PETROLEUM.

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BY JOSEPH D. WEEKS.

The history of the production of crude petroleum in the United States, its geographical and geological distribution, as well as its technology, were so thoroughly presented in the admirable report of Professor S. F. Peckham, made at the Tenth Census, that it has not been deemed necessary to discuss these topics in detail in the present report. They will only be treated of with sufficient fullness to make intelligent the statistics of the production of petroleum at the Eleventh Census.

It may be proper here to acknowledge the great indebtedness to the several volumes of Mineral Resources of the United States, to Stowell's Petroleum Reporter, the American Manufacturer and Iron World, both published at Pittsburg, Pennsylvania, to the writings of the late Dr. Charles A. Ashburner, Mr. John F. Carll, and Professor Edward Orton, and to the reports of the geological surveys of the various states. It is desired also especially to acknowledge indebtedness to the officers of the Standard Oil Company and its associate organizations for the constant assistance rendered in the preparation of this report. This assistance has been freely given, and has been most important. This report would have been lacking in many details which it now includes, and which add greatly to its value, had not this co-operation been given. No organization was more willing and ready to furnish not only the information called for in the schedule but much of the data used in the preparation of the report.

The difficulties of this investigation growing out of the methods of the industry have been very great, and, in connection with certain of the inquiries, well-nigh insurmountable. Much of the work of drilling and operating the wells, of building rigs, tanks, and pipe lines is done by contract; building rigs at so much a foot or a rig; drilling wells at a fixed sum per foot, including furnishing all labor and materials; pumping wells at so much a barrel, sometimes paid in money and in other instances in a percentage of the oil. Tanks and pipe lines are also usually built or laid at a given contract price. It is very readily seen how difficult it will be to arrive at the number of employés, the wages paid, and the value of materials of this contract work; and yet it is evident that, in order to arrive at a correct statement, not only should the work done and materials furnished by the producer and reported by him in his report on labor and wages and materials used be reported, but the contract work should be included, as well as that done by the producer's employés.

The value of this contract work could be ascertained, it would be supposed, from the parties owning the wells, but it can not be so learned. Very many petroleum producers keep no books. Many of them have no permanent address. They drill a well in new territory, "wild cat", as it is called. If oil is found the well and lease are sold and the parties migrate to another section, and there is no record of cost or even of production except what may be found in the pipe-line companies' reports. In many instances a well or a group of wells will change ownership more than once in a year. The records of labor, production, cost, etc., rarely pass with the ownership. The new owner can not even estimate what the production was, much less cost and labor, and the former owner may or may not be accessible. In such cases the only source of information is the pipe-line reports.

These remarks apply especially to the Pennsylvania and New York and the Lima fields. How these and other difficulties have been met will appear in the proper place in the report. All that is claimed for the statistics here published is that they are the best and most accurate tha tcould be obtained, and that they are the most complete ever published.

HISTORY OF THE PRODUCTION OF CRUDE PETROLEUM IN THE UNITED STATES.

The history of the production of crude petroleum in the United States may be said to have begun with the striking of oil in the Drake well at Titusville in 1859, though petroleum had been known to exist in this country, and especially in what are now the Pennsylvania petroleum regions, from its earliest explorations by the French. The discovery of petroleum at Titusville led not only to the search for oil in the immediate vicinity but all over the United States. There is scarcely a state in the Union in which explorations for petroleum have not been undertaken. The years from 1859 to 1869 were prolific in the formation of companies with capital aggregating

hundreds of millions of dollars, some of it representing actual money invested, the most of it an inflated idea as to the possibilities of the discovery of petroleum in the section of the country covered by the operations of the proposed companies. During these years western Pennsylvania was quite thoroughly exploited for oil, as were also West Virginia, eastern Ohio, Kentucky, Tennessee, Alabama, Colorado, and California. In all of these states oil in some quantities was found. The Macksburg field, in Ohio, was discovered as early as 1860, but assumed little importance until 1884. Oil was found in West Virginia probably as early as 1861 or 1862, but not in great quantities until 1865. The Kentucky, Tennessee, and other fields in the states to the southward of these have never assumed much importance, though considerable oil has been found, especially in Kentucky, in the neighborhood of Glasgow and Bowling Green. The first wells sunk in Colorado were in 1862, though it was not until 1883 that the production assumed any importance. Southern California was quite thoroughly exploited early in the sixties, and operations there have been continuous ever since, though it was not until early in the seventies that the production assumed any degree of importance or continuity.

The year 1885 seems to have marked a new era in the history of petroleum. The importance of the Trenton limestone as an oil producer in the United States was first recognized at this time, and this year marks the discovery of the Lima (Ohio) and the Indiana fields. From the Lima field alone was derived more than one-third of all the oil produced in the United States in 1889.

Near the close of the eighties a remarkable development began in southwestern Pennsylvania in a territory which it was supposed had been thoroughly exploited for oil in previous years without any great returns. Some of the very best oil districts in Pennsylvania, producing in proportion to their area a larger amount of oil than any previously discovered districts, are located in southwestern Pennsylvania, in sections in which it was believed that oil in paying quantities would not be found. Writing in September, 1885, before these wonderful discoveries in southwestern Pennsylvania, the late Dr. Ashburner expresses the opinion that the boundaries of the oil regions of Pennsylvania were well established and that there were no reasonable expectations that any new or extensive field would be found. At this time, according to Dr. Ashburner's statement, a small amount of oil had been found in isolated pools to the south and southeast of Beaver county. One of these pools in which small amounts of oil had been found was in the vicinity of Washington, Washington county. This isolated pool of Washington, yielding small quantities of oil in 1885, furnished nearly 4,000,000 of the 21,487,435 barrels of oil produced in Pennsylvania and New York in 1889, its production being exceeded only by the Butler and Clarion and the Bradford districts.

ORIGIN OF PETROLEUM AND NATURAL GAS.

It hardly falls within the range of this report to discuss at length the various theories which have been advanced as to the origin of both petroleum and natural gas, though a brief statement is necessary to the better understanding of what shall be said regarding the occurrence of these products in the different states. There are two theories advanced for the origin of these members of the paraffin series, one advanced chiefly by chemists and the other by geologists. The chemical theories that have received the widest currency and discussion are those of Berthelot, a distinguished French chemist, and of Dr. Mendeléjeff, of Saint Petersburg. Both of these gentlemen ascribe the origin of petroleum and natural gas to the action of chemical force on inorganic matter. Berthelot's theory assumes the existence of the alkali metals potassium and sodium in the interior of the earth in a free or uncombined state and at high temperatures. If surface water carrying carbonic acid in solution should find access to these metals in these conditions, chemical reactions could easily take place by which certain of the hydrocarbons would be generated. There is no doubt that various compounds of the bituminous series can be formed artificially, but this seems the only proved fact in Berthelot's theory. There is nothing to prove the assumption that the alkali metals exist in the interior of the earth in a free or uncombined state; in other words, that the conditions necessary to produce petroleum exist in the interior of the earth.

The second chemical theory, that of Dr. Mendeléjeff, has received much wider attention. He also assumes that petroleum is never of organic origin, but purely a product of a reaction between inorganic substances. He assumes, and gives plausible reasons to prove, that petroleum and natural gas have been formed at points much lower than the strata in which they are found and have risen, instead of having been produced at a higher point in the geological scale and descended, basing his views on the well-known facts regarding the cracking, dislocation, and fissuring of the earth's surface and the view of the interior of the earth resulting from the acceptance of Laplace's theory, and still further on Deville's theory of dissociation. He claims that when, in consequence of cooling or some other cause, a fissure takes place through which a mountain range is protruded the crust of the earth is bent and at the foot of the hills fissures are formed or such conditions produced that surface waters are able to make their way deep into the bowels of the earth and to reach occasionally the heated deposits of metallic carbides, which may exist either in a separated condition or blended with other matter. Iron, or whatever metal may be present, forms an oxide with the oxygen of the water. Hydrogen is either set free or combined with the carbon which was associated with the metal and becomes a volatile substance, that is, naphtha. The water which had penetrated down to the incandescent mass is changed into steam; a portion of it finds its way to the porous substance with which the fissures were filled and carries with it the vapors of the newly-formed hydrocarbon, and this mixture of vapors is

condensed wholly or in part as soon as it reached the cooler strata. The chemical composition of the hydrocarbons produced will depend upon the conditions of temperature and pressure under which they are formed. Hence it is that mineral oils, mineral pitch, ozocerite, and similar products differ so greatly from each other in the relative proportions of hydrogen and carbon. Artificial petroleum has been frequently prepared by a process analogous to that described. This is Dr. Mendelćjeff's theory. Without discussing it at length, it is sufficient to say that his statements as to the conditions of structure near the surface of the earth which are necessary to his theory do not exist in many of the petroleum districts of this country. As Professor Orton shows, the entire range of the facts of American experience demonstrates the unsoundness of his theory that storage should be provided for in fissures and rents formed in the rock. Possibly an exception to this may be found in the conditions existent in the Colorado field. It may be said here in a general way that Dr. Mendelćjeff's theory has not been accepted by American geologists.

Most of the geologists who have discussed the theory of the origin of petroleum have ascribed it to organic matter incorporated with the stratum when the latter was formed. There is substantial harmony among geologists as to this point. But there is a wide divergence of opinion as to the source of the organic matter and the method by which petroleum and natural gas were formed from it. The majority of geologists incline to the opinion that the chief sources of these hydrocarbons have been vegetable substances, animal remains being also, in the view of some, an important source. Some geologists consider animal remains as the chief source. Many geologists hold that petroleum and natural gas are the results of destructive distillation of organic matter, while others ascribe it to the primary decomposition of organic matter. According to some of the advocates of the destructive distillation theory, petroleum is constantly forming in the rocks, while the views of the others ascribe the time of its formation, as, for example, in the Allegheny fields, to the period when the Appalachian mountains were elevated.

While there are some difficulties in the way of the acceptance of the theory of the primary decomposition of organic matter, it seems to many geologists on the whole to be the best explanation of the facts for which they are obliged to account.

GEOLOGICAL OCCURRENCE OF PETROLEUM IN THE UNITED STATES.

While petroleum has been found in all the geological formations from the silurian up to the tertiary, it is not uniformly distributed through them, but is found principally in the rocks of the silurian and devonian ages and to a less extent in the mesozoic and tertiary. Cases are known where petroleum has been found in rocks older than the silurian, but it is in small quantities. The great deposits of western Pennsylvania are in the devonian, the Venango, Warren, and McKean groups being of this age, though the place of the Venango group is somewhat open to question, some geologists placing it in the Chemung, others in the Catskill, and some even as high as the Pocono. Considerable oil is produced in Pennsylvania, however, from the carboniferous, the oil on Dunkard creek, in Greene county, being from the Mahoning. Some of the oil sands of Washington, Beaver, and Lawrence counties are from the conglomerate, while the Pocono, or No. X of Rogers, holds the Berea grit, which produces oil and gas in Lawrence and Beaver counties and a large quantity of gas in Butler. The oil, however, found in the carboniferous in Pennsylvania is in small amounts compared with that found in the devonian.

It may be also assumed that the statements regarding the oil horizons of Pennsylvania will apply to the entire oil-producing territory of the western slopes of the Appalachian range.

The oil horizon of western Ohio and Indiana is the Trenton limestone, which is by far the most important single source of petroleum in the United States at the present time. All of the oil produced in the new fields of Ohio and Indiana is from this single horizon, while, as pointed out above, the oil produced in Pennsylvania is from several distinct strata of sandstone of very unequal value, distributed through several thousand feet of the devonian and carboniferous.

The horizon in which the heavy lubricating oils of Kansas and Texas are found has not been determined.

The deposit of petroleum at Florence, in Colorado, is derived from the Larimer shales of the cretaceous formation. By reference to the detailed statement regarding the production of petroleum in Colorado it will be seen that while the drill reaches oil in this shale it is by no means positive that it is even the reservoir. The indications are that it flows into this shale from other rocks.

The oils of California, according to Professor Peckham, are found in the miocene of the tertiary.

LOCALITIES IN THE UNITED STATES IN WHICH PETROLEUM IS FOUND.

While petroleum has been found in nearly every state and territory, the localities in which it is produced in quantity are but few. These are the well-known oil regions of western Pennsylvania and New York, the Turkey Foot and other districts of West Virginia, the Macksburg and Lima fields in Ohio, the Florence district of Colorado, and the oil fields of southern California. Practically all the petroleum produced in the United States is from the districts named, though a few thousand barrels were produced in Indiana, Kentucky, Illinois, Kansas, and Texas in 1889.

Not only are the localities named above the chief petroleum producing districts in the United States, but the indications are that, with the possible exception of Wyoming, they will continue so to be. The Indiana field has some promise, and may be a producer of some importance in the future. The Kentucky and other southern oil fields, which at one time it was supposed would be factors of some importance in the oil production of the United States, give at the present time no such indication. The Illinois field is an exceedingly small one, with but little promise for the future, while the Kansas and Texas fields will at the best probably produce only a few thousand barrels each year of a high-grade lubricating oil. However, there have been so many surprises in petroleum that these statements must be regarded as only setting forth the present indications.

CHARACTER AND COMPOSITION OF AMERICAN PETROLEUM.

While the petroleum from different wells in the same district usually differs but little in character, there is a marked variation in many cases in the oils from different districts. The most notable distinction is in the solid constituents of the oil. The "basis" of all the petroleums in the United States, except a portion of those found in the southern part of California, is paraffin; of those of southern California, in most cases, asphalt.

In most of the oils a varying quantity of the lighter hydrocarbons, known in a general way as naphtha, is found. In others these lighter products are almost entirely wanting, or at least in refining all of the distillate is sold as illuminating oil. The composition of certain oils is also such that a large amount of lubricating oil, or heavy oils adapted to lubricating, is produced. For example, the Kansas and Texas oils are natural lubricating oils and can be used without any preparation except straining to remove any grit, while other so-called natural lubricating oils have to be prepared by a process of distillation, the various grades of density being used for various kinds of lubrication.

It may be said in a general way that the products of petroleum are: naphthas, or the lighter hydrocarbons; illuminating oils; heavy oils, or lubricants; residuum, paraffin or asphalt, and water.

Regarding the oils of western Pennsylvania, New York, West Virginia, and the Macksburg district of Ohio, which are chiefly used for the production of illuminating oil, it may be said that the petroleums of these districts as they come from the ground are clear, semitransparent oils, generally of an amber color, but varying somewhat in this regard with their density. When allowed to stand, however, a thick emulsion, reported in the tables of stocks as "B. S.", or sediment, separates itself from the oil. The amount of this sediment varies greatly, the longer the oil is allowed to stand the greater being the proportion of "B. S.", and the less the proportion of the lighter hydrocarbons. It is for this reason that fresh oil, or oil just produced, commanded a premium in 1889 over old oil or that which had been allowed to stand in the tanks, its yield of the lighter hydrocarbons and of the better grades of illuminating oil being greater when fresh than after having been stored.

The percentages of the products of fresh oil in refining will depend largely upon the methods of refining. This can be carried on so as to make the product of heavy oils almost nothing. From a refinery in western Pennsylvania the following statement as the results of their operations for 2 years has been received:

PERCENTAGE OF PRODUCTS FROM PENNSYLVANIA PETROLEUM.

PRODUCTS.	Per cent.	Per cent.
Naphthas	10.34	10.89
Illuminating oils	75.00	78.20
Heavy oils	2.00 to 6.00	2.00 to 4.00
Residuum	4.65	2.86
Water and loss	5.00 to 8.00	5.00 to 8.00

But little Lima or, better, Trenton limestone oil produced in western Ohio and eastern central Indiana had been refined in a commercial way prior to 1889. The chief obstacle to this use of the oil was the difficulty of removing the sulphur compounds present in it and the small percentage of illuminating oil which could be produced from the crude. At least 2 refineries succeeded in overcoming the difficulties in the way of the sulphur compounds during 1889, and American Trenton limestone oil became a factor in the market to some extent and promises to be a much more important one in the future. The actual facts, however, as to the yield of different products from this oil have been very difficult to obtain. In a general way it may be said to yield a comparatively large percentage of the lighter products and a small percentage of illuminating oil. In general conversation it is customary to assume a yield of 22 per cent in illuminating oils and 15 per cent of naphtha.

In a recent number of the Journal of the American Chemical Society appears an analysis of Lima petroleum, made in the laboratory, however, which shows a yield as follows:

PRODUCTS FROM LIMA (OHIO) PETROLEUM.

	PER CENT.
Naphtha at 70° B	16
Burning oil	68
Paraffin oils	6
Solid residuum	10
Total	100

These results are never reached in actual practice. Another sample of Lima petroleum gave the following

	PER CENT.
Distillate at 59° B	13.75
Distillate at 57° B	35.11
Distillate at 39° B	7.93
Distillate at 36.5° B	13.40
Distillate at 36° B	18.60
Residuum	9.65
Water	0.70
Total	99.14

The foregoing would indicate a production of oils approximately as follows:

		PER CENT.
Naphtha and burning oil		56.80
Heavy oils		32.00
Residuum		9.60
Water		0.70
Sulphur, first determination	0.63	
Sulphur, duplicate	0.68	
Sulphur, average		0.65
Total		99.75

The petroleum from the Florence oil field in Colorado seems to be lacking in the lighter hydrocarbons or naphthas, or at least in refining it all of the distillate is sold as illuminating oil, the whole product of refining being divided into only two classes, illuminating oil and residuum. It yields in refining from 34 to 44 per cent of this illuminating oil of about 125° fire test. This oil contains no B. S.

As has already been pointed out, most of the oil of southern California differs from that of all other sections of the country in having asphaltum as its base instead of paraffin. The oils from the different fields of this section also differ greatly in their character, some being practically liquid bitumens, yielding a very small amount of illuminating oils on distillation, while others have less asphaltum, producing larger percentages of illuminating oil. Here also the results of distillation are only two, one illuminating oil, of which about 35 per cent is produced from the crude charge, the other residuum, which is sold for fuel.

The approximate classification of the distillates of California oil, as given by Mr. Durand Woodman in the Journal of the American Chemical Society, is as follows:

PRODUCTS FROM CALIFORNIA PETROLEUM.

	PER CENT.
Naphtha under 0.73 specific gravity	10 +
Illuminating oils	40 ±
Lubricating oils	40 ±
Residuum	10 +
Sulphur	0.18
Water	0.27
Paraffin	None separable.

CENSUS STATISTICS.

NUMBER OF ESTABLISHMENTS.

In the meaning attached to it in manufacturing there is no such thing as an establishment in the crude petroleum industry. An establishment, as the word is used in manufacturing industries, is the aggregation of buildings, machinery, and appliances devoted to the production of the articles or wares whose manufacture or production is the object of the business carried on in the establishments. The only term in the petroleum industry that corresponds to an establishment in manufactures is a well, so that if the term "establishments" is to be used it must be regarded as the number of wells, which, on December 31, 1889, was 35,163.

TOTAL PRODUCTION OF CRUDE PETROLEUM IN THE UNITED STATES.

In the following table will be found a statement of the total production of crude petroleum of all grades in the United States in 1889, by states:

PRODUCTION OF PETROLEUM IN THE UNITED STATES IN 1889, BY STATES.

	BARRELS. (a)
Pennsylvania and New York	21,487,435
Ohio	12,471,466
West Virginia	544,113
Colorado	316,476
California	303,220
Indiana	33,375
Kentucky	5,400
Illinois	1,460
Kansas	500
Texas	48
Missouri	20
Total	35,163,513

a 42 gallons.

In this table the production of Pennsylvania and New York is united. The Bradford (Pennsylvania) field extends into Cattaraugus county, New York, and is so closely connected with the Allegany county (New York) field as to cause them to be regarded as one in most reports. Of the 21,487,435 barrels reported as being produced in Pennsylvania and New York, 7,158,363 barrels were taken from the Bradford-Allegany district. It will probably be approximately correct to estimate that 26.5 per cent of this was produced in New York, 8.5 per cent being from Cattaraugus county and 18 per cent from Allegany county. This would make the production of New York 1,896,966 barrels, and of the Pennsylvania portion of this district 5,261,397 barrels. The production of Cattaraugus county, New York, assuming this estimate to be correct, was 608,461 barrels, and of Allegany county, New York, 1,288,505 barrels.

In the following table will be found consolidated the statistics of the production of petroleum in the United States from the beginning of operations in these fields, so far as the same could be ascertained:

PRODUCT OF CRUDE PETROLEUM IN THE UNITED STATES FROM 1859 TO 1889. (*a*)

[Barrels of 42 gallons.]

YEARS.	Total United States.	Pennsylvania and New York.	Ohio.	West Virginia.	Colorado.	California.	Indiana.	Kentucky and Tennessee.	Illinois.	Kansas.	Texas.	Missouri.
Total	408,332,710	368,288,546	30,512,542	5,327,561	690,383	3,283,262	33,375	195,013	1,460	500	48	20
1859	2,000	2,000										
1860	500,000	500,000										
1861	2,113,609	2,113,609										
1862	*b*3,056,690	3,056,690										
1863	2,611,309	2,611,309										
1864	2,116,109	2,116,109										
1865	2,497,700	2,497,700										
1866	3,597,700	3,597,700										
1867	3,347,300	3,347,300										
1868	3,646,117	3,646,117										
1869	4,215,000	4,215,000										
1870	5,260,745	5,260,745										
1871	5,205,234	5,205,234										
1872	6,293,194	6,293,194										
1873	9,893,786	9,893,786										
1874	10,926,945	10,926,945										
1875	*c*12,162,514	8,787,514	*d*200,000	*d*3,000,000		*d*175,000						
1876	9,132,669	8,968,906	31,763	120,000		12,000						
1877	13,350,363	13,135,475	29,888	172,000		13,000						
1878	15,396,868	15,163,462	38,179	180,000		15,227						
1879	19,914,146	19,685,176	29,112	180,000		19,858						
1880	26,286,123	26,027,631	38,940	179,000		40,552						
1881	27,661,238	27,376,509	33,867	151,000		99,862						
1882	*e*30,510,830	30,053,500	39,761	128,000		128,636		*e*160,933				
1883	23,449,633	23,128,389	47,632	126,000		142,857		4,755				
1884	24,218,438	23,772,209	90,081	90,000		262,000		4,148				
1885	21,847,205	20,776,041	650,000	91,000		325,000		5,164				
1886	28,064,841	25,798,000	1,782,970	102,000		377,145		4,726				
1887	28,278,866	22,356,193	5,018,015	145,000	76,295	678,572		4,791				
1888	27,612,025	16,488,668	10,010,868	119,448	297,612	690,333		5,096				
1889	35,163,513	21,487,435	12,471,466	544,113	316,476	303,220	33,375	5,400	1,460	500	48	20

a Some oil was produced in other states, but no record has been secured other than that contained in note *b*.

b In addition to this amount, it is estimated that for want of a market some 10,000,000 barrels ran to waste in and prior to 1862 from the Pennsylvania fields; also a large amount from West Virginia and Tennessee.

c Including all production prior to 1876 in Ohio, West Virginia, and California.

d Includes all production prior to 1876.

e This includes all the petroleum produced in Kentucky and Tennessee prior to 1883.

PRODUCTION AND VALUE OF CRUDE PETROLEUM IN THE UNITED STATES IN 1889 ACCORDING TO USES.

In the following table are shown by states the production, total value, and value per barrel of the petroleum produced in the United States in 1889 according to uses:

PRODUCTION, VALUE, ETC., OF CRUDE PETROLEUM IN 1889, BY STATES.

STATES.	TOTAL.			ILLUMINATING.			LUBRICATING.			FUEL.		
	Production. (Barrels.)	Value.	Average per barrel.	Production. (Barrels.)	Value.	Average per barrel.	Production. (Barrels.)	Value.	Average per barrel.	Production. (Barrels.)	Value.	Average per barrel.
Total	35,163,513	$26,963,340	$0.76⅝	22,649,847	$24,569,190	$1.08½	121,146	$325,927	$2.69	12,392,520	$2,068,223	$0.16¾
Pennsylvania and New York.	21,487,435	23,475,163	1.09¼	21,393,159	23,225,453	1.08⅝	94,276	249,710	2.64⅞			
Ohio	12,471,466	2,173,995	0.17⅜	317,037	340,683	1.07½	1,240	10,334	8.33⅜	12,153,189	1,822,978	0.15
West Virginia	544,113	653,827	1.20⅛	520,511	595,730	1.14½	23,602	58,097	2.46⅛			
Colorado	316,476	280,240	0.88½	316,476	280,240	0.88½						
California	303,220	356,048	1.17⅜	97,264	121,684	1.25⅛				265,956	234,364	1.13¾
Indiana	33,375	10,881	0.32⅝							33,375	10,881	0.32⅝
Kentucky	5,400	5,400	1.00	5,400	5,400	1.00						
Illinois	1,460	4,906	3.36				1,460	4,906	3.36			
Kansas	500	2,500	5.00				500	2,500	5.00			
Texas	48	340	7.08⅓				48	340	7.08⅓			
Missouri	20	40	2.00				20	40	2.00			

It should be said, in explanation of the preceding table, that the classification is according to uses for which the oil was intended. That classified as illuminating oil includes that production usually sold and delivered to refineries for making into illuminating oil, but in connection with this manufacture there is a certain amount of lighter products, such as benzine, as well as, when it is so desired, a certain amount of lubricating oil, and also of residuum, which may be used as fuel. Under the head of "Fuel" is included the production from those districts the oil of which is used chiefly for fuel purposes, though a small portion of this oil was used in 1889 for the manufacture of illuminating oil, and much larger amounts since. Under the head of "Lubricating" is included only what are known as the natural lubricating oils, which are used only as lubricators, either without any preparation or with slight refining. From this table it will be noticed that the total production of what is classed as illuminating oil in the United States in 1889 was 22,649,847 barrels, valued at $24,569,190, an average value of $1.08½ per barrel. The product of lubricating oil was 121,146 barrels, valued at $325,927, or $2.69 per barrel. The production of what is classed as fuel oil was 12,392,520 barrels, valued at $2,068,223, or 16¾ cents per barrel. With the exception of 205,956 barrels produced in California, all of the fuel oils, so called, produced in the United States were from the Trenton limestone oil fields of Ohio and Indiana. The total production of all grades of oil in the United States was 35,163,513 barrels, valued at $26,963,340, or 76⅝ cents per barrel.

STOCKS OF CRUDE PETROLEUM.

The stocks of crude petroleum held in tanks at the wells in the United States on December 31, 1888 and 1889 as well as the total production for December, 1888, and December, 1889, are given in the following table. In the states other than Pennsylvania, Ohio, and West Virginia these stocks at the wells represent all the stocks of crude petroleum held by producers or for them. In Pennsylvania, Ohio, and West Virginia to these stocks at the wells should be added the stocks held by the pipe-line companies. Even this total will not represent the amount of crude petroleum in the country, but only that held by the producer or the party who has purchased the oil from him which is still carried in the tanks of the pipe-line companies. The crude petroleum held by the refiners is not included in the statement.

The table of stocks on hand December 31, 1888 and 1889, is as follows:

PRODUCTION AND WELL STOCKS OF CRUDE PETROLEUM IN 1888 AND 1889, BY STATES.

STATES.	1888.			1889.		
	Production, December. (Barrels.)	Stock on hand at wells December 31. (Barrels.)	Per cent of stock at wells, production.	Production, December. (Barrels.)	Stock on hand at wells December 31. (Barrels.)	Per cent of stock at wells, production.
Total	2,727,154	447,370	16.40	3,171,893	967,268	30.49
Pennsylvania and New York	1,582,741	339,187	21.43	2,055,247	423,336	20.60
Ohio	1,070,746	81,224	7.59	971,538	470,125	48.39
West Virginia	19,060	6,194	32.03	81,453	6,835	8.39
Colorado	25,769	13,092	50.81	34,570	51,034	147.63
California	28,671	7,547	26.32	25,737	3,440	13.37
Indiana				*a*2,730	12,250	443.72
Kentucky				*a*450		
Illinois	*a*120	110	91.67	*a*120	100	83.33
Kansas	*a*42	100	238.10	*a*42	100	238.10
Texas	*a*4	6	150.00	*a*4	48	1,200.00
Missouri	*a*1			*a*2		

a Average per month for the year.

From this table it appears that out of a total production in the United States of 2,727,154 barrels in December, 1888, 447,370 barrels, or 16.40 per cent, were carried in stock at the wells on December 31, 1888, while of a production of 3,171,893 barrels in December, 1889, 967,268 barrels, or 30.49 per cent, were carried in stock at the wells. It will be noted that at the close of December, 1888, stocks carried at the wells of Pennsylvania were 21.43 per cent of the total production, and at the close of December, 1889, 423,336 barrels, or 20.60 per cent were carried in stock at the wells. In Ohio but 7.59 per cent of the production of December, 1888, was carried at the wells at the close of that month, while 48.39 per cent of the production of December, 1889, was so carried. The other figures are of but little importance.

The stock of crude petroleum carried by the pipe lines in Pennsylvania and New York at the close of December, 1888, was 18,995,814 barrels. On December 31, 1889, this had decreased to 11,562,593 barrels. The stocks held by the pipe lines in Ohio at the close of December, 1888, were 10,161,842 barrels. At the close of December, 1889, this had increased to 14,415,997 barrels, making a total stock held by the pipe lines at the close of December, 1888, of 29,157,656 barrels, and at the close of December, 1889, of 25,978,590 barrels. Adding these amounts to the stocks carried at the wells, there would be a total of 29,605,026 barrels in stock December 31, 1888, and 26,945,858 barrels on December 31, 1889.

WELLS.

The number of producing wells in the United States reported at the close of 1888 was 27,841; at the close of 1889, 35,163. Of the 27,841 wells at the close of 1888, 1,621 were flowing wells and 26,220 pumping wells. Of the 35,163 at the close of 1889, 3,209 were flowing and 31,954 pumping wells.

The statements regarding rigs building, wells drilling, number of wells completed, and initial daily production of those completed will be found in the special reports of each state.

The total amount expended for materials used in pumping, operating, and caring for wells is given as $9,505,935. In the following table will be found the number of wells by states:

NUMBER OF PRODUCING PETROLEUM WELLS, BY STATES.

STATES.	TOTAL.		FLOWING.		PUMPING.	
	December 31, 1888.	December 31, 1889.	December 31, 1888.	December 31, 1889.	December 31, 1888.	December 31, 1889.
Total	27,841	35,163	1,621	3,209	26,220	31,954
Pennsylvania and New York	25,420	31,768	1,358	2,398	24,062	29,370
Ohio	1,788	2,640	255	785	1,533	1,855
West Virginia	505	623	8	23	497	600
Colorado	23	22	.....	.....	23	22
California	88	89	.....	.....	88	89
Indiana	.....	3	.....	3	.....	.....
Kentucky	5	6	.....	.....	5	6
Illinois	5	5	.....	.....	5	5
Kansas	4	4	.....	.....	4	4
Texas	2	2	.....	.....	2	2
Missouri	1	1	.....	.....	1	1

CAPITAL.

The total capital invested in the production of crude petroleum in the United States in 1889, including that invested in lands, wells, tanks, pipe lines at wells, and other property, is reported as $114,157,370. Of this, $41,195,525 represented the value of oil lands, while $72,961,845 represented the value of all other property.

The total acreage of oil lands in the United States, both owned and leased, was 1,557,546, of which 356,761 acres were owned and 1,200,785 were leased. Of this land 1,434,019 acres were held in the states of Pennsylvania, New York, Ohio, and West Virginia. The average value of this land per acre is given as $26.45. The average value of the land held in Pennsylvania and New York per acre was $31.13, of that held in Ohio $22.62, and of that held in West Virginia $3.42. It is evident that this is an underestimate. There is no oil land in any of these states that could be bought to-day for anywhere near the largest sum, that is, $31.13. It would be fair to assume not only that the value of the oil land in these states was at least $100 per acre, but to name this sum as the average value of the oil lands all through the United States would be a conservative estimate. This would make the value of the oil lands in the United States $155,754,600, instead of $41,195,525. At present (time of writing this report) there is a small field of some 2,000 acres in western Pennsylvania that could not be bought for $20,000,000. Large amounts of land, including wells, were sold in Pennsylvania in 1889 and 1890 on the basis of $1,200 to $1,500 per well per barrel of production per day. A well producing 5 barrels a day would be worth $6,000 to $7,500. This price was paid in Pennsylvania north of Allegheny county. From this it will be seen that the estimate of $100 an acre is not an excessive one. This would add to the capital employed $114,559,075, a sum very nearly equal to the total capital reported in the table, making the total capital on this basis $228,716,445.

The total value of wells, including rigs, boilers, engines, tubing, casing, etc., is given at $64,679,991. On the basis of 35,163 wells, this would be an average value of $1,839, which, from what is stated above, is evidently very low. A discussion of the question of this average value of wells is given in connection with the report on Pennsylvania.

The statistics of the total capital invested, with that invested in land, wells, rigs, etc., in the production of crude petroleum in 1889 in the United States, are given in the following table by states:

STATISTICS OF THE TOTAL CAPITAL AND THE CAPITAL INVESTED IN PETROLEUM LAND, WELLS, RIGS, ETC.

STATES.	Total capital.	LAND.				
		Owned (acres).	Leased (acres).	Total (acres).	Value of land, both owned and leased.	Average value per acre.
Total	$114,157,370	356,761	1,200,785	1,557,546	$41,195,525	$26.45
Pennsylvania and New York	89,562,008	288,510	584,889	873,399	27,184,857	31.13
Ohio	17,771,152	23,513	416,888	440,401	9,963,302	22.62
West Virginia	a1,472,598	396	119,823	120,219	411,663	3.42
Colorado	3,000,000	33,015	6,100	39,115	2,517,215	64.35
California	2,186,958	10,607	.....	10,607	1,060,000	99.93
Indiana	49,918	.....	12,585	12,585	5,528	0.44
Kentucky	25,000	100	51,500	51,600	10,150	0.20
Illinois	12,336	20	5,000	5,020	2,600	0.52
Kansas	75,000	.....	4,000	4,000	40,000	10.00
Texas	1,650	.....	.....	.....	.....	.....
Missouri	750	600	.....	600	210	0.35

STATES.	WELLS, RIGS, TANKS, PIPE LINES, ETC.							
	Total.	Value of rigs, wells, engines, boilers, etc.	Value of tanks.	Value of tank cars.	Pipe lines.	Oil in stock December 31, 1889.	Value of other property.	Average value of wells.
Total	$72,961,845	$64,679,991	$1,825,356	$63,188	$1,471,115	$594,636	$4,327,559	$1,839
Pennsylvania and New York	62,377,151	55,936,194	1,327,614	7,255	1,268,928	446,305	3,390,855	1,761
Ohio	7,807,850	6,627,835	373,052	.....	123,762	76,063	607,138	2,511
West Virginia	1,060,935	985,769	35,904	.....	3,775	17,713	17,774	1,582
Colorado	482,785	229,659	63,581	8,333	7,903	45,268	128,041	10,439
California	1,126,958	840,164	11,250	40,000	61,257	4,036	170,251	9,449
Indiana	44,390	15,650	10,335	5,800	2,130	4,075	6,400	5,217
Kentucky	14,850	9,000	750	1,800	200	.....	3,100	1,500
Illinois	9,736	9,000	250	.....	150	336	.....	1,800
Kansas	35,000	25,000	2,500	.....	3,000	500	4,000	6,250
Texas	1,650	1,200	100	.....	10	340	.....	600
Missouri	540	520	20	.....	.....	.....	.....	520

a To this should be added $10,243 capital represented by the cost of leases of 17,630 acres of land on which no developments have been made.

LABOR AND WAGES.

The total number of persons reported as employed in the production of crude petroleum in the United States in 1889 was 22,539, to whom $8,546,900 were paid in wages. This by no means, however, indicates the total number of persons so employed. A great deal of the work in drilling, torpedoing, and operating wells is done by contract. The books of the producers only show, if they contain any information on this point, the total amount paid for this contract work, which includes not only labor but materials and the profit to the contractor as well, without any of their details. The persons so employed under contract go from place to place through the different oil regions, spending a month or 6 weeks at one place drilling a well, a month at another, a few days deepening a well here, and then a few days somewhere else. In torpedoing wells a similar condition of affairs exists, the time required to torpedo it being very short and the workmen going from well to well and town to town in the oil regions. No estimate of the persons employed in this way has been procured. So also in building tankage and pipe lines. These are usually built by contract, and no labor is paid directly by the petroleum producer. These figures of labor and wages must therefore be understood as including only that labor directly employed and paid by the producers. In order to arrive at the number of persons employed and the wages paid in producing crude petroleum, there must be added to these figures the number of persons employed and the wages paid by contractors in drilling, operating, and caring for wells and in building tankage and pipe lines.

Of the $8,546,900 paid labor by the petroleum producers $534,860 was paid for labor in building rigs, $3,067,886 in drilling wells, $4,505,564 in operating, pumping, and caring for wells, $109,384 in torpedoing wells, $121,318 in building or repairing tankage, $44,732 in building and repairing pipe lines at the wells, and $163,156 to the office force. The amount of money paid in the office does not include what would be termed executive officers of the different companies, but probably only clerks, bookkeepers, and similar persons. At a great many wells there is no office force at all, the proprietor of a well, who may be engaged in other business, letting the contract for pumping his oil to certain parties and paying but little attention himself to the well, and receiving only the pipe-line transportation company's statement as to the amount of oil due him.

Concerning the different rates of wages paid foremen, pumpers or engineers, and drillers, shown in the various tables of classified wages that will appear through this report, it should be noted that a pumper or engineer may operate a number of wells and the lowest rate given may be for one well and the highest rate for a group of wells. A similar remark will apply to the wages of foremen.

The statistics of labor and wages in the production of crude petroleum in the United States in 1889, by states, are as follows:

TOTAL NUMBER OF EMPLOYÉS AND NUMBER OF EACH CLASS AND WAGES PAID.

STATES.	Number of employés.	Total wages.	Number of foremen.	Wages paid to foremen.	Number of mechanics.	Wages paid to mechanics.	Number of laborers.	Wages paid to laborers.	Number of boys under 16.	Wages paid to boys.	OFFICE FORCE.			
											Number of males.	Wages.	Number of females.	Wages.
Total	22,539	$8,546,900	1,354	$846,205	11,084	$4,125,991	9,772	$3,358,355	156	$53,193	166	$161,852	7	$1,304
Pennsylvania and New York.	19,832	7,423,781	1,230	744,674	10,049	3,742,416	8,256	2,748,453	156	53,193	134	153,741	7	1,304
Ohio	2,123	836,377	94	71,613	724	235,607	1,282	509,421	.....	.....	23	19,736	.....	.....
West Virginia	339	160,974	17	14,520	213	108,298	107	36,756	.....	.....	2	1,400	.....	.....
Colorado	90	34,632	5	4,950	56	19,138	28	8,744	.....	.....	1	1,800	.....	.....
California	95	75,056	5	8,000	25	18,147	62	46,284	.....	.....	3	2,625	.....	.....
Indiana	34	6,080	1	1,200	7	725	25	4,105	.....	.....	*1	50	.....	.....
Kentucky	14	3,050	2	1,248	8	660	4	1,142	.....	.....	.....	.....	.....	.....
Illinois	1	600	.....	.....	.....	.....	1	600	.....	.....	.....	.....	.....	.....
Kansas	10	6,000	.....	.....	2	1,000	6	2,500	.....	.....	2	2,500	.....	.....
Missouri	1	350	.....	.....	.....	.....	1	350	.....	.....	.....	.....	.....	.....

TOTAL WAGES PAID AND WAGES PAID FOR THE SEVERAL CLASSES OF WORK.

STATES.	Total.	WAGES PAID IN—						
		Building rigs.	Drilling wells.	Operating and caring for wells.	Torpedoing wells.	Building and repairing tankage.	Building and repairing pipe lines.	Office.
Total	$8,546,900	$534,860	$3,067,886	$4,505,564	$109,384	$121,318	$44,732	$163,156
Pennsylvania and New York.	7,423,781	4 214	2,780,795	3,773,139	105,626	110,268	40,694	135,045
Ohio	836,377	30,254	174,299	595,518	3,728	9,440	3,402	19,736
West Virginia	160,974	19,869	82,312	55,903	30	1,460	.....	1,400
Colorado	34,632	2,703	8,099	21,494	.....	.....	536	1,800
California	75,056	3,195	20,131	49,055	.....	50	.....	2,625
Indiana	6,080	125	600	5,305	.....	.....	.....	50
Kentucky	3,050	200	1,650	1,200	.....	.....	.....	.....
Illinois	600	.....	.....	600	.....	.....	.....	.....
Kansas	6,000	300	.....	3,000	.....	100	100	2,500
Missouri	350	.....	.....	350	.....	.....	.....	.....

STATISTICS OF THE PRODUCTION OF CRUDE PETROLEUM IN 1889.

The condensed statistics of the production of crude petroleum, stocks, number of wells, capital and labor employed, and wages paid in the United States in 1889 are as follows:

PRODUCTION OF OIL IN 1889.

	BARRELS.
Illuminating	22,649,847
Lubricating	121,146
Fuel	12,392,520
Total	35,163,513

VALUE AT WELLS OF ALL OIL PRODUCED, EXCLUDING PIPAGE.

KINDS OF OIL.	Total value.	Value per barrel.
Total	$26,963,340	$0.76⅔
Illuminating	24,569,190	1.08⅓
Lubricating	325,927	2.69
Fuel	2,068,223	0.16⅔

STOCKS OF ALL GRADES ON HAND AT WELLS.

	BARRELS.
December 31, 1888	447,370
December 31, 1889	967,268

WELL RECORD.

Total number of producing wells December 31, 1888	27,841
Total number of producing wells December 31, 1889	35,163
Total number of flowing wells December 31, 1888	1,621
Total number of flowing wells December 31, 1889	3,209
Total number of pumping wells December 31, 1888	26,220
Total number of pumping wells December 31, 1889	31,954
Number of wells completed in 1889	6,496
Number of dry holes in 1889	995
Number of producing wells completed in 1889	5,501
Initial daily production of new wells (barrels)	136,322
Number of rigs building December 31, 1888	216
Number of rigs building December 31, 1889	500
Number of wells drilling December 31, 1888	323
Number of wells drilling December 31, 1889	681
Value of materials used in caring for and operating wells in 1889	$9,505,935

CAPITAL.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in business		$114,157,370
Number of acres of oil land:		
Owned	356,761	
Leased	1,200,785	
Total acreage	1,557,546	
Present value of land, both owned and leased		41,195,525
Average value per acre, $26.45.		
Value of rigs, wells, engines, boilers, etc		$64,679,991
Average value of wells, $1,839.		
Value of tanks		1,825,356
Value of tank cars		63,188
Value of pipe lines at wells owned by parties making report		1,471,115
Value of oil in stock at wells December 31, 1889		594,636
Value of other property and improvements		4,327,559
Total		72,961,845

LABOR AND WAGES.

All labor, not including office force:		
Number of foremen or overseers	1,354	
Total wages paid all workmen of this class in 1889		$846,205
Number of mechanics	11,084	
Total wages paid all workmen of this class in 1889		4,125,991
Number of laborers	9,772	
Total wages paid all workmen of this class in 1889		3,358,355
Boys under 16 years	156	
Total wages paid all boys under 16 years		53,193
Office force:		
Total number of males	166	
Total number of females	7	
Total wages paid males		161,852
Total wages paid females		1,304
Total number of persons employed and wages paid in 1889	22,539	8,546,900

Wages paid for labor:	
In building rigs	$534,860
In drilling wells	3,067,886
In operating and caring for wells	4,505,564
In torpedoing wells	109,384
In building or repairing tankage	121,318
In building and repairing pipe lines at wells	44,732
In office	163,156
Total	8,546,900

PENNSYLVANIA.

Owing to their intimate connection in a commercial way, it is almost impossible to make an exact separation between the oil produced in New York and Pennsylvania. The basis for all information regarding the production of oil in Pennsylvania and New York is the pipe-line reports, and in these reports of the Bradford district no distinction is made between the oil produced in Pennsylvania and that in New York, the Bradford district including portions of McKean county, Pennsylvania, and Cattaraugus county, New York. The returns for the northern field, as it is called, includes not only the Bradford district, and, consequently, the production of the wells in Cattaraugus county, New York, but also of the wells of Allegany county, in the same state. An attempt has been made to separate the oil produced in New York from that in Pennsylvania, but at best the result must be regarded only as an approximation.

In this report Pennsylvania is divided into eleven districts, as follows: (1) the Bradford district, (2) Forest county, (3) Warren county, (4) Butler, Clarion, and Elk counties, etc., (5) Tidioute and Titusville, (6) Allegheny (Pennsylvania) county, (7) Beaver county, (8) Washington county, (9) Greene county, (10) the Franklin lubricating oil district, and (11) Smiths Ferry district. These may be classified in a general way into the Bradford, Middle, Lower, and Washington or Southwestern districts.

The Bradford district lies chiefly in Pennsylvania, in McKean county, but the main field extends some 5 or 6 miles into New York. An outlying basin of oil rock, which properly belongs to the Bradford basin, is situated for the greater part in Carrollton township, Cattaraugus county, New York. This field also includes the small outlying district of Kinzua, which lies southwest from the main district and contains large and long-lived wells, and the Windfall Run field, lying in Pennsylvania near Eldred, which has only small wells. The sand from which the oil in the Allegany (New York) and Bradford districts is obtained is a gray, black, dark brown, or chocolate brown sand of about the coarseness of the ordinary beach sand of the New Jersey coast. The oil obtained is dark amber green, and occasionally black. Its gravity is generally slightly greater than that of the oil usually obtained from the Venango and Butler districts.

The Middle field, the Warren and Forest, is located in the counties from which it takes its name. It includes such pools as Cherry Grove, Balltown and Cooper, Stoneham, Clarendon, Tiona, Kane, Grand Valley, and others in these 2 counties. The oil in this district comes from sands of varying geological horizons, having somewhat the general appearance of the Bradford and Allegany sand, but frequently coarser grained. The late Dr. Ashburner was of the opinion that the Allegany (New York), Bradford, Warren, and Forest district oil sands were of the Chemung (devonian) age. The oils from the several Warren and Forest pools differ very greatly in color and gravity, but they are generally spoken of as amber oils.

The Lower field begins with a few pools in the southwestern corner of Warren and the western end of Forest counties and embraces all the oil-producing territory southward, including the fields of Venango, Clarion, and Butler counties, the field on the Ohio river in Beaver county, and the fields in Lawrence county. The oil of the Venango subdivision of the Lower district is obtained from 3 principal sand beds, known, respectively, as the first, second, and third oil sands, contained within an interval of about 350 feet. These sands are believed to belong to the Catskill (devonian) formation. These sands were the first discovered in Pennsylvania, and drillers from this field operating in other districts designated the sands which were found in the new districts as the first, second, and third sands, irrespective of their geological position. The Venango sands generally consist of white, gray, or yellow pebble rock. The oils vary, though generally they are green in color, sometimes black, and in a few instances amber. The gravity varies from 30° to 51°, 48° being about the average of the oil obtained from the third sand, which is the greatest producer. The Butler subdivision of the Lower district includes oil pools in Butler, Clarion, southeastern Venango, and Armstrong counties. The character of the sands and oils are very much the same as the Venango district. The Beaver subdivision of the Lower district includes chiefly the Slippery Rock and Smiths Ferry fields. In both of these pools heavy oil is obtained from the representative of the Pottsville conglomerate and amber oil from the Berea grit, in the subcarboniferous series.

The Washington or Southwestern district includes the wells in Allegheny, Washington, and Greene counties, in southwestern Pennsylvania. The general character of the sands and oil is similar to that of the Lower district.

PRODUCTION IN PENNSYLVANIA AND NEW YORK.

In the table on the following page is given the actual production of crude petroleum in the states of Pennsylvania and New York in 1889, by months and districts. The total production is shown by this report to be 21,487,435 barrels. This total differs somewhat from the totals of the pipe-line runs, which are the receipts from the wells by the pipe-lines as published from month to month. These runs, as shown elsewhere, are 21,790,953 barrels, but these runs include all the production of Pennsylvania and New York and a portion of the production of West Virginia. After making due allowance for the West Virginia runs, the totals as given in the table of production and the pipe-line totals do not differ greatly. In fact, so far as it can be ascertained the pipe-line runs in 1889 approximated very closely to the actual production.

The production of crude petroleum in Pennsylvania and New York in 1889, by districts and months, is as follows:

PRODUCTION OF CRUDE PETROLEUM IN PENNSYLVANIA AND NEW YORK IN 1889, BY DISTRICTS AND MONTHS.

[Barrels of 42 gallons.]

DISTRICTS.	Total.	January.	February.	March.	April.	May.
Pennsylvania and New York	21,487,435	1,542,806	1,332,482	1,628,661	1,635,933	1,821,776
Bradford district, Pennsylvania and New York, and Allegany county, New York.	7,158,363	603,946	490,878	607,804	548,903	595,371
Forest county	258,955	19,537	16,737	21,689	19,393	23,699
Warren county	2,347,434	174,437	162,844	190,188	201,159	209,474
Butler and Clarion counties, etc	5,358,403	412,733	352,432	405,950	406,797	432,769
Tidioute and Titusville	885,119	66,569	61,135	70,321	67,122	83,560
Allegheny county	541,092	20,495	22,599	28,996	32,625	50,598
Beaver county	602,736	27,361	23,230	28,159	28,092	45,796
Washington county	3,848,145	185,516	171,165	244,474	301,799	949,192
Greene county	392,912	24,707	23,873	22,383	21,836	23,527
Franklin district	65,276	5,088	5,172	6,280	5,790	5,373
Smiths Ferry district (a)	29,000	2,417	2,417	2,417	2,417	2,417

DISTRICTS.	June.	July.	August.	September.	October.	November.	December.
Pennsylvania and New York	1,811,485	1,954,168	1,964,227	1,867,610	1,959,169	1,913,871	2,055,247
Bradford district, Pennsylvania and New York, and Allegany county, New York.	614,286	638,763	628,792	586,686	618,286	598,952	625,696
Forest county	22,647	23,673	22,336	21,823	22,432	23,132	21,857
Warren county	202,385	211,600	201,766	191,843	206,944	195,290	199,504
Butler and Clarion counties, etc.	413,407	451,064	490,873	475,925	502,541	484,772	529,140
Tidioute and Titusville	72,476	77,392	75,450	68,728	78,365	80,920	83,081
Allegheny county	55,214	56,529	54,387	49,942	59,086	49,606	61,015
Beaver county	41,071	51,675	49,354	49,545	57,670	78,007	122,776
Washington county	357,033	401,325	397,093	376,007	363,830	351,509	349,202
Greene county	24,792	33,819	36,767	38,768	42,719	44,176	55,545
Franklin district	5,757	5,911	4,992	5,927	4,880	5,091	5,015
Smiths Ferry district (a)	2,417	2,417	2,417	2,416	2,416	2,416	2,416

a Smiths Ferry production, which was very regular, is averaged at 2,416.67 barrels per month.

In the following table will be found the production of Pennsylvania and New York for 1888 and 1889, compared by districts:

PRODUCTION OF CRUDE PETROLEUM IN PENNSYLVANIA AND NEW YORK IN 1888 AND 1889, BY DISTRICTS.

[Barrels.]

DISTRICTS.	1888.	1889.
Total	16,488,668	21,487,435
Bradford-Allegany	6,284,375	7,158,363
Forest county	204,250	258,955
Warren county	1,865,366	2,347,434
Butler, Clarion, Venango, etc., counties (a)	4,698,441	5,423,679
Tidioute and Titusville	660,328	885,119
Beaver county	356,684	602,736
Washington and Allegheny counties (b)	2,326,190	4,418,237
Greene county	93,034	392,912

a Including Franklin district. b Including Smiths Ferry district.

The notable feature in the above comparison is the great increase in production in 1889 over that of 1888. This is due to two causes. The production of the earlier months of 1888 was very much curtailed, owing to the agreement to reduce production entered into by the members of the Petroleum Producers' Association. The compact was that at least 17,500 barrels of the daily product and as much more as possible should be shut in. This agreement lasted from the 1st of November, 1887, to the 1st of November, 1888. The result was that the production declined from 22,356,193 barrels in 1887 to 16,488,668 in 1888, but with the removal of this restriction it began to increase, and in the older districts the increases in 1889 over 1888 are due mainly to this removal of the restriction. This is especially shown in the Bradford and Allegany districts, the Forest and Warren, Tidioute and Titusville, and to a less extent in the Butler and Clarion districts. It is probable that all of the increased production in 1889 over 1888 in the first 4 named districts is to be ascribed to this removal of the restriction of production. Part of the increase in Butler county is due to an extension of the field.

Nearly all of the increased production in Beaver, Washington, Allegheny, and Greene counties, or in the Southwestern district, is due to what may be called an extension of the field or the discovery of new pools.

Assuming that the production of Smiths Ferry oil was an average of 2,416.67 barrels per month, the production of crude petroleum in Pennsylvania and New York in 1888, as compared with 1889, by months, shows the following:

PRODUCTION OF CRUDE PETROLEUM IN PENNSYLVANIA AND NEW YORK IN 1888 AND 1889, BY MONTHS.

[Barrels.]

MONTHS.	1888.	1889.
Total	16,488,668	21,487,435
January	1,155,937	1,542,806
February	1,290,718	1,332,482
March	1,338,877	1,628,661
April	1,349,403	1,635,933
May	1,473,362	1,821,776
June	1,459,703	1,811,485
July	1,394,847	1,954,168
August	1,382,077	1,964,227
September	1,273,080	1,867,610
October	1,354,518	1,959,169
November	1,442,405	1,913,871
December	1,582,741	2,055,247

A similar increase in production by months in 1889, as compared with 1888, is noticeable in this table, as in the table of production by districts, and the causes are the same, namely, the resumption of production after the restriction of 1888 and the opening up of new fields or extensions of those already known.

The total production of crude petroleum in the Pennsylvania and New York oil fields from 1871 to 1889, by months and years, is as follows:

TOTAL PRODUCT OF CRUDE PETROLEUM IN THE PENNSYLVANIA AND NEW YORK OIL FIELDS FOR THE YEARS 1871–1889, BY MONTHS AND YEARS.

[Barrels.]

YEARS.	Total.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1871	5,205,234	418,407	372,568	400,334	385,930	408,797	410,340	456,475	462,582	461,940	485,243	464,610	477,958
1872	6,293,194	583,575	462,985	461,590	462,090	537,106	491,130	517,762	549,909	500,430	442,432	638,610	645,575
1873	9,893,786	632,617	608,300	665,291	641,520	776,364	793,470	807,473	936,138	954,270	942,493	991,470	1,084,380
1874	10,926,945	1,167,243	835,492	883,438	778,740	895,745	921,750	1,033,447	931,519	840,630	919,739	861,060	858,142
1875	8,787,514	852,159	719,824	789,539	675,060	696,508	696,210	788,361	718,766	698,940	731,073	700,200	720,874
1876	8,968,996	712,225	668,885	718,177	701,490	735,351	723,600	763,623	782,223	780,600	809,162	786,480	787,090
1877	13,135,475	842,890	783,216	901,697	972,810	1,127,594	1,130,790	1,189,005	1,273,759	1,214,910	1,269,326	1,173,420	1,256,058
1878	15,163,462	1,203,296	1,094,856	1,208,380	1,195,890	1,264,862	1,217,250	1,283,865	1,341,928	1,315,710	1,369,797	1,348,950	1,318,673
1879	19,685,176	1,369,921	1,261,935	1,499,315	1,530,450	1,644,922	1,675,650	1,637,767	1,892,302	1,856,700	1,836,378	1,710,480	1,769,356
1880	26,027,631	1,904,113	1,876,908	2,015,992	2,015,700	2,228,931	2,158,440	2,248,430	2,341,027	2,346,300	2,385,636	2,274,420	2,238,634
1881	27,376,509	2,244,090	1,913,128	2,274,532	2,205,780	2,393,293	2,377,860	2,372,678	2,331,727	2,193,420	2,323,171	2,266,830	2,480,000
1882	30,053,500	2,353,551	2,131,332	2,482,170	2,402,790	2,486,572	2,825,949	3,258,162	3,104,495	2,620,380	2,297,658	2,192,940	1,897,510
1883	23,128,389	1,948,319	1,756,188	1,830,674	1,816,530	1,962,052	1,977,900	2,020,394	1,879,437	1,913,370	2,076,659	1,958,340	1,988,526
1884	23,772,209	1,825,838	1,880,650	2,052,262	2,065,860	2,381,854	1,862,190	2,059,950	2,099,165	1,948,260	1,961,866	1,811,700	1,822,614
1885	20,776,041	1,652,176	1,437,884	1,638,133	1,780,290	1,771,371	1,767,210	1,775,804	1,705,961	1,712,790	1,874,105	1,761,669	1,898,657
1886	25,798,000	1,748,958	1,604,848	1,928,448	1,938,360	2,178,773	2,335,380	2,418,961	2,413,206	2,418,540	2,408,111	2,222,790	2,181,625
1887	a21,478,883	1,990,851	1,827,924	2,007,196	1,960,860	1,993,517	1,912,860	1,899,525	1,848,877	1,779,930	1,843,291	1,125,450	1,288,602
1888	16,488,668	1,155,937	1,290,718	1,338,877	1,349,403	1,473,362	1,459,703	1,394,847	1,382,077	1,273,080	1,354,518	1,442,405	1,582,741
1889	21,487,435	1,542,806	1,332,482	1,628,661	1,635,933	1,821,776	1,811,485	1,954,168	1,964,227	1,867,610	1,959,169	1,913,871	2,055,247

a Not including 877,310 barrels dump oil and oil shipped by private lines.

For some years previous to and including 1887 the total production as given is simply the total of the pipe-line runs. The statistics in the early years, as indeed all of the figures up to the close of 1888, are those published in Stowell's Petroleum Reporter.

As the pipe-line runs for 1888 and 1889 differ from the totals of production as given in the above table, and as these runs are of sufficient importance to those interested in the production of petroleum to become a matter of record, the runs of these 2 years are given on the following page.

The runs of the several pipe lines for 1889 as reported from month to month in Pennsylvania and New York and that portion of West Virginia tributary to the southwestern Pennsylvania field are as follows, by months and lines:

PIPE-LINE RUNS IN PENNSYLVANIA AND NEW YORK IN 1889, BY LINES AND MONTHS.

[Barrels.]

MONTHS.	Total.	National.	Tide water.	Octave.	Miller.	Western Atlantic.	Southwest.	Franklin.
Total	21,790,953	13,675,776	1,593,939	32,536	188,113	2,501,826	3,734,519	64,244
January	1,513,012	1,071,087	128,904	1,847	16,734	110,718	178,720	5,002
February	1,307,652	901,549	104,962	2,034	14,564	105,060	174,397	5,086
March	1,608,755	1,102,168	111,387	2,179	17,020	142,150	227,657	6,194
April	1,629,203	1,071,665	89,900	2,079	17,277	176,699	265,879	5,704
May	1,794,129	1,119,920	126,692	2,908	16,497	207,896	314,929	5,287
June	1,804,671	1,104,626	133,160	2,421	15,877	209,506	333,410	5,671
July	1,945,668	1,181,209	132,106	2,719	17,348	232,940	373,530	5,825
August	1,961,426	1,174,489	130,835	3,186	15,399	277,143	355,468	4,906
September	1,860,140	1,103,009	125,908	3,863	14,813	277,662	329,044	5,841
October	1,968,513	1,185,362	133,965	3,318	14,362	263,834	362,878	4,794
November	1,898,626	1,118,210	146,226	2,668	14,086	243,813	368,618	5,005
December	2,499,158	1,542,491	229,894	3,314	14,136	254,405	449,989	4,929

The total runs by months for 1888 and 1889 are given below. It should be borne in mind, as stated above, that the runs for 1889 include a portion of the production of West Virginia as well as all of the production of Pennsylvania and New York.

PIPE-LINE RUNS IN PENNSYLVANIA AND NEW YORK IN 1888 AND 1889, BY MONTHS.

[Barrels.]

MONTHS.	1888.	1889.
Total	16,022,792	21,790,953
January	1,126,035	1,513,012
February	1,240,092	1,307,652
March	1,211,086	1,608,755
April	1,320,936	1,629,203
May	1,433,469	1,794,129
June	1,422,960	1,804,671
July	1,370,080	1,945,668
August	1,365,992	1,961,426
September	1,253,149	1,860,140
October	1,311,643	1,968,513
November	1,416,448	1,898,626
December	1,550,902	2,499,158

VALUE OF CRUDE PETROLEUM PRODUCED IN THE PENNSYLVANIA AND NEW YORK OIL FIELD IN 1889.

The total value of the 21,487,435 barrels of petroleum produced in Pennsylvania in 1889 was $23,475,163, an average of $1.09¼ per barrel. Of the total production 21,393,159 barrels were classified as illuminating oil, and was valued at $23,225,453, or $1.08⅝ per barrel. There were 94,276 barrels classed as lubricating oil, which was valued at $249,710, or $2.64⅞ per barrel.

The value of the lubricating oil produced in the Franklin district is discussed in connection with the remarks on the Franklin district. It need only be said here that 3 grades of oil are produced in this district, and are known as Old District, No. 1, and No. 2. The Old District, which was much the largest production, sold for $3.65 per barrel, No. 1 for $2.50, and No. 2 for $1.25, the average, considering the amount sold at each price, being $3.30. The Smiths Ferry lubricating oil, of which 29,000 barrels were produced in 1889, was valued at the same price as other Beaver county oil, namely, $1.19¼.

The values of the illuminating oils in Pennsylvania are based on the average value of pipe-line certificates. These averages for 1889, by months, were as follows:

MONTHLY AVERAGE PRICE OF PIPE-LINE CERTIFICATES IN 1889.

January	$0.86⅝	July	$0.95⅛
February	0.89¼	August	0.99½
March	0.90⅞	September	0.99⅛
April	0.88	October	1.01⅜
May	0.83⅛	November	1.08½
June	0.83⅞	December	1.04⅛

Average, $0.94⅛.

These averages it is to be understood are not true averages, that is, the average which considers both price and quantity sold at that price, but they are the averages of the prices obtained in the different primary markets from day to day, which are the bases of the prices paid by the larger consumer, the Standard Oil Company, for all oil bought by them on that day. It is probable that the true average prices are slightly under the averages usually obtained. These, however, under the circumstances, are the only averages that can be ascertained, and do not vary greatly from the average of the prices.

The only oil that sold at the average in 1889 was that from the Bradford-Allegany district. The oil from each of the other districts commanded a premium above the price of pipe-line certificates, owing to its being better adapted to the production of light products and water-white oil. The average premium, as it was called, in the Forest, Warren, Butler-Clarion-Venango, and Allegheny (Pennsylvania) districts was 20 cents; in the other districts, 25 cents.

The total production, total value, and average value of all of the oil produced in the Pennsylvania and New York district in 1889, by districts, were as follows:

TOTAL PRODUCTION, TOTAL VALUE, AND AVERAGE VALUE OF CRUDE PETROLEUM PRODUCED IN THE PENNSYLVANIA AND NEW YORK DISTRICT IN 1889, BY DISTRICTS.

DISTRICTS.	ILLUMINATING.			LUBRICATING.		
	Production. (Barrels.)	Value.	Price per barrel.	Production. (Barrels.)	Value.	Price per barrel.
Total	21,393,159	$23,225,453	$1.08⅝	94,276	$249,710	$2.64⅞
Bradford-Allegany	7,158,363	6,737,809	0.94⅛	.....	.....	.....
Forest	258,955	295,532	1.14⅛	.....	.....	.....
Warren	2,347,434	2,679,010	1.14⅛	.....	.....	.....
Butler-Clarion-Venango (*a*)	6,243,522	7,125,421	1.14⅛	.....	.....	.....
Allegheny, Pennsylvania	541,092	617,512	1.14⅛	.....	.....	.....
Beaver	602,736	718,010	1.19⅛	*b*29,000	34,546	1.19⅛
Washington	3,848,145	4,584,103	1.19⅛	.....	.....	.....
Greene	392,912	468,056	1.19⅛	.....	.....	.....
Franklin	.....	.....	.....	65,276	215,164	3.30

a Including Tidioute and Titusville district. *b* Smiths Ferry district.

In the table from Stowell's Petroleum Reporter, given on the following page, will be found the monthly and yearly average of pipe-line certificates or the prices at primary markets of crude petroleum per barrel of 42 gallons from 1865 to 1889, inclusive. The remarks made above regarding the value of these averages should be noted in examining this table; that is, that these are not true average prices, but the average of the prices obtained daily.

MONTHLY AND YEARLY AVERAGE PRICES OF PIPE-LINE CERTIFICATES OF CRUDE PETROLEUM AT WELLS FROM 1865 TO 1889.

YEARS.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Yearly.
1865	$8.25	$7.50	$6.00	$6.00	$7.37½	$5.62½	$5.12½	$4.62½	$6.75	$8.12½	$7.25	$6.50	$6.59
1866	4.50	4.40	3.75	3.95	4.50	3.87½	3.00	3.75	4.50	3.39	3.10	2.12½	3.74
1867	1.87½	1.85	1.75	2.07½	2.35	1.90	2.62½	3.15	3.40	3.55	2.50	1.87½	2.41
1868	1.95	2.00	2.55	2.82½	3.75	4.50	5.12½	4.57½	4.00	4.12½	3.75	4.35	3.62½
1869	5.75	6.95	6.00	6.70	5.35	4.95	5.37½	5.57½	5.50	5.50	5.80	5.12½	5.63¾
1870	4.52½	4.52½	4.45	4.22½	4.40	4.17½	3.77½	3.15	3.25	3.27½	3.22	3.40	3.84
1871	3.82½	4.38	4.25	4.01	4.60	3.85½	4.79	4.66	4.65	4.82½	4.25	4.00	4.34
1872	4.02½	3.80	3.72½	3.52½	3.89	3.85	3.80	3.58½	3.25	3.15	3.83½	3.32½	3.63
1873	2.60	2.20	2.12½	2.30	2.47½	2.22½	2.00	1.42½	1.15	1.20	1.25	1.00	1.87
1874	1.20	1.40	1.60	1.90	1.62½	1.32½	1.02½	0.95	0.95	0.85	0.55	0.61½	1.15
1875	1.03	1.52½	1.75	1.36¼	1.40	1.26½	1.09	1.13	1.33	1.32½	1.44	1.55	1.36
1876	1.80	2.60	2.01	2.02½	1.90½	2.01¾	2.24½	2.71⅜	3.81	3.37½	3.11	3.73	2.56¼
1877	3.53¼	2.70	2.67½	2.58	2.24	1.94⅜	2.07½	2.51	2.38	2.56¾	1.91	1.80	2.42
1878	1.43	1.65½	1.59	1.37½	1.35¼	1.14	0.98¾	1.01	0.86⅜	0.82⅛	0.89⅜	1.16	1.19
1879	1.03	0.98	0.86¼	0.78½	0.76	0.68⅜	0.69⅞	0.67⅛	0.69⅜	0.88⅛	1.05⅝	1.18⅛	0.85⅝
1880	1.10¼	1.03⅛	0.88¾	0.78	0.80	1.00	1.06¼	0.91	0.96	0.96⅞	0.91⅞	0.91⅝	0.94⅓
1881	0.95½	0.90⅜	0.83⅜	0.86¼	0.81⅞	0.81¼	0.76⅞	0.78⅜	0.97⅛	0.91¼	0.85¼	0.84⅜	0.85⅞
1882	0.83⅛	0.84½	0.81⅜	0.78⅜	0.71½	0.54⅜	0.57⅜	0.58⅜	0.72⅛	0.93¾	1.14	0.90	0.78⅛
1883	0.93¾	1.01	0.97⅜	0.94⅜	1.00⅛	1.16⅜	1.05⅞	1.08	1.12½	1.11⅛	1.14½	1.14¾	1.05⅗
1884	1.11	1.04⅜	0.98⅛	0.94	0.85⅜	0.68⅜	0.63½	0.81⅞	0.78	0.71⅛	0.72½	0.74⅜	0.83½
1885	0.70⅞	0.72⅜	0.80⅜	0.78½	0.79	0.82	0.92½	1.00¼	1.00⅜	1.05½	1.04⅜	0.89⅝	0.87⅞
1886	0.88⅜	0.79⅞	0.77½	0.74½	0.70	0.66½	0.66	0.62⅛	0.63⅜	0.65⅛	0.71⅝	0.70⅝	0.71¼
1887	0.70	0.64⅝	0.63⅜	0.64⅞	0.64⅛	0.62⅝	0.59⅛	0.60⅛	0.67	0.70⅞	0.73⅞	0.80⅞	0.66⅞
1888	0.91¼	0.91⅜	0.93⅝	0.82⅜	0.86⅞	0.75⅞	0.80⅜	0.90⅞	0.93⅝	0.90⅝	0.85⅜	0.89¼	0.87⅝
1889	0.86⅜	0.89¼	0.90⅞	0.88	0.83⅛	0.83⅞	0.95⅛	0.99⅛	0.99⅛	1.01⅜	1.08½	1.04⅝	0.94⅛

SHIPMENTS OF PETROLEUM FROM PENNSYLVANIA AND NEW YORK.

In the following table will be found a statement of the number of barrels of crude petroleum and of refined petroleum reduced to its equivalent shipped out of the Pennsylvania and New York oil regions either by pipe line or railroad from 1871 to 1889, inclusive. In some years, especially in the earlier ones covered by this table, a considerable portion of the oil was shipped as refined. In this table that is reduced to its equivalent in crude, a barrel of refined being regarded as being produced from 1½ barrels of crude.

SHIPMENTS OF CRUDE PETROLEUM AND REFINED PETROLEUM, REDUCED TO CRUDE EQUIVALENT, OUT OF THE PENNSYLVANIA AND NEW YORK OIL FIELDS FOR THE YEARS 1871–1889, BY MONTHS AND YEARS.

[Barrels.]

YEARS.	Total.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1871	5,664,791	437,691	347,718	383,890	389,147	587,375	501,754	541,137	528,134	551,075	505,071	480,977	410,822
1872	5,899,947	476,966	407,606	276,220	428,512	510,417	529,228	591,238	621,954	541,607	607,468	477,945	430,786
1873	9,499,775	573,124	527,440	668,374	708,191	768,176	696,414	814,449	864,768	952,955	1,010,852	959,589	955,443
1874	8,821,500	843,663	501,220	518,246	803,499	899,027	815,413	940,281	793,865	1,014,570	543,341	546,117	602,348
1875	8,942,938	453,095	327,776	693,918	729,581	681,679	745,986	904,537	882,089	1,109,392	871,917	671,066	871,902
1876	10,164,452	677,289	519,193	623,762	603,037	646,150	921,862	1,228,539	1,203,402	1,154,549	524,190	871,496	1,190,983
1877	12,832,573	743,461	484,904	913,919	903,526	1,234,324	1,391,124	1,096,951	1,425,943	1,563,797	1,268,971	1,205,634	600,919
1878	13,676,000	775,791	774,234	741,512	846,632	960,894	1,135,119	1,330,454	1,655,651	1,434,225	1,747,390	1,281,410	992,688
1879	15,886,470	603,998	702,729	973,879	1,136,188	1,331,469	1,369,314	1,625,035	1,808,239	1,627,120	1,662,269	1,453,645	1,532,585
1880	15,677,402	1,650,469	1,395,151	1,613,371	842,268	1,095,259	975,083	1,231,611	1,394,129	1,252,635	1,665,933	1,226,030	1,335,613
1881	20,284,235	1,061,617	915,028	1,276,746	1,948,398	1,563,436	1,729,697	1,925,532	2,214,877	2,131,950	2,080,467	2,066,906	1,969,581
1882	21,900,314	1,657,067	1,787,909	1,718,956	1,678,134	1,827,356	2,172,685	2,402,970	2,047,545	1,992,171	2,089,428	1,404,640	1,121,453
1883	21,979,369	1,357,815	1,250,824	1,641,899	1,908,379	1,995,634	1,747,789	1,634,467	2,086,478	2,325,574	2,215,421	2,065,602	1,749,547
1884	23,657,597	1,686,961	1,723,261	1,873,890	1,643,336	1,899,329	1,827,553	1,740,621	2,000,371	2,292,087	2,510,283	2,078,261	2,382,244
1885	23,713,326	1,804,028	1,895,021	1,887,034	1,823,726	2,097,099	2,034,025	1,961,152	2,049,099	2,116,659	2,050,150	1,857,080	2,138,253
1886	26,653,852	1,991,561	2,032,794	2,055,750	2,070,468	2,032,672	2,117,489	2,418,961	2,059,299	2,157,323	2,441,848	2,724,796	2,559,891
1887	27,279,028	2,312,067	1,995,757	2,332,324	1,998,278	2,328,564	2,165,439	2,000,173	2,220,768	2,342,227	2,573,008	2,462,082	2,698,341
1888	25,138,631	2,205,109	2,163,957	1,979,753	1,928,435	1,773,994	1,956,115	2,098,551	2,223,263	2,289,486	1,558,115	2,503,491	2,397,782
1889	29,638,898	2,388,609	2,272,060	2,263,009	2,236,004	2,256,122	2,268,280	2,949,597	2,625,825	2,567,459	2,747,284	2,393,131	2,671,518

These shipments are, for the latter years, chiefly what are known as pipe-line deliveries. It will be seen that the shipments for 1889 were the largest in the history of the trade, being 2,359,870 barrels greater than in 1887, the year of the largest previous shipment, when the total shipments were 27,279,028 barrels. It will also be noted that the shipments were over 8,000,000 barrels in excess of the production. This increased shipment makes itself

very manifest in the statement of stocks held in the Pennsylvania and New York oil regions at the close of 1889, which are given below.

These figures of shipments must not be taken as showing the actual consumption of oil. To them must be added, in order to ascertain what becomes of the oil produced in the oil regions, all of the sediment, the dump oil, or oil that does not pass through the pipe line, as well as the amount of oil destroyed by fire and disposed of in other ways than by refining or direct consumption. There is also a certain amount of loss by evaporation and otherwise. This is provided for by the pipe lines in receiving the oil from the producers, a certain number of gallons per barrel being allowed for such loss. 44 gallons are generally delivered by the producer to the pipe line as a barrel, but certificates are issued for barrels of 42 gallons only.

STOCKS OF CRUDE PETROLEUM IN THE PENNSYLVANIA AND NEW YORK OIL FIELDS.

The reduction in stocks of petroleum held by the pipe lines in 1889 was most notable. The stocks at the close of that year, as will be seen in the following table, were less than at any time since 1879, being on December 31, 1889, 11,562,593 barrels, compared with 8,470,490 barrels at the close of 1879. Between 1879 and 1889 the stocks had risen to 37,366,126 barrels at the close of December, 1884. From this there was a gradual reduction until 1887, when the stocks stood 28,006,211 barrels on December 31 of that year, from which they dropped a little more than 9,000,000 barrels, or to 18,995,814, at the close of 1888, and to 11,562,593 at the close of 1889, notwithstanding, as has already been pointed out, the greatly increased production in 1889 over 1888. This increase, as above stated, in the Pennsylvania and New York oil fields was 4,998,767 barrels, yet the decrease in stocks was 7,433,221 barrels.

The following table shows the total stocks of crude petroleum in the Pennsylvania and New York oil fields from 1871 to 1889, by months and years:

TOTAL STOCKS OF CRUDE PETROLEUM IN THE PENNSYLVANIA AND NEW YORK OIL FIELDS FOR THE YEARS 1871–1889, BY MONTHS AND YEARS.

[Barrels.]

YEARS.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Averages.
1871	537,751	587,021	642,000	771,000	695,000	554,000	511,220	530,146	541,300	495,102	502,960	532,000	567,458
1872	532,971	579,793	662,497	877,832	950,803	1,010,302	990,229	997,166	951,410	914,423	880,909	1,084,423	869,897
1873	1,183,728	1,265,373	1,244,657	1,178,643	1,102,541	1,324,493	1,433,620	1,513,890	1,521,185	1,452,777	1,493,875	1,625,157	1,369,162
1874	1,948,919	2,283,032	2,648,210	2,623,534	2,594,286	2,701,625	2,279,479	2,932,444	2,758,594	3,134,902	3,449,845	3,705,639	2,755,035
1875	4,011,703	4,546,188	4,592,364	4,537,843	4,552,672	4,502,896	4,386,729	4,223,397	3,812,945	3,672,101	3,701,235	3,559,207	4,174,189
1876	3,585,143	3,734,835	3,829,251	3,900,703	3,989,904	3,791,642	3,526,726	3,304,495	2,930,456	3,040,198	2,955,092	2,551,199	3,411,622
1877	2,604,128	2,860,636	3,210,454	3,279,731	3,173,008	2,912,074	3,004,728	2,852,544	2,503,657	2,504,012	2,471,798	3,127,837	2,875,434
1878	3,555,342	3,875,964	4,342,852	4,692,090	4,996,058	5,078,189	5,031,600	4,717,877	4,599,362	4,221,769	4,289,309	4,615,299	4,501,308
1879	5,321,222	5,813,663	6,318,099	6,689,111	6,980,064	7,263,150	7,353,382	7,114,195	7,620,525	7,794,634	8,051,469	8,470,490	7,065,834
1880	8,724,194	9,004,062	9,606,683	10,780,153	11,916,577	13,099,934	14,116,753	15,063,651	16,157,316	16,877,019	18,025,409	18,928,430	13,525,015
1881	20,110,993	21,108,003	22,105,789	22,963,171	23,793,028	24,441,191	24,888,337	25,095,187	25,066,657	25,309,361	25,509,285	26,019,704	23,860,051
1882	26,716,188	27,059,611	27,822,825	28,547,481	29,206,697	29,859,952	30,715,144	31,772,094	32,400,303	32,608,533	33,728,555	34,596,612	30,419,500
1883	35,187,116	35,692,489	35,881,255	37,789,406	35,755,824	35,985,935	36,371,922	36,164,881	35,752,677	35,613,915	35,506,653	35,745,632	35,953,975
1884	35,884,509	36,041,898	36,220,270	36,642,794	38,631,203	38,665,838	38,985,767	39,084,561	38,740,734	38,192,317	37,925,756	37,366,126	37,698,481
1885	37,214,274	36,757,137	36,508,236	36,464,800	36,139,072	35,872,257	35,686,909	35,343,771	34,939,902	34,763,857	34,668,437	34,428,841	35,732,291
1886	34,186,238	34,082,775	33,954,493	33,823,385	33,969,486	34,187,377	34,428,490	34,800,397	35,061,614	35,027,877	34,525,871	34,156,605	34,350,384
1887	33,835,389	33,288,630	32,932,592	32,955,084	32,642,339	32,389,750	32,289,269	32,003,536	31,340,939	30,662,583	29,325,951	28,006,211	31,806,015
1888	26,927,634	26,084,574	25,404,276	24,893,223	24,653,043	24,219,496	23,586,951	22,825,238	21,876,681	20,722,024	19,734,132	18,995,814	23,326,929
1889	18,165,607	17,240,428	16,634,437	16,076,501	15,668,331	15,258,863	14,541,693	13,859,207	13,198,452	12,468,969	12,021,924	11,562,593	14,724,776

For the last 2 years the total stocks of petroleum as given in the foregoing table are in excess of those held by the pipe lines. The stocks given in the table include, in addition to those held by the pipe lines, all that are held at wells, but not those of crude held at refineries.

WELL RECORDS IN THE PENNSYLVANIA AND NEW YORK OIL FIELDS.

In the tables following are given what are known as the well records; that is, the statistics of the drilling of new wells and the number of producing wells in Pennsylvania and New York. New York is included in this well report for reasons previously given, namely, that in the pipe line reports it is so difficult to arrive at the exact statistics of production in the oil territory in New York contiguous to Pennsylvania, the oil pools running from one state into the other and the oil being run through pipe lines to a common receptacle, often without any opportunity of measuring the oil from different wells in the different states belonging to the same parties.

In the following table is shown the number of rigs building, preparatory to drilling wells, at the close of each month of 1889, by districts and by totals:

NUMBER OF RIGS BUILDING IN THE PENNSYLVANIA AND NEW YORK OIL FIELDS AT THE CLOSE OF EACH MONTH DURING 1889, BY DISTRICTS.

MONTHS.	Total.	Bradford-Allegany.	Forest.	Warren.	Butler-Clarion-Venango.	Washington.	Allegheny.	Beaver.	Greene.
Total	3,829	770	58	276	1,808	497	240	62	118
January	219	26	3	18	108	37	19	1	7
February	229	27	12	1	132	34	18	.....	5
March	311	55	2	33	153	43	18	.....	7
April	267	52	1	16	134	33	17	7	7
May	279	45	2	14	122	50	34	.....	12
June	278	55	1	13	126	36	33	7	7
July	246	53	6	13	107	34	29	.....	4
August	351	81	6	34	144	46	22	.....	18
September	347	58	3	34	179	18	27	13	15
October	427	102	9	46	191	42	12	15	10
November	453	120	11	27	199	64	6	14	12
December	422	96	2	27	213	60	5	5	14

From this it will be seen that the number of rigs building increased from January to March, was stationary to the close of June, declined a little in July, increased rapidly from August to November, when the number was 453, the largest number during the year.

In the following table is given the number of wells actually drilling at the close of each month in 1889, by districts. This includes only drilling wells, excluding rigs building and wells actually completed during or at the close of the month.

NUMBER OF WELLS DRILLING AT THE CLOSE OF EACH MONTH IN 1889, BY DISTRICTS.

MONTHS.	Total.	Bradford-Allegany.	Forest.	Warren.	Butler-Clarion-Venango.	Washington.	Allegheny.	Beaver.	Greene.
Total	6,580	1,154	85	406	2,497	1,550	600	54	234
January	341	45	3	19	174	56	22	2	20
February	350	50	17	5	151	92	13	.....	22
March	453	63	3	44	186	113	25	.....	19
April	487	79	3	16	179	143	41	7	19
May	574	93	2	43	206	132	79	.....	19
June	612	76	5	34	205	170	105	1	16
July	598	97	4	36	193	148	113	5	2
August	598	113	6	49	194	148	61	.....	27
September	600	85	9	43	230	142	59	10	22
October	698	166	14	35	273	150	28	13	19
November	659	139	9	37	275	124	35	12	28
December	610	148	10	45	231	132	19	4	21

About the same remarks may be made on this table as were made in regard to that showing the number of rigs building, except that the increase was a gradual one from the beginning of the year to the last of June, and was then stationary until the last of September, increasing over 16 per cent in October, making the total number of wells drilling at the close of October 698, the largest number of wells drilling at the close of any one month during the period covered by the table given on the following page, or from 1871 to 1889.

NUMBER OF DRILLING WELLS IN THE PENNSYLVANIA AND NEW YORK OIL FIELDS AT THE CLOSE OF EACH MONTH FOR THE YEARS 1871–1889, BY MONTHS AND YEARS.

YEARS.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Averages.
1871	140	173	240	279	356	303	329	330	439	486	477	394	329
1872	363	369	313	302	386	391	359	392	391	311	354	318	347
1873	361	349	227	177	228	395	340	267	197	163	137	60	242
1874	37	55	99	213	225	210	180	128	107	82	57	54	121
1875	40	40	45	64	127	162	118	96	132	170	179	168	112
1876	142	151	230	267	307	340	353	374	511	565	618	496	363
1877	457	463	395	448	512	395	365	417	535	573	565	426	463
1878	334	326	379	409	376	266	188	185	240	282	297	218	292
1879	265	323	406	468	460	384	329	258	270	313	372	440	357
1880	540	535	577	580	460	440	452	515	491	469	475	408	495
1881	383	420	437	446	470	408	379	352	388	445	475	468	423
1882	422	438	403	405	381	220	240	194	177	184	154	138	281
1883	126	151	205	199	216	228	262	315	314	341	301	263	243
1884	270	273	260	284	244	123	123	91	79	100	86	78	168
1885	97	109	139	190	228	209	242	308	382	355	359	277	241
1886	320	337	356	318	358	403	340	290	322	272	285	238	321
1887	201	177	155	155	157	142	135	137	107	104	114	88	139
1888	64	72	65	59	82	106	124	166	166	187	327	273	136
1889	341	350	453	487	574	612	598	598	600	698	659	610	548

The effect of the increased demand for petroleum and the decrease in stocks, shown in previous tables, and the reduction of production, owing to the shut-down in 1888, will be seen by comparing the figures of wells drilling in 1888 and 1889, as shown in the above table. It will be remembered that the shut-in began in November, 1887, and lasted until November, 1888. In January, 1888, there were but 64 wells drilling, as compared with 341 in the same month of 1889. The average for 1888 was 136 wells, as compared with 548 for 1889.

In the following table is given a statement of the number of wells completed in each district in the Pennsylvania and New York oil fields during each month of 1889, by months and districts:

NUMBER OF WELLS COMPLETED IN THE PENNSYLVANIA AND NEW YORK OIL FIELDS IN 1889, BY MONTHS AND DISTRICTS.

MONTHS.	Total.	Bradford-Allegany.	Forest.	Warren.	Butler-Clarion-Venango.	Washington.	Allegheny.	Beaver.	Greene.
Total	a5,435	1,034	55	636	2,685	577	231	83	98
January	284	39	4	32	189	16	7	.....	6
February	288	34	1	16	207	10	14	.....	6
March	353	52	2	38	196	49	8	.....	8
April	401	59	1	52	224	51	6	3	5
May	431	82	4	46	207	47	34	.....	11
June	537	83	4	71	275	54	34	4	12
July	549	107	9	62	228	69	69	.....	14
August	508	104	7	65	233	71	23	.....	5
September	478	97	2	70	222	59	5	26	6
October	559	143	7	62	250	59	18	8	12
November	540	121	9	72	252	56	5	15	10
December	471	113	5	50	211	54	8	27	3

a Including 36 wells drilled in Franklin district, data for which by months were not obtainable.

From this it will be seen that the total number of wells completed in 1889 was 5,435, as compared with 1,515 in 1888. This is the largest number of wells completed in these states in any one year, the nearest approach to it being in 1880, when 4,217 wells were completed.

The table on the following page gives the number of drilling wells completed in each month from January, 1872, to the close of 1889.

NUMBER OF DRILLING WELLS COMPLETED IN THE PENNSYLVANIA AND NEW YORK OIL FIELDS EACH MONTH FOR THE YEARS 1872–1889, BY MONTHS AND YEARS.

YEARS.	Total.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1872	1,183	37	120	89	121	135	84	128	118	82	100	64	105
1873	1,263	93	94	100	105	102	130	114	120	106	101	100	98
1874	1,317	102	104	110	113	109	101	121	107	104	120	106	120
1875	2,398	190	187	195	186	172	190	200	210	201	220	217	230
1876	2,920	240	231	242	200	202	261	248	270	209	273	272	272
1877	3,939	281	241	291	269	320	403	317	255	322	407	391	382
1878	3,004	274	226	211	409	470	269	203	186	174	229	248	165
1879	3,048	136	132	238	270	402	330	327	283	210	232	227	261
1880	4,217	320	230	367	500	426	310	338	368	356	364	336	302
1881	3,880	222	220	271	316	406	374	336	332	312	322	363	406
1882	3,304	347	340	385	432	469	340	185	253	164	117	150	122
1883	2,847	125	126	142	209	231	228	261	309	321	321	302	272
1884	2,265	229	227	256	298	311	244	268	145	89	59	73	66
1885	2,761	64	62	82	116	213	242	217	283	356	397	384	345
1886	3,478	270	280	291	328	343	365	357	313	253	272	221	185
1887	1,660	158	162	138	160	148	162	159	142	134	100	101	96
1888	1,515	57	52	56	49	56	97	82	96	132	229	307	302
1889	a5,435	284	288	353	401	431	537	549	508	478	559	540	471

a Including 36 wells drilled in Franklin district, data for which by months were not obtainable.

In the following table is given the number of dry holes, that is, the number of wells drilled that produced no oil, in New York and Pennsylvania in 1889:

NUMBER OF DRY HOLES DRILLED IN THE PENNSYLVANIA AND NEW YORK OIL FIELDS IN 1889, BY MONTHS AND DISTRICTS.

MONTHS.	Total.	Bradford-Allegany.	Forest.	Warren.	Butler-Clarion-Venango.	Washington.	Allegheny.	Beaver.	Greene.
Total	875	a81	9	40	546	66	73	13	47
January	66	6	2	5	47	2	2	.....	2
February	66	4	.....	1	56	1	2	.....	2
March	59	7	.....	2	41	1	1	.....	7
April	79	1	.....	6	57	10	2	.....	3
May	83	8	.....	4	48	5	10	.....	8
June	99	8	1	3	60	6	15	3	3
July	91	4	2	2	46	6	21	.....	10
August	68	3	.....	b5	45	7	5	.....	2
September	67	10	.....	3	38	3	2	7	4
October	78	13	1	1	45	6	6	3	3
November	68	7	3	6	36	11	2	.....	3
December	51	10	.....	1	27	8	5	.....	.....

a 9 gas wells. *b* 1 gas well.

The total production of the new wells completed during 1889 is shown in the following table:

INITIAL DAILY PRODUCTION OF NEW WELLS IN THE PENNSYLVANIA AND NEW YORK OIL FIELDS IN 1889, BY MONTHS AND DISTRICTS.

[Barrels.]

MONTHS.	Total.	Bradford-Allegany.	Forest.	Warren.	Butler-Clarion-Venango.	Washington.	Allegheny.	Beaver.	Greene.
Total	a71,323	6,863	478	3,210	22,813	26,297	6,223	2,572	2,745
January	2,777	219	11	133	1,254	730	200	.....	230
February	3,042	296	10	79	1,500	473	544	.....	140
March	6,504	291	12	187	1,666	4,048	275	.....	25
April	3,817	396	8	169	1,686	1,100	183	30	245
May	5,931	454	24	340	1,561	2,594	818	.....	140
June	7,193	529	85	344	2,055	3,152	588	15	425
July	6,832	643	65	232	1,590	2,815	1,387	.....	100
August	7,712	757	68	306	2,501	3,246	469	.....	365
September	6,684	652	15	217	2,427	2,433	270	660	10
October	6,118	905	84	495	1,981	1,883	292	235	243
November	8,107	854	60	342	2,710	1,761	800	1,080	500
December	6,484	867	36	366	1,882	2,062	397	552	322

a Including 122 barrels in Franklin district, data for which by months were not obtainable.

The average daily production of the new wells completed in the Pennsylvania and New York oil fields from 1882 to 1889 is as follows:

AVERAGE DAILY PRODUCT OF THE NEW WELLS IN THE PENNSYLVANIA AND NEW YORK OIL FIELDS FROM 1882 TO 1889, BY MONTHS AND YEARS.

[Barrels.]

MONTHS.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.
January	19.50	22.40	13.70	40.00	13.50	25.50	15.43	13.08
February	19.40	14.90	15.00	41.30	13.40	44.75	12.48	10.50
March	22.25	22.50	17.00	23.30	22.90	29.75	66.00	19.70
April	22.00	21.00	12.00	40.00	32.00	43.50	9.40	15.17
May	21.30	17.50	18.00	23.00	38.60	22.00	68.71	12.00
June	36.80	15.00	17.50	10.60	25.00	38.51	40.55	13.50
July	108.80	15.00	59.30	10.30	31.10	18.14	14.38	13.20
August	84.20	13.80	22.60	10.60	51.90	49.30	19.00	15.50
September	25.75	14.40	41.70	13.20	62.40	57.70	19.00	14.14
October	15.90	14.20	165.50	14.00	28.00	25.98	13.72	11.50
November	12.90	13.80	87.40	10.90	28.00	19.69	12.80	15.20
December	20.40	11.80	92.60	10.90	23.00	11.40	13.30	14.25

It will be seen from this table that the average production of each well for 1889 is less than any year covered by the tables.

In the following table is given the number of producing, flowing, and pumping wells in each district of Pennsylvania and New York at the close of 1888 and 1889:

TOTAL NUMBER OF PRODUCING, FLOWING, AND PUMPING WELLS IN THE PENNSYLVANIA AND NEW YORK OIL FIELDS AT THE CLOSE OF 1888 AND 1889.

DISTRICTS.	TOTAL NUMBER OF PRODUCING WELLS.		TOTAL NUMBER OF FLOWING WELLS.		TOTAL NUMBER OF PUMPING WELLS.	
	December 31, 1888.	December 31, 1889.	December 31, 1888.	December 31, 1889.	December 31, 1888.	December 31, 1889.
Total	25,420	31,768	1,358	2,398	24,062	29,370
Bradford-Allegany	14,371	16,293	179	182	14,192	16,111
Forest	240	299	84	67	156	232
Warren	2,880	4,178	790	1,586	2,090	2,592
Butler-Clarion-Venango-Armstrong, etc	6,138	8,336	28	308	6,110	8,028
Allegheny	176	298	160	36	16	262
Beaver and Smiths Ferry	199	270	3	14	196	256
Washington	618	1,232	108	186	510	1,046
Greene	193	231	6	19	187	212
Franklin	605	631	.....	.....	605	631

From the above table it appears that the number of producing wells in Pennsylvania increased from 25,420 at the close of 1888 to 31,768 at the close of 1889, a total increase of 6,348, though the number of producing wells completed in Pennsylvania and New York in 1889 was but 4,560, leaving an excess of 1,788 wells to be accounted for in addition to the wells that were abandoned in the state during the year. This difference is no doubt due to the fact that a large number of wells which were shut in at the close of 1888, owing to the restriction of production before referred to, were not counted as producing wells. So also a number of wells that were not producing and practically abandoned at the close of 1888 were drilled deeper or cleaned out and became producers in 1889.

As the production of Pennsylvania for the month of December, 1889, was 2,055,247 barrels, it appears that the average production per well for that month was 64.7 barrels, an average of a little over 2 barrels a day. The average for the different districts varies greatly, but can be readily ascertained by dividing the production given on page 441 by the number of wells given above.

The amount of money expended for materials used in pumping, operating, and caring for wells in 1889, including fuel, materials for repairs, replacing old machinery, and materials, was $8,633,391. This is divided among the districts as shown in the statement on the following page.

VALUE OF MATERIALS USED IN PUMPING, CARING FOR, AND OPERATING WELLS IN THE PENNSYLVANIA AND NEW YORK OIL FIELDS IN 1889, BY DISTRICTS.

Bradford-Allegany	$2,603,248
Forest	29,900
Warren	1,022,966
Butler-Clarion-Venango-Armstrong, etc	1,787,296
Allegheny	215,096
Beaver and Smiths Ferry	214,026
Washington	2,454,446
Greene	274,460
Franklin	31,953
Total	8,633,391

WELL RECORD.

Total number of producing wells December 31, 1888	25,420
Total number of producing wells December 31, 1889	31,768
Total number of flowing wells December 31, 1888	1,358
Total number of flowing wells December 31, 1889	2,398
Total number of pumping wells December 31, 1888	24,062
Total number of pumping wells December 31, 1889	29,370
Number of wells completed in 1889	5,435
Number of dry holes in 1889	875
Number of producing wells completed in 1889	4,560
Initial daily production of new wells (barrels)	71,323
Number of rigs building December 31, 1888	179
Number of rigs building December 31, 1889	422
Number of wells drilling December 31, 1888	273
Number of wells drilling December 31, 1889	610

CAPITAL EMPLOYED IN PRODUCING CRUDE PETROLEUM IN PENNSYLVANIA AND NEW YORK OIL FIELDS IN 1889.

The total capital employed in producing crude petroleum in Pennsylvania and New York districts at the close of 1889, according to the table given below, was $89,562,008. Of this, $27,184,857 represented the value of land and $62,377,151 the value of all other property.

The total capital invested in Pennsylvania, the value of lands, and the total amount invested in all other property, by districts, are as follows:

TOTAL CAPITAL INVESTED IN THE PRODUCTION OF CRUDE PETROLEUM IN PENNSYLVANIA IN 1889, BY DISTRICTS.

DISTRICTS.	Total capital.	Total value of land.	Total value of all other property.
Total	$89,562,008	$27,184,857	$62,377,151
Bradford-Allegany	32,288,195	8,562,827	23,725,368
Forest	1,162,174	648,338	513,836
Warren	10,680,618	3,971,524	6,709,094
Butler-Clarion-Venango-Armstrong, etc	26,020,574	8,322,204	17,698,370
Allegheny	2,070,926	739,876	1,331,050
Beaver and Smiths Ferry	2,203,219	998,055	1,205,164
Washington	12,238,107	2,703,816	9,534,291
Greene	2,171,763	978,427	1,193,336
Franklin	726,432	259,790	466,642

The total amount of oil land owned and leased in the Pennsylvania and New York oil regions was 873,399 acres. Of this, 288,510 acres were owned and 584,889 leased. The value given to this land in the schedules was $27,184,857, an average value, ignoring fractions, of $31 an acre. The largest amount of land was held in the Butler-Clarion-Venango-Armstrong district, the smallest amount in the Franklin district. The highest average value per acre was in the Franklin district, being $53 an acre. The lowest value was in the Forest district, the average being $21 an acre. It is evident to any one at all acquainted with oil lands that these averages are very much below the actual value of this territory as oil land. This class of land is worth to-day all the way from $100 to $400 an acre. Recent purchases in the Bradford district, one of the oldest, have been as high, where the fee has been bought, as $150 to $250 an acre, while it is almost impossible to place a value upon oil lands in the Washington district or in several of the newer ones of the southwestern fields. As is stated elsewhere, land was bought in 1889 at a valuation of $1,500 for each barrel of daily production.

In leasing oil lands it is usual to pay a certain price for the lease, varying from $1 to $20 per acre, together with a certain proportion of the oil produced as royalty. This royalty varies from one-sixteenth to one-fourth of the oil produced, the almost universal custom being one-eighth. In estimating the worth of the oil land the value seems to have been put by the producer, so far as it relates to the leased land, at the amount paid per acre for the lease, while probably a fair price, though a low one, has been placed upon the land owned. It is evident, however, that this valuation is not a fair one, as certainly it should be estimated with some reference to the price paid for land when purchased in fee, having in consideration at the same time the amount of oil produced. Under these considerations it is believed that $100 an acre would be a very conservative estimate as the average value per acre of the owned and leased oil lands in Pennsylvania. At this figure the value of these lands would be $87,339,900, instead of $27,184,857.

The number of acres of land held as oil territory in the Pennsylvania and New York oil districts, together with the total value of the same and the value per acre, are as follows:

STATISTICS OF LAND HELD AS OIL TERRITORY IN THE PENNSYLVANIA AND NEW YORK OIL DISTRICTS IN 1889.

DISTRICTS.	Total acreage.	Owned. (Acres.)	Leased. (Acres.)	Total value of land.	Value per acre.
Total	873,399	288,510	584,889	$27,184,857	$31
Bradford-Allegany	182,861	90,515	92,346	8,562,827	47
Forest	30,895	12,194	18,701	648,338	21
Warren	88,486	33,744	54,742	3,971,524	45
Butler-Clarion-Venango-Armstrong, etc	351,278	142,634	208,644	8,322,204	24
Allegheny	31,971	2,407	29,564	739,876	23
Beaver and Smiths Ferry	28,812	981	27,831	998,055	35
Washington	112,137	2,544	109,593	2,703,816	24
Greene	42,083	275	41,808	978,427	23
Franklin	4,876	3,216	1,660	259,790	53

The total capital invested in the production of crude petroleum in Pennsylvania and New York, outside of that invested in lands, amounted in 1889 to $62,377,151. Of this, $55,936,194 was invested in wells, including rigs, wells proper, engines, boilers, casings, etc.; $1,327,614 in tanks; $7,255 in tank cars owned by the producers, but not including those owned by transportation companies; $1,268,928 in pipe lines at wells, but not including the lines owned by the pipe-line transportation companies; $446,305 in oil in stock at wells, and $3,390,855 in other property. One or two of these amounts demand some explanation. It should be distinctly noted that the value of tank cars and pipe lines given above does not include in any case the value of these properties owned by the various pipe-line and other transportation companies, but only the properties of the several kinds mentioned that were actually a part of the well outfit.

The total value of the wells, that is, rigs, wells proper, engines, boilers, and other apparatus, not including tanks, tank cars, or pipe lines, was $55,936,194. On the basis of 31,768 producing wells, this would give an average value of $1,761 per well. The average value of the wells in each district, as shown in the table of capital invested in them, is given below:

AVERAGE VALUE PER WELL IN EACH OF THE DISTRICTS IN THE PENNSYLVANIA AND NEW YORK OIL FIELDS IN 1889.

Bradford-Allegany	$1,237
Forest	1,360
Warren	1,335
Butler-Clarion-Venango-Armstrong, etc	1,998
Allegheny	4,297
Beaver and Smiths Ferry	4,202
Washington	7,428
Greene	4,971
Franklin	690

In the older districts it is customary to estimate the value of a well at the price at which the material at the well, including casings, rigs, engines, boilers, etc., could be sold. In the newer districts, especially in the southwestern country, a much higher estimate than this has been made, though even there it is believed that in arriving at the value sufficient account has not been taken of the income that the wells bring to their owners.

The number of producing wells at the beginning of 1889 was 25,420; at the close of 1889 it was 31,768. Assuming that the average number of producing wells throughout the year was in round numbers 28,000, they produced an average of 767 barrels, worth on the average in the neighborhood of $1.10 a barrel, or $844 per well. This number of wells (28,000), producing this value of oil in 1 year, should certainly be worth on an average more than $1,761, when the old materials from these wells will be worth from $1,250 to $1,500 in the upper region, and in

the lower fields from $2,000 to $3,000. Some of the wells in the Washington district will probably produce from 50,000 to 75,000 barrels of oil before they are abandoned.

The capital invested in the production of crude petroleum in Pennsylvania and New York, outside of that invested in land, was as follows in 1889, by districts:

DISTRICTS.	Total.	Rigs, wells, engines, etc.	Tanks.	Tank cars.	Pipe lines.	Oil in stock December 31, 1889.	Other property.
Total	$62,377,151	$55,936,194	$1,327,614	$7,255	$1,268,928	$446,305	$3,390,855
Bradford-Allegany	23,725,368	20,149,046	534,594	510	681,549	181,376	2,178,293
Forest	513,836	406,559	15,911	495	42,755	7,668	40,448
Warren	6,709,094	5,575,578	160,376	.....	215,212	60,820	697,108
Butler-Clarion-Venango-Armstrong, etc	17,698,370	16,654,912	421,192	5,250	233,300	70,676	313,040
Allegheny	1,331,050	1,280,455	10,900	.....	4,771	6,857	28,067
Beaver and Smiths Ferry	1,205,164	1,134,572	21,046	.....	2,632	18,904	28,010
Washington	9,534,291	9,151,407	139,590	.....	81,819	99,054	62,421
Greene	1,193,336	1,148,224	13,750	.....	2,762	950	27,650
Franklin	466,642	435,441	10,255	1,000	4,128	.....	15,818

The totals of capital, acres of oil land held and its value, and the value of other property for the states of Pennsylvania and New York in 1889, were as follows:

CAPITAL.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in the business		$89,562,008
Number of acres of oil land:		
Owned	288,510	
Leased	584,889	
Total acreage	873,399	
Present value of land, both owned and leased		27,184,857
Average value per acre, $31.		
Value of rigs, wells, engines, boilers, etc		$55,936,194
Value of tanks		1,327,614
Value of tank cars		7,255
Value of pipe lines at wells owned by parties making report		1,268,928
Value of oil in stock at wells December 31, 1889		446,305
Value of other property and improvements		3,390,855
Total		62,377,151

LABOR AND WAGES.

The total number of persons reported as employed in the production of crude petroleum in Pennsylvania in 1889 was 19,832, to whom were paid $7,423,781 in wages. The number reported as foremen or overseers was 1,230; as mechanics, 10,049; as laborers, 8,256; as boys under 16 years of age, 156; as employed in offices, males 134, females 7.

While these statistics may correctly represent what they claim to give, namely, the persons actually employed in producing crude petroleum whose wages were paid by the different individuals, firms, or companies producing petroleum, they are misleading, and do not by any means represent the number of persons actually employed in building rigs, drilling wells, and building tankage and pipe lines in the oil regions. A great deal of this work is done by contract, building rigs at so much a rig or so much a foot, in drilling wells at so much a foot, or pumping wells at so much a day or so much a barrel. While the amounts so paid appear in a statement of payments for operating, pumping, and drilling wells, neither the number of men employed nor the amount so paid would appear under the head of wages paid for labor; nor is there any means of arriving at the total number of men so employed or their wages.

The classification of wages, though it is a general one in certain departments of the census, is unfortunate in the petroleum industry, as it is exceedingly difficult to classify the workmen engaged in drilling and operating wells under these classes. A pumper or engineer is neither a foreman, an overseer, a mechanic, nor a laborer, as the term "mechanic" is understood, meaning, as it does in the oil regions, usually a blacksmith, carpenter, or man engaged in a similar occupation. In some instances a pumper, who is the only workman at the well, has been classified as a foreman or overseer.

The division of employés in the table of classified wages given with each district is better than the list following, but as in many instances no return was made in the table of classified wages, the totals of the different employés given in these lists in no case equals the total number of employés given.

The total number of persons employed and the wages paid in the production of crude petroleum in Pennsylvania in 1889, so far as the same have been ascertained, are given in the following tables, by districts:

CLASSES OF LABOR AND WAGES PAID IN PENNSYLVANIA AND NEW YORK OIL FIELDS IN 1889, BY DISTRICTS.

DISTRICTS.	Total number of employés.	Total wages paid.	FOREMEN OR OVERSEERS.		MECHANICS.		LABORERS.		BOYS UNDER 16 YEARS.		OFFICE.			
											Males.		Females.	
			Number.	Wages.	Number.	Wages.	Number.	Wages.	Number.	Wages.	Number.	Wages.	Number.	Wages.
Total	19,832	$7,423,781	1,230	$744,674	10,049	$3,742,416	8,256	$2,748,453	156	$53,193	134	$133,741	7	$1,304
Bradford-Allegany	6,255	2,094,342	432	244,392	3,037	913,488	2,709	873,036	31	6,587	45	56,479	1	360
Forest	191	86,799	13	9,039	77	33,785	99	42,850	.....	.....	2	1,125	.....	.....
Warren	2,286	864,744	120	67,276	1,256	519,476	866	260,360	20	6,600	24	11,032	.....	.....
Butler-Clarion-Venango-Armstrong, etc.	8,386	2,639,406	492	298,692	4,164	1,214,336	3,636	1,099,566	66	16,316	22	9,552	6	944
Allegheny	318	210,255	17	12,613	155	134,386	142	61,131	.....	.....	4	2,125	.....	.....
Beaver and Smiths Ferry	354	240,994	11	7,550	196	175,076	147	58,368	.....	.....	.....	.....	.....	.....
Washington	1,557	1,019,418	117	85,356	894	611,697	477	254,671	39	23,690	30	44,004	.....	.....
Greene	296	206,938	21	15,071	177	127,335	92	55,732	.....	.....	6	8,800	.....	.....
Franklin	189	60,885	7	4,685	93	12,837	88	42,739	.....	.....	1	624	.....	.....

EMPLOYMENTS OF LABOR IN PENNSYLVANIA AND NEW YORK OIL FIELDS IN 1889, BY DISTRICTS.

DISTRICTS.	Total wages paid.	Building rigs.	Drilling wells.	Operating and caring for wells.	Torpedoing or cleaning wells.	Building or repairing tanks.	Building or repairing pipe lines.	Office.
Total	$7,423,781	$478,214	$2,780,795	$3,773,139	$105,626	$110,268	$40,694	$135,045
Bradford-Allegany	2,094,342	120,868	548,558	1,296,607	44,153	9,266	18,031	56,839
Forest	86,799	5,015	31,849	45,547	110	1,562	1,591	1,125
Warren	864,744	81,048	393,668	333,848	23,248	11,830	10,070	11,032
Butler-Clarion-Venango-Armstrong, etc	2,639,406	161,908	1,097,416	1,326,976	21,230	18,406	2,974	10,496
Allegheny	210,255	8,919	117,977	79,565	.....	1,669	.....	2,125
Beaver and Smiths Ferry	240,994	27,696	126,409	82,989	.....	3,900	.....	.....
Washington	1,019,418	66,780	373,689	464,846	12,882	52,950	4,267	44,004
Greene	206,938	3,277	75,747	101,191	3,372	10,590	3,761	8,800
Franklin	60,885	2,703	15,482	41,570	431	75	.....	624

The division of the $7,423,781 into amounts paid for various purposes shows that $478,214 was paid for labor engaged in building rigs, $2,780,795 in drilling wells, $3,773,139 in operating and caring for wells, $105,626 in torpedoing and cleaning wells, $110,268 in building and repairing tankage at wells, $40,694 in building and repairing pipe lines at wells, and $135,045 in the offices. The only figures that require much comment are those relating to the item of labor paid for drilling wells, which amounted to $2,780,795. This includes not only the amount paid for drilling new wells, but in many instances the cost of drilling and cleaning out old wells. The number of new wells drilled and completed in Pennsylvania and New York in 1889 was 5,435. Where this was done by contract the price ran from 40 cents to $1.50 per foot, the cost of drilling by contract including labor, fuel, wear and tear of tools, and use of machinery and appliances. Possibly 60 cents a foot would represent the cost of drilling a well, of which not much less than 40 cents would be the cost of labor. Assuming that the average depth of wells drilled in Pennsylvania and New York in 1889 was 1,200 feet, this would make the cost of labor per well in round numbers $500, making the total cost of labor in drilling the 5,435 wells drilled in 1889 $2,717,500. A portion of this sum should be added to the $2,780,795 given as the labor cost paid for drilling the same. Relative to drilling by contract, very full information on this subject has been received from Mr. J. L. Wilson, secretary of the Well Drillers' Association, of Titusville, Pennsylvania. Estimating the cost of wells in what is known as the upper district, Mr. Wilson gives the following figures: cost of rig, from $275 to $325; lumber in rig, from 8,000 to 10,000 feet, worth from $8 to $11 per thousand; iron, $70 to $80; timber, besides the lumber mentioned above, $30 to $50; carpenters' work and grading, $75 to $90; carpenters' wages, from $2 to $3.50 per day of 10 hours.

Relative to the cost of machinery, Mr. Wilson states that it is difficult to give exact information, as it is not known just how long machinery will last, its work being divided between drilling and pumping. Drilling machinery rents for drilling purposes, however, at from 10 to 15 cents per foot of drilling done, or from $50 to $75 for 30 days, the machinery including boiler, engine, pipes and fittings, belt, and bull rope. Boilers used in the oil region cost from $275 to $425, engines from $150 to $180, belts from $30 to $50, bull ropes from $15 to $20, and pipes and fittings from $5 to $10.

Drilling costs in the upper region from 40 to 50 cents per foot. This includes cost of labor, fuel, wear and tear of materials, and rent of tools, including ropes, the first cost of tools and rope being from $800 to $1,000. The depth of the new wells of the upper regions is from 600 to 1,000 feet, the time consumed in drilling being from 8 to 15 days of 24 hours each, drilling being continued night and day. The cost of labor is as follows: 2 drillers, at from $3 to $4.50 per day of 12 hours; 2 tool dressers, at from $2.50 to $3.50 per day; fuel, 4 to 5 cents per foot of well drilled, and casing from 30 to 45 cents per foot. The amount used is from 150 to 400 feet. Tubing used, according to depth of well, at from 13 to 17 cents per foot; fittings per well, $12 to $25; sucker rods, 5 to 7 cents per foot. The amount of sucker rods used is the same as tubing, varying with the depth of the well. The cost of drilling given above includes putting into the well the casing, tubing, and rods, but not the furnishing of them.

When the well is to be torpedoed, from 20 to 180 quarts of nitroglycerin are used, worth from 90 cents to $1 per quart.

The following is a condensed statement of the labor and wages statistics for the entire states of Pennsylvania and New York in the production of crude petroleum in 1889:

STATISTICS OF LABOR AND WAGES IN THE PENNSYLVANIA AND NEW YORK OIL REGIONS IN 1889.

All labor, not including office force:		
Number of foremen or overseers	1,230	
Total wages paid all workmen of this class in 1889		$744,674
Number of mechanics	10,049	
Total wages paid all workmen of this class in 1889		3,742,416
Number of laborers	8,256	
Total wages paid all workmen of this class in 1889		2,748,453
Boys under 16 years	156	
Total wages paid all boys under 16 years		53,193
Office force:		
Total number of males	134	
Total number of females	7	
Total wages paid males		133,741
Total wages paid females		1,304
Total number of persons employed and wages paid in 1889	19,832	7,423,781
Wages paid for labor:		
In building rigs		$478,214
In drilling wells		2,780,795
In operating and caring for wells		3,773,139
In torpedoing wells		105,626
In building or repairing tankage		110,268
In building and repairing pipe lines		40,694
In office		135,045
Total		7,423,781

BRADFORD-ALLEGANY DISTRICT.

As has already been pointed out, this district lies partly in New York and partly in Pennsylvania, the commercial conditions being such that it is almost impossible to give definitely the proportion of oil produced in each state.

The Allegany portion of the Bradford-Allegany district includes the Richburg and several smaller outlying fields in Allegany county, New York. The area of productive oil territory in this district was estimated in 1885 by the late Dr. Charles A. Ashburner at 31 square miles, of which the Richburg field embraced 28 square miles. At that date Dr. Ashburner estimated that the total production of the district had been about 15,000,000 barrels, or an average of 419,000 barrels per square mile of territory. These figures of production, like nearly all statements published up to within the last 2 years, were based upon statistics contained in Stowell's Petroleum Reporter.

The Bradford portion of the Bradford-Allegany district embraces the oil pools in McKean county, Pennsylvania, and in southern Cattaraugus county, New York. Dr. Ashburner estimated that the area of productive oil territory in this district was 135 square miles and the production at 820,000 barrels per square mile.

The sand and the geological horizon from which this oil is obtained, as well as the character of the oil, are described elsewhere.

The statistics of the production of oil in the Bradford-Allegany district are as follows:

TOTAL PRODUCTION AND VALUE.

Total production in 1889 (barrels of 42 gallons)	7,158,363
Total value at wells of all oil produced, excluding pipage	$6,737,809
Value per barrel	$0.94⅛

STOCKS OF OIL ON HAND AT WELLS.

	BARRELS.
December 31, 1888	219,753
December 31, 1889	200,824

WELL RECORD.

Total number of producing wells December 31, 1888	14,371
Total number of producing wells December 31, 1889	16,293
Total number of flowing wells December 31, 1888	179
Total number of flowing wells December 31, 1889	182
Total number of pumping wells December 31, 1888	14,192
Total number of pumping wells December 31, 1889	16,111
Number of wells completed in 1889	1,034
Number of dry holes in 1889	81
Number of producing wells completed in 1889	953
Initial daily production of new wells (barrels)	6,863
Number of rigs building December 31, 1888	15
Number of rigs building December 31, 1889	96
Number of wells drilling December 31, 1888	29
Number of wells drilling December 31, 1889	148
Value of material used in caring for and operating wells in 1889	$2,603,248

CAPITAL.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in the business		$32,288,195
Number of acres of oil land:		
Owned	90,515	
Leased	92,346	
Total acreage	182,861	
Present value of land, both owned and leased		8,562,827
Average value per acre, $47.		
Value of rigs, wells, engines, boilers, etc		$20,149,046
Value of tanks		534,594
Value of tank cars		510
Value of pipe lines at wells owned by parties making report		681,549
Value of oil in stock at wells December 31, 1889		181,376
Value of other property and improvements		2,178,293
Total		23,725,368

LABOR AND WAGES.

All labor, not including office force:		
Number of foremen or overseers	432	
Total wages paid all workmen of this class in 1889	.....	$244,392
Number of mechanics	3,037	
Total wages paid all workmen of this class in 1889	.....	913,488
Number of laborers	2,709	
Total wages paid all workmen of this class in 1889	.....	873,036
Boys under 16 years	31	
Total wages paid all boys under 16 years	.....	6,587
Office force:		
Total number of males	45	
Total number of females	1	
Total wages paid males	.....	56,479
Total wages paid females	.....	360
Total number of persons employed and wages paid in 1889	6,255	2,094,342
Wages paid for labor:		
In building rigs		$120,868
In drilling wells		548,558
In operating and caring for wells		1,296,607
In torpedoing wells		44,153
In building or repairing tankage		9,286
In building and repairing pipe lines		18,031
In office		56,839
Total		2,094,342

CLASSIFIED WAGES.

CLASS OF LABOR.	Number of each class.	Range of wages.
Foremen	207	$100 to $133 per month.
Pumpers or engineers	2,209	$5 to $85 per month.
Carpenters	687	$2 to $3.50 per day.
Rig builders	601	$50 to $190 per rig. $2.50 to $3 per day.
Drillers	1,061	40 cents to $1 per foot. $3.50 to $4 per day.
Tool dressers	22	$2.50 to $3 per day.
Laborers	882	$1.25 to $2.50 per day.
Teamsters	52	$50 to $125 per month.
Boys under 16 years	8	$1 to $1.50 per day.
Well cleaners	334	$4 to $6.25 per day.
Sundry mechanics	69	$50 per month. $2.50 to $4 per day.

FOREST COUNTY DISTRICT, PENNSYLVANIA.

The Forest county district is that portion of what is known as the Middle field embraced in the county of Forest. Part of these pools lie in Forest county and part in Warren county. They are small in area, the entire Forest county field, including that in Warren county, covering an area of about 9 square miles. The sand has somewhat the general appearance of the Bradford sand, but is coarser grained, and contains small pebbles. The Cooper third sand is found at the depth of 1,850 feet, and is supposed to occupy the same geological horizon as the Bradford and Allegany and to be of the Chemung.

The statistics of the production of petroleum in Forest county district are as follows:

TOTAL PRODUCTION AND VALUE.

Total production in 1889 (barrels of 42 gallons)	258,955
Total value at wells of all oil produced, excluding pipage	$295,532
Value per barrel	$1.14⅛

STOCKS OF OIL ON HAND AT WELLS.

	BARRELS.
December 31, 1888	5,531
December 31, 1889	6,801

WELL RECORD.

Total number of producing wells December 31, 1888	240
Total number of producing wells December 31, 1889	299
Total number of flowing wells December 31, 1888	84
Total number of flowing wells December 31, 1889	67
Total number of pumping wells December 31, 1888	156
Total number of pumping wells December 31, 1889	232
Number of wells completed in 1889	55
Number of dry holes in 1889	9
Number of producing wells completed in 1889	46
Initial daily production of new wells (barrels)	478
Number of rigs building December 31, 1888	3
Number of rigs building December 31, 1889	2
Number of wells drilling December 31, 1888	3
Number of wells drilling December 31, 1889	10
Value of materials used in pumping, operating, and caring for wells in 1889	$29,900

CAPITAL.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in the business		$1,162,174
Number of acres of oil land:		
Owned	12,194	
Leased	18,701	
Total acreage	30,895	
Present value of land, both owned and leased		648,338
Average value per acre, $21.		
Value of rigs, wells, engines, boilers, etc		$406,559
Value of tanks		15,911
Value of tank cars		495
Value of pipe lines at wells owned by parties making report		42,755
Value of oil in stock at wells December 31, 1889		7,668
Value of other property and improvements		40,448
Total		513,836

LABOR AND WAGES.

All labor, not including office force:		
Number of foremen or overseers	13	
Total wages paid all workmen of this class in 1889		$9,039
Number of mechanics	77	
Total wages paid all workmen of this class in 1889		33,785
Number of laborers	99	
Total wages paid all workmen of this class in 1889		42,850
Office force:		
Total number (males)	2	
Total wages paid (males)		1,125
Total number of persons employed and wages paid in 1889	191	86,799
Wages paid for labor:		
In building rigs		$5,015
In drilling wells		31,849
In operating and caring for wells		45,547
In torpedoing wells		110
In building or repairing tankage		1,562
In building and repairing pipe lines		1,591
In office		1,125
Total		86,799

CLASSIFIED WAGES.

CLASS OF LABOR.	Number of each class.	Range of wages.
Foremen	9	$50 to $100 per month.
Pumpers or engineers	57	$20 to $60 per month.
Carpenters	10	$2 to $3.50 per day.
Rig builders	25	$62.75 to $125 per rig.
Drillers	50	40 to 60 cents per foot.
Tool dressers	5	$3 to $3.50 per day.
Laborers	22	$1.50 to $2.50 per day.
Teamsters	7	$5 per day.
Well cleaners	2	$5 per day.
Sundry mechanics	1	$60 per month.

WARREN COUNTY.

The Warren county portion of the Warren district includes the oil pools in eastern Warren county, of which the largest is the Clarendon, and also the Warren county portion of the Cooper and Sheffield fields, which lie partly in Warren and partly in Forest counties. The depths of the Warren district oil sands, according to Mr. Carll, are as follows: the North Warren sand, 1,100 feet; the third Warren sand, 1,300 feet; the Clarendon fourth sand, 1,450 feet; the Cherry Grove third sand, 1,625 feet. As stated before, the oils from the Warren pools vary greatly in color and gravity. They are, however, generally spoken of as amber oils.

The statistics of the production of petroleum in Warren county in 1889 are as follows:

TOTAL PRODUCTION AND VALUE.

Total production in 1889 (barrels of 42 gallons)	2,347,434
Total value at wells of all oil produced, excluding pipage	$2,679,010
Value per barrel	$1.14⅛

STOCKS OF OIL ON HAND AT WELLS.

	BARRELS.
December 31, 1888	36,972
December 31, 1889	53,292

WELL RECORD.

Total number of producing wells December 31, 1888	2,880
Total number of producing wells December 31, 1889	4,178
Total number of flowing wells December 31, 1888	790
Total number of flowing wells December 31, 1889	1,586
Total number of pumping wells December 31, 1888	2,090
Total number of pumping wells December 31, 1889	2,592
Number of wells completed in 1889	636
Number of dry holes in 1889	40
Number of producing wells completed in 1889	596
Initial daily production of new wells (barrels)	3,210
Number of rigs building December 31, 1888	19
Number of rigs building December 31, 1889	27
Number of wells drilling December 31, 1888	20
Number of wells drilling December 31, 1889	45
Value of materials used in pumping, operating, and caring for wells in 1889	$1,022,966

CAPITAL.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in the business		$10,680,618
Number of acres of oil land:		
Owned	33,744	
Leased	54,742	
Total acreage	88,486	
Present value of land, both owned and leased		3,971,524
Average value per acre, $45.		
Value of rigs, wells, engines, boilers, etc		$5,575,578
Value of tanks		160,376
Value of pipe lines at wells owned by parties making report		215,212
Value of oil in stock at wells December 31, 1889		60,820
Value of other property and improvements		697,108
Total		6,709,094

LABOR AND WAGES.

All labor, not including office force:		
Number of foremen or overseers	120	
Total wages paid all workmen of this class in 1889	.....	$67,276
Number of mechanics	1,256	
Total wages paid all workmen of this class in 1889	.....	519,476
Number of laborers	866	
Total wages paid all workmen of this class in 1889	.....	260,360
Boys under 16 years	20	
Total wages paid all boys under 16 years	.....	6,600
Office force:		
Total number (males)	24	
Total wages paid (males)	.....	11,032
Total number of persons employed and wages paid in 1889	2,286	864,744

Wages paid for labor:	
In building rigs	$81,048
In drilling wells	393,668
In operating and caring for wells	333,848
In torpedoing wells	23,248
In building or repairing tankage	11,830
In building and repairing pipe lines	10,070
In office	11,032
Total	864,744

CLASSIFIED WAGES.

CLASS OF LABOR.	Number of each class.	Range of wages.
Foremen	62	$40 to $100 per month.
Pumpers or engineers	442	$10 to $75 per month.
Carpenters	204	$2.50 to $3.25 per day.
Rig builders	302	$65 to $200 per rig.
Drillers	616	$40 to $90 per month.
Tool dressers	34	$3 to $3.50 per day.
Laborers	444	$1.50 to $2 per day.
Teamsters	86	$1.50 to $5 per day.
Well cleaners	84	$5 per day.
Sundry mechanics	20	$1.70 to $3.50 per day.

THE BUTLER-CLARION-VENANGO DISTRICT.

In this district are included the wells usually classified under 2 districts, the Butler-Armstrong and the Venango-Clarion. None of the wells producing lubricating oil in what is generally called the Franklin district of Venango county, however, are included in this district. The oils of this district all come from the same group of oil sands, there being 3 principal sand rocks. The first sand, which is the uppermost of the 3, lies about 450 feet below the base of the Olean conglomerate. They are all contained within an interval of 350 feet, and are believed to belong to the Catskill formation. They generally consist of white, gray, or yellow pebble rock. The oils are generally green and, in some instances, amber. The average gravity of the oil from the third sand, which is the greatest producer, is about 48°.

Dr. Ashburner estimated the total area of the Venango district as 65 square miles, and that of the Butler district as 76 square miles.

The statistics of the production of petroleum in the Butler-Clarion-Venango district are as follows:

TOTAL PRODUCTION AND VALUE.

Total production in 1889 (barrels of 42 gallons)	6,243,522
Total value at wells of all oil produced, excluding pipage	$7,125,421
Value per barrel	$1.14⅛

STOCKS OF ILLUMINATING OIL ON HAND AT WELLS.

	BARRELS.
December 31, 1888	34,406
December 31, 1889	60,262

WELL RECORD.

Total number of producing wells December 31, 1888	6,138
Total number of producing wells December 31, 1889	8,336
Total number of flowing wells December 31, 1888	28
Total number of flowing wells December 31, 1889	308
Total number of pumping wells December 31, 1888	6,110
Total number of pumping wells December 31, 1889	8,028
Number of wells completed in 1889	2,685
Number of dry holes in 1889	546
Number of producing wells completed in 1889	2,139
Initial daily production of new wells (barrels)	22,813
Number of rigs building December 31, 1888	83
Number of rigs building December 31, 1889	213
Number of wells drilling December 31, 1888	136
Number of wells drilling December 31, 1889	231
Value of materials used in caring for and operating wells in 1889	$1,787,296

CAPITAL.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in the business		$26,020,574
Number of acres of oil land:		
Owned	142,634	
Leased	208,644	
Total acreage	351,278	
Present value of land, both owned and leased		8,322,204
Average value per acre, $24.		
Value of rigs, wells, engines, boilers, etc		$16,654,912
Value of tanks		421,192
Value of tank cars		5,250
Value of pipe lines at wells owned by parties making report		233,300
Value of oil in stock at wells December 31, 1889		70,676
Value of other property and improvements		313,040
Total		17,698,370

LABOR AND WAGES.

All labor, not including office force:		
Number of foremen or overseers	492	
Total wages paid all workmen of this class in 1889	.....	$298,692
Number of mechanics	4,164	
Total wages paid all workmen of this class in 1889	.....	1,214,336
Number of laborers	3,636	
Total wages paid all workmen of this class in 1889	.....	1,099,566
Boys under 16 years	66	
Total wages paid all boys under 16 years	.....	16,316
Office force:		
Total number of males	22	
Total number of females	6	
Total wages paid males	.....	9,552
Total wages paid females	.....	944
Total number of persons employed and wages paid in 1889	8,386	2,639,406
Wages paid for labor:		
In building rigs	.....	$161,908
In drilling wells		1,097,416
In operating and caring for wells		1,326,976
In torpedoing wells		21,230
In building or repairing tankage		18,406
In building and repairing pipe lines		2,974
In office		10,496
Total		2,639,406

CLASSIFIED WAGES.

CLASS OF LABOR.	Number of each class.	Range of wages.
Foremen	134	$20 to $100 per month.
Pumpers or engineers	2,538	$30 to $85 per month.
Carpenters	286	$1.25 to $3 per day.
Rig builders	1,234	$50 to $200 per rig.
Drillers	2,474	35 cents to $1 per foot.
Tool dressers	32	$2.50 to $3 per day.
Laborers	818	$1 to $2.50 per day.
Teamsters	110	$2.50 to $5 per day.
Boys under 16 years	18	$10 to $20 per month.
Well cleaners	274	$2.50 to $5 per day.
Sundry mechanics	74	$1.25 to $4 per day.

ALLEGHENY COUNTY.

The oil produced in Allegheny county is from several districts, among them being Shannopin and Brush Creek. The Shannopin oil field, which came into prominence in February, 1886, derives its oil from the lower part of the Venango oil group, which in this locality seems to be spotted or unreliable, as was shown in the early operations in this field by the large proportion of dry holes to productive wells. In June, 1886, 46 wells were drilled, of which 26 were dry; in October 97 wells were drilled, of which 42 were dry, and in December 132 wells were drilled, of which 48 were dry. The remarks regarding the Shannopin field will apply to the other districts in the Allegheny valley.

The statistics of the production of petroleum in Allegheny county in 1889 are as follows:

TOTAL PRODUCTION AND VALUE.

Total production in 1889 (barrels of 42 gallons)	541,092
Total value at wells of all oil produced, excluding pipage	$617,512
Value per barrel	$1.14⅕

STOCKS OF ILLUMINATING OIL ON HAND AT WELLS.

	BARRELS.
December 31, 1888	2,378
December 31, 1889	7,111

WELL RECORD.

Total number of producing wells December 31, 1888	176
Total number of producing wells December 31, 1889	298
Total number of flowing wells December 31, 1888	160
Total number of flowing wells December 31, 1889	36
Total number of pumping wells December 31, 1888	16
Total number of pumping wells December 31, 1889	262
Number of wells completed in 1889	231
Number of dry holes in 1889	73
Number of producing wells completed in 1889	158
Initial daily production of new wells (barrels)	6,223
Number of rigs building December 31, 1888	17
Number of rigs building December 31, 1889	5
Number of wells drilling December 31, 1888	24
Number of wells drilling December 31, 1889	19
Value of materials used in caring for and operating wells in 1889	$215,096

CAPITAL.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in the business		$2,070,926
Number of acres of oil land:		
Owned	2,407	
Leased	29,564	
Total acreage	31,971	
Present value of land, both owned and leased		739,876
Average value per acre, $23.		
Value of rigs, wells, engines, boilers, etc		$1,280,455
Value of tanks		10,900
Value of pipe lines at wells owned by parties making report		4,771
Value of oil in stock at wells December 31, 1889		6,857
Value of other property and improvements		28,067
Total		1,331,050

LABOR AND WAGES.

All labor, not including office force:		
Number of foremen or overseers	17	
Total wages paid all workmen of this class in 1889	....	$12,613
Number of mechanics	155	
Total wages paid all workmen of this class in 1889	....	134,386
Number of laborers	142	
Total wages paid all workmen of this class in 1889	....	61,131
Office force:		
Total number (males)	4	
Total wages paid (males)	....	2,125
Total number of persons employed and wages paid in 1889	318	210,255
ages paid for labor:		
In building rigs		$8,919
In drilling wells		117,977
In operating and caring for wells		79,565
In building or repairing tankage		1,669
In office		2,125
Total		210,255

CLASSIFIED WAGES.

CLASS OF LABOR.	Number of each class.	Range of wages.
Foremen	17	$45 to $100 per month.
Pumpers or engineers	144	$20 to $65 per month.
Carpenters	10	$2.50 per day.
Rig builders	46	$100 to $180 per rig.
Drillers	85	50 cents to $1.15 per foot.
Laborers	6	$50 to $60 per month.
Well cleaners	2	$2.50 to $3.50 per day.

BEAVER COUNTY.

Under Beaver county in the table of production of crude petroleum in 1889 is included all of the oil produced in that county except that produced in the Smiths Ferry district, which is reported by itself. The production in Beaver county proper, which includes all that produced in the Brush Creek and Shannopin districts, in Beaver county, and all other districts except Smiths Ferry, was 602,736 barrels. The production of Smiths Ferry, a small amount of which came from wells in Ohio, was 29,000 barrels, making a total in Beaver county of 631,736 barrels. The ordinary Beaver county oil was worth on an average $1.19⅛ per barrel, 25 cents above the price of pipe-line certificates. The Smiths Ferry oil was worth about the same.

The only district calling for any particular description is that known as the Smiths Ferry. This district lies principally in Beaver county, north of the Ohio river and east of Beaver creek. About one-fourth of the total production is furnished by wells along Island run, located in Columbiana county, Ohio. The territory covered by this district is about 4 miles square, containing about 2,500 acres. During 1889 there were 25 companies, firms, or individuals who owned or operated a total of 84 producing wells in this district. The entire production was 29,000 barrels of 42 gallons each, about one-third of which went directly to refineries situated at Smiths Ferry. This oil is carried to the refineries by tank wagons, the wells being from 2.5 to 4 miles from them. The refiners find difficulty in securing a regular supply of oil, as the deliveries are dependent upon the condition of the roads. The wells in this district are from 700 to 1,300 feet deep, are small producers, but promise to continue as producers for many years. The product is a heavy amber-colored oil, very desirable for lubricating purposes, and finds a regular market. Of the 25 operators in this district all but 10 cared for and pumped their own wells. Most of the wells are pumped by heads, few being pumped continuously. Rigs cost from $300 to $350 each. The cost of drilling is from 70 to 75 cents per foot.

The statistics of the production of petroleum in the Beaver county district in 1889 are as follows:

PRODUCTION OF OIL IN 1889.

	BARRELS.
Illuminating	602,736
Lubricating	29,000
Total	631,736

VALUE AT WELLS OF ALL OIL PRODUCED, EXCLUDING PIPAGE.

KINDS OF OIL.	Value.	Value per barrel.
Total	$752,556	$1.19⅛
Illuminating	718,010	1.19⅛
Lubricating	34,546	1.19⅛

STOCKS OF OIL ON HAND AT WELLS.

	BARRELS.
December 31, 1888:	
Illuminating	6,106
Lubricating	642
Total	6,748
December 31, 1889:	
Illuminating	14,910
Lubricating	703
Total	15,613

WELL RECORD.

Total number of producing wells December 31, 1888	199
Total number of producing wells December 31, 1889	270
Total number of flowing wells December 31, 1888	3
Total number of flowing wells December 31, 1889	14
Total number of pumping wells December 31, 1888	196
Total number of pumping wells December 31, 1889	256
Number of wells completed in 1889	83
Number of dry holes in 1889	13
Number of producing wells completed in 1889	70
Initial daily production of new wells (barrels)	2,572
Number of rigs building December 31, 1889	5
Number of wells drilling December 31, 1889	4
Value of materials used in caring for and operating wells in 1889	$214,026

CAPITAL.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in the business		$2,203,219
Number of acres of oil land:		
Owned	981	
Leased	27,831	
Total acreage	28,812	
Present value of land, both owned and leased		998,055
Average value per acre, $35.		
Value of rigs, wells, engines, boilers, etc		$1,134,572
Value of tanks		21,046
Value of pipe lines at wells owned by parties making report		2,632
Value of oil in stock at wells December 31, 1889		18,904
Value of other property and improvements		28,010
Total		1,205,164

LABOR AND WAGES.

All labor, not including office force:		
Number of foremen or overseers	11	
Total wages paid all workmen of this class in 1889		$7,550
Number of mechanics	196	
Total wages paid all workmen of this class in 1889		175,076
Number of laborers	147	
Total wages paid all workmen of this class in 1889		58,368
Total number of persons employed and wages paid in 1889	354	240,994
Wages paid for labor:		
In building rigs		$27,696
In drilling wells		126,409
In operating and caring for wells		82,989
In building or repairing tankage		3,900
Total		240,994

CLASSIFIED WAGES.

CLASS OF LABOR.	Number of each class.	Range of wages.
Foremen	9	$50 to $150 per month.
Pumpers or engineers	81	$8.33⅓ to $70 per month.
Carpenters	13	$2.50 per day.
Rig builders	42	$110 to $225.50 per rig.
Drillers	84	$70 to $90 per month.
Laborers	35	$1.39 to $2 per day.
Teamsters	1	⅛ cent per gallon.
Sundry mechanics	18	$61.39 per month.

WASHINGTON COUNTY.

The interest in drilling operations in Washington county began in 1885 with the drilling of the Gantz well by the Citizens' Fuel Company of Washington, Pennsylvania. It was drilled for the purpose of obtaining natural gas. At a depth of 2,200 feet a small showing of oil was found, and the hopes of the proprietors turned from gas to oil. After two small flows, one in January and the other in February, 1885, they were compelled to accept the fact that the well was only a pumper. Matters remained in abeyance until August, 1885, when with the drilling in of the Gordon gusher, drilled by the owners of the Gantz well, attention was once more attracted to this field and drilling again began. The total production of Washington county in 1885 was only some 10,500 barrels. In 1886 the interest in petroleum in Pennsylvania centered in this district.

The importance of the Washington field as a producer of petroleum really began in March, 1886. On the 11th of that month the Pew and Emerson Manifold well came in as a heavy producer, and in April the Thayer well followed with 2,000 barrels daily production, and a field of "gushers" was opened. The production reached 4,000 barrels daily at the close of May. In June it had risen to 10,120 barrels a day, and during October a production of 17,549 barrels a day was reached. This heavy yield was not maintained for any length of time, the output of the field at the close of 1886 being only about 10,000 barrels a day. The total production of the Washington field in 1886 was 3,189,822 barrels. In 1887 this had fallen to 2,859,344 barrels. In 1888 it still further declined to 2,322,190 barrels. There was somewhat of an increase in 1889, the production being 3,848,145 barrels, but at the close of 1889 the field continued to decrease in production, many wells having fallen off to such an extent that abandonment was seriously considered. The character of this oil and the horizon in which it is found have been discussed so thoroughly in other parts of this report that they need not be repeated in detail here, it being deemed sufficient to add that the principal part of the oil in the Washington district comes from the Gantz sand and the 50-foot rock lying in the horizon of the first sand of the Venango oil group. Large wells have also been obtained in the Gordon sand, lying near the bottom of the group, as well as in the basal rocks of the carboniferous series above the oil group.

The statistics of the production of petroleum in 1889 in the Washington district are as follows:

TOTAL PRODUCTION AND VALUE.

Total production in 1889 (barrels of 42 gallons)	3,848,145
Total value at wells of all oil produced, excluding pipage	$4,584,103
Value per barrel	$1.19⅛

STOCKS OF OIL ON HAND AT WELLS.

	BARRELS.
December 31, 1888	33,078
December 31, 1889	78,761

WELL RECORD.

Total number of producing wells December 31, 1888	618
Total number of producing wells December 31, 1889	1,232
Total number of flowing wells December 31, 1888	108
Total number of flowing wells December 31, 1889	186
Total number of pumping wells December 31, 1888	510
Total number of pumping wells December 31, 1889	1,046
Number of wells completed in 1889	577
Number of dry holes in 1889	66
Number of producing wells completed in 1889	511
Initial daily production of new wells (barrels)	26,297
Number of rigs building December 31, 1888	33
Number of rigs building December 31, 1889	60
Number of wells drilling December 31, 1888	42
Number of wells drilling December 31, 1889	132
Value of materials used in pumping, caring for, and operating wells in 1889	$2,454,446

CAPITAL.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in the business		$12,238,107
Number of acres of oil land:		
Owned	2,544	
Leased	109,593	
Total acreage	112,137	
Present value of land, both owned and leased		2,703,816
Average value per acre, $24.		
Value of rigs, wells, engines, boilers, etc		$9,151,407
Value of tanks		139,590
Value of pipe lines at wells owned by parties making report		81,819
Value of oil in stock at wells December 31, 1889		99,054
Value of other property and improvements		62,421
Total		9,534,291

LABOR AND WAGES.

All labor, not including office force:		
Number of foremen or overseers	117	
Total wages paid all workmen of this class in 1889		$85,356
Number of mechanics	894	
Total wages paid all workmen of this class in 1889		611,697
Number of laborers	477	
Total wages paid all workmen of this class in 1889		254,671
Number of boys under 16 years	39	
Total wages paid to all boys in 1889		23,690
Office force:		
Total number (males)	30	
Total wages paid (males)		44,004
Total number of persons employed and wages paid in 1889	1,557	1,019,418
Wages paid for labor:		
In building rigs		$66,780
In drilling wells		373,689
In operating and caring for wells		464,846
In torpedoing wells		12,882
In building or repairing tankage		52,950
In building and repairing pipe lines		4,267
In office		44,004
Total		1,019,418

CLASSIFIED WAGES.

CLASS OF LABOR.	Number of each class.	Range of wages.
Foremen	90	$80 to $125 per month.
Pumpers or engineers	610	$15 to $60 per month.
Carpenters	30	$2.50 to $3 per day.
Rig builders	198	$150 to $200 per rig.
Drillers	588	$1 to $1.50 per foot.
Tool dressers	6	$5 per day.
Laborers	252	$1.25 to $2.50 per day.
Well cleaners	36	$2 to $5 per day.
Sundry mechanics	21	$50 to $60 per month.

GREENE COUNTY.

The first wells drilled in Greene county, on Dunkard creek, were begun in 1865, operations being quite extensive. In their character the wells were shallow, and but few produced largely. The more recent developments have been deeper. The oil obtained in these sands has been much more abundant than that found in the early operations. The general character of the developments here are similar to those in Washington, of which they are practically extensions.

The statistics of the production of petroleum in Greene county in 1889 are as follows:

TOTAL PRODUCTION AND VALUE.

Total production in 1889 (barrels of 42 gallons)	392,912
Total value at wells of all oil produced, excluding pipage	$468,056
Value per barrel	$1.19⅛

STOCKS OF OIL ON HAND AT WELLS.

	BARRELS.
December 31, 1888	321
December 31, 1889	672

WELL RECORD.

Total number of producing wells December 31, 1888	193
Total number of producing wells December 31, 1889	231
Total number of flowing wells December 31, 1888	6
Total number of flowing wells December 31, 1889	19
Total number of pumping wells December 31, 1888	187
Total number of pumping wells December 31, 1889	212
Number of wells completed in 1889	98
Number of dry holes in 1889	47
Number of producing wells completed in 1889	51
Initial daily production of new wells (barrels)	2,745
Number of rigs building December 31, 1888	5
Number of rigs building December 31, 1889	14
Number of wells drilling December 31, 1888	17
Number of wells drilling December 31, 1889	21
Value of materials used in caring for and operating wells in 1889	$274,460

CAPITAL.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in the business		$2,171,763
Number of acres of oil land:		
Owned	275	
Leased	41,808	
Total acreage	42,083	
Present value of land, both owned and leased		978,427
Average value per acre, $23.		
Value of rigs, wells, engines, boilers, etc		$1,148,224
Value of tanks		13,750
Value of pipe lines at wells owned by parties making report		2,762
Value of oil in stock at wells December 31, 1889		950
Value of other property and improvements		27,650
Total		1,193,336

LABOR AND WAGES.

All labor, not including office force:		
Number of foremen or overseers	21	
Total wages paid all workmen of this class in 1889		$15,071
Number of mechanics	177	
Total wages paid all workmen of this class in 1889		127,335
Number of laborers	92	
Total wages paid all workmen of this class in 1889		55,732
Office force:		
Total number (males)	6	
Total wages paid (males)		8,800
Total number of persons employed and wages paid in 1889	296	206,938
Wages paid for labor:		
In building rigs		$3,277
In drilling wells		75,747
In operating and caring for wells		101,191
In torpedoing wells		3,572
In building or repairing tankage		10,590
In building and repairing pipe lines		3,761
In office		8,800
Total		206,938

THE FRANKLIN DISTRICT.

Under this head is included only the lubricating oil from the neighborhood of Franklin, Pennsylvania. This oil is entirely a lubricating oil, and is produced chiefly if not entirely from the first oil sand. It is noticeable that this lubricating oil, which is of a dark brownish-green color and of 32° gravity (31° to 33° being the range), comes from the same sand as a greenish-black oil of 46° gravity produced in Warren county, a dark amber oil of 47.5° gravity produced between Titusville and Pleasantville, and the light-amber oil of 52° gravity produced in Washington county. The thickness of this sand at Franklin is about 35 feet. 3 grades of these oils are produced, known respectively as Old District oil, No. 1, and No. 2. The production of these several grades of oil in 1889 was as follows: Old District oil, 49,879 barrels, worth $3.65 per barrel; No. 1, 11,088 barrels, worth $2.50 per barrel, and No. 2, 4,309 barrels, worth $1.25 per barrel, making a total production of 65,276 barrels, worth $215,164.

The product in the heavy-oil district has greatly diminished, and but little new production is being developed in newly drilled territory. The wells, however, seem to be long-lived. Mr. E. W. Shippen writes that the first well drilled on his property was in February, 1865. It produced 180 barrels of oil in 3 days, being worth $30 a barrel at the well at that time. It has produced oil, but in diminished quantities, ever since. In 1883 the production was about 1 barrel a day. It now produces only about one-third of a barrel a day. Mr. Shippen also states that in February and March, 1862, he loaded petroleum on the bark Katharine in Philadelphia, which he believes to be the first full cargo ever shipped from this country to London, and it overstocked the market.

The statistics of the production of petroleum in the Franklin district in 1889 are as follows:

TOTAL PRODUCTION AND VALUE.

Total production in 1889 (barrels of 42 gallons)	65,276
Total value at wells of all oil produced, excluding pipage	$215,164
Value per barrel	$3.30

But very little oil is carried over at the wells.

GRADES OF OIL.	Production. (Barrels.)	Value per barrel.	Total value.
Total	65,276	$3.30	$215,164
Old District	49,879	3.65	182,053
No. 1	11,088	2.50	27,720
No. 2	4,309	1.25	5,386

WELL RECORD.

Total number of producing wells December 31, 1888	605
Total number of producing wells December 31, 1889	631
Total number of pumping wells December 31, 1888	605
Total number of pumping wells December 31, 1889	631
Number of wells completed in 1889	36
Number of producing wells completed in 1889	36
Initial daily production of new wells (barrels)	122
Number of rigs building December 31, 1888	4
Number of wells drilling December 31, 1888	2
Value of materials used in pumping, caring for, and operating wells in 1889	$31,953

CAPITAL.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in the business		$726,432
Number of acres of oil land:		
Owned	3,216	
Leased	1,660	
Total acreage	4,876	
Present value of land, both owned and leased		259,790
Average value per acre, $53.		
Value of rigs, wells, engines, boilers, etc		$435,441
Value of tanks		10,255
Value of tank cars		1,000
Value of pipe lines at wells owned by parties making report		4,128
Value of other property and improvements		15,818
Total		466,642

LABOR AND WAGES.

All labor, not including office force:		
Number of foremen or overseers	7	
Total wages paid all workmen of this class in 1889	....	$4,685
Number of mechanics	93	
Total wages paid all workmen of this class in 1889	....	12,837
Number of laborers	88	
Total wages paid all workmen of this class in 1889	....	42,739
Office force:		
Total number (males)	1	
Total wages paid (males)	....	624
Total number of persons employed and wages paid in 1889	189	60,885
Wages paid for labor:		
In building rigs		$2,703
In drilling wells		15,482
In operating and caring for wells		41,570
In torpedoing wells		431
In building or repairing tankage		75
In office		624
Total		60,885

CLASSIFIED WAGES.

CLASS OF LABOR.	Number of each class.	Range of wages.
Foremen	5	$60 to $75 per month.
Pumpers or engineers	69	$8 to $57.50 per month.
Carpenters	15	$1.75 to $3 per day.
Rig builders	20	$35 to $80 per rig.
Drillers	59	50 to 60 cents per foot.
Tool dressers	2	$2.50 per day.
Laborers	12	$1.50 to $2 per day.
Teamsters	1	$1.50 per day.
Sundry mechanics	1	$5.27 per day.

OHIO.

The oil-producing sections of Ohio may be roughly divided into 3 districts, as follows: (1) The Lima, or Northwestern, including the remarkable developments in the district of which Lima may be regarded as the center, and including the production in Allen, Auglaize, Hancock, Sandusky, and Wood counties. The oil from this district is found in the Trenton limestone. (2) The Macksburg district, which may be regarded as including the wells in Washington, Noble, Belmont, and Harrison counties. Though there are several productive sands in this district, the chief producer is the Berea grit. (3) This district includes the old well-known Mecca and Belden fields. These also derive their oil from the Berea. These districts will be more fully described in speaking of the statistics of production of each.

PRODUCTION.

The total production and value and the value per barrel of the petroleum produced in the several districts of Ohio in 1889 were as follows:

TOTAL PRODUCTION AND VALUE AND VALUE PER BARREL OF PETROLEUM PRODUCED IN OHIO IN 1889.

DISTRICTS.	Total production. (Barrels.)	Total value.	Value per barrel.
Total	12,471,466	$2,173,995	$0.17⅜
Lima	12,153,189	1,822,978	0.15
Macksburg	317,637	340,683	1.07½
Mecca-Belden	1,240	10,334	8.33⅓

In the classification of this oil all of that produced in Lima is classed as fuel oil, that of Macksburg district as illuminating, and all of that produced in the Mecca-Belden district as lubricating oil. This classification is correct with the exception of the Lima district. While it is true that most of the Lima oil that was consumed in 1889 was used as fuel, strenuous efforts were being made to find a method for refining it, so that considerable

of the oil that was produced in 1889 and went into pipe-line stocks has since been used for illuminating purposes, the oil producing some 22 per cent of illuminants, the balance being sold for fuel purposes. All of the oil produced in the Mecca-Belden district was used for lubricating purposes, and all of that produced in the Macksburg district was what may be termed refinery oil, or for manufacture into illuminating oil.

From the above statement it will be seen that the total production of petroleum in Ohio in 1889 was 12,471,466 barrels, of which the Lima field produced 12,153,189 barrels, or 97.45 per cent, the Macksburg district 317,037 barrels, or 2.54 per cent, and the Mecca-Belden district 1,240 barrels, or a little less than 0.01 of 1 per cent. The total value of this oil was $2,173,995, or an average of 17⅜ cents per barrel. The oil from the Lima district was valued at $1,822,978, or 15 cents a barrel; that from the Macksburg district at $340,683, or $1.07½ per barrel, and that from the Mecca-Belden district at $10,334, or $8.33⅓ per barrel. But little need be said as to these values. The Lima oil was produced in such quantities, it was so difficult to refine because of its odor (resulting from the sulphur compounds contained in it), and its distance from large manufacturing centers was so great that its price was exceedingly low, 15 cents per barrel. In 1889 two prices ruled for Macksburg oil. That known as shallow oil, representing the oil produced from the shallow wells, which was of a better quality than that from deep wells, commanded a premium of 10 cents a barrel above pipe-line certificates. In September, 1889, this premium was extended to a little oil produced at Glencoe, Belmont county, and about the middle of November to the Eureka shallow oil, produced on the Ohio side of the river. Macksburg deep oil commanded no premium in 1889. Two-thirds of the oil produced in the Macksburg district was shallow oil. The product of lubricating oil in the Mecca-Belden district was sold exclusively for lubricating purposes, at about 20 cents a gallon.

The total production of petroleum in Ohio since the beginning of operations in that state is placed at 30,512,542 barrels. The production by years since 1876 is as follows:

PRODUCTION OF PETROLEUM IN OHIO FROM 1876 TO 1889, BY YEARS.

	BARRELS.
1876	31,763
1877	29,888
1878	38,179
1879	29,112
1880	38,940
1881	33,867
1882	39,761
1883	47,632
1884	90,081
1885	650,000
1886	1,782,970
1887	5,018,015
1888	10,010,868
1889	12,471,466
Total	30,312,542

To this total of 30,312,542 are added, in the table of production of crude petroleum in the United States from 1859 to 1889, 200,000 barrels, which is estimated to include all the production in Ohio prior to 1876, making the total production, as given, 30,512,542 barrels. In the above table will be noted the enormous increase in production, beginning with 1885, which marks the commencement of developments in the Lima field. The production of this field, as shown elsewhere, was 1,064,025 barrels in 1886, 4,650,375 in 1887, 9,682,683 in 1888, and 12,153,189 in 1889.

STOCKS.

The total stocks of oil held in Ohio December 31, 1888, were 10,243,066 barrels, of which 10,161,842 barrels were held by the pipe lines and 81,224 were held in stock at the wells. At the close of 1889 these stocks had increased to 14,886,122 barrels, of which 14,415,997 barrels were held by the pipe lines and 470,125 at the wells. The distribution of these stocks by districts is shown in the following table:

STOCKS OF PETROLEUM IN OHIO DECEMBER 31, 1888, AND DECEMBER 31, 1889.

[Barrels.]

PERIODS.	Total.	Lima.	Macksburg.	Mecca-Belden.
December 31, 1888:				
Pipe-line stocks	10,161,842	9,810,714	351,128	.....
At wells	81,224	78,118	2,726	380
Total at close of 1888	10,243,066	9,888,832	353,854	380
December 31, 1889:				
Pipe-line stocks	14,415,997	14,105,149	310,848	.....
At wells	470,125	466,308	3,337	480
Total at close of 1889	14,886,122	14,571,457	314,185	480

From the preceding table it will appear that not only was all the oil produced in the Macksburg district in 1889 disposed of, but stocks were drawn on to the extent of nearly 40,000 barrels. The stocks in this district at the close of 1889 were actually 39,669 barrels less than at the close of 1888. On the other hand, stocks in the Lima district had increased 4,682,625 barrels, which would indicate a consumption of 7,470,564 barrels of Lima oil in 1889. It should be remembered, however, that reductions in stocks in the pipe lines do not always indicate actual consumption, as oil may be carried in tanks outside of those owned by the pipe lines.

WELLS.

The total number of wells in all districts in Ohio at the close of 1889 was 2,640, of which 2,242 were in the Lima district, 390 in the Macksburg district, and 8 in the Mecca-Belden district. At the close of 1888 there were 1,788 wells in the state, the increase in 1889 being 852. Of this increase, 777 were in the Lima field, 73 in the Macksburg, and 2 in the Mecca-Belden.

During the year 759 producing wells are reported as having been completed. Of these, 667 were completed in the Lima district, 86 in the Macksburg district, and 6 in the Mecca-Belden district. The initial daily production of all of these wells was 55,930 barrels, an average of $73\frac{7}{10}$ barrels. The average initial production per well in the Lima district was $82\frac{1}{3}$ barrels per day, the Macksburg district $13\frac{1}{10}$, the Mecca-Belden $\frac{1}{2}$ barrel.

The well statistics for the whole state of Ohio for 1889 are as follows:

WELL RECORD.

Total number of producing wells December 31, 1888	1,788
Total number of producing wells December 31, 1889	2,640
Total number of flowing wells December 31, 1888	255
Total number of flowing wells December 31, 1889	785
Total number of pumping wells December 31, 1888	1,533
Total number of pumping wells December 31, 1889	1,855
Number of wells completed in 1889	825
Number of dry holes in 1889	66
Number of producing wells completed in 1889	759
Initial daily production of new wells (barrels)	55,930
Number of rigs building December 31, 1888	26
Number of rigs building December 31, 1889	59
Number of wells drilling December 31, 1888	38
Number of wells drilling December 31, 1889	45
Value of materials used in pumping, caring for, and operating wells in 1889	$650,503

CAPITAL.

The total capital invested in the oil business in Ohio in 1889, according to the reports received, was $17,771,152. Of this, $9,963,302 represents the value of land and $7,807,850 the value of wells, tanks, pipe lines, oil in stock at wells, and other property and improvements.

Of the total capital as above stated $16,802,637 was invested in the Lima district, $944,721 in the Macksburg district, and $23,794 in the Mecca-Belden district.

Of the $7,807,850 invested in wells, etc., $6,627,835 was invested in wells proper, including the rigs, engines, boilers, etc., $373,052 in tanks, and $123,762 in pipe lines at wells, not including those belonging to pipe-line companies; $76,063 represents the stock of oil at the wells on December 31, 1889, while $607,138 represents the value of other property, including cash and improvements.

The total acreage of oil lands, both owned and leased, is 440,401. Of this, 23,513 acres are reported as owned and 416,888 acres as leased. The total value of this land, both owned and leased, is given as $9,963,302. This is but $23 an acre, ignoring fractions, for all the oil lands throughout the state. The value of the 371,619 acres of oil lands in the Lima district is given as $9,693,466, an average of $26 an acre; that of the 68,171 acres of land in the Macksburg district is stated to be $255,841, an average of only $4 an acre; while the value of the 611 acres in the Mecca-Belden district is $13,995, or an average of $23 an acre. It is evident, as has already been stated in connection with the general discussion of the value of oil lands, that this is an underestimate, the probability being that to the actual value of the land owned is added the actual amount of money paid for the leased land, and these two sums are taken as the total value of all the land. Even with Lima oil at the prices ruling in 1889, $100 an acre would be a very low estimate of the average value of the oil lands in the state of Ohio, and this amount would place these lands at $44,040,100, instead of a little less than $10,000,000.

The total value of the wells, including rigs, engines, boilers, casings, etc., but excluding the tanks and pipe lines, as given below, is $6,627,835. Of this amount, $5,990,285 represents the value of the wells in the Lima district, $630,950 the value of those in the Macksburg district, and $6,600 the value of those in the Mecca-Belden district. This would make the value of each well in the Lima district $2,672, in the Macksburg district $1,618, and in the Mecca-Belden district $825. As has already been stated, it is the usual custom in oil districts to estimate the value of a well at about what the casing, etc., would be worth to remove to another well, and not by its producing capacity.

The consolidated statistics of the capital in all of the districts of Ohio are as follows:

STATISTICS OF THE CAPITAL EMPLOYED IN THE OHIO FIELDS IN 1889.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in the business		$17,771,152
Number of acres of oil land:		
Owned	23,513	
Leased	416,888	
Total acreage	440,401	
Present value of land, both owned and leased		9,963,302
Average value per acre, $23.		
Value of rigs, wells, engines, boilers, etc.		$6,627,835
Value of tanks		373,052
Value of pipe lines at wells owned by parties making report		123,762
Value of oil in stock at wells December 31, 1889		76,063
Value of other property and improvements		607,138
Total		7,807,850

LABOR AND WAGES.

The same remarks as to the value of the statistics of labor and wages given in the general discussion of this subject in a previous part of this report will apply to the figures concerning Ohio. In a general way it may be said that a large proportion of the work of building rigs, drilling and torpedoing wells, and erecting tankage is done by contract, and the items for the labor in connection with these operations do not appear in this report; so also the general classification of foremen or overseers, mechanics, laborers, and boys is confusing and misleading, different proprietors classifying the same workmen under different heads, as, for instance, a pumper who has charge of the works at the well will be in some cases classed as a foreman, in others as a mechanic, and in others as a laborer.

The total number of employés at the oil wells in Ohio at the close of 1889 was 2,123. There was paid for labor by the proprietors of the wells, not including, as stated above, that paid drillers working by contract, $836,377. Of the employés, 1,798 were in the Lima district, 318 in the Macksburg, and 7 in the Mecca-Belden district. The amount of wages paid in the Lima district was $722,975, in the Macksburg $111,402, and in the Mecca-Belden district $2,000.

There were 94 men classed as overseers, to whom $71,613 was paid in wages; 724 classed as mechanics, to whom $235,607 was paid, and 1,282 classed as laborers, to whom $509,421 was paid. No boys under 16 years are reported as having been employed at wells, and the total office force reported was 23, to whom $19,736 was paid in wages. This last item evidently includes only employés in offices, even if it includes all who are regarded as office force, and does not include owners, proprietors, or officers of companies.

The wages paid for labor in building rigs in Ohio, with the exceptions above noted, was $30,254; for drilling wells, $174,299; in operating and caring for wells, $595,518; in torpedoing wells, $3,728; in building or repairing tankage, $9,440; in building and repairing pipe lines, $3,402, and in the office, $19,736.

The statistics of labor and wages in the Ohio oil fields in 1889 are as follows:

LABOR AND WAGES.

All labor, not including office force:		
Number of foremen or overseers	94	
Total wages paid all workmen of this class in 1889	.....	$71,613
Number of mechanics	724	
Total wages paid all workmen of this class in 1889	.....	235,607
Number of laborers	1,282	
Total wages paid all workmen of this class in 1889	.....	509,421
Office force:		
Total number (males)	23	
Total wages paid (males)	.....	19,736
Total number of persons employed and wages paid in 1889	2,123	836,377
Wages paid for labor:		
In building rigs		$30,254
In drilling wells		174,299
In operating and caring for wells		595,518
In torpedoing wells		3,728
In building or repairing tankage		9,440
In building and repairing pipe lines		3,402
In office		19,736
Total		836,377

LIMA DISTRICT.

Probably the most remarkable oil district ever developed in this country is that known as the Lima or Northwestern Ohio district. Its discovery opened up a new horizon (the Trenton limestone) as an oil producer. Its development has been rapid since it first began to assume prominence in 1885, and its production has increased enormously. For a while it was believed that the character of the oil was such that no market could be found for it for illuminating purposes, but this theory has been exploded, and it is safe to predict that in the near future a large portion of the demand for illuminating oil, at least in the United States, will be supplied by the distillate from the limestone oil.

The Lima oil field, according to Professor Orton, who has written most fully upon it, constitutes a flat-lying tract of the Trenton limestone. It is as near a level terrace as an area of this sort ever becomes. The very gentle slope that exists in it is mainly to the northward, not amounting to more than 4 feet to the mile, and at times reduced even to 1 or 2 feet. The rises in the floor, or, in other words, the knobs and bosses of this great limestone sheet, are always favorable to production, other things being equal. In this field are included all of the oil-producing districts in northwestern Ohio. They are generally divided into the Lima, Findlay, New Baltimore, Saint Marys, Gibsonburg, Upper Sandusky, and Spencerville fields. Oil was produced in this district in 1889 in Auglaize, Hancock, Mercer, Sandusky, and Wood counties.

The oil is found at Lima at a depth of about 1,300 feet. It requires about 60 days to drill a well, the cost being some $2,500. The first wells drilled in this territory were none of them very large producers. Early in 1886 no well exceeded, if, indeed, any reached, 150 barrels a day. Toward the close of 1886 and the first of 1887, however, some very large wells were brought in, one being reported at 1,500 barrels a day, another reaching the 1,000-barrel limit, and others maintaining a rate of several hundred barrels per day, week after week. In 1889 the average production of the new wells in this district was 80½ barrels, some wells yielding as high as 1,500 barrels and others dropping as low as 30 barrels, from 50 to 75 barrels being the most common figures of production.

The Lima oil and, indeed, all limestone oils differ greatly in character from the oils of the sandstones. They are dark or black and rather heavy, and contain sulphur compounds. In these respects the oils of northwestern Ohio resemble those of Canada and Tennessee. These oils, though they would be classed as rather heavy, differ greatly in specific gravity. In the first wells struck the oil had a gravity of 36° B.; in the later wells it reaches 37° or 38°, and in some even 41°.

There have been two great drawbacks to the use of Lima oil for illuminating purposes: first, the presence of sulphur compounds, and, secondly, the yield as compared with the Pennsylvania oils. It is claimed that a way has been found to deprive this oil of its sulphur, and the price and market that are being obtained for the residuum after distilling off the illuminating oil have largely done away with the second objection. As is stated elsewhere, this oil has largely entered into use as an illuminator.

The production of petroleum in the Lima (Ohio) oil fields from 1886 to 1889 is as follows:

PRODUCTION OF PETROLEUM IN THE LIMA (OHIO) DISTRICT FROM 1886 TO 1889.

	BARRELS.
1886	1,064,025
1887	4,650,375
1888	9,682,683
1889	12,153,189

The statistics of the production of petroleum in the Lima field in 1889 are as follows:

TOTAL PRODUCTION AND VALUE.

Total production in 1889 (barrels of 42 gallons)	12,153,189
Total value at wells of all oil produced, excluding pipage	$1,822,978
Value per barrel	$0.15

STOCKS OF FUEL OIL ON HAND AT WELLS.

	BARRELS.
December 31, 1888	78,118
December 31, 1889	466,308

WELL RECORD.

Total number of producing wells December 31, 1888	1,465
Total number of producing wells December 31, 1889	2,242
Total number of flowing wells December 31, 1888	157
Total number of flowing wells December 31, 1889	682
Total number of pumping wells December 31, 1888	1,308
Total number of pumping wells December 31, 1889	1,560
Number of wells completed in 1889	701
Number of dry holes in 1889	34
Number of producing wells completed in 1889	667
Initial daily production of new wells (barrels)	54,800
Number of rigs building December 31, 1888	23
Number of rigs building December 31, 1889	57
Number of wells drilling December 31, 1888	33
Number of wells drilling December 31, 1889	38
Value of materials used in pumping, caring for, and operating wells in 1889	$318,000

CAPITAL.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in the business		$16,802,637
Number of acres of oil land:		
Owned	22,477	
Leased	349,142	
Total acreage	371,619	
Present value of land, both owned and leased		9,693,466
Average value per acre, $26.		
Value of rigs, wells, engines, boilers, etc		$5,990,285
Value of tanks		355,157
Value of pipe lines at wells owned by parties making report		117,049
Value of oil in stock at wells December 31, 1889		69,946
Value of other property and improvements		576,734
Total		7,109,171

LABOR AND WAGES.

All labor, not including office force:		
Number of foremen or overseers	86	
Total wages paid all workmen of this class in 1889		$65,563
Number of mechanics	537	
Total wages paid all workmen of this class in 1889		183,210
Number of laborers	1,134	
Total wages paid all workmen of this class in 1889		454,826
Office force:		
Total number (males)	21	
Total wages paid (males)		19,376
Total number of persons employed and wages paid in 1889	1,798	722,975
Wages paid for labor:		
In building rigs		$22,352
In drilling wells		129,638
In operating and caring for wells		537,201
In torpedoing wells		3,728
In building or repairing tankage		7,640
In building and repairing pipe lines		3,040
In office		19,376
Total		722,975

CLASSIFIED WAGES.

CLASS OF LABOR.	Number of each class.	Range of wages.
Foremen	81	$15 to $214 per month.
Pumpers or engineers	977	$5 to $75 per month.
Carpenters	48	$2.50 per day.
Rig builders	151	$60 to $125 per rig.
Drillers	276	45 to 80 cents per foot.
Tool dressers	5	$3 per day.
Laborers	186	$1 to $2 per day.
Teamsters	5	$3 to $5 per day.
Well cleaners	20	$3.50 to $5 per day.
Sundry mechanics	13	$2.25 to $2.50 per day.

MACKSBURG (OHIO) DISTRICT.

The second largest oil-producing district in Ohio, and the one producing oil that compares with the best product of Pennsylvania, is that known as the Macksburg district. The chief production of this district is in Washington county, but a large quantity is reported also from Noble county, and small amounts from Harrison and Belmont counties.

The development of the Macksburg district was almost coincident with that of the western Pennsylvania oil fields, the first well having been bored in 1860. This well was but 56 feet deep, and yielded many thousands of barrels of heavy lubricating oil. It is reported that at first the daily yield was from 100 to 200 barrels. A well a short distance west of this yielded at first 150 barrels a day. Notwithstanding the early exploitation of this district, it however assumed but little importance until the spring of 1884, when a number of successful wells were bored. During 1885 the production increased rapidly, the runs through the Macksburg pipe line being 661,586 barrels. In 1886 the production reached 703,945 barrels, and this was the year of its greatest output.

The production of the Macksburg district for the last 5 years has been as follows:

PRODUCTION OF PETROLEUM IN THE MACKSBURG (OHIO) DISTRICT FROM 1885 TO 1889.

	BARRELS.
1885	661,586
1886	703,945
1887	372,257
1888	291,585
1889	317,037

Though oil is produced from 4 sands in this field, the important one is the Berea grit. The first oil well in this formation was struck in 1878, and was a 10-barrel flowing well.

Search for oil in this horizon in 1889 was quite persistent. A dozen wells were drilled near Cadiz, several of which started with a production of from 5 to 10 barrels of oil per day, only a few maintaining a production of 4 or 5 barrels at the close of the year. In Belmont and Jefferson counties some work was done, but the result was, on the whole, somewhat unsatisfactory.

The statistics of the production of petroleum in the Macksburg district in 1889 are as follows:

TOTAL PRODUCTION AND VALUE.

Total production in 1889 (barrels of 42 gallons)	317,037
Total value at wells of all oil produced, excluding pipage	$340,683
Value per barrel	$1.07½

STOCKS OF OIL ON HAND AT WELLS.

	BARRELS.
December 31, 1888	2,726
December 31, 1889	3,337

WELL RECORD.

Total number of producing wells December 31, 1888	317
Total number of producing wells December 31, 1889	390
Total number of flowing wells December 31, 1888	98
Total number of flowing wells December 31, 1889	103
Total number of pumping wells December 31, 1888	219
Total number of pumping wells December 31, 1889	287
Number of wells completed in 1889	118
Number of dry holes in 1889	32
Number of producing wells completed in 1889	86
Initial daily production of new wells (barrels)	1,127
Number of rigs building December 31, 1888	3
Number of rigs building December 31, 1889	2
Number of wells drilling December 31, 1888	5
Number of wells drilling December 31, 1889	7
Value of materials used in caring for and operating wells in 1889	$331,255

CAPITAL.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in the business		$944,721
Number of acres of oil land:		
Owned	745	
Leased	67,426	
Total acreage	68,171	
Present value of land, both owned and leased		255,841
Average value per acre, $4.		
Value of rigs, wells, engines, boilers, etc		630,950
Value of tanks		17,450
Value of pipe lines at wells owned by parties making report		6,695
Value of oil in stock at wells December 31, 1889		3,731
Value of other property and improvements		30,054
Total		688,880

LABOR AND WAGES.

All labor, not including office force:		
Number of foremen or overseers	8	
Total wages paid all workmen of this class in 1889		$6,050
Number of mechanics	167	
Total wages paid all workmen of this class in 1889		52,397
Number of laborers	141	
Total wages paid all workmen of this class in 1889		52,595
Office force:		
Total number (males)	2	
Total wages paid (males)		360
Total number of persons employed and wages paid in 1889	318	111,402
Wages paid for labor:		
In building rigs		$7,902
In drilling wells		44,661
In operating and caring for wells		56,317
In building or repairing tankage		1,800
In building and repairing pipe lines		362
In office		360
Total		111,402

CLASSIFIED WAGES.

CLASS OF LABOR.	Number of each class.	Range of wages.
Foremen	10	$40 to $75 per month.
Pumpers or engineers	111	$10 to $60 per month.
Carpenters	41	$2.50 per day.
Rig builders	75	$50 to $205 per rig.
Drillers	131	45 to 60 cents per foot.
Tool dressers	13	$2 to $3.50 per day.
Laborers	24	$1 to $2 per day.
Teamsters	3	$3 to $5 per day.
Sundry mechanics	3	$2.50 per day.

MECCA-BELDEN DISTRICT.

The wells in this district are located in Lorain and Trumbull counties, and include the Grafton and Mecca-Belden districts. All the oils in this district are from the Berea grit.

The Mecca district produces a lubricating oil from a few shallow wells. The total production in 1889 was 1,240 barrels, worth at the railroad station, 3 miles distant, package included, from 30 to 35 cents, according to quality. There were 8 producing wells in 1889, and all were pumped by heads. The oil is obtained mixed with water highly charged with sulphurated hydrogen, as many as 1,000 barrels of water being often pumped out for 1 barrel of oil. The wells are owned and operated by farmers, who engage in this work when circumstances permit. The wells range from 50 to 60 feet deep, at which depth a fissure or crevice is found containing inexhaustible quantities of water, carrying a greater or less amount of oil. This water is collected and the oil permitted to settle, when it is skimmed off and, after settling, is heated by steam to still further drive off the water, and it is then put up in barrels and sold. A well was drilled in 1889 to a depth of 2,375 feet with the hope of obtaining a larger amount of oil, but without success.

There are no productive wells now in Mecca proper, all being in East Mecca.

The oil obtained from Grafton, in Lorain county, is lighter than that obtained at Mecca. The wells in what is commonly known as the Grafton district, but which is more properly called the Belden district (no producing wells now being located at Grafton), range in depth from 150 to 250 feet. The wells are steady though small producers, one having yielded about 50 gallons of oil per day for 10 years. This well is pumped by heads, and is the only well in the district that is cased off. While the oil produced here is charged with sulphur, it is not as strong as that at Mecca. The well referred to produces a small amount of natural gas, which is used under the boiler at the well. The production in this district, while small, is of a high grade, and will probably be continued for years.

The statistics of the production of petroleum in the Mecca-Belden district of Ohio in 1889 are as follows:

TOTAL PRODUCTION AND VALUE.

Total production in 1889 (barrels of 42 gallons)	1,240
Total value at wells of all oil produced, excluding pipage	$10,334
Value per barrel	$8.33⅓

STOCKS OF LUBRICATING OIL ON HAND AT THE WELLS.

	BARRELS.
December 31, 1888	380
December 31, 1889	480

WELL RECORD.

Total number of producing wells December 31, 1888	6
Total number of producing wells December 31, 1889	8
Total number of pumping wells December 31, 1888	6
Total number of pumping wells December 31, 1889	8
Number of wells completed in 1889	6
Number of producing wells completed in 1889	6
Initial daily production of new wells (barrels)	3
Value of materials used in caring for and operating wells in 1889	$1,248

CAPITAL.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in the business		$23,794
Number of acres of oil land:		
Owned	291	
Leased	320	
Total acreage	611	
Present value of land, both owned and leased		13,995
Average value per acre, $23.		
Value of rigs, wells, engines, boilers, etc		$6,600
Value of tanks		445
Value of pipe lines at wells owned by parties making report		18
Value of oil in stock at wells December 31, 1889		2,386
Value of other property and improvements		350
Total		9,799

LABOR AND WAGES.

Total number of persons employed in 1889	7
Total wages paid all workmen	[a]$2,000

[a] Paid for operating and caring for wells.

The rates of wages paid pumpers or engineers ranged from $15 to $42.50 per month.

WEST VIRGINIA.

The oil fields of West Virginia divide themselves geographically into 4 districts, namely, the Turkey Foot district, in Hancock county, which is a continuation of the Pennsylvania oil fields; the Mount Morris district, which includes the wells in Monongalia county and the developments in progress in Marion county; the Volcano and Eureka districts, the Volcano being in Wood and Ritchie counties and the Eureka in Pleasants county, a continuation of a field of the same name in Ohio, and the old Burning Springs district, in Wirt county.

In the Turkey Foot, Mount Morris, and Burning Springs districts the entire production is classed as illuminating oil, while of the production of the Volcano and Eureka districts 142,133 barrels are illuminating and 23,602 barrels lubricating.

Petroleum has been known to exist in West Virginia from the earliest times. As far back as 1771 Jefferson gave an interesting description of a burning spring and the oil connected with it in the Great Kanawha valley. Up to 1865, however, but little oil had been produced except in prospecting, but in this and the succeeding years operations began almost simultaneously at a number of points, including Burning Springs and Volcano. Considerable quantities of oil were found at these places, it being light at most points, except at Volcano. The light-oil regions ran a rapid course, giving a large yield during their productive career, and ceased to be of importance until recently. The developments in Pennsylvania and the Macksburg (Ohio) region have extended into West Virginia, and the Turkey Foot and Mount Morris regions represent a continuation of the Pennsylvania oil fields and the Eureka of the Macksburg field, while the Volcano and Burning Springs remain producers.

Up to 1876 it was estimated that the production of oil in West Virginia had been 3,000,000 barrels, varying in specific gravity from 27° to 45° B., the greater portion varying from 27° to 33°.

The descriptions given in Pennsylvania of the Lower oil field, the character of the strata and of the oil produced, will apply to the Mount Morris and the Turkey Foot districts. That given in Ohio concerning the Macksburg district will apply to the Eureka. Regarding the other districts, it is sufficient to say that in most of the producing wells of the Volcano and Burning Springs districts the oil is found near the top of the carboniferous rocks.

The production of the Volcano region consists of five grades of oil, ranging in gravity from 28° to 44°, the light oils ranging from 35° to 44° and the heavy oils from 28° to 31.5°. It is estimated that about one-fifth of the heavy oil is of 28° gravity and less than 29°, one-fourth from 29° to 30°, seven-twentieths from 30° to 31°, and one-fifth 31°. This heavy oil seems to be a special production of the Wood county field.

PRODUCTION.

The total production of petroleum in West Virginia in 1889 was 544,113 barrels, valued at $653,827, or 1.20\frac{1}{2}$ per barrel. Of this amount the Turkey Foot district produced 199,460 barrels; the Mount Morris, 174,758 barrels; the Volcano and Eureka, 165,735 barrels, of which 23,602 barrels were lubricating, and the Burning Springs, 4,160 barrels; making a total of 520,511 barrels of illuminating oil, valued at $595,730, or 1.14\frac{1}{2}$ per barrel, and 23,602 barrels of lubricating oil, valued at $58,097, or 2.46\frac{1}{2}$ per barrel. Tabulating these figures, the result is as follows:

TOTAL PRODUCTION AND VALUE OF PETROLEUM PRODUCED IN WEST VIRGINIA IN 1889.

DISTRICTS.	TOTAL.			ILLUMINATING.			LUBRICATING.		
	Total production. (Barrels.)	Total value.	Price per barrel.	Total production. (Barrels.)	Total value.	Price per barrel.	Total production. (Barrels.)	Total value.	Price per barrel.
Total	544,113	$653,827	1.20\frac{1}{2}$	520,511	$595,730	1.14\frac{1}{2}$	23,602	$58,097	2.46\frac{1}{2}$
Turkey Foot	199,460	243,192	1.21$\frac{7}{8}$	199,460	243,192	1.21$\frac{7}{8}$	.....	.....	.....
Mount Morris	174,758	194,949	1.11$\frac{1}{2}$	174,758	194,949	1.11$\frac{1}{2}$	.....	.....	.....
Volcano and Eureka	165,735	211,526	1.27$\frac{3}{4}$	142,133	153,429	1.07$\frac{7}{8}$	23,602	58,097	2.46$\frac{1}{2}$
Burning Springs	4,160	4,160	1.00	4,160	4,160	1.00	.....	.....	.....

PRODUCTION AND STOCKS.

There are no separate reports of stocks of West Virginia oil held by pipe lines. The stocks held in Turkey Foot and Mount Morris are probably reported with the stocks of the pipe line in southwestern Pennsylvania, while the stocks of Eureka oil held by pipe lines are in the Macksburg report. There were, however, 6,104 barrels of oil in stock at wells December 31, 1888, and 6,835 barrels December 31, 1889. As the production of December, 1888, was 19,060 barrels, this would make the stocks at wells at the close of December, 1888, 32.03 per cent of the production of that month. The production of December, 1889, was 81,453 barrels, and 6,835 barrels were held in stock at wells at the close of the month, making stocks at wells but 8.39 per cent of the production for that month.

The number of producing wells in West Virginia at the close of December, 1888, was 505, and 623 at the close of December, 1889. Of the wells producing in this field at the close of 1888, 8 were flowing and 497 pumping. At the close of 1889 there were 23 wells flowing and 600 pumping. The well statistics for the entire region are as follows:

WELL RECORD.

ITEMS.	Total.	Turkey Foot.	Mount Morris.	Volcano and Eureka.	Burning Springs.
Total number of producing wells December 31, 1888	505	5	.....	493	7
Total number of producing wells December 31, 1889	623	103	23	499	7
Total number of flowing wells December 31, 1888	8	.....	.....	7	1
Total number of flowing wells December 31, 1889	23	11	3	8	1
Total number of pumping wells December 31, 1888	497	5	.....	486	6
Total number of pumping wells December 31, 1889	600	92	20	482	6
Number of wells completed in 1889	206	153	24	29	.....
Number of dry holes in 1889	41	40	1	.....	.....
Number of producing wells completed in 1889	165	113	23	29	.....
Initial daily production of new wells (barrels)	7,591	3,726	3,298	567	.....
Number of rigs building December 31, 1888	5	2	1	2	.....
Number of rigs building December 31, 1889	16	11	3	2	.....
Number of wells drilling December 31, 1888	5	2	.....	3	.....
Number of wells drilling December 31, 1889	24	15	4	5	.....
Value of materials used in caring for and operating wells in 1889	$122,769	$92,254	$25,136	$5,379	.....

The total capital invested in oil production in West Virginia in 1889 was $1,472,598. Of this amount $411,663 represents the value of land and $1,060,935 the value of other property.

The amount of land held as oil land in this state is 120,219 acres, of which 396 acres were owned and 119,823 acres leased. The value of this land was $411,663, or, ignoring fractions, $3 an acre. To this amount should be added 17,630 acres of land leased for oil purposes on which no developments have been made, representing an outlay for leases of $10,243.

The total amount of capital invested in other property was $1,060,935. Of this amount $985,769 represents the value of rigs, wells, etc., $35,904 the value of tanks, $3,775 the value of pipe lines, $17,713 the value of oil in stock at wells, and $17,774 the value of other property.

As there were 623 producing wells in this state at the close of the year, and the value of these wells was $985,769, the value of each well would be $1,582.

The remarks made in Pennsylvania in discussing the question of land and value of wells will apply here also.

In the following table will be found a statement of the capital used in West Virginia, by districts, and its division into totals of land and other property:

CAPITAL INVESTED, BY DISTRICTS.

DISTRICTS.	Total capital.	Value of land.	Total value of other property.
Total	$1,472,598	$411,663	$1,060,935
Turkey Foot	489,180	188,173	301,007
Mount Morris	501,254	142,111	359,143
Volcano and Eureka	476,028	80,718	395,310
Burning Springs	6,136	661	5,475

The following table shows the acreage of land in each district in West Virginia, together with the value of the same and the value per acre:

ACREAGE AND VALUE OF LAND.

DISTRICTS.	NUMBER OF ACRES.			Total value.	Value per acre.
	Total.	Owned.	Leased.		
Total	120,219	396	119,823	$411,663	$3.42
Turkey Foot	32,345	50	32,295	188,173	5.82
Mount Morris	49,307	244	49,063	142,111	2.88
Volcano and Eureka	36,595	100	36,495	80,718	2.21
Burning Springs	1,972	2	1,970	661	0.34

In the following table will be found the division of the capital invested in West Virginia other than in land:

DIVISION OF CAPITAL OTHER THAN LAND.

DISTRICTS.	Total.	Rigs, wells, etc.	Tanks.	Pipe line.	Oil in stock.	Other property.	Value per well.
Total	$1,060,935	$985,769	$35,904	$3,775	$17,713	$17,774	$1,582
Turkey Foot	301,007	291,210	6,413	620	850	1,914	2,827
Mount Morris	359,143	337,114	6,056	110	863	15,000	14,657
Volcano and Eureka	395,310	352,795	22,610	3,045	16,000	860	720
Burning Springs	5,475	4,650	825				604

LABOR AND WAGES.

The total number of employés returned as engaged in the production of crude petroleum in West Virginia at the close of 1889 was 339, who were paid $160,974. The division of these workmen into classes and wages paid is as follows:

All labor, not including office force:		
Number of foremen or overseers	17	
Total wages paid all workmen of this class in 1889		$14,520
Number of mechanics	213	
Total wages paid all workmen of this class in 1889		108,298
Number of laborers	107	
Total wages paid all workmen of this class in 1889		36,756
Office force:		
Total number (males)	2	
Total wages paid (males)		1,400
Total number of persons employed and wages paid in 1889	339	160,974

The character of work for which this total amount of wages was paid is shown in the following table:

WAGES PAID FOR LABOR.

In building rigs	$19,869
In drilling wells	82,312
In operating and caring for wells	55,903
In torpedoing wells	30
In building or repairing tankage	1,460
In office	1,400
Total	160,974

Following will be found statements showing the statistics of the production of each of the districts in West Virginia.

TURKEY FOOT DISTRICT.

The statistics of the production of petroleum in the Turkey Foot district in 1889 are as follows:

TOTAL PRODUCTION AND VALUE.

Total production in 1889 (barrels of 42 gallons)	199,460
Total value at wells of all oil produced, excluding pipage	$243,192
Value per barrel	$1.21⅞

STOCKS OF OIL ON HAND AT WELLS.

	BARRELS.
December 31, 1888	1,804
December 31, 1889	1,557

WELL RECORD.

Total number of producing wells December 31, 1888	5
Total number of producing wells December 31, 1889	103
Total number of flowing wells December 31, 1889	11
Total number of pumping wells December 31, 1888	5
Total number of pumping wells December 31, 1889	92
Number of wells completed in 1889	153
Number of dry holes in 1889	40
Number of producing wells completed in 1889	113
Initial daily production of new wells (barrels)	3,726
Number of rigs building December 31, 1888	2
Number of rigs building December 31, 1889	11
Number of wells drilling December 31, 1888	2
Number of wells drilling December 31, 1889	15
Value of materials used in caring for and operating wells in 1889	$92,254

CAPITAL.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in the business		$489,180
Number of acres of oil land:		
Owned	50	
Leased	32,295	
Total acreage	32,345	
Present value of land, both owned and leased		188,173
Average value per acre, $6.		
Value of rigs, wells, engines, boilers, etc		$291,210
Value of tanks		6,413
Value of pipe lines at wells owned by parties making report		620
Value of oil in stock at wells December 31, 1889		850
Value of other property and improvements		1,914
Total		301,007

LABOR AND WAGES.

All labor, not including office force:		
Number of foremen or overseers	5	
Total wages paid all workmen of this class in 1889	----	$3,690
Number of mechanics	131	
Total wages paid all workmen of this class in 1889	----	79,065
Number of laborers	47	
Total wages paid all workmen of this class in 1889	----	16,971
Office force:		
Total number (males)	2	
Total wages paid (males)	----	1,400
Total number of persons employed and wages paid in 1889	185	101,126
Wages paid for labor:		
In building rigs		$11,180
In drilling wells		66,445
In operating and caring for wells		20,661
In building or repairing tankage		1,440
In office		1,400
Total		101,126

CLASSIFIED WAGES.

CLASS OF LABOR.	Number of each class.	Range of wages.
Foremen	5	$10 to $100 per month.
Pumpers or engineers	24	$50 to $75 per month.
Carpenters	12	$2.50 per day.
Rig builders	42	$140 to $200 per rig.
Drillers	76	60 cents to $1.40 per foot.
Laborers	18	$2 per day.
Teamsters	6	$5 per day.

MOUNT MORRIS DISTRICT.

The statistics of the production of petroleum in Mount Morris district in 1889 are as follows:

TOTAL PRODUCTION AND VALUE.

Total production in 1889 (barrels of 42 gallons)	174,758
Total value at wells of all oil produced, excluding pipage	$194,949
Value per barrel	$1.11½

The stock on hand December 31, 1889, amounted to 678 barrels of illuminating oil.

WELL RECORD.

Total number of producing wells December 31, 1889	23
Total number of flowing wells December 31, 1889	3
Total number of pumping wells December 31, 1889	20
Number of wells completed in 1889	24
Number of dry holes in 1889	1
Number of producing wells completed in 1889	23
Initial daily production of new wells (barrels)	3,298
Number of rigs building December 31, 1888	1
Number of rigs building December 31, 1889	3
Number of wells drilling December 31, 1889	4
Value of materials used in caring for and operating wells in 1889	$25,136

CAPITAL.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in the business		$501,254
Number of acres of oil land:		
Owned	244	
Leased	49,063	
Total acreage	49,307	
Present value of land, both owned and leased		142,111
Average value per acre, $3.		
Value of rigs, wells, engines, boilers, etc		$337,114
Value of tanks		6,056
Value of pipe lines at wells owned by parties making report		110
Value of oil in stock at wells December 31, 1889		863
Value of other property and improvements		15,000
Total		359,143

LABOR AND WAGES.

All labor, not including office force:		
Number of foremen or overseers	4	
Total wages paid all workmen of this class in 1889		$2,850
Number of mechanics	26	
Total wages paid all workmen of this class in 1889		15,331
Number of laborers	25	
Total wages paid all workmen of this class in 1889		7,272
Total number of persons employed and wages paid in 1889	55	25,453
Wages paid for labor:		
In building rigs		$6,484
In drilling wells		6,000
In operating and caring for wells		12,969
Total		25,453

CLASSIFIED WAGES.

CLASS OF LABOR.	Number of each class.	Range of wages.
Foremen	4	$75 to $125 per month.
Pumpers or engineers	13	$40 to $60 per month.
Carpenters	7	$2 to $2.50 per day.
Rig builders	13	$150 to $280 per rig.
Drillers	4	$1.35 to $1.40 per foot.
Laborers	12	$1.50 to $2 per day.
Sundry mechanics	2	$60 per month.

VOLCANO AND EUREKA DISTRICT.

The statistics of the production of petroleum in Volcano and Eureka district in 1889 are as follows:

PRODUCTION IN 1889.

	BARRELS.
Illuminating	142,133
Lubricating	23,602
Total	165,735

VALUE AT WELLS OF ALL OIL PRODUCED, EXCLUDING PIPAGE.

KINDS OF OIL.	Total value.	Value per barrel.
Total	$211,526	$1.27⅝
Illuminating	153,429	1.07⅞
Lubricating	58,097	2.46½

STOCKS OF OILS ON HAND AT WELLS.

	BARRELS.
December 31, 1888:	
Illuminating	500
Lubricating	3,800
Total	4,300
December 31, 1889:	
Illuminating	500
Lubricating	4,100
Total	4,600

WELL RECORD.

Total number of producing wells December 31, 1888	493
Total number of producing wells December 31, 1889	490
Total number of flowing wells December 31, 1888	7
Total number of flowing wells December 31, 1889	8
Total number of pumping wells December 31, 1888	486
Total number of pumping wells December 31, 1889	482
Number of wells completed in 1889	29
Number of producing wells completed in 1889	29
Initial daily production of new wells (barrels)	567
Number of rigs building December 31, 1888	2
Number of rigs building December 31, 1889	2
Number of wells drilling December 31, 1888	3
Number of wells drilling December 31, 1889	5
Value of materials used in caring for and operating wells in 1889	$5,379

CAPITAL.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in the business		$476,028
Number of acres of oil land:		
Owned	100	
Leased	36,495	
Total acreage	36,595	
Present value of land, both owned and leased		80,718
Average value per acre, $2.		
Value of rigs, wells, engines, boilers, etc		$352,795
Value of tanks		22,610
Value of pipe lines at wells owned by parties making report		3,045
Value of oil in stock at wells December 31, 1889		16,000
Value of other property and improvements		860
Total		395,310

LABOR AND WAGES.

All labor, not including office force:		
Number of foremen or overseers	8	
Total wages paid all workmen of this class in 1889		$7,980
Number of mechanics	56	
Total wages paid all workmen of this class in 1889		13,902
Number of laborers	32	
Total wages paid all workmen of this class in 1889		11,193
Total number of persons employed and wages paid in 1889	96	33,075
Wages paid for labor:		
In building rigs		$2,205
In drilling wells		9,867
In operating and caring for wells		20,953
In torpedoing wells		30
In building or repairing tankage		20
Total		33,075

CLASSIFIED WAGES.

CLASS OF LABOR.	Number of each class.	Range of wages.
Foremen	8	$45 to $105 per month.
Pumpers or engineers	28	$1 to $1.50 per day. $40 to $50 per month.
Carpenters	4	$2.50 to $3 per day.
Rig builders	18	$36 to $200 per rig.
Drillers	27	65 to 90 cents to $1 per foot.
Tool dressers	2	$2 to $3 per day.
Laborers	4	$1.25 to $1.50 per day.
Well cleaners	2	$5 per day.
Sundry mechanics	3	$50 per month.

BURNING SPRINGS DISTRICT.

The statistics of the production of petroleum in Burning Springs district in 1889 are as follows:

TOTAL PRODUCTION AND VALUE.

Total production in 1889 (barrels of 42 gallons)	4,160
Total value at wells of all oil produced, excluding pipage	$4,160
Value per barrel	$1

There was no stock on hand December 31, 1888 and 1889.

WELL RECORD.

Total number of producing wells December 31, 1888	7
Total number of producing wells December 31, 1889	7
Total number of flowing wells December 31, 1888	1
Total number of flowing wells December 31, 1889	1
Total number of pumping wells December 31, 1888	6
Total number of pumping wells December 31, 1889	6

CAPITAL.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in the business		$6,136
Number of acres of oil land:		
Owned	2	
Leased	1,970	
Total acreage	1,972	
Present value of land, both owned and leased		661
Average value per acre, $0.34.		
Value of rigs, wells, engines, boilers, etc		$4,650
Value of tanks		825
Total		5,475

LABOR AND WAGES.

Total number of persons employed in 1889	3
Total wages paid all workmen in 1889	*a*$1,320

a Paid for operating and caring for wells.

The number of pumpers or engineers employed was 3, whose wages ranged from $10 to $50 per month.

COLORADO.

Though indications of petroleum, such as oil springs, sandstones impregnated with petroleum or with the residuum after evaporation, and "oozes", are reported from many parts of Colorado, the only locality from which oil has been produced in paying quantities is the field located in the valley of the Arkansas near Florence, in Fremont county, known as the Florence field. This field extends from near Cañon City, 8 miles above Florence, to an as yet undetermined distance southeast of Florence. The present productive field is confined to a small area, about 2 miles square, of the valley of the Arkansas river and adjacent "mesa" or table-land. It is reached by the Denver and Rio Grande and Atchison, Topeka and Santa Fe railroads. The productive wells at present seem to be confined to a basin 1½ to 2 miles wide. East and west of this basin the petroleum is displaced by water. A notable spring of soda water was recently struck about 2 miles east of Florence at a depth of 2,200 feet, the water issuing from the ground at a temperature of 80° F. The length of this basin is northwest and southeast. What its extent is along its length is not as yet determined. The first wells, as will be seen below, were struck near Cañon City, about 8 miles northwest of Florence; but these wells have been abandoned, and all the production is in the immediate vicinity of Florence. The drilling at the present time is chiefly toward the southeast from Florence, toward Pueblo, the larger bodies of land held by the different companies being in this direction. Wells have been bored near Pueblo, about 30 miles down the river, which have yielded water abundantly, but no oil. There is quite a stretch of country just below Florence which has the same geological structure as that in which the wells have been drilled. It is possible that the oil field may extend some distance down the river toward Pueblo.

As stated above, indications of oil have been found in many other places in Colorado. Beneath the Laramie deposit the Colorado group of the cretaceous formation consists of bituminous shales 1,500 to 2,500 feet in thickness. These have been disturbed in the vicinity of the mountains, and gas and oil have been found issuing from them in many places, as on the north branches of the San Juan river, in the coal basin below Glenwood Springs, and in the White River country. These bituminous shales of the Laramie have yielded and probably will still yield large quantities of petroleum. At Morrison, 11 miles from Denver, on the Denver and South Park railroad, the Denver Natural Gas and Oil Company is drilling for oil, encouraged by the presence of a sand rock colored dark brown or black by the residual products of the liquid hydrocarbons, which exists five-eighths of a mile west of the drilling point. The rock outcrops at this point, dipping about 30° east. Drilling was begun five-eighths of a mile east of the outcrop under the supposition that oil would be found at greater quantities at this depth. The drilling is in a shale, and was in May, 1891, down to a depth of 1,950 feet, no oil having been reached at that time. The drilling of this well, known as the Morrison well, has been discontinued.

The first indications of petroleum in Fremont county were found at Oil Springs, about 6 miles northeast from Cañon City and half a mile above the mouth of Oil Creek cañon. Mr. Joseph Lamb and other pioneers claimed to have seen the springs in 1859, but Mr. Gabriel Bowen is generally credited with the discovery. In 1862 the late Mr. A. M. Cassady purchased the springs from Mr. Bowen and in March of the same year began collecting the crude oil by sinking 6 wells, first digging and sinking shafts, following with spring pole and drill to a depth of 60 to 100 feet. 2 wells were sunk from 300 to 500 feet, but oil was only found near the surface.

Between the years 1862 and 1865 Mr. Cassady collected and refined oil, most of which was transported by team and sold in Pueblo, Denver, and Sante Fe. For some of the refined oil he realized as high as $5 per gallon.

As Mr. Cassady's method of refining was crude and expensive, the advent of railroads across the plains from the Missouri river rendered his industry unremunerative and he abandoned it. Other parties at later dates attempted to sink wells in the same locality, but without success.

In 1881, while a well was being drilled near the coal mines at the town of Coal Creek for a water supply, oil was discovered at a depth of 1,260 feet. A company was organized, composed of citizens of Cañon City, called the Land Investment Coal and Oil Company, which commenced operations in November, 1882, and on April 7, 1883, after expending about $20,000, struck oil on the farm of Mr. Edwin Lobach, near the town of Florence, the present center of the oil industry of Colorado. This company was not successful, and in a few years was merged into the Colorado Oil Company, which company, with the Arkansas Valley Oil and Land Company and other interests, organized the United Oil Company in 1887.

Other operations since the organization of the United Oil Company have been undertaken at Florence. The only one, however, operating in the census year was the Florence Oil and Refining Company. These 2 companies produced all the oil from this district in 1889. 4 other companies, however, have since begun operations in this field, namely, the Rocky Mountain Oil Company, Triumph Oil Company, Colorado Coal and Iron Company, and the Beaver Land Company.

The geology of the country near Florence is very simple. The Arkansas valley at Florence has cut through the Laramie group, the upper member of the cretaceous, exposing the upper portion of the Colorado group, the middle member of the cretaceous. East and west of Florence the rocks of the Laramie, sandstones and shales, with beds of coal lying nearly horizontal, are exposed on the mountain side. In the valley at Florence, where the wells have been put down, the formation consists almost entirely of blue or bluish-black shale, having a thickness of from 3,000 to 4,000 feet. The wells are all sunk in this shale, no well that has yet been put down having passed through

it, though some wells have been drilled 3,500 feet or more. Farther up the valley of the Arkansas these sedimentary strata are uplifted and rest against a granite axis of the Greenhorn range. The slate or shale in which the oil is found dips southwest about 10°. As stated above, the wells drilled in this district have never gone through the shale, which lies just below the drift, but it is questionable if the origin of the oil is in the shale. The indications are that it drains into the shale probably from the direction of Cañon City. It is noted in drilling that when the shale seems to be solid and unbroken no oil is found, but when in drilling crevices are struck and the strata appears broken oil is almost sure to be discovered. A well at a given point, which, when drilled, shows crevices and broken strata, may produce 150 to 200 barrels a day, while another well 100 feet from it, drilled through solid shale, will not give the least indication of oil. About 1 well in 3 has proved a producer.

The depth at which oil is found varies greatly. There are producing wells as deep as 1,960 feet, and others not over 1,000 feet. In one case there are 2 wells within 300 feet of each other, in one of which oil was found at a depth of 1,630 feet, and in the other no oil was found until 1,960 feet had been reached. The earlier wells of the Florence field were drilled 1,000 to 1,200 feet. In many cases these wells, after producing for awhile, ceased, but upon drilling deeper they began producing again. No water is found in the wells after leaving the surface.

It will thus be seen that the conditions under which oil is found in Colorado are very different from those of its occurrence in Pennsylvania and Ohio. There are no pools as the word is understood in the east, but the oil seems to flow through the crevices or shattered strata to the drill hole. It is also a remarkable fact that the wells, instead of decreasing, actually increase in production. A certain well on the property of one of the companies, which began producing 90 barrels of oil, now produces 150, the maximum being reached within a short time after the well was struck, it gaining every day for about 2 weeks. Another well that began with a production of 100 barrels ran up in 5 days to 210, and has been producing at this rate for months. On the other hand, sometimes increase in production is very gradual, wells that are now several years old having recently increased their production. One well that started off producing 40 barrels in this way has recently run up to 150. The life of wells in the Florence district is also very long, and some wells have been remarkable producers, one having produced up to May 1, 1891, over 6,000,000 gallons. The large production and long life of the wells of this district may be due to the fact that it is a new field and comparatively few wells have as yet been put down.

It is also a fact that it does not hurt these wells to shut them down for a period. Often when the demand for oil has not been equal to the production the wells have been shut in, starting off again with full production when pumped. This will account for the variation in the number of producing wells shown in the table given elsewhere. This variation is not due to the drilling of new wells and the abandonment of old, but to stopping of production by shutting in the wells.

The Florence oil has a number of peculiarities as compared with Pennsylvania. It is a heavy oil, being about 31° B. It contains little or no lighter hydrocarbon, all the products that pass over in refining being sold as illuminating oil. Nor does the oil deposit any B. S. It yields in refining about 35 to 44 per cent water-white illuminating oils of about 125° fire test.

There is little or no market for the residuum from refining other than for fuel, for which purpose it is sold at 25 cents a barrel. The demand for this purpose has not been equal to the supply; it is run into a depression near the refinery in such quantities that it has formed a lake of petroleum residuum.

PRODUCTION.

The following table gives the total production of all Colorado oil wells for the year 1889, and includes all oil paid as royalty to owners of land upon which wells were drilled. There is no market in Colorado for crude oil, and none is bought and sold except a very small amount of royalty oil, which is pumped and bought by refineries and is paid for at the rate of 2 cents per gallon or 84 cents per barrel.

PRODUCT OF CRUDE OIL IN COLORADO IN 1889.

	BARRELS.
January	27,270
February	26,120
March	25,845
April	17,229
May	20,550
June	18,837
July	23,360
August	27,561
September	28,071
October	32,289
November	34,774
December	34,570
Total	316,476
Total value at wells of all oil produced	$280,240

STOCK OF CRUDE OIL AT WELLS.

	BARRELS.
1888.	
December 31	13,092
1889.	
January 31	10,870
February 28	24,496
March 31	34,792
April 30	39,593
May 31	41,883
June 30	41,953
July 31	38,355
August 31	40,516
September 30	35,519
October 31	38,418
November 30	40,854
December 31	51,034
Average	36,524
Value of stock on hand at wells December 31, 1889	$45,267.56

The value of these stocks is calculated on the same basis as that of production.

DISTRIBUTION OF PRODUCT.

There are no pipe lines or distribution lines used in Colorado. All oil produced is consumed by refineries. The per cent of oil evaporated is very small.

DISTRIBUTION OF THE COLORADO OIL PRODUCT.

	BARRELS.
Stocks at wells December 31, 1888	13,092
Produced in 1889	316,476
Total	329,568
Stock December 31, 1889	51,034
Distribution in 1889:	
Dump oil	277,211
Evaporated	1,323
Remaining on hand December 31, 1889	51,034
Total	329,568

TOTAL NUMBER OF RIGS BUILDING BUT NOT COMPLETED.

[No rigs building in months omitted in 1889.]

December 31, 1888	3	July 31, 1889	1
January 1, 1889	2	August 31, 1889	1
February 28, 1889	1	September 30, 1889	1

Total value of materials used in building rigs, $3,600.

TOTAL NUMBER OF RIGS COMPLETED.

[No rigs completed in months omitted in 1889.]

During—		During—	
January, 1889	3	July, 1889	1
February, 1889	2	August, 1889	1
March, 1889	1	September, 1889	1

Total cost of rigs built in 1889, $7,200.

TOTAL NUMBER OF WELLS DRILLING.

[No wells drilling in months omitted in 1889.]

December 31, 1888	4	July 31, 1889	2
January 31, 1889	3	August 31, 1889	2
February 28, 1889	1	September 30, 1889	2

Total value of materials used in drilling wells, $27,500.

Where dry holes have been drilled it frequently occurs that the rig is removed and another well started, thus reducing the cost of the following well.

The value of materials used in drilling wells is that of the tools and fixtures necessary to drill wells, and is not the value of materials used within the wells, such as tubing, casing, rods, etc.

OIL WELLS COMPLETED IN COLORADO IN 1889.

MONTHS.	Total number of wells completed in each month.	Number of dry holes.	Number of wells producing.	Initial daily production of new wells. (Barrels.)
Total	14	8	6	260
January	4	3	1	8
February	3	2	1	50
March	1	.....	1	50
April	.....	.....	.....	.....
May	.....	.....	.....	.....
June	.....	.....	.....	.....
July	.....	.....	.....	.....
August	2	1	1	90
September	2	1	1	12
October	1	.....	1	50
November	1	1	.....	.....
December	.....	.....	.....	.....

Out of 14 wells completed it will be noticed that 8 were dry holes, 6 only being productive. The average initial production of wells was 43⅓ barrels for the first 24 hours.

NUMBER OF PRODUCING OIL WELLS IN COLORADO.

MONTHS.	Total number producing. (a)	Total number abandoned.	MONTHS.	Total number producing. (a)	Total number abandoned.
Total	.....	6	1889.		
			May 31	16	.....
1888.			June 30	15	.....
December 31	23	.....	July 31	22	.....
1889.			August 31	23	.....
January 31	24	.....	September 30	24	.....
February 28	25	.....	October 31	24	1
March 31	25	1	November 30	23	.....
April 30	12	3	December 31	22	1

a All pumping.

Some wells, although productive, were shut down during the year on account of lack of storage and limited demand for crude product at the refineries. 6 wells that had ceased to produce were cleaned, but without results. 13 other wells were cleaned with good results, bringing the production back to almost the original amount. No wells were torpedoed in this state during 1889.

TANKAGE.

The tankage in this state consists chiefly of cement and brick cisterns, it having been demonstrated that evaporation is less than if wood or iron tankage were used.

STATISTICS OF OIL TANKS IN COLORADO.

NUMBER.	SIZE.				Material.	Capacity. (Barrels of 42 gallons.)
	Diameter.		Height.			
	Ft.	*In.*	*Ft.*	*In.*		
1	20	2	13	0	Cement and brick	672
1	25	0	12	0	....do	1,090
1	25	0	13	9	....do	1,086
13	31	8	9	6½	....do	1,258
1	30	0	13	4	....do	1,511
1	28	7	15	5	....do	1,581
1	30	0	22	0	Iron	2,770
1	59	11	28	0	....do	14,204
1	86	0	17	6	....do	18,105
7	.....		.....		Wood	37
15	10	0	8	0	....do	100

TANK RECORD.

Total number of tanks	43
Total capacity of tanks (barrels)	42,324
Total value of materials used in building or repairing tanks in 1889	$9,039
Total value of all materials used in building or repairing tank cars in 1889	$7,000
Total length of pipe lines at wells, not including that belonging to pipe-line companies (feet)	39,228
Total value of pipe lines at wells	$7,904
Sizes of pipe used and length of each size:	
3-inch pipe (feet)	8,781
2-inch pipe (feet)	29,724
1-inch pipe (feet)	723

The amount of money expended for tankage at wells is really an expense for storage, and includes a limited amount of expense incurred from pipe lines at wells to refineries and storage cisterns.

The condensed statistics of the production of petroleum in Colorado in 1889 are as follows:

TOTAL PRODUCTION AND VALUE.

Total production in 1889 (barrels of 42 gallons)	316,476
Total value at wells of all oils produced, excluding pipage	$280,240
Value per barrel	$0.88½

STOCKS OF ILLUMINATING OILS ON HAND AT WELLS.

	BARRELS.
December 31, 1888	13,092
December 31, 1889	51,034

WELL RECORD.

Total number of producing wells December 31, 1888	23
Total number of producing wells December 31, 1889	22
Total number of pumping wells December 31, 1888	23
Total number of pumping wells December 31, 1889	22
Number of wells completed in 1889	14
Number of dry holes in 1889	8
Number of producing wells completed in 1889	6
Initial daily production of new wells (barrels)	260
Number of rigs building December 31, 1888	3
Number of wells drilling December 31, 1888	4
Value of materials used in pumping, caring for, and operating wells in 1889	$27,500

CAPITAL INVESTED IN COLORADO OIL FIELDS.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in the business		$3,000,000
Number of acres of oil land:		
Owned	33,015	
Leased	6,100	
Total acreage	39,115	
Present value of land, both owned and leased		2,517,215
Average value per acre, $64.		
Value of rigs, wells, engines, boilers, etc		$229,659
Value of tanks		63,581
Value of tank cars		8,333
Value of pipe lines at wells owned by parties making report		7,903
Value of oil in stock at wells December 31, 1889		45,268
Value of other property and improvements		128,041
Total		482,785

LABOR EMPLOYED IN PRODUCING COLORADO OIL.

All labor, not including office force:		
Number of foremen or overseers	5	
Total wages paid all workmen of this class in 1889	....	$4,950
Number of mechanics	56	
Total wages paid all workmen of this class in 1889	....	19,138
Number of laborers	28	
Total wages paid all workmen of this class in 1889	....	8,744
Office force:		
Total number (males)	1	
Total wages paid (males)	....	1,800
Total number of persons employed and wages paid in 1889	90	34,632

WAGES PAID IN PRODUCING COLORADO OIL.

Wages paid for labor:	
In building rigs	$2,703
In drilling wells	8,099
In operating and caring for wells	21,494
In building and repairing pipe lines	536
In office	1,800
Total	34,632

CLASSIFIED WAGES.

CLASS OF LABOR.	Number of each class.	Range of wages.	Average.	Days employed.
Foremen	4	$4.17 to $5 per day	$4.58	330
Pumpers or engineers	20	$2.50 per day	2.50	145
Carpenters	10	$3 per day	3.00	86
Drillers	8	$4 per day	4.00	127
Tool dressers	10	$3 per day	3.00	112
Laborers	38	$2 per day	2.00	115

CALIFORNIA.

The petroleum fields of California where oil is found in merchantable quantities are almost exclusively within the boundaries of the southern counties, though oil has been found in many other parts of the state.

The oil-producing territory in California in 1889 may be divided into two general sections: (1) that included in the Santa Paula region, in which are found the Ojai, Sespe, Ex-Mission (which includes the Adams and other districts), the Torrey cañon in the San Fernando mountain, 22 miles west of Newhall, the San Fernando district, including the Pico, Wiley, and Elsemere fields, and the Puente district, in which only one field, the Puente, is found; (2) the Santa Clara district, in Santa Clara county, which is known sometimes as Moody Gulch.

The wells in the Santa Paula subdistrict of the southern fields are in Ventura county; the Pico and Puente subdistricts are in Los Angeles county.

Oil was at one time produced in San Mateo county, a short distance below San Francisco on the coast, and small amounts in other counties; but the only production in 1889 was in Santa Clara, Ventura, and Los Angeles counties.

The oil belt commences near Santa Paula, in Ventura county, and extends thence in a southeasterly direction about 80 miles to Puente, in Los Angeles county, taking in the Sespe, Torrey Cañon, and other wells in Ventura county, Pico, Newhall, Elsemere, Puente, and other districts in Los Angeles county. This belt has a variable width of from 2 to 3 miles, though oil is not found all through the entire length, it being apparently in pools.

Though petroleum has been known to exist in California from the time of its first settlement by the whites, no attempt was made to utilize the deposits until about the time of the discovery of the Pennsylvania oil fields, which led to the prospecting for petroleum at localities pointed out by petroleum and tar springs and by seepage from the asphaltum beds. During the years 1865 and 1866 upward of 70 companies were incorporated in California to search for petroleum and a large amount of money was spent, but no considerable amount of oil was found. The developments at this date were in Los Angeles and Ventura counties.

Discouraged at the result of the first efforts, but little was done until 1875, when the business began to revive. In this year 2 wells were put down in the Pico cañon, which have been producers ever since. These two wells produced in 1875 about 650 barrels of oil. In 1877 6,332 barrels were produced from the Ex-Mission field, and in 1878 300 barrels were produced from the Santa Clara district.

The first wells put down in the Pico cañon were drilled with spring poles. At least 3 wells were drilled in this way, 2 of which are still producing.

The petroleum fields of California are the most interesting in the United States. In many respects they differ entirely from any other fields yet opened. The oil, with the exception of that from Santa Clara, has usually, as its "base", asphaltum instead of paraffin. The Pacific Coast Oil Company at one time pressed paraffin wax from the Santa Clara oil, but the low price of the wax and the reduction in the production of the crude compelled them to discontinue this production. The strata in which the oil is found are tilted at a high angle. Drilling is difficult and expensive, owing to the character of the rock and angle at which the oil-bearing strata stand. The oil, while carrying but a small proportion of the illuminating hydrocarbons, finds a ready market as fuel, owing to the high price of coal in California, and it contains practically no B. S.

While there is a certain general resemblance in all of the southern fields, there are certain important differences which make a description of each field of importance.

Describing the most northwesterly, the Santa Paula, first, it may be said that this field includes, as has been stated above, a number of small subdivisions, such as the Ex-Mission, Adams, Sespe, Ojai, Santa Paula, Torrey cañon, and others. These cañons are sharp ravines cut laterally in the sides of the mountains and usually at right angles with the course of the range. The strata in these various districts stand at an angle of about 75°. In sinking wells the drills pass through shales until the oil sand is struck, which is from 2 to 40 feet in thickness. This sand is believed to be in the tertiary, though of this there is some doubt. A red sand that used to be regarded as barren is now giving some very good wells.

The great angle at which the strata stand in this district makes drilling exceedingly difficult, resulting often in crooked holes, causing the drills to lodge in the wells and requiring torpedoing and reaming out and very expensive work in recovering them. This liability of the wells to become crooked suggested the employment of the diamond drill in boring. A well was bored in this way at Pico, but it was not a success, though a straight hole was secured. The fine mud that results from the use of the diamond drill seemed to fill up the interstices in the rock and prevented production. The reaming out of the well by a drill resulted in a very largely increased production. The same fact regarding the tilting strata also suggested the use of tunnels in producing petroleum. Indeed, some of the earliest work in mining for petroleum in California was by the use of tunnels. In fact, in the early history of this field and of all southern California prospecting for petroleum was by these tunnels, which were driven into the sides of the mountains where the surface indications, such as tar springs or seepage from asphaltum deposits, gave any prospect of getting oil. Many of these tunnels are still in existence and some are producing. One of these tunnels was driven in 1864 by a company of which Senator Stanford was a member. This produced at first 25 barrels of oil a day. Twelve years later the production had fallen to 8 barrels a day, and when Messrs. Hardison & Stewart purchased the property, in 1885, it was producing 5 barrels a day, and at the present time 2 barrels a day.

This method of producing oil has never been in great favor in California. It is somewhat dangerous, as is all tunneling. It is known locally as "coyoting". There are many things, however, to commend it for these fields. As suggested above, the difficulty and expense of drilling, and especially the caving in of the wells, owing to the peculiar structure of the shale through which the wells are drilled, makes it difficult and expensive, not only to put down wells, but to case off the water. In these tunnels there is no caving in of strata, no casing, no pumping, and, in fact, no expense after the tunnel is once driven.

The first or Stanford tunnel was driven 350 feet. One driven some 4 years ago was 625 feet long. The oil was found in different strata, and paid for it before it was finished. The yield of this tunnel was about 60 barrels a day when first finished; now it is 8 barrels a day. The cost of driving these tunnels is from $5 to $10 a running foot. The wells cost as much as this at times. The size of the tunnel is usually 4 by 6 feet. In 1889 there were 4 of these tunnels producing.

Another peculiarity of these wells, growing out of the tilting of the strata above referred to, is the great increase in the production of different wells put down to reach the strata at different depths. As has already been stated, these strata dip about 75°. A series of 5 wells has been put down at one place in the Adams cañon, the wells being started on the surface at different heights up the mountain side above the stream at its base. The first well was put down a short distance above the point where the oil-bearing rock came to the surface, the presence of the oil showing itself by seepage from the outcropping rock. The sand rock was struck at a depth of 110 feet and produced 20 barrels a day. The second well was started a little higher up the mountain side, the rock pitching toward the mountain, striking the oil-bearing rock at a depth of 130 feet, giving a production of 25 barrels a day, draining or, perhaps better, stopping production entirely in No. 1. A third well was started still farther up the mountain side, which struck the rock at a depth of 330 feet, producing 75 barrels a day and stopping production in the second well. A fourth well, started still higher up the mountain side, struck the rock at a depth of 682 feet and started off producing 300 barrels a day, stopping production in No. 3. The fifth well is being put down very much higher up the mountain, but had not struck the sand rock at the time this report closed, though it had been drilled to a depth of 2,450 feet. The fourth well described above produced up to a given period 123,000 barrels, the production of the 4 wells being for the same time 250,000 barrels.

Another peculiarity is noticed in these wells. Sometimes the depth of shale is very slight, the well being drilled entirely through sand (not sand rock), a little oil being produced all the way down. It is customary to case the well and perforate the casing, the oil flowing in from the sand almost the entire depth of the well. In a short time, however, the sand packs around the casing, the oil begins to percolate through it, and, to use the expression of the region, the well "gets its pace and is a stayer".

The oil of the Santa Paula field produces about 15 per cent of distillate; 35 per cent can be secured, but the quality of the illuminant is not satisfactory. But little oil from this district is refined, most of it being sold for fuel purposes. The gravity is from 16° to 32°, the average being about 26°. The oil from the same region differs greatly in its character. In putting down wells up the sides of a hill 6 or 7 different grades of oil will be found in as many ledges. In one case 6 wells were put down, beginning at the bottom of the hill and going up the sides 400 feet. In the first well going up the hill a black oil of 26° gravity was found; in the second well the oil was black and of 28° gravity; in the third it was a heavy oil and brown; in the fourth well the oil was 18° gravity, tarry and

black; in the fifth well the gravity was 18°, heavy and green, and in the sixth well the gravity was 30° and the oil was light green in color with some yellow.

The strata in the other districts are not pitched as in the Santa Paula, where they stand at an angle of some 75°. In the Pico field they are 65°, and in the Puente 30°. This excessive tilting makes drilling difficult and expensive.

Not only are the strata very much tilted, but they are so much so all through southern California that but little dependence can be placed in their continuity. This resulted in the early history of mining for oil in California in the spending of very large sums of money, but with very little result, but in later years it has led to very cautious explorations. It also has resulted in very small fields, with the exception of the Santa Paula. In this field there are practically continuous deposits for a distance of some 40 miles, though the deposits are in pools. The Pico producing field is but a few hundred feet, possibly a mile in length by 700 or 800 feet broad, though developments are being made for 8 miles, while the Puente, as developed, is but 3,500 feet long by 800 feet broad. This also is probably much larger.

Many of the conditions existing in the Pico cañon are similar to those in the Santa Paula district; but there are a number of conditions that are more manifest here than in Santa Paula. The San Fernando district, as stated above, comprises three subfields, the Pico, which is the most important, the Wiley, and the Elsemere, which are recent developments. The Pico field is some 7.5 miles west of Newhall, which is on the Southern Pacific railroad; the Wiley some 5.5 miles southwest, and the Elsemere 2.5 miles to the southeast. These are all connected with Newhall by pipe lines.

As has already been stated, drilling was begun in this field in 1875, August 22 being the date of the beginning of the first well, which was finished September 8. This well was drilled to a depth of 120 feet with a spring pole. At the depth of 30 feet oil was struck in a shale, giving a production of 2 barrels a day. At the depth of 120 feet oil was found, also in shale, the production being 10 to 12 barrels a day. In 1887 this well was deepened with modern drilling tools to a depth of 600 feet. At a depth of 175 feet the well produced by pumping 30 barrels a day. In 1882 this well was still further deepened to 735 feet, but there was no increase in production. The best sand was found in this well at a depth of 170 feet. Well No. 2, very close to No. 1, was drilled in November, 1875, also with a spring pole. The best sand was struck at a depth of 250 feet, the well flowing from 20 to 25 barrels a day. At 520 feet the production was 40 barrels, the well being pumped. In well No. 3 sand producing 4 barrels a day was struck at 90 feet, another at 145 feet producing 8 barrels a day, while at 170 feet one producing 11 barrels a day was struck. In well No. 5 the first oil-producing sand was struck at 900 feet, while in No. 7 sand was found at 850 feet, giving a flowing well. The deepest producing wells in this district are from 1,400 to 1,730 feet.

The same difficulty in drilling wells exists here as in the Santa Paula district. The wells are put down on the sides of very steep cañons, requiring very expensive work in securing a level place to begin drilling, oftentimes requiring blasting in the mountain side. Crooked holes are not infrequent, and it is nothing uncommon for wells to cost from $6,000 to $20,000 apiece. Contracts have been taken in this district to put down wells at $6 a foot, the company owning the land furnishing fuel, water, and casing.

The wells in this district never suffer from drowning out by water. Though some of the wells produce both water and oil. The average proportion of water to oil is very small. In some wells the water contains material in solution that eats the casing, making it thin, like paper. In this district, as in others, considerable gas is found in the wells, which is utilized for pumping and drilling, saving possibly in this district 20 tons of coal a day. Wells are never shot for production. Sometimes when a hole is crooked and tools are stuck in them they are shot to release the tools, but not to increase the yield of oil.

The oil of the Pico field is in some respects better than that of the other fields, some of it containing a little paraffin occasionally, and it yields a larger percentage of illuminants in refining than the Santa Paula oil, crude being about 40° gravity.

In the Wiley subdivision of the Pico field two different oils are found, taken from the same well, a green and a black. The production of these two oils is about 4½ barrels a day, and was found at a depth of from 600 to 800 feet. In drilling this well sand, not sandstone, was struck at a depth of from 400 to 600 feet. This sand followed the drill up the well fully 50 feet. It is from this sand that the oil comes. It had to be shut off from the well by casing and the casing perforated. A similar phenomenon is noticed in the Santa Paula district.

The Elsemere field was not developed until after the close of 1889.

The Puente field is located in the Puente hills, 7 miles from Puente station, on the Southern Pacific railroad. Oil in some instances is found in a shale just above the sand, but mostly in the sand. It has asphaltum as its base, carrying about 15 per cent. Wells are struck at various depths, but the best producers begin at 500 feet. It is difficult to drill below 1,200 feet, owing to the caving in of the strata, noticed in connection with the remarks on other fields. One well has been drilled in this district to a depth of 1,200 feet, but the deepest producer is at 1,000 feet.

The strata are very much pitched and broken, dipping about 30° north, the strike being a little northwest of west. The field as at present developed is 3,500 feet long by 800 feet wide.

The first well was drilled in this field in 1883. The occasion of drilling the well was the discovery of a large amount of seepage near where the well was first put down. No. 2 and No. 3 were drilled early in 1884, and no

others were drilled until 1886. The earlier wells up to No. 3 were drilled to the depth of 200 feet, and produced a heavy oil to the amount of 3 or 4 barrels a day. These are still producing, but in smaller amounts, from 1 to 2 barrels daily. No. 4 well, which was drilled in 1886, was also a small producer, yielding 15 barrels a day. No. 5, drilled in 1886, began with a production of 75 barrels. 3 wells were drilled in 1888 and 3 in 1889. The same difficulty in drilling noted in other districts in this state obtain here also, such as crooked holes, caving in of sides, losing of tools, etc. The cost of drilling is from $3 to $6 a foot or more. In this district what is known as stovepipe casing is used. This is a thin riveted casing, two joints being put together, one being smaller than the other. The inner casing on one end projects beyond the outer casing, while the outer casing projects at the other end beyond the inner, forming a socket at one end, into which the projection at the other fits. The casing is ticked together at the joints, requiring no nuts or screws or couplings. The casing is sometimes jacked down into place. All of the oil from this district is piped over the hills to near the Puente station, loaded in tank cars and sent to Los Angeles, and consumed for fuel.

No dry holes have ever been found in this district. Every well that has ever been sunk was a producer and is still producing. The wells are all pumped by heads. Though 1 or 2 spouters have been struck, they soon dropped in production and are now pumping.

The following is an analysis of various tests made of the oil from these wells, having a gravity of 32°:

ANALYSIS OF OIL FROM THE PUENTE FIELD, CALIFORNIA.

	PER CENT.
Benzine, from 80° to 58°	15
Illuminating, 58° to 42°	26
Lubricating, 42° to 30°	14
Lubricating, 30° to 24°	27
Asphalt (maltha)	18
Total	100

STATISTICS OF PRODUCTION OF PETROLEUM IN CALIFORNIA IN 1889.

In the table given below are the consolidated statistics of the production of petroleum in California in 1889. From this it appears that the total production was 303,220 barrels, of which 97,264 barrels were classed as illuminating and 205,956 barrels as fuel oil. The probability is that a small proportion of that oil classed as fuel oil was also sold to refineries, but the division named is the best that was possible under the circumstances. The illuminating oil was priced at $1.25⅛ per barrel at the well, the fuel at $1.13¾. Some of this oil classed as fuel oil was a very heavy oil carrying a large percentage of asphaltum, and was sold as a paint for painting iron pipes. A small portion of the oil classed as illuminating was sold for mixing with asphaltum for thinning or tempering it, as it is termed. This oil brought 20 cents a gallon. These amounts in each case, however, were so small that they may be ignored and the classification allowed to stand.

PRODUCTION OF OILS IN 1889.

	BARRELS.
Illuminating	97,264
Fuel	205,956
Total	303,220

VALUE AT WELLS OF ALL OIL PRODUCED, EXCLUDING PIPAGE.

KINDS OF OIL.	Total value.	Value per barrel.
Total	$356,048	$1.17⅜
Illuminating	121,684	1.25⅛
Fuel	234,364	1.13¾

Concerning the other statistics but little need be said. It has been exceedingly difficult to collect these figures, and even now there is some doubt as to their accuracy. The business of producing crude petroleum in southern California is so complicated in certain fields as to lead to possible duplication of returns in some instances and to insufficient returns in others. It is believed, however, that the statements given in this report are nearer correct than those usually published regarding the production of crude oil in California, being the result of a personal visit by the special agent to the field.

STOCKS OF OIL ON HAND AT WELLS.

	BARRELS.
December 31, 1888:	
Illuminating	1,758
Fuel	5,789
Total	7,547
December 31, 1889:	
Illuminating	1,264
Fuel	2,176
Total	3,440

WELL RECORD.

Total number of producing wells December 31, 1888	88
Total number of producing wells December 31, 1889	89
Total number of pumping wells December 31, 1888	88
Total number of pumping wells December 31, 1889	89
Number of wells completed in 1889	10
Number of dry holes in 1889	4
Number of producing wells completed in 1889	6
Initial daily production of new wells (barrels)	76
Number of rigs building December 31, 1888	2
Number of rigs building December 31, 1889	1
Number of wells drilling December 31, 1888	3
Number of wells drilling December 31, 1889	2
Value of materials used in caring for and operating wells in 1889	$51,680

CAPITAL.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in the business		$2,186,958
Number of acres of oil land owned	10,607	
Present value of land		1,060,000
Average value per acre, $100.		
Value of rigs, wells, engines, boilers, etc		$840,164
Value of tanks		11,250
Value of tank cars		40,000
Value of pipe lines at wells owned by parties making report		61,257
Value of oil in stock at wells December 31, 1889		4,036
Value of other property and improvements		170,251
Total		1,126,958

LABOR AND WAGES.

All labor, not including office force:		
Number of foremen or overseers	5	
Total wages paid all workmen of this class in 1889		$8,000
Number of mechanics	25	
Total wages paid all workmen of this class in 1889		18,147
Number of laborers	62	
Total wages paid all workmen of this class in 1889		46,284
Office force:		
Total number (males)	3	
Total wages paid (males)		2,625
Total number of persons employed and wages paid in 1889	95	75,056
Wages paid for labor:		
In building rigs		3,195
In drilling wells		20,131
In operating and caring for wells		49,055
In building or repairing tankage		50
In office		2,625
Total		75,056

CLASSIFIED WAGES.

CLASS OF LABOR.	Number of each class.	Range of wages.
Foremen	6	$100 to $200 per month.
Pumpers or engineers	9	$65 to $80 per month.
Carpenters	7	$3 to $4 per day.
Drillers	18	$3 to $4 per day.
Laborers	58	$1.50 to $3 per day.
Sundry mechanics	2	$2.50 to $4 per day.

INDIANA.

Although reports of the discovery of oil in Indiana were rife in 1889, the only production in this state concerning which statistics have been secured was at Terre Haute, in Vigo county, and at Montpelier, Blackford county. The notable developments in Indiana have all been subsequent to that year.

On May 6, 1889, oil was struck in the Diall well at Terre Haute. The flow was estimated at 1,000 barrels per day, but its production rapidly declined, the total production for the 8 months after the well was struck being but 30,000 barrels, an average for the entire time of 3,750 barrels a month, or about 125 a day. At the close of the year it was estimated that the production did not exceed 75 barrels a day. The excitement following this find, which was in some respects unlucky, was intense. Company after company was formed, and over $60,000 was expended in exploiting for oil. Up to the close of the year only one producing well in addition to the Diall had been struck. This was a small producer, rated at first as a 50-barrel well, but averaging in December only 15 barrels a day. The oil in these wells is found in the upper part of the Hamilton limestone at a depth of 1,615 feet. The other locality in which oil was found in 1889 was in Montpelier, Blackford county. During that year two wells were drilled at this point. The well drilled by the citizens of the place as a company was intended to demonstrate the presence of oil or gas, and, finding oil, the well was plugged and as late as April, 1891, no use had been made of the product. A well was also drilled at the same place by a firm composed of residents of Montpelier and some oil was secured. The production in 1889, however, was very small. This product is used on the spot for burning under a boiler at a stone quarry, and occasionally a tank car is sold to one of the fuel companies. In this case the price of Lima crude controls the market. The oil is of a dark color, is supposed to be a limestone oil, but has not the sulphurous odor peculiar to the limestone oil from Lima. At the close of the year developments were being pursued in this district with good prospects of securing a supply of oil. Some interest was also being taken in a territory at Keystone, Wells county, 3 miles north of Montpelier, in a section which it was assumed was a continuation of the Montpelier district, and in 1890 some wells were struck and the district gave great promise of becoming an important one in the future.

At Dundee, Madison county, about 6 miles west of Montpelier, and at Bryant, southeast of Montpelier, there are also indications of oil. This whole territory can be named the Montpelier district, from the point at which oil was first struck.

The statistics of the production of petroleum in Indiana in 1889 are given as follows:

TOTAL PRODUCTION AND VALUE.

Total production in 1889 (barrels of 42 gallons)	33,375
Total value at wells of all oil produced, excluding pipage	$10,881
Value per barrel	0.32⅝

The stock on hand at the wells December 31, 1889, was 12,250 barrels of fuel oil.

WELL RECORD.

Total number of producing wells December 31, 1889	3
Total number of flowing wells December 31, 1889	3
Number of wells completed in 1889	3
Number of producing wells completed in 1889	3
Initial daily production of new wells (barrels)	1,135
Number of rigs building December 31, 1888	1
Value of materials used in pumping, caring for, and operating wells in 1889	$15,777

CAPITAL.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in the business		[a]$49,918
Number of acres of oil land leased	12,585	
Present value of land		5,528
Average value per acre, $0.44.		
Value of rigs, wells, engines, boilers, etc		$15,650
Value of tanks		10,335
Value of tank cars		5,800
Value of pipe lines at wells owned by parties making report		2,130
Value of oil in stock at wells December 31, 1889		4,075
Value of other property and improvements		6,400
Total		44,390

[a] In addition to the above, information has been received of the expenditure of $54,874 in the drilling of 17 wells in Vigo county, all of which were dry holes. Of this amount $51,524 is reported as absolutely lost.

LABOR AND WAGES.

All labor, not including office force:		
Number of foremen or overseers	1	
Total wages paid all workmen of this class in 1889	.....	$1,200
Number of mechanics	7	
Total wages paid all workmen of this class in 1889	.....	725
Number of laborers	25	
Total wages paid all workmen of this class in 1889	.....	4,105
Office force:		
Total number (males)	1	
Total wages paid (males)	.....	50
Total number of persons employed and wages paid in 1889	34	6,080
Wages paid for labor:		
In building rigs		$125
In drilling wells		600
In operating and caring for wells		5,305
In office		50
Total		6,080

CLASSIFIED WAGES.

CLASS OF LABOR.	Number of each class.	Range of wages.	Days employed.
Foremen	1	$150 per month	240
Rig builders	3	$125 per rig	
Drillers	4	60 cents per foot	
Laborers	1	$25 per month	
Sundry mechanics	22	$75 per month	

KENTUCKY.

The only petroleum produced in Kentucky in 1889 was from the Boyds Creek district, in Barren county, some 3.5 miles from Glasgow. From January to August, 5 wells were operated in this district, and 6 from August to the close of the year. Some 5,400 barrels were produced, which were distilled (it could hardly be called refined) by the operator in a still near the wells, and the distillates sent to Louisville to be refined. The naphtha and residuum were also shipped to the Louisville refinery.

Near Somerset, Pulaski county, oil was struck about 85 feet below the surface. The oil sand was drilled into to a depth of 45 feet, and it was in this rock that the oil was procured. Just before boring this well the same operators bored another one at a point 4 or 5 miles northeast, in which the same oil-bearing rock was struck near the surface; there was, however, barely a showing of oil. The results obtained in drilling these wells convinced the operators that the dip of the oil-bearing sand rock was in a southwesterly direction, and their opinion is substantiated by the fact that many years ago some wells were developed at a point 40 miles southwest of the second well referred to. The well first referred to was plugged after some 3 or 4 barrels of oil had been obtained, the operators concluding that to obtain oil in paying quantities they would have to go farther southwest.

This oil has been tested by Professor W. Dicore, of Cincinnati, Ohio. It shows a specific gravity of 0.870, of 43½° B., and on distillation 5 per cent of light oil boiling below 130° F., 18 per cent of light oil boiling at from 130° to 300° F., and 34 per cent of illuminant of 48° gravity B.

After these are taken off a lubricating oil of 28° B. is obtained, which, on further heating, yields oil of 39° B., out of which 17 per cent of heavy lamp oil of 43° can be produced, increasing the total of lamp oil to 51 per cent. The remainder is a lubricating oil (of a consistency like linseed oil) of 22° B., flashing at 330° F.

The color of the crude oil is a greenish brown, and the odor not more offensive than that of well purified gasoline. There is no sediment or inorganic substance, nor a separation of the higher hydrocarbons after long standing.

In Russell county some 15 or 16 years ago (1874) a refinery was operated by some parties who also had a well at the same location, but during their operations there was a great depression in the price of oil, and, coupled with the burning of their tank and the fact that they had no means of transporting their product, except in wagons for a long distance in order to reach railway transportation, they could not make the continued operation of their well profitable. It was therefore abandoned and the well plugged. The oil is still there and can be seen seeping from the hole, and is of the same character as the oil found near Somerset.

About the same time that this refinery and well were operated in Russell county there were some wells bored in Cumberland county, which adjoins Russell county, but they were also abandoned about the same time that the

Russell county operators ceased, and for similar reasons, namely, lack of transportation facilities and depression in the price of oil.

Early in 1890 there was 1 well being drilled in Cumberland county and 3 rigs in course of construction for the purpose of further development, and it was said that there would be 10 or 12 rigs at work in this and Russell counties during the earlier months of that year.

Natural gas in considerable volume was struck early in January, 1890, in Cumberland county, but was cased off, since the operators wished to continue drilling for the purpose of finding oil, for which there was every prospect of success.

Wayne county also had producing oil wells in former years, which likewise were abandoned for the lack of transportation and the failure of the company prosecuting the development.

In all there are upward of 70,000 acres of land under lease for oil purposes in Pulaski, Wayne, Russell, Clinton, and Cumberland counties, to which that under lease in Barren county should be added.

Operations are being energetically pushed in Barren county, which lies west of Russell and Cumberland counties, and a refinery was being erected near Glasgow late in 1889. Wells completed in this county, however, were not found to exceed 15 barrels daily production.

A little heavy, dark oil, with weak brine, has been found at a depth of 70 feet near Lexington, in the Trenton rock. Near North Middletown, Bourbon county, a well in the Lower Hudson 98 feet deep yielded in 1888 100 gallons of good lubricating oil per week. The oil is black, and has a gravity of 23.5° B.

The statistics of the production of petroleum in Kentucky in 1889 are as follows:

TOTAL PRODUCTION AND VALUE.

Total production in 1889 (barrels of 42 gallons)	5,400
Total value at wells of all oil produced, excluding pipage	$5,400
Value per barrel	$1

No stock is reported on hand December 31, 1888 and 1889.

WELL RECORD.

Total number of producing wells December 31, 1888	5
Total number of producing wells December 31, 1889	6
Number of pumping wells December 31, 1888	5
Number of pumping wells December 31, 1889	6
Number of wells completed in 1889	3
Number of dry holes in 1889	1
Number of producing wells completed in 1889	2
Initial daily production of new wells (barrels)	7
Value of materials used in caring for and operating wells in 1889	$3,050

CAPITAL.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in the business		$25,000
Number of acres of oil land:		
Owned	100	
Leased	51,500	
Total acreage	51,600	
Present value of land, both owned and leased (actual expenditures on same for oil purposes)		10,150
Average value per acre, $0.20.		
Value of rigs, wells, engines, boilers, etc		$9,000
Value of tanks		750
Value of tank cars		1,800
Value of pipe lines at wells owned by parties making report		200
Value of other property and improvements		3,100
Total		14,850

LABOR AND WAGES.

All labor, not including office force:		
Number of foremen or overseers	2	
Total wages paid all workmen of this class in 1889		$1,248
Number of mechanics	8	
Total wages paid all workmen of this class in 1889		660
Number of laborers	4	
Total wages paid all workmen of this class in 1889		1,142
Total number of persons employed and wages paid in 1889	14	3,050
Wages paid for labor:		
In building rigs		$200
In drilling wells (part contract)		1,650
In operating and caring for wells		1,200
Total		3,050

CLASSIFIED WAGES.

CLASS OF LABOR.	Number of each class.	Range of wages.	Days employed.
Foremen	2	$52.50 to $70 per month	50 to 313
Pumpers or engineers	4	$24 to $30 per month	50 to 313
Rig builders	2	$1 per day	20
Drillers	4	60 cents per foot	40
Tool dressers	2	$1.75 per day	40
Laborers	2	90 cents to $1 per day	Various.

ILLINOIS.

The only oil produced in Illinois in 1889 was from some wells near Litchfield, in Montgomery county. The oil is a lubricating one, dark, almost black in color, and of 22° B. specific gravity. The cold test is remarkable, the oil remaining fluid at 20° below zero. It is largely used by the factories in the neighborhood of Litchfield, and is sold to consumers at near-by points for lubricating purposes, bringing from 8 to 10 cents per gallon in bulk, according to quantity.

In all there have been 30 wells bored in the neighborhood of Litchfield, chiefly for gas. The depth of these wells ranges from 640 to 670 feet. All save 5 were abandoned years ago. These 5 wells continue to produce the character of petroleum mentioned above. The average production of these wells is about 4 barrels a day. They are pumped by heads, and 1 man attends to them all. Natural gas from wells near by is used to some extent in furnishing fuel for pumping the wells. The supply of gas is about equal to 12 tons of coal a year, and 12 tons additional are used in pumping. The supply of natural gas is gradually diminishing.

The statistics of the production of petroleum in Illinois in 1889 are as follows:

TOTAL PRODUCTION AND VALUE.

Total production in 1889 (barrels of 42 gallons)	1,460
Total value at wells of all oil produced, excluding pipage	$4,906
Value per barrel	$3.36

STOCKS OF OIL ON HAND AT WELLS.

	BARRELS.
December 31, 1888	110
December 31, 1889	100

WELL RECORD.

Total number of producing wells December 31, 1888	5
Total number of producing wells December 31, 1889	5
Total number of pumping wells December 31, 1888	5
Total number of pumping wells December 31, 1889	5
Value of materials used in pumping, operating, and caring for wells in 1889	$760

CAPITAL.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in the business		$12,336
Number of acres of oil land:		
Owned	20	
Leased	5,000	
Total acreage	5,020	
Present value of land, both owned and leased		2,600
Average value per acre, $0.52.		
Value of rigs, wells, engines, boilers, etc		$9,000
Value of tanks		250
Value of pipe lines at wells owned by parties making report		150
Value of oil in stock at wells December 31, 1889		336
Total		9,736

LABOR AND WAGES.

Total number of persons employed in 1889	1
Total wages paid all workmen	*a*$600

a Paid for operating and caring for wells.

1 engineer or pumper was employed 365 days at $50 per month.

KANSAS.

The only section of Kansas in which oil has been found in what may be termed paying quantities, and even here the production is very small, is in Miami county, near Paola. In this county "tar" or oil springs have been known to exist from the earliest settlement of the state. One of these springs, some 8 miles east of the town of Paola, has led to the drilling of a number of wells in search of oil during the past 30 years. As early as 1858 leases were obtained, and there was considerable talk of developing the oil field here. In 1861 a well was drilled 5 miles east of Paola, in which it is reported that oil was found, but the well filled with water, soon caved in, and no oil in commercial quantities was produced. Another well was started 2 miles east of Paola in the same year, but was abandoned before the oil rock was reached.

In a report made by Professor Mudge in 1864 he refers to the existence of oil and bitumen in the eastern tiers of counties of the state. In Professor Swallow's report of 1865 he makes reference to 19 different tar springs within Miami county, and adds that "scarcely a well has been dug without finding petroleum in some of its forms". Professor Swallow concludes that these facts are "very strong evidence of the existence of large reservoirs in these localities". Although large reservoirs of oil or gas may be found, as Professor Swallow predicted, yet the facts which he presents in themselves are not necessarily sufficient to warrant such a conclusion.

In 1865 a Saint Louis company drilled 2 wells about 10 miles east of Paola. These wells were reported to have been drilled to a depth of 700 feet, when the tools were lost.

In 1873 a company was organized, known as the Kansas Mining Company, and the same year drilled a well on the northeast quarter of section 16, township 19, range 24 (Westfall farm), near one of the largest of the "tar springs". At a depth of 320 feet a strong flow of gas was found and work stopped. Other gas wells were soon drilled on the same farm and gas was piped to Paola, a distance of 7 miles, by the Paola Gas Company.

In 1888 one of the wells on the Westfall farm was drilled deeper, and it was found that under the gas rock there was an oil rock 12 to 16 feet thick, producing a very heavy black oil. This well bailed from 1 to 2 barrels per day. As the oil interfered with the gas, for which the well was drilled, it was plugged off at the bottom of the gas rock and the well turned again into the gas main. It was soon ascertained, however, that the oil was of such value as a lubricant that wells of 1 or 2 barrels per day could be worked at a profit, and the Paola Gas and Land Company purchased the property of the Paola Gas Company, and prospecting for oil began in the spring of 1889. The first well of recent years, drilled especially for oil, was put down in May, 1889, on the northwest quarter of section 16, township 17, range 24, and at a depth of 330 feet a good oil sand was struck, the gas sand lying at 316 and 328 feet and the oil sand at 330 to 341 feet. This well, known as No. 29, was shot with 10 quarts of nitroglycerin, and when cleaned out the gas shot a stream of oil to the top of the derrick. The well was tubed, the casing head packed, and the oil flowed by the gas. This well at first produced 15 barrels per day for 4 months.

In the fall of 1889 and spring of 1890 4 wells were drilled by the same company 3 miles southwest of Paola, and the oil rock struck at about the same level as in the eastern field, but the rock was much harder and the oil much lighter. The west field has a much stronger head and promises a much larger yield than the east field.

There are at least 3 districts near Paola. The first is Russell tract, or Westfall farm, about 7 miles east of Paola and 2 miles from Somerset station, on the Missouri Pacific railroad; the others are nearer Paola, one being 3 miles southwest, as above noted, and the other just at the edge of the town.

As above noted, gas was at first the object of the recent drilling near Paola. Well No. 1 in Russell tract was bored for gas in 1882. Since that time 56 wells have been drilled by the Paola Oil, Gas and Mining Company and

its predecessors. As stated above, it was not until 1888 that wells began to be drilled for oil. The Russell tract is now one of value as an oil producer, the pressure of the gas not being strong enough to force it through the 2½ inch pipe laid from Russell to Paola, a distance of 7 miles. 13 wells are now (1890) producing oil.

The structural geological conditions of Kansas when viewed by themselves are favorable to the existence of natural gas and oil. The rocks underlying Kansas are comparatively horizontal, the general dip being toward the west and northwest. The highest geological strata in eastern Kansas is the carboniferous, while westwardly higher formations are found. Going from the northern toward the southern portion of the state, within the coal measure area, the strata thicken, as the records of the oil and salt wells in Miami county seem to prove.

The best oil well in this district, No. 39, drilled in May, 1889, has the following record:

	FEET.
Cased to	280
Soapstone	20
Sandy shale	11
White slate	3
Gas sand (very good)	10
White slate	4
Oil sand	13
Total	341

The sand in which the oil is found is stated to be "identical with Bradford in appearance". It certainly has that look of light-colored coarse maple sugar that is seen in the Bradford sand when filled with oil.

The oil itself is a heavy, black, fatty substance of remarkable lubricating properties. A test taken by the writer on the afternoon of May 7, 1891, temperature 70° F., showed the gravity to be 23½° B., zero cold test, and 280° fire test. This refers to the oil in the Russell tract, or from the Westfall farm. That from the district 3 miles southwest of Paola is much lighter, having a gravity of 30°, zero cold test, 100° fire test, and not so densely black as the oil in the eastern field. The oil contains none of the lighter hydrocarbons; even at 300° F. nothing distilled over. A little water remains obstinately entangled in the oil, which at that temperature produces frothing to such a degree as to interrupt further distillation. Even in some cases the temperature of the retort has been carried to 400° F. without the production of a drop of distillate. As stated above, the quality of this oil as a lubricant is phenomenal. Without the least artificial preparation it has given some remarkable results as a lubricant under the most severe tests, especially on railroads running through the alkali country.

While the foregoing statements apply chiefly to the oil produced in Miami county near Paola, oil has been found in other portions of the state apparently on the same general degree line as at Paola. These discoveries of oil have been made chiefly when boring for natural gas.

In Kansas City, Kansas, oil was struck when boring for natural gas, usually at a depth of from 300 to 400 feet. As natural gas was the product sought in drilling the wells, and as it was difficult to market the oil, which was produced in small quantities, at satisfactory prices, the wells were allowed to drown out in most cases when it was found that they did not produce sufficient natural gas to pay for operating them.

The record of a well bored in Kansas City is as follows:

RECORD OF A WELL BORED AT KANSAS CITY, KANSAS, FOR NATURAL GAS IN 1889.

[Feet.]

STRATA.	Thickness of each stratum.	Total depth.
Loam and clay	14.0	14.0
Limestone	19.0	33.0
Shale	30.0	63.0
Limestone	12.0	75.0
Shale	5.0	80.0
Limestone	20.0	100.0
Shale	5.0	105.0
Limestone	10.0	115.0
Shale	30.0	145.0
Flint	10.0	155.0
Shale	25.0	180.0
Limestone	15.0	195.0
Shale	18.0	213.0
Limestone	10.0	223.0
Shale	170.0	393.0
Limestone	5.0	398.0
Shale	38.0	436.0
Limestone	4.0	440.0
Black shale	26.0	466.0
Sand rock	16.8	482.8

Oil was struck at a little over 400 feet; gas from 266 to 476 feet; hard, close sand from 476 to 480 feet; gas from 480 to 482.8 feet.

At Fort Scott, Kansas, oil was found in 2 or 3 wells when drilling for natural gas. Its character seemed to be the same as that of the Paola oil. As the quantity of gas was insufficient to pay for operating the wells they were abandoned. At Wyandotte and Coffeyville oil has been found under similar conditions to those existing at Paola, but no attempt has been made to save the same.

It has been extremely difficult to secure statistics of the production of oil in Kansas for 1889, as no record was kept. The best information received indicates that there were 3 wells producing oil December 31, 1889, at Paola, the production for that year being about 300 barrels, valued at $1,500. Nearly the entire amount of this oil remained on hand at the close of the year, little or no product having been sold.

A small amount of oil, some 200 barrels, was also produced in Kansas City from wells drilled for gas. This was also lubricating oil of about the same quality as that produced in Paola.

The statistics of the production of petroleum in Kansas in 1889 are as follows:

TOTAL PRODUCTION AND VALUE.

Total production in 1889 (barrels of 42 gallons)	500
Total value at wells of all oil produced, excluding pipage	$2,500
Value per barrel	$5

STOCKS OF OIL ON HAND AT WELLS.

	BARRELS.
December 31, 1888	100
December 31, 1889	100

WELL RECORD.

Total number of producing wells December 31, 1888	4
Total number of producing wells December 31, 1889	4
Total number of pumping wells December 31, 1888	4
Total number of pumping wells December 31, 1889	4
Number of rigs building December 31, 1889	2
Value of material used in pumping, caring for, and operating wells in 1889	$500

CAPITAL.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in the business		$75,000
Number of acres of oil land leased	4,000	
Present value of land		40,000
Average value per acre, $10.		
Value of rigs, wells, engines, boilers, etc.		$25,000
Value of tanks		2,500
Value of pipe lines at wells owned by parties making report		3,000
Value of oil in stock at wells December 31, 1889		500
Value of other property and improvements		4,000
Total		35,000

LABOR AND WAGES.

All labor, not including office force:		
Number of mechanics	2	
Total wages paid all workmen of this class in 1889		$1,000
Number of laborers	6	
Total wages paid all workmen of this class in 1889		2,500
Office force:		
Total number (males)	2	
Total wages paid (males)		2,500
Total number of persons employed and wages paid in 1889	10	6,000
Wages paid for labor:		
In building rigs		$300
In operating and caring for wells		3,000
In building or repairing tankage		100
In building and repairing pipe lines		100
In office		2,500
Total		6,000

CLASSIFIED WAGES.

CLASS OF LABOR.	Number of each class.	Range of wages.	Days employed.
Pumpers or engineers	1	$1.50 per day	All.
Carpenters	1	$2.50 per day	200
Rig builders	1	$2.50 per day	100
Drillers	2	$3.50 per day	250
Tool dressers	2	$2 per day	250
Laborers	2	$1.25 per day	300

TEXAS.

Similar conditions to those found in Kansas, New Mexico, and the southern part of California exist in Texas. Springs known locally as tar springs are found scattered over various portions of the state, especially in the northeast, southeast, and central portions. The oil wells of Kansas and Missouri are found a little east of the ninety-fifth meridian of longitude west of Greenwich. The Texas springs are a little to the east of the ninety-fourth meridian, and some are also found on the ninety-third and east of it. The petroleum produced in Texas in 1889 was in Bexar county, near San Antonio, about midway between the ninety-eighth and ninety-ninth meridians.

The product of these springs is known locally as petroleum, and is in this report so classified, though some geologists, especially those who have been connected with the geological survey of California, insist on calling it maltha. At present, however, they acknowledge that this so-called maltha and petroleum are similar substances. Chemically they may be; practically they are not.

The Texas oil is a natural lubricator of from 28° to 30° gravity, and is said to be found in a conglomerate. The wells are shallow, the oil being struck in various parts of the state at from 125 to 350 feet. The Bexar county wells, which produced the petroleum reported upon from this state in 1889, are about 300 feet deep. As there is but a limited demand for the oil, there is no effort to produce it in large quantities. The 2 wells producing in 1889, which were on the ranch of Mr. George Dulnig, were wells that had been drilled originally for procuring water. They were found to yield small quantities of oil and gas. The production of these 2 wells in 1889 was about 4 barrels a month.

Outside of the oil produced in Bexar county none seems to have been produced in the state on a commercial scale, though reports as to the discovery of oil at various points in Texas are frequent. At Sulphur Springs, in Hopkins county, there are certain so-called "sour wells", which produced a few gallons of oil. In 1887 and 1888 considerable excitement was occasioned by the reported striking of oil in Nacogdoches county. The locality was some 80 miles southwest of Shreveport. The wells were driven wells, and some oil was obtained at the depth of 85 feet, in other cases at a depth of 300 feet. Quite a number of wells were driven in 1887 and 1888, but no petroleum was produced in 1889.

The oil produced in Bexar county was used for lubrication. It retailed in barrels at 20 cents a gallon, in tin cans of 5 gallons at 30 cents, and in smaller quantities than 5 gallons at 35 cents a gallon.

The statistics of the production of petroleum in Texas in 1889 are as follows:

TOTAL PRODUCTION AND VALUE.

Total production (barrels of 42 gallons)	48
Total value at wells of all oil produced, excluding pipage	$340
Value per barrel	$7.08⅓

STOCKS OF OIL ON HAND AT WELLS.

	BARRELS.
December 31, 1888	6
December 31, 1889	48

WELL RECORD.

Total number of producing wells December 31, 1888	2
Total number of producing wells December 31, 1889	2
Total number of pumping wells December 31, 1888	2
Total number of pumping wells December 31, 1889	2

CAPITAL.

Total capital invested in wells (*a*), leases, etc., and employed in the business	$1,650
Value of rigs, wells, engines, boilers, etc	1,200
Value of tanks	100
Value of pipe lines at wells owned by party making report	10
Value of oil in stock at wells December 31, 1889	340
Total	1,650

a These wells are sunk on the ranch of the owner, and no value is placed upon the land as oil territory.

The work is all done by ranch hands; no special men are employed, the production of the wells being but 4 barrels per month.

MISSOURI.

The only oil produced in Missouri in 1889 concerning which it has been possible to secure any information was in west Boone township, Bates county, near the Kansas state line, southwest from Paola, where the oil produced in Kansas in 1889 was found.

This oil was all produced from 1 well drilled in 1886 for water. The oil comes from sand 220 feet in depth. It is similar in every respect to the Kansas oil. The well is pumped by a windmill and yields less than 1 barrel a day. The oil is sold to local trade for lubricating purposes. In 1889, 20 barrels of oil, valued at $40, were produced. All oil is sold as soon as produced.

The cost of operating the well in 1889 was $350; the total capital, $750. The territory consists of 600 acres of land, valued, as oil territory, at $210, the rigs, wells, engines, etc., being valued at $520 and tank at $20. There was but 1 producing well and 1 tank. The cost of drilling the well was $1.50 a foot.

There is an interesting history connected with the drilling of some wells at Adrian, Bates county, Missouri. Oil was discovered here in 1889 at a depth of 33 feet while prospecting for coal. The oil sand was some 25 feet thick, overlaid with soapstone shale to a thickness of 8 feet. The oil oozed from the rock into the shaft and was bailed out. The shaft was in the creek bottom, and being flooded by the first high water the well ceased to produce.

A number of drill holes were then put down. 3 of these produced about 6 gallons in 10 hours, but the holes were not cased, and they were soon drained out by water.

In 1883 a derrick was erected, proper oil tools procured, and a well sunk over 500 feet. All the oil secured in this well was found at from 33 to 90 feet in depth. The well was pumped but once, and then only for 10 hours, the product being 20 gallons of oil, with a large quantity of water.

The oil is similar in character to that found at Paola.

Mr. R. B. Marshall, of Adrian, states that he has done a great deal of prospecting for oil in that section of the country, and finds a strip of territory some 10 miles long and from 1 to 3 miles wide underlaid with gas and oil, but that the difficulty with the region as a producing territory is that the sand is too fine and the oil too thick to give any great production. There is a great deal of sand rock impregnated with oil which can be driven out by heat.

The statistics of the production of petroleum in Missouri in 1889 are as follows:

TOTAL PRODUCTION AND VALUE.

Total production in 1889 (barrels of 42 gallons)	20
Total value at wells of all oil produced, excluding pipage	$40
Value per barrel	$2

No stock was reported on hand at the wells December 31, 1888 and 1889.

WELL RECORD.

Total number of producing wells December 31, 1888	1
Total number of producing wells December 31, 1889	1
Total number of pumping wells December 31, 1888	1
Total number of pumping wells December 31, 1889	1
Value of materials used in pumping, operating, and caring for wells in 1889	$5

CAPITAL.

Total capital (real and personal) invested in lands, wells, leases, etc., and employed in the business	$750
Number of acres of oil land owned	600
Present value of land as oil territory	$210
Average value per acre, $0.35.	
Value of rigs, wells, engines, boilers, etc	$520
Value of tanks	20
Total	540

LABOR AND WAGES.

Total number of persons employed in 1889	1
Total wages paid all workmen	*a*$350

a Paid for operating and caring for wells.

TENNESSEE.

At a point about 8 miles north of White Bluff, in Dickson county, Tennessee, on Jones creek, oil has been known to exist since 1865. It is said 7 wells have been drilled at this place by different parties, some of them being shallow, and the deepest well being upward of 2,000 feet deep. There was but 1 actually dry hole, and that was abandoned at 640 feet. The shallow wells produced oil in small quantities at a depth of 187 feet. 2 wells have been cased and have small quantities of oil in them, but since there is no market for crude oil in this state or immediate vicinity wells have been neglected and no attention paid to its development. The product is not utilized except to a small extent for lubricating purposes. It is firmly maintained by residents there that oil can be found in remunerative quantities.

Oil is generally found at an average depth of 150 feet, in a sandstone of 20 feet thickness. Gas and salt water are also found.

ALABAMA.

Though no oil was produced in Alabama during the census year, still, in view of the fact that drilling was recommenced in 1890, some account is given of the history of oil production in this state and the prospects of future production.

In various parts of northern Alabama there are found springs which yield natural gas and petroleum to a limited extent, though as yet these products have not been found in sufficient quantities to be of any commercial value. There are also found in the same section in the outcroppings of the carboniferous formations "tar" springs somewhat similar to those of California, from which there exudes a thin bitumen, known as "maltha". Shortly after the beginning of the petroleum excitement in Pennsylvania in 1859 many wells were drilled at points indicated by these natural gas and petroleum and tar springs. Some oil was found, but not in sufficient quantities to justify the continuance of operations.

The best known of the Alabama tar springs are just outside of Moulton valley. These springs are in the outcroppings of a very highly fossiliferous, coarse-grained, siliceous limestone that has a cover of reddish and greenish argillaceous shales. Near the lower of the 2 springs is a well said to have been drilled for oil some years ago to a depth of 106 to 107 feet. The Goyer Oil Company, of Memphis, Tennessee, proposes to put down wells near these springs. At present (June, 1891) 2 wells have been completed, in 1 of which a dark-green oil was found at a depth of 1,509 feet. The first oil secured in small quantities was at the top of the Trenton limestone, at a depth of 1,355 feet. This well was computed by Dr. McRae to be a 25-barrel well. The second oil sand, from which most of the oil came, is believed by Mr. Henry McCalley to be some 300 feet down in the Trenton limestone, or some 200 feet lower geologically than any known productive oil sand in this country.

Oil wells are to be drilled in other parts of the state.

WYOMING.

Though oil has been known to exist in Wyoming for more than 30 years, and though developments made in 1885 and since point to the presence of valuable oil deposits in this territory, the oil industry has assumed, as yet, no importance, owing chiefly to the distance of the producing territory from any important market and the expense of transportation thereto.

The developments of importance have been confined chiefly to 2 districts, one known as the "George B. Graff oil-mining district", in the county of Fremont, in the western part of the territory, not far from Dallas, and at the base of the Wind River mountain, and the other known as the "Stockade oil-mining district", in Weston county, in the extreme northeastern part of the territory, near the Black hills and New Castle.

The first district, the "George B. Graff", is named for the late Dr. George B. Graff, of Omaha, who developed the property. The amount of oil in this district is indicated from the fact that there are about 50 open oil springs in Fremont county, 14 within a radius of 20 miles of Lander.

In 1885, 4 wells were sunk to the upper oil-bearing sand. The depth of these wells and their product, as given at that time, are as follows:

WELLS.	Depth, in feet.	Flow per day, in barrels.
Total	.....	1,335
No. 1	85	85
No. 2	100	100
No. 3	350	325
No. 4	1,200	825

It is probable the production of some of these wells as given is too great. Several statements received from this district are to the effect that 3 of the wells which were drilled about this time were shut in or "packed" with Hodley packers; that they would produce, if they were allowed to flow, or, to use the local expression, "let loose", some 200 barrels per day per well, and that in the neighborhood of these wells a lake, 300 yards long by 30 yards wide, was made to receive their overflow, and it is estimated that in this lake there are now some 15,000 barrels that were produced as long ago as 1886. Nothing has been done in the way of development or production in this district since this date.

Regarding this oil field, Mr. L. D. Ricketts, territorial geologist, states: "These wells are cased and supplied with valves to prevent the oil from escaping, but owing to the great gas pressure a leakage can not be prevented. The pressure is so great that upon suddenly opening the valves the oil spurts up 75 feet into the air, like some black-watered geyser. After the pipe thus clears itself the steady flow of oil is resumed, which, as variously estimated, will aggregate from 600 to 1,000 barrels per 24 hours."

The oil is found in 2 strata, the upper a "black sand", averaging about 70 feet in thickness, and the other is a "black pebble" or "dark conglomerate", varying in thickness, according to different authorities, from 400 to 800 feet. The oil in this district is low in illuminants, averaging about 25 per cent. It is proposed, and a company has been organized for the purpose, to pipe the oil to Denver, 250 miles distant, and to sell it for fuel.

Regarding the second district, the "Stockade oil-mining district", which is located in the Black hills near New Castle, in Weston county, but little information has been obtained. A large quantity of government land, supposed to contain oil, has been located in this district. A list of some 376 locations of 160 acres each, amounting to 60,160 acres, has been furnished the special agent. This land, at the government price of $2.50 an acre, would be valued at $150,400. In order to hold these leases $200 worth of improvements must be put upon the land. If all of the claims were finally taken up, this would add $75,200 to the value of the land entered as oil land in this district. It is known, however, that in many cases the claims have been abandoned. So far as has been learned, no amount of oil has ever been produced in this district, though indications are very favorable to the securing of a large supply.

NEW MEXICO.

Information has been received of a very small production of a heavy lubricating oil in Bernalillo county, on section 11, township 16 north, range 16 west. This oil flows naturally from the rocks containing it. The product is stated to be a barrel a day, which is probably in excess of the actual production. It is sold in small quantities to consumers in the immediate vicinity at the rate of $10 a barrel. The larger proportion of the production is wasted and lost.

It is also reported that there are several places on the Navajo Indian reservation where petroleum exudes in a similar manner from the crevices in bituminous sandstone, and there is no doubt that at many places in New Mexico the same phenomena that are noticed in Colorado and Wyoming will be found to exist.