and Shasta Counties. Occasionally the wells have been bored very deep. Some in Contra Costa and San Mateo are 1200 feet deep. There is a well in Humboldt in the Mattole district over 2000 feet deep. They have all yielded a small amount of oil, but there are no wells that give more than a few barrels a day. The oils along the coast from Santa Clara northwards in San Mateo, Mendocino and Humboldt Counties, and eastward to Colusa County, are very different in quality from the southern oils. They are lighter in color—usually yellow—lighter in gravity, varying between 19° Bé. and 40° Bé., and contain a paraffin residue, with little or no asphaltum.

To recapitulate, we find that oil is distributed over this entire western coast, but as yet practically the whole amount produced comes from a few districts in the southern part of California. The following table compiled by Mr. C. L. Yates for the State Mining Bureau, will illustrate this.

The statistics for last year have not been accurately compiled, but the total amount produced will be 13,000,000 barrels. In spite of this greatly increased supply, the price is gradually rising, and when the present long-term contracts have expired, the price will probably go still higher.

The method of boring wells is practically the same as used in

PETROLEUM PRODUCTION OF CALIFORNIA FROM 1897 TO 1901.

County.	1897. Product. Bbls.	1897. Value.	1898. Product. Bbls.	1898. Value.	1899. Product. Bbls.	1899. Value.	1900. Product. Bbls.	1900. Value.	1901. Product. Bbls.	1901. Value.
Fresno........	70,140	$ 70,840	154,000	$ 154,000	439,372	$ 439,372	547,960	$ 547,960	525,433	$ 236,444
Kern	......	......	10,000	10,000	15,000	13,500	919,275	827,348	3,902,125	1,131,616
Los Angeles...	1,327,011	1,327,011	1,462,871	1,462,871	1,409,356	1,409,356	1,722,887	1,722,887	2,304,432	1,062,038
Orange	12,000	12,000	60,000	60,000	108,077	108,077	254,397	254,397	302,652	181,591
Santa Barbara .	130,136	130,136	132,217	112,549	208,370	191,288	183,486	165,138	203,616	113,385
Ventura.......	368,282	368,282	427,000	571,000	496,200	496,200	443,000	398,700	472,057	236,028
Miscellaneous .	4,000	10,000	3,000	6,000	1,500	3,000	248,945	236,498	......	......
	1,911,569	$1,918,269	2,249,088	$2,366,420	2,677,875	$2,660,793	4,329,950	$4,152,928	7,710,315	$2,961,101

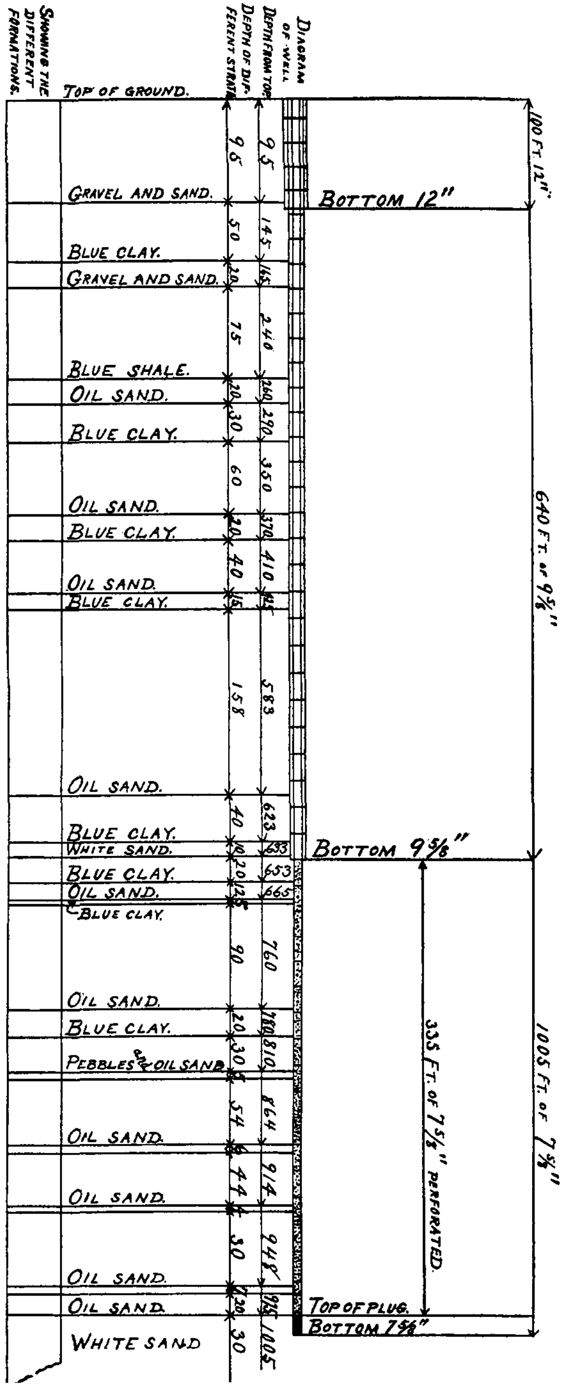
the east. The character of the formations passed through varies greatly according to the district. As the Kern River district is the largest, the following diagram showing a typical well is given.

There is apparently much difference in the quality of California petroleums obtained from different localities, but actually they are very much the same. The differences probably result from natural distillations or filtrations, a lighter oil being obtained, leaving a heavy residue containing asphaltum. Extreme variation is from 10° Bé. for oils of the McKittrick and Sunset district; to 35° Bé. for Coalinga and Puento. A water-white oil is found in the Newhall district that has a gravity of only 50° Bé. and leaves scarcely any residuum. It is evidently a natural filtrate or distillate. San Mateo, Colusa and Humboldt oils are apparently very different from most of the others. as they apparently contain little or no asphaltum. They have a gravity of from 17° to 50° Bé.

Chemically considered, California petroleums seem to be intermediate between Eastern and Russian oils. They contain paraffins, benzenes and naphthenes. Most of them contain nitrogen and sulphur. The sulphur seems to be contained in a volatile body, and is frequently almost entirely removed in a fraction boiling between comparatively narrow limits.

The chief use of California crude petroleum is for fuel. Many of the large steam plants have discarded coal and now burn oil. The annual consumption of coal in California has been nearly 2,000,000 tons, and nearly half of this has been displaced by oil. Crude oil in bulk does not burn readily, especially if it is heavy. A special form of burner must be used. The usual method is to inject the oil in a very fine spray, by means of steam, and the heated, finely divided particles will burn easily and completely.

As the flame is exceedingly hot, it is directed on to brickwork on the bottom of the fire-box, and the boiler heated to a large extent by radiation. The intense heat is wearing on the boilers, but the advantages of oil over coal, especially on this coast, are many. It is more convenient to handle,—it is cleaner and it is cheaper. The liquid oil is transported much more easily than the solid coal. When properly burned, there is no smoke or soot or cinders. There are no ashes, so the boiler tubes do not get stopped up. Oil-heating is particularly desirable for locomotive engines. Ease of loading and firing and absence of cinders, with consequent comfort to passengers, and no danger of setting fire to grain fields or



Typical Well of the Kern River District, Bakersville.

fences, are self-evident advantages. In Russia, nearly all the locomotives are thus run. Many of the engines in this state are oil burners, and it is only a question of time when practically all will be altered. The cheapness depends partly on the relatively greater economy in handling and partly on the greater heating value as compared with coal. Seven barrels of oil will weigh about a ton; at a cost of $1.25 per barrel, this would be equivalent to $8.90 per ton; at $1.50 per barrel, $10.50 a ton. But the heating value of oil, weight for weight, is greater than that of coal. From a number of experiments we have made in our laboratory, we find that the heating value of California oil is between 10,000 and 11,000 calories, averaging about 10,500. The best coals of this coast average 7,000 to 8,000 calories, and the usual steam coals much less. Comparing the cost of coal and oil at the above prices as to the theoretical heat value, a ton of oil would be worth $6.00 to $8.00 and the coal $8.00 to $9.00. The actual difference is very much greater than this, as there is much less waste in oil heating. From many actual experiments made under boilers, it has been found that from 4 to 4½ barrels of oil is equivalent to one long ton of good coal, a saving of from 25 per cent. to 40 per cent., so that coal cannot compete with petroleum at the present prices nor can it until its cost is reduced to between $4.00 and $5.00 a ton, whereas it is between $7.00 and $8.00 a ton, and the best qualities bring from $10.00 to $14.00. Oil is selling in San Francisco now at less than 70 cents a barrel. This brings the cost of fuel on this coast to a par with the cost in the east, with its consequent great advantages. The smelters around the bay are using oil with a saving of over 50 per cent. in the cost of fuel.

Outside of fuel, crude petroleum is used to a slight extent on this coast in gas-making, as a coarse lubricant and as an insecticide in the orchards. A comparatively small amount is thus consumed. The Elmore process for concentrating ores, which employs petroleum, may consume a quantity.

The refining of oil is conducted on an increasing scale. Thirty-three refineries are now in operation. The capacity varies from 50 to 2000 barrels a day, the aggregate amounting to from 8000 to 10,000 barrels daily. The usual distillates are made—benzines, illuminating and lubricating oils. None of these except the benzines are of very good quality. They are used chiefly to mix with eastern oils.

Physical Characteristics of California Petroleums.

Serial No.	District.	Color.	Gravities temperature. °C.	Corresponding °Bé.	Flashing-point. °C.	Burning-point. °C.
54	Los Angeles.	Black.	0.9589 at 15.0	16.1	115.5	134.0
116	Whittier.	"	0.9397	19.3	....	....
87	Ventura.	"	0.9460 " 22.0	18.3	73.0	80.2
155	"	"	0.9830 " 11.0	11.6	....	....
50	"	Brown.	0.9143 " 18.0	23.6	....	....
186	"	......	0.9159 " 15.0	22.8	29.0	35.0
93	Newhall.	Water-white.	0.8059 " 19.0	45.0	....	....
156	Kern.	Black.	0.9572 " 18.5	15.7	....	....
157	"	"	0.9533 " 20.3	15.9	....	....
111	"	"	0.9760 " 18.0	13.5	....	....
112	"	"	0.9651 " 18.1	15.1	....	....
134	McKittrick.	"	0.9458 " 18.0	18.5	....	....
135	"	"	0.9628 " 18.0	15.4	....	....
103	Sunset.	"	0.9589 " 17.0	16.2	....	....
85	"	"	0.9245 " 18.0	22.0	....	....
149	Summerland.	"	0.9815 " 21.0	12.7	....	....
147	"	"	0.9792 " 21.0	13.0	....	....
160	Coalinga.	Brown.	0.9276 " 21.1	21.4	70.0	94.0
52	"	"	0.8962 " 26.2	27.0	....	....
51	"	"	0.9493 " 17.4	17.9	....	....
159	Santa Clara.	Light brown.	0.8515 " 18.0	34.4	89.5	104.0
184	San Mateo.	Brown.	0.9206 " 15.0	22.6	90.0	102.0
127	Santa Cruz.	Black.	0.9565 " 18.0	16.8	....	....
100	Napa.	Brown.	0.9603 " 18.0	16.0	131.0	138.0
98	"	Dark brown.	0.9655 " 18.0	15.1	135.0	140.0
154	Colusa.	Yellow.	0.8229 " 19.0	40.0	....	....
142	Contra Costa.	Black.	0.9653 " 17.0	15.1	....	....
161	Humboldt.	Red-brown.	0.8810 " 15.5	28.9	....	....
94	"	Yellow.	0.8992 " 18.0	26.3	41.0	44.0
95	"	"	0.8951 " 18.0	27.0	109.0	114.0
96	"	"	0.9489 " 19.0	17.9	101.0	117.0
99	"	"	0.7825 " 19.0	50.5	17.0	18.0
101	"	"	0.8263 " 15.0	40.6	less than 10.0	less than 10.0
187	......	......	0.9670 " 15.5	15.0	91.0	105.0

The asphalt residue is of excellent quality and finds a ready sale. In fact, in some cases, the oil was used for the asphaltum only, the distillates being rejected.

The future. of the oil industry appears to be bright. The southern part of the state appears to contain a large supply of petroleum, particularly in the upper part of the San Joaquin valley There is a large demand for fuel purposes alone, and there is little doubt but that uses for the distillates will be found. Benzene derivatives appear to be present in considerable quantities and it will pay to separate them. The greatest significance, however, will be the solution of the fuel problem.

As very little has been published in regard to the character of California oils, the following results may be of value. They have been compiled from analyses made in this laboratory during the past two years. They cover oils from the various districts, and serve to show the great variance in physical characteristics.

SPECIFIC VISCOSITIES OF CRUDE OILS AT 60° F. AND 185° F. = 15½° C. AND 85° C.

Sample number.	15.5° C. 60° F.	85° C. 185° F.	Sample number.	60° F.	185° F.
145	4.88	1.28	135	282.03	3.57
134	63.15	2.12	149	1462.83	8.35
157	299.59	4.70	160	11.19	1.54
161	1.57	1.05	95	3.00	1.15
101	1759.13	7.51	99	1.17	0.96
156	373.11	3.67	100	10.35	1.34
184	10.96	1.50	186	34.28	1.84
101	1.10	0.95	192	3259.27	9.00
112	274.35	3.35	187	347.77	3.37
2	19.40	1.60	4	16.96	1.53
138	396.72	4.28	113	142.66	2.85
189	310.56	3.38			

It will be noticed that the viscosity diminishes very rapidly as the temperature increases. At a temperature of 100° the viscosity approaches that of water or may even be less.

The following table shows the percentage of volatile matter at various temperatures. It is of value chiefly as showing the variant character of the oils from different districts. The analyses were carried out under practically the same conditions, and the results are comparative.

FRACTIONAL DISTILLATION OF CALIFORNIA PETROLEUM.

Serial number.[1]	District.	Water.	Below 100° C. 212° F.	100° C. to 150° C. 212° F. to 302° F.	150° C. to 250° C. 302° F. to 482° F.	250° C. to 350° C. 482° F. to 662° F.	350° C. to asphalt. 662° F. to asphalt.	Asphalt.	Loss.
111	Kern.	1.4	0.00	0.00	3.9	34.0	27.2	31.6	1.9
112	Kern.	0.5	0.00	1.00	9.25	19.74	48.13	21.25	..
160	Coalinga.	0.00	0.00	1.10	21.70	40.70	21.50	14.60	0.4
99	Coalinga.	0.00	0.00	32.60	28.20	17.20	16.00	5.00	1.0
51	Coalinga.	1.00	0.00	0.80	15.00	42.50	14.50	25.40	0.8
52	Coalinga.	0.20	7.70	10.30	18.70	30.00	18.00	16.20	0.9
134	McKittrick.	0.00	0.00	0.00	19.10	20.80	45.82	14.25	..
135	McKittrick.	0.00	0.00	trace	8.50	23.50	53.25	15.00	..
85	Sunset.	0.00	0.00	6.50	17.26	17.25	47 98	11.00	..
103	Sunset.	0.00	0.00	0.00	11.90	26.40	37.80	23.90	..
87	Ventura.	2.74	....	....	....	....	....	....	..
155	Ventura.	9.50	0.00	0.00	11.20	34.05	8.75	36.50	..
50	Ventura.	0.00	0.00	17.00	11.50	9.00	21.50	41.00	..
186	Ventura.	0.00	2.50	9.50	16.00	54.50	2.20	13.80	1.5
101	Humboldt.	0.00	0.00	39.50	29.80	24.00	1.50	4.70	0.5
161	Humboldt.	0.00	0.00	0.00	47.50	35.20	9.60	7.50	0.2
94	Humboldt.	0.00	0.00	13.70	33.40	22.20	10.80	19.40	0.5
95	Humboldt.	0.00	0.00	0.00	15.70	35.10	44.30	4.90	..
96	Humboldt.	0.00	0.00	0.00	16.10	53.60	3.20	26.50	0.5
99	Humboldt.	0.00	5.20	27.40	28.20	17.20	16.00	5.00	1.0
100	Napa.	0.00	0.00	0.00	0.00	87.00	4.20	9.00	..
98	Napa.	0.00	0.00	0.00	0.00	15.70	72.60	11.40	0.3
154	Colusa.	0.00	0.00	0.00	8.80	96.00	21.60	0.50	0.1
93	Newhall	0.00	12.50	46.20	32.27	....	3.23	5.30	0.5
159	Santa Clara.	0.00	....	15.00	35.80	31.20	14.40	3.60	..
142	Contra Costa.	5.70	0.00	3.70	17.50	37.00	15.20	21.00	0.1
127	Santa Cruz.	21.50	0.00	0.00	6.20	34.00	14.40	22.80	1.1
149	Summerland.	25.00	0.00	0.00	6.50	17.10	27.50	22.50	1.4
184	San Mateo.	14.90	0.00	0.00	0.00	0.00	58.90	26.00	0.2

The percentage of carbon and hydrogen is shown in the following table: The difference is not put down as oxygen for the reason that most of the oils contain at times considerable quantities of nitrogen and sulphur.

Oil. Serial No.	Hydrogen. Per cent.	Carbon. Per cent.	Specific gravity.	District.
145	10.84	88.26	0.9700	Colusa.
114	11.30	85.80	......	Bakersfield.
115	11.50	86.09	0.9397	Whittier.
155	10.81	80.42	0.9830	Ojai Valley.
170	12.16	84.86	0.9572	Kern.

[1] Numbers are volume per cent.

Oil. Serial No.	Hydrogen. Per cent.	Carbon. Per cent.	Specific gravity.	District.
156	10.72	6.32	0.9572	Bakersfield.
110	11.18	82.45	0.9760	Kern.
134	11.45	86.06	0.9458	McKittrick.
157	11.30	85.75	0.9533	Kern.
103	11.30	85.83	0.9589	Sunset.
142	10.83	84.66	0.9653	Contra Costa.
177	10.70	84.74	......	......
169	11.80	87.62	0.8620	Coalinga.
162	12.10	87.41	......	......
...	12.74	86.99	0.8059	......
...	11.82	86.61	......	......
100	11.13	88.08	0.9603	Napa County.
161	12.03	86.69	0.8810	Humboldt.
159	12.88	86.08	0.8515	Santa Clara.

The percentage of sulphur and nitrogen is shown in the following table: Various methods were tried for the determination of the sulphur, but the most accurate and convenient was to effect the combustion of the oil in oxygen at twenty-five atmospheres pressure in a Mahler bomb, and determine the sulphuric acid produced. Apparently none of the sulphur escaped oxidation. On allowing the gases to pass through bromine water, the solution gave no trace of sulphuric acid.

The Kjeldahl method was used for determining the nitrogen. Oxidation was slow but complete.

SULPHUR AND NITROGEN IN CALIFORNIA PETROLEUMS.

Number.	Specific gravity.	Nitrogen. Per cent.
1	0.8254	0.001
103	0.9589	0.047
115	0.9306	0.669
169	0.8679	0.100
171	0.9774	0.0278
172	0.9629	0.185
174	0.8749	0.243
175	0.8801	0.204
150	0.9720	0.155
		Sulphur. Per cent.
154	0.8229	0.50
156	0.9572	0.80
157	0.9533	0.668
159	0.8515	0.920
169	0.8679	0.062
135	0.9628	0.880
134	0.9458	0.870
115	0.9397	0.700
112	0.9651	0.950
103	0.9589	0.86

The following table shows the calorific value of various California oils. The determinations were made in a Mahler bomb, with oxygen at 25 atmospheres pressure, in the usual manner.

CALORIFIC VALUE OF CALIFORNIA PETROLEUMS.

Number.	Specific gravity.	°Bé.	Calorific value. T. U. (calories.)	B. T. U.
103	0.9589	16.3	10,380	18,684
111	0.9760	13.5	10,190	18,342
112	0.9651	15.2	10,471	18,847.8
113	0.9518	17.5	10,350	18,630
115	0.9397	19.5	10,827	19,488.6
129	0.8861	28.6	10,800	19,440
134	0.9458	18.5	10,375	18,675
135	0.9628	15.6	10,317	18,570.6
...	0.9276	21.1	10,531	18,956
159	0.8515	34.4	11,192	20,145.6
145	0.9700	14.5	10,360	18,648
115	0.9397	19.3	10,725	19,305
156	0.9572	16.5	10,359	18,646.2
110	0.9760	13.5	10,263	18,473.4
157	0.9533	17.2	10,443	18,797.4
103	0.9589	18.0	10,380	18,684

Many more results of determinations might be given, but the foregoing serve to give an idea of some of the characteristics of California crude petroleum, and indicate the great diversity in physical properties. Chemically, they resemble each other much more closely, as will be shown in a subsequent paper.

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THE INFLUENCE OF ATMOSPHERIC OXIDATION UPON THE COMPOSITION AND ANALYTICAL CONSTANTS OF FATTY OILS.

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IT is well known that the so-called non-drying and semi-drying as well as the drying oils may absorb oxygen from the air at ordinary temperatures and that the analytical constants are more or less changed by such oxidation. This subject was studied by Ballantyne[1] who found that olive, rape, cottonseed, arachis and linseed oils after exposure to sunlight in uncorked bottles showed

[1] *J. Soc. Chem. Ind.*, 10, 29 (1891).