

THE PETROLEUM INDUSTRY IN INDIANA IN 1903.

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DEFINITION OF PETROLEUM.—Crude petroleum, or “rock oil,” is a natural bitumen, composed mainly of the combustible elements, carbon and hydrogen. In its most common form it is a brownish-black, ill-smelling liquid, with a specific gravity of about .86. When kindled, it burns readily with a bright flame and without leaving a residue. When exposed to the atmosphere it gives up slowly its volatile gases, and is, in time, reduced to a thick, semi-solid, asphaltum-like mass. The name petroleum comes from two Latin words, “*petra*,” a rock, and “*oleum*,” oil, and in many localities it is known as “rock oil,” or simply “oil.”

DISTRIBUTION OF PETROLEUM.—Petroleum is widely distributed throughout the countries of the world, and is found in the rocks of almost every geological formation, from those of the old Archæan time up to the later members of the Tertiary Age. In some of the older countries, as India and Japan, it has been known to and used by man as a remedial agent for more than 2,500 years. For many centuries, however, its uses were few, its possibilities of furnishing valuable products by distillation not being known. With the advancement in the knowledge of chemistry came a better understanding of its component elements, and within the past quarter of a century it has come to be one of the great and necessary resources of the earth. Its value has fluctuated from time to time, but since 1900 the tendency has been upward, for the demand has come to exceed the supply. For a year or two the refiners have been using the crude oil faster than it is being pumped into the pipe lines, and the reserve stocks of millions of barrels in the great iron tanks have been called upon to supply the deficiency.

During the year 1902 the United States produced 80,894,590 barrels of petroleum, which brought, delivered into the pipe lines,

\$69,610,348. In the same year Russia produced 80,493,381 barrels. The United States thus stood first in the rank of petroleum producing countries, and, aside from Russia, produced more oil than all the rest of the world combined.

The oil from the different parts of the United States varies much in character and grade. That from Pennsylvania, New York, West Virginia and southeastern Ohio, known as "Pennsylvania Oil," is considered best for making illuminating products, and brings the highest price on the market. The "Lima Oil" from the Trenton rocks of northwestern Ohio and northeastern Indiana ranks second in grade. Like the Pennsylvania oil, it possesses a paraffine base, but contains a certain percentage of sulphur, not found in the former, and for that reason is more expensive to refine. The oils of Kansas, Colorado and Corsicana, Texas, have also a paraffine base, and rank about equal with the Lima oil in value. Most of the petroleum produced in Louisiana, Texas and California has an asphaltum base, and consequently yields an illuminating oil of low value. It is used largely for fuel and brings a much lower price per barrel than the oils with a paraffine base.

While the increase in petroleum production in the United States in 1902 was 11,505,396 barrels, the great percentage of gain was in the low grade oils of California and Texas. The high grade Pennsylvania product decreased 1,646,651 barrels, while the medium grade Lima output increased 1,425,247 barrels, all of which came from new developments in Indiana. During that year the accumulated stocks of Pennsylvania and Lima oils were decreased 4,175,173 barrels. In other words, the supply of high and medium grade oils throughout the year averaged 11,000 barrels a day less than the demand. For that reason the price rose gradually in 1902, and again in 1903, when the shipments of Lima oil exceeded the output of the wells by 3,780,288 barrels. At the present writing it is the opinions of experienced oil operators that the price of the better grades of crude petroleum will not soon, if ever, fall below the dollar mark. The prospects for any increased output of the paraffine oil production of the United States are being gradually narrowed down each succeeding year. At the same time there has been a constant increase in the demand

for all classes of products that are manufactured from the higher grades of petroleum, with no indications of any immediate change.

USES OF PETROLEUM.—The average person has but little knowledge of the many uses to which crude petroleum is put or of the variety of products made from it in the great refineries. The most important and best known of these products is, of course, the illuminating oil known as kerosene, or "coal oil." This oil has become one of the greatest adjuncts of modern civilization; in fact, such a necessity of daily life that millions of inhabitants of this and other lands would find it difficult to do without. Besides kerosene, all the gasoline, benzine and naphtha of commerce come over as distillates from the crude petroleum. Among the solid products are vaseline, used so extensively as an external application, and paraffine, the candles of which have almost wholly superseded the old tallow "dip." Much paraffine is also used in making matches; as a preservative for eggs and various food stuffs; in laundry work as an auxiliary to soap, and for many other purposes. Rhigolene, a volatile product of crude petroleum, is a valuable anæsthetic, particularly for local application to produce cold.

Both petroleum products and crude petroleum are much used in the manufacture of artificial gas. In the making of "air gas," or carburetted air, gasoline is needed, while for "oil gas" and carburetted water gas crude petroleum is used, the liquid hydrocarbons of the oils being converted into permanent gas of high illuminating power. The crude petroleum is also often used for the enriching of coal gas., i. e., for making it of higher illuminating power.

Mineral oils from petroleum and the crude product itself are now almost wholly used for lubricating machinery, especially railway engines. As noted above, the poorer grades of crude petroleum, especially those with an asphaltum base, are extensively used as fuel.

In the words of the superintendent of one of the leading refineries of the country: "Practically nothing is now allowed to go to waste. Our by-products are really more valuable than the refined oil itself. Benzine and gasoline, which were formerly not considered by us, are now very valuable commodities. The coke which results from the burning of crude oil was formerly dumped into the river; now it is used in the manufacture of the carbons

for electric lights, and we can not get enough of it. The vapors arising from the oil are condensed and recondensed, and are added to our list of by-products. In fact, nothing is permitted to get away which can, in any manner, shape or form, be utilized, and this is ascertained by our chemists and inventive men.

"There is not a thing designed or invented that will aid us either in our manner of refining the oil, or in effecting a saving so that we can utilize what was formerly wasted, that we do not have in our refineries. The changes that have taken place in the last ten or fifteen years are simply wonderful. Take refined oil, for instance. Many of our people can easily recall when it was almost as yellow as saffron; now it is as clear as crystal, and has been refined to such a degree that not a drop of it need be wasted. Our oils are used in soaps, perfumes, liniments, vaseline, and in so many different ways that I have neither the time nor the inclination to try to define their varied uses."

Petroleum in commercial quantities was first produced in Indiana in 1889, in a well put down by the Northern Indiana Oil Company, on the D. A. Bryson farm, near Keystone, Chester township, Wells County. From that date until January 1, 1904, the industry has gradually grown, until it has become one of the greatest in the State. From 33,375 barrels, valued at \$10,881, in 1889, the output has increased to 9,177,722 barrels, valued at \$10,476,369, in 1903. That the yearly output depends largely upon the price, and not upon the capacity of the field, is shown by the fact that the years 1897 and 1898 were the only ones, since the striking of oil in the State, in which the production fell off, and during those years the price was low, ranging only between 40 and 60 cents per barrel. Since 1898 there has been, for the most part, an upward tendency in price, and as a result the output has nearly trebled.

Petroleum in commercial quantities has been found in three distinct geological formations in Indiana, viz., the Trenton limestone of the Lower Silurian Age; the Corniferous limestone of the Devonian Age, and the Huron sandstone of the Sub-Carboniferous Age. It is, however, from the Trenton limestone that the great bulk of the crude petroleum of the State is produced. Each of these formations will now be taken up in order and its petroleum output treated.

TRENTON ROCK PETROLEUM.

FORMATION OF THE TRENTON LIMESTONE.—The Trenton limestone is one of the lower or older formations of the Lower Silurian System. Like other limestones, it owes its origin mainly to the presence of minute organisms in the water in which it was first laid down. The animals from whose remains the oil of the Trenton limestone was, for the most part, derived, were probably very low forms—the polyps and bryozoans of the ancient Silurian seas. In untold numbers they existed, and the carbonate of lime which makes up 80 per cent. of the unmodified Trenton rock is largely the remains of their secretions and incrustations. Associated with these lower forms were myriads of higher ones—crinoids, brachiopods, trilobites, gastropods, and even fishes. The presence of such swarms of animal life made necessary the existence of an abundance of plants, since the plant must ever precede the animal and gather for the latter the energy, and form for it the food, the living protoplasm, necessary to its existence. These plants were mostly marine algæ, or seaweeds and fucoids, though doubtless many other forms existed of which no remains have been preserved in the rocks of that age.

The Trenton limestones were evidently formed in rather clear water, at moderate depths. Near the bottoms of these shallow seas great beds of calcareous sediment were gradually collected, and were swept to and fro by the tides and currents. Rivers from the older Cambrian rocks brought down their eroded particles and added to the thickness of the ocean floor. Within these beds of sediment both plants and animals found a grave, their bodies in vast numbers being buried beneath the slowly accumulating deposits of centuries. Once buried in such deposits, they did not decay, as do animals on land, because by the waters above and the calcareous ooze around them they were shut off from free oxygen, which is the chief agent in decay. Gradually this ooze or fine sediment was, by the agency of the sea water, cemented and consolidated into limestone. In this manner that great layer of Trenton rock, which underlies at variable depths the whole of Indiana, was formed. From it has been derived, directly or indirectly, more wealth than from any other formation either underlying or forming a portion of the surface of our State.

ORIGIN OF PETROLEUM.—In time the waters of the ocean containing this vast stratum of Trenton limestone, with its enclosed accumulation of undecayed plants and animals, became turbid, and, instead of calcareous sediment, deposited mud and clayey sediment in thick beds on top of the limestone strata. These deposits of mud and silt were afterward, by later deposits, compressed into the fine grained, impervious Utica shale, 100 to 300 feet in thickness, which thus effectually sealed the Trenton limestones, and so retained within them the oil and gas derived from their enclosed organic remains. This oil and its more volatile portion, the natural gas, was probably not formed in a short time, but is the result of a slow decomposition or destructive distillation carried on through thousands of centuries. Accumulating in vast reservoirs, the more porous portions of the Trenton limestone, or mother rock, it there remained until man came with his iron drill and furnished a vent through which it could rise. Then by combustion he caused it to yield up the stored energy, conserved since the sun's rays fell on the plants of the old Silurian seas.

ORIGIN OF NATURAL GAS.—From what has been said, it will be seen that both natural gas and oil have a common origin, viz., the destructive distillation, carried on through thousands of years, of the plants and animals which existed in the Trenton Period. It is a well known fact that if wood, coal or the body of any animal be placed in an air-tight retort and heated, a distillation will occur, and the object will be changed to gaseous, oily and solid matters. In the absence of heat and air a very long period of time will bring about the same results. By this is meant the process of "slow destructive distillation" above mentioned. The primary product of such distillation was probably a light oil, which in the course of ages has, by volatilization, yielded the gas, and has itself been condensed into the heavier petroleum. The gas being lighter and more volatile than the oil, gradually rose into the higher interstices of the limestone. If an open barrel be filled with crude petroleum from the Trenton limestone of Indiana and exposed for a single summer to the air, more than half of the contents will pass away in the form of a vapor, and a sticky, tar-like residue will remain. If by some means the escaping vapor could be collected and analyzed it would be found in the main to have the same composition as natural gas. In fact, it would be natural gas, and

would burn as freely as a sample of that valuable fuel, collected in the ordinary way. In the depths of the rock the evaporation of the oil has been extremely slow, and the amount has been limited both by the varying pressure of the overlying gas and the underlying water. There is little doubt, however, but that all the natural gas of the Trenton limestone has been so derived.

DISTRIBUTION OF PETROLEUM IN THE TRENTON LIMESTONE.—

Not only Trenton limestones, but every other limestone, as well as most shales, have in the past produced petroleum in greater or less quantities. Distributed in minute proportions through the substances of the rocks, it easily escapes notice, but when intelligently looked for its presence is revealed, and, though the percentage is small, the aggregate is often vast. If, for example, a stratum carries but one-tenth of one per cent. of petroleum and is 500 feet in thickness, it contains more than 2,500,000 barrels to the square mile. Indeed, so common is the occurrence of petroleum in stratified rocks that wherever a close-grained shale occurs there is almost always a small accumulation of oil directly underneath it. The same thing is found when an impervious stratum of any other composition than shale occurs in the geological series.

If petroleum has been thus generally formed throughout the Trenton limestone, why do not all parts of that formation yield it in somewhat equal amounts? Why is it that a bore that pierces the Trenton in one locality is a "dry hole," while another, but a short distance away, results in a "hundred-barrel" well? The answer to such questions lies in the fact that the formation of large accumulations of oil depends as much upon the presence of suitable strata to receive and retain them as upon an adequate source of supply. In the minutely diffused state in which the oil was originally formed it was wholly without value. Like all other forms of mineral wealth, it had to be concentrated into reservoirs, the so-called "pools" of the oil field, before it could be utilized by man. The thousands of bores put down to the Trenton limestone for oil and gas in both Ohio and Indiana have proven that four conditions are necessary before an accumulation and preservation of oil in commercial quantities can take place. If any one of these conditions is absent, a dry hole or salt water well will invariably result. These necessary conditions are:

1. A porous stratum of the Trenton rock to form a reservoir.

2. An impervious cover above the reservoir.
3. An arched or anticlinal structure of the rock in which the reservoir is located.
4. A pressure behind the oil to force it into the reservoir.

1. *The Porous Portions of Trenton Limestone.*—We have seen that the Trenton limestone is a sedimentary rock; i. e., one which was laid down in water, the bottom of the sea, ages ago. When first formed it was a nearly pure calcium carbonate or carbonate of lime. In the course of time certain areas of the sea bottom, covered with the incipient limestone, were slowly raised until they became higher than the others, and formed shallow basins, lagoons or bays. Some of these raised portions covered very large areas. Others were isolated or separated from the main area by a distance of one to 30 miles. The outline of all was irregular, with many indentations along the margins. In these more shallow portions of the Silurian seas the water became in time very briny and caused a chemical change in the rock. To the lime carbonate was added some magnesia from the brine, and a magnesia-lime carbonate called "dolomite" resulted. Wherever this change took place, which was only in the shallow, briny areas noted, the resulting dolomite was porous. This porous condition was due to the fact that the new crystals of dolomite were smaller than, and never entirely filled the spaces occupied by, the older crystals of lime carbonate. *The larger areas of the Trenton limestone deposit beneath the present bounds of Indiana were either too impure to admit of a change into dolomite, or the conditions of sea level were never such that the change took place; hence they are nonporous and barren of either oil or gas.*

Even in rich oil fields the porous dolomite has only been formed in a small proportion of the thickness of the Trenton rock. Usually two or more "pay streaks" or porous strata are found in the upper 70 feet of the Trenton. The upper one of these has a thickness of 3 to 10, or sometimes 15 feet, and usually occurs within 30 feet of the top of the Trenton. If the level of the Trenton is low at the point where the bore is put down, the upper streak is often lacking. The second porous stratum, usually the most productive, lies about 15 to 20 feet below the first and is separated from it by a bed of unchanged, nonporous limestone. This alternation of dolomite and limestone strata is probably due to changes in the

sea levels at the time the limestone was being transformed into dolomite. Wherever the Trenton limestone assumes its normal character and ceases to be dolomitic, it ceases also to be oil-bearing. The change from an area containing porous rock into one wholly lacking it, is often abrupt. It is only the former which contains the oil, and there is no known method, except by drilling, of determining where the porous rock occurs.

2. *The Impervious Cover.*—In order to properly retain the accumulated petroleum the porous rock must be entirely covered with an impervious stratum, i. e., one through which neither oil nor its volatile gas will pass or can be forced by the enormous pressure behind it. Such a cover is usually a fine-grained shale, and wherever such a stratum covers a porous rock, petroleum in greater or less quantities is usually found. In the Indiana oil field the Trenton rock is covered by an average thickness of 250 feet of that dark brown, close-grained deposit known as the Utica shale, which possesses every quality of a typical impervious cover. The driller recognizes this stratum as soon as he strikes it by its color, its comparative freedom from fossils, and the ease with which it is drilled and mixed with water. No free oil is found in the Utica shale, though by distilling portions of it an amount equal to three per cent. of the shale* has been obtained.

3. *The Anticlinal Structure.*—The surface of the Trenton limestone is not level as many people suppose, but, like the surface of the earth, is a series of alternating arches and depressions or ridges and valleys. The arches or domes are like inverted troughs and vary much in width and area, as do also the depressions between them. Wherever gas and oil occur they will be found in a porous stratum in one of the arches or *anticlines*, as they are called. If a bore happens to be put down and strikes a depression or *syncline* between the arches, salt water will invariably be found. If both gas and oil are present in a certain area, and the bore strikes the flank or side of the arch, oil will result. If the bore strikes the crest or dome of the arch, gas will flow. The cause of this is simple, being due to the arrangement of the three fluids according to their relative weights. When the oil was first formed, it was pushed or carried hither and thither by the heavier salt water be-

*Dana, Manual of Geology, 4th Ed., 522.

hind it. Much of it was carried away by the water and lost, but wherever one of the porous areas existed in the side or top of an anticline, the oil was carried into it and there remained. During the ages which have elapsed much of the oil was changed into a volatile gas, which rose into the higher porous portions of the anticlines or ridges of the Trenton limestone. As this gas accumulated, it pressed back the remaining oil into the sides or flanks of the arch. The oil being lighter than the water, rested upon the latter and prevented it from rising into the higher porous portions of the limestone. When a bore is put down and strikes gas the latter will flow until the quantity which is stored in the porous area of the anticline is exhausted, when the oil, if any be present on the flanks or lower portions of the porous stratum, will rise in the gas well. It may be that the oil has been carried by the salt water into the porous portions of another anticline, and that only salt water occurs beneath the gas. If this be true, the water will fill the porous reservoir as soon as the gas is exhausted. The anticlines vary much in size, their domes running from scores of miles down to a half mile or less in width. The gas in the higher part of each anticline is, therefore, often shut off from that in a neighboring anticline by the intervening oil or water, or both. In the same way the oil in an anticline which contains oil only may be shut off from that in another anticline by the salt water filling all the porous portions of the syncline between. It often happens that a gas bore is put down which strikes the crest of a narrow anticline or raised portion of Trenton limestone which has not before been pierced. As a result the so-called rock pressure of the gas is at first high, but rapidly declines on account of the small size of the anticline. All the wider and higher anticlines in the main gas field in Indiana in which porous Trenton occurs, have been pierced many times, and the stored gaseous product has become almost exhausted.

In the Indiana oil field the production of a new well can usually be foretold by the depth at which the top of Trenton rock is found. If it is from five to ten feet higher than the average in the nearby productive wells, the chances are that it will yield much gas and little oil. On the other hand, if the Trenton is struck ten to fifteen feet lower than the average, the bore has pierced a trough or syncline, and a salt water well usually results. Sometimes, how-

ever, there are apparent exceptions. Of two wells in which the Trenton is found at the same depth, one will be a "gusher," and the other, but a short distance away, a "dry hole." The only explanation which can be given in such a case is that the latter has pierced a close-grained or nonporous area of the Trenton, into which no fluid has found its way.

4. *The Pressure Behind the Oil.*—Whenever the drill pierces a stratum of porous rock containing oil, the latter is pushed upward by the so-called "rock pressure" behind it. Sometimes this pressure is so great that when the oil stratum is reached the boring tools are expelled from the drill hole, and the oil escapes in a fountain, rising high above the derrick, much of it being lost before the flow can be controlled. In most instances, even if the well proves to be one of small production, the oil is forced upward several hundred feet in the drill hole. As noted above, this rock pressure has, in the past, had much to do with the accumulation of oil in the porous reservoirs.

It is now almost universally admitted that the rock pressure in any oil field is nothing more or less than water pressure, as in artesian wells, the water entering the Trenton limestone at some point where the latter outcrops and so forming a head or source. Hence, the deeper the well, the greater the head of water and the higher the rock pressure. The porous rock contains a limited amount of oil, held in place by the overlying shale. The salt water is below this oil, ever pressing it upward into the vent furnished by the drill hole. As the supply of oil is gradually lessened, the water rises to fill the pores, and the rock pressure is lowered. The pressure does not tell us anything about the volume or amount of oil stored in the rock; but the rate of diminution of pressure furnishes an excellent index of the rapidity with which that amount is being lessened. When the supply of oil is exhausted, as it naturally will be in time, there is no source from which it can be renewed. The salt water will rise and occupy the space which formerly held the oil and it will come to stay.

Salt water also occurs in the Trenton rock in all portions of the Indiana field. Usually a difference of only six to ten feet in the elevation or depression of the surface of Trenton defines oil and salt water territory. If the well has been located over a syncline, or trough, in the Trenton, salt water is apt to be found before the

drilling has proceeded very far into that formation, and a well yielding only salt water usually results. If, however, the bore pierces the dome or flank of an anticline, either gas or oil will be struck, and the operator is usually careful to see that the drilling is stopped before the level of the water producing rock is reached.

In some cases, however, both water and oil are found together in the same stratum. Some of the best wells in the Indiana field are big salt water wells, pumping from 150 to 700, or even more, barrels of salt water, and 40 to 150 barrels of oil daily. It costs much more to operate a well of this kind, as it has to be pumped with a beam and, therefore, requires a separate power. Such wells

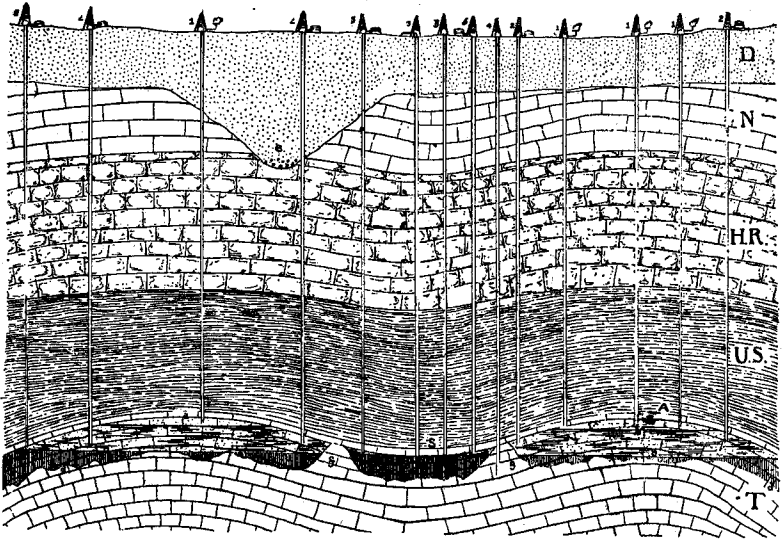


Fig. 1. D., Drift. N., Niagara limestone. H. R., Hudson River limestone. U. S., Utica shale. T., Trenton limestone. A., anticline. S., syncline. a to b, gas bearing stratum. b to c, oil bearing stratum. c to d, water bearing stratum of porous rock. e, preglacial channel through Niagara limestone. f, non-porous Trenton limestone.

Wells, Nos. 1 produce gas; Nos. 2, oil; Nos. 3, salt water; No. 4, dry hole; Nos. 5, oil and salt water.

are usually longer lived, as the salt water seems to renew the quantity of oil by bringing it in from quite an area of the porous stratum which the bore has pierced. Moreover, the salt water seems to keep the pores of the oil rock free from paraffine and other materials which have a tendency to clog them up, and a well producing four or five barrels of water a day in connection with the oil, is preferred by many operators to one that produces oil alone.

The accompanying illustration (Fig. 1) will probably lead to a better understanding of the above mentioned facts regarding the accumulation and preservation of petroleum in the "Trenton rock" fields of Indiana.

NECESSITY OF ACCURATE SURFACE LEVELS.—The trend, width and dip of the anticlines and synclines in the top of the Trenton limestone in any locality can only be ascertained by an accurate determination of the surface levels between a number of wells. Where a bore for petroleum has resulted in a good producing well, the level of the surface of the Trenton rock below tide should be carefully ascertained. This can be done only by running a transit level from the nearest point where the surface level is known, usually on a railway, to the site of the bore. By subtracting the surface level of the bore from the depth at which Trenton limestone is first struck, the surface level of the latter will be obtained. In but a few places in the State is the top of Trenton found above sea level. Where so found the depth to Trenton will be less than the surface level of the bore, and should be subtracted accordingly.

For example, the surface level at one point (*a*) near Hartford City is 894 feet above tide and the depth to top of Trenton 969 feet. The latter is, therefore, 75 feet below sea level. At another point (*b*), a short distance away, the surface level of the bore is 890 feet and the depth to Trenton 968 feet. At this bore the top of Trenton is therefore, 78 feet below tide, or three feet lower than at (*a*). The dip of the Trenton is, therefore, from *a* to *b*. The bore at *a* yielded much oil; that at *b* much salt water and little oil.

The location of the first half-dozen or so wells in any area a mile or two square must of necessity be largely a matter of guesswork, but if the surface level of the Trenton in each bore, productive or dry, be carefully ascertained, the trend of the anticline and the approximate limits of the field or pool can be soon determined. Too much guesswork concerning the surface level of the spot on which the well is located has been done in the past. In a broken country it is difficult for any man to guess approximately at the relative levels of two points a quarter of a mile apart, and the new level should always be ascertained with instruments. Of course the surface level of the bore has nothing to do with the absolute

height or surface level of the Trenton, or the absence or presence of the petroleum, but it has a great deal to do with the *accurate determination* of the surface level of the Trenton; and therefore with the location of future wells. If a few thousand dollars had been spent in Indiana in past days in the careful determination of surface levels, it would have saved a few hundred thousand which have been sunk in dry holes.

POOLS NOT NECESSARILY CONNECTED.—A fallacy which is held by many would-be operators in the Indiana field is, that oil fields or pools run in lines, and that one field is connected with all others, the oil flowing from one to the other through a continuous strip of porous rock. This may in part be true in the Pennsylvania oil regions, but it is wholly untrue in the Trenton limestone area of Ohio and Indiana. While all the so-called "pools" of that area are found in the anticlines in the Trenton formation, they are not necessarily connected, nor do the anticlines run in straight lines. From what has been said about the origin of the porous areas of the Trenton limestone, it will be seen that a pool may be of any shape, and may lie in any direction from any other pool. Its boundaries may be straight or sinuous; its area one square yard or one thousand square miles. If the conditions necessary for the storing of petroleum, namely, a porous reservoir, located in the flank or dome of an anticline of the Trenton limestone, with an impervious cover above it and a water pressure below it, have been present in the past, the oil will very likely be found, whatever the shape, size or relative location as to other similar reservoirs. If any one of these conditions is lacking or has been lacking, the bore is sure to be a dry hole. Inasmuch as the top of the Trenton limestone in the main Indiana field is everywhere from 700 to 1,100 feet below the surface, it will be seen that the problem of locating in advance a paying well is a most difficult one.

CONDEMNED TERRITORY.—During the first few years of drilling for oil in Indiana much territory was needlessly condemned by isolated bores which were dry or very small producers. The average operator, then, as now, was in search of "gushers" or big wells, and turned down in disgust any territory where wells came in for less than ten barrels. With but little knowledge of the conditions governing the accumulation of oil it was thought that a dry hole condemned a square mile or more of the area about it. Experience,

gained by the sinking of thousands of bores, has, however, proven that "one well is a test for but one location," that is, for an area of but a few acres about the bore. As a result, much of the condemned territory has been redrilled, and, in most instances, good producing wells have been developed where at one time it was thought no oil existed.

When oil was but 40 to 60 cents a barrel it did not pay to pump wells which averaged only three barrels a day. Now that the price has risen to \$1.30, wells which yield but one barrel are pumped with profit, provided a number of them are operated by a single power. In a number of places leases have been abandoned as non-productive or as not paying the cost of operating, and have since been taken up by new parties and found to be very productive.

Examples of such leases are near Montpelier, Blackford County, where in section 3 Harrison township, the Baltus Oil Co. is operating a lease on which nine small wells had been drilled and abandoned up to 1900. In 1903, three new wells were drilled which averaged 30 barrels each at the start. On the Miller lease just north of Montpelier, four wells were pulled out in 1899 and the lease abandoned. It was retaken and three new bores sunk in 1903, all of which are fair producers. Still a third example is that of the Penrod and Hart leases in section 19, Washington township, Blackford County. These were held for some time by the Fort Wayne Gas Co., but only small producers were obtained and the leases and power house were finally sold for \$350 to Miller & Davenport, of Bluffton. The new owners, at a cost of \$1,400, put down a well on the Penrod farm which made two tanks of oil in 14 days. This brought \$356, or more than the original cost of the property, and they then sold the leases and well for \$15,000, after owning it but 42 days. The last owners have sunk two additional paying bores, and are well pleased with the property. These are but three examples of scores that could be given. They go to show that the operator in the Indiana oil field is taking chances with every bore he sinks. He has no way of knowing beforehand what the results will be. He may pierce the center of a reservoir and get a 300 barrel well; he may strike near its outer rim and get a 10 barrel well; he may miss it altogether and get a dry hole. One thing he can rely upon if he strikes a productive well, and that is, that he is drawing upon a stored product which is not now

being formed in the rock from which it is drawn, and that, therefore, he must eventually exhaust the stock of oil from the immediate vicinity of his bore.

SURFACE INDICATIONS OF OIL.—Scarcely a day passes but that I am in receipt of a letter asking me to come to some point in Indiana and locate a well which will produce oil; or stating that bubbles of gas are continually escaping from some pond, spring or stream; or that a scum of oil occurs upon the surface of some body of water. The writers of these letters evidently believe that I possess a knowledge of the surface which will indicate where paying wells can be located, or that such bubbles or scum are certain indications of the presence of gas or oil in paying quantities. If they possess either or both of these suppositions they are woefully mistaken, for in Indiana *there are absolutely no surface indications which denote the presence of either gas or oil in paying quantities in the underlying rocks.* The conditions are such that no man on earth can, with certainty, locate in advance a productive well in any portion of the Indiana field. Gas and oil are found in commercial quantities in the State only at depths ranging from 500 to 1,600 feet below the surface.* Between the formations containing the gas and oil, namely, the Trenton and Corniferous limestones and the Huron sandstone, there are always one or more close-grained shales 50 to 300 feet in thickness. These shales are wholly impervious to both gas and oil; i. e., no particle of either of these fluids can find its way through them. In fact, such a shale is an absolute necessity to the presence of a commercial body of either gas or oil, else both of these would have long since found their way upward into the atmosphere. The bubbles of gas, noted as escaping from water, are, in almost every instance, marsh gas, which is formed by decaying organic matter at the bottom of the water, or in some deposit of carbonaceous material near by. The oil has exuded in minute quantities from some shale, clay, limestone or sandstone, as all such rocks contain some oil. But a drop or two is necessary to form many square feet of film or scum over the surface of a spring or pool. In many instances the supposed oil on the surface of a spring is not oil, but a brownish yellow precipitate of iron oxide.

*The Jasper County field is an exception to this, a heavy form of oil being there found in the Corniferous limestone at 100 to 120 feet below the surface. However, a shale impervious to the oil lies between it and the surface.

Again, the oil producing rocks in Indiana follow no definite direction, as in some other States. There is no northwest-southeast, or northeast-southwest axis or trend which the intelligent operator can follow and sink a productive bore 99 times out of a hundred. His operations in Indiana have always an element of chance connected with them. If he keeps well within the bounds of productive territory his chances of failure are much fewer than if wildecutting on the outside of such limits. But on the best area of known productive territory an occasional bore will come in dry.

OIL SMELLERS AND OIL FINDERS.—The man with the "hazel rod," the "magnetic finder," and other forms of instruments which can locate oil a thousand feet below the surface is still in existence—still invades our State and catches suckers by the score. He is usually a fair guesser who knows enough to keep inside the limits of known producing territory. There, by chance, six wells out of ten which he locates come in as fair producers and from them he gains a prestige which enables him to land more of the innocent and unwary.

One of these so-called oil wizards has been operating extensively in Indiana during the winter of 1903-'04. He is fathered by a Chicago firm which advertises stock for sale and promises to guarantee the finding of oil to all who will invest. The inventor and handler of the instrument sent out by the company says that it is electro-magnetic in character, and that no one can successfully operate it but himself. According to his belief, all oil flows in streams which are continuous from one State to another and also from one geological formation to another. With this instrument he claims that he can locate these "oil streams" wherever he goes, whether on railway train, on horseback, or afoot. Thirty-five or more of such streams enter Indiana, mostly from the northwest, etc., etc.

It is strange that in an enlightened age like the present such claims and opinions should find credence, and that a company making such pretenses should be able to sell its stock, yet many believe, a number invest, but how many ever have or ever will realize one penny on the investment? There is one instrument and but one that can be used in locating oil in Indiana and that is the *drill*. All others are and ever will be humbugs; and all men who claim to be able to locate oil in commercial quantities by hazel

rods, instruments or what not, are either harmless innocents or fakirs of high degree. The man sent out by the Chicago company above mentioned evidently believes in his instrument and can be classed with the "innocents;" but the company back of him, which guarantees to find oil and pay its investors a handsome profit, is evidently composed of men who take advantage of his innocence to fleece the unwary.

FAKE OIL COMPANIES.—During the year 1903 most of the fake oil companies which came into existence with the discovery of oil at Beaumont, Texas, went to the wall. They reached the acme of their growth and income in 1902 and during the next year gradually dwindled and died. Not one out of a hundred ever paid back a small percentage of the amount invested. The highway robber who takes the money of his victim at the point of a gun is an honest man in comparison with some of these barefaced scoundrels who fleeced victims of high and low degree with the glittering advertising sheets and stock certificates of their mushroom oil companies. In Indiana alone hundreds of thousands of dollars went into the coffers of these fake companies which had their headquarters in Chicago, in Cleveland, and even in Indianapolis. Adams & Sarber, of Cleveland, were at the head of several of these fake companies. This firm failed in June, 1903, with liabilities of \$309,792. Their books showed that the income from the stock sold in October, 1902, was \$149,709; in November, \$156,424; December, \$83,601; January, \$113,322; February, \$113,131; and March, \$85,931, or a total for the six months of \$702,118, all taken from the pockets of the gullible, and much of it doubtless representing the savings of years.

A large amount of Indiana capital went into the hands of promoters who claimed to operate at Beaumont, Texas. This is lost, even to a penny, as the conditions there existing were at no time such that operations could be carried on with profit, even had honest men been at the head of the company. The Oil Investor's Journal, in speaking of these conditions, says: "Sometimes the failure to obtain revenue from properties has been the result of bad management, sometimes the extraordinary conditions that have arisen on Spindle Top from time to time have prevented the realization of profits, but at the bottom of the whole matter is the unheard of price which most of the companies paid for their prop-

erty. Such figures as those obtained for Spindle Top acreage—and fractional acreage—up to a few months ago, could only prevail where there was some inducement beyond the producing and selling of oil. This inducement was the demand for property for promotion purposes. The promoters felt the pulse of the investing public and with trained faculties for perceiving the heart's desire of this same public, discovered that *what the people wanted was Beaumont oil stock.*

“Without previous experience they went into the field, bought their little piece of proven land, let a contract for a ‘guaranteed gusher’ and went to work selling stock.

“The ‘oil business’ on a thirty-second or a sixty-fourth of an acre, even in the Beaumont field with its marvelous production per well, was a speculative experiment, with the odds very heavily against the speculator. The promoter seldom took any chances, but allowed the purchasers of the stock to enjoy the excitement of taking all the risks.

“Those who bought freely of the stocks of these thirty-second-of-an-acre companies are now realizing the difficulties of conducting a successful oil business on a piece of land about the size of the small front yard which goes with a six-room dwelling in a crowded city. It was possible, when the wells first quit gushing, to operate these wells on small lots by compressed air or steam-heads. Compressed air is about played out at Beaumont and steam-heads are giving way to walking-beams, and now the little fellows find they haven't room on the property for a walking-beam outfit.”

A number of fake companies were organized to operate in the Jasper County and other Indiana fields and some of them are yet in existence. Their available assets consist of little more than a superb allowance of gall; leases on a few hundred acres of supposed oil territory and a hundred or two dollars invested in prospectuses and stock certificates. All persons are warned against investing any money in any company having stock for sale which claims to operate in Jasper County or vicinity. All holdings of importance in that field, which are yielding any oil of consequence, are owned by the Federal Oil and Asphaltum Company, of London, England, which is a responsible company, but which has no stock on the market. A few other companies whose responsibility is unquestioned are also operating there on a small scale, but they

have no stock for sale. The whole Jasper County field, at the present rate of production, will not yield in 20 years, what a single one of the fake companies offers to produce in one year. Better it would be for the person who has money to invest, to buy grass seed and scatter it abroad for the sparrows, than to invest in the stock of these or other similar companies. The assurance of some kind of returns from the investment would be infinitely greater.

I would go farther, and say do not invest money in the stock of any oil company unless you are well acquainted with the promoters and know them to be honest men who are experienced oil operators. However, if the speculative tendency is too strong to be withstood, either go into the field personally, or send some one in whom you have implicit confidence and investigate the holdings of the company whose stock you are thinking of buying. By so doing you will lessen the profits, as well as the number of such fake companies as we have mentioned. The oil business is a big enough gamble within itself—that is, the risks of losing in the legitimate companies are great enough—without taking a thousand-to-one shot in the stock certificates of those get-rich-quick concerns whose members do not know a walking-beam from a derrick. In investing in oil stock, or anything else, it never pays to “buy a pig in a poke.”

SHALLOW BORES IN CENTRAL-SOUTHERN AND WESTERN INDIANA.—Investigations carried on during recent years in the central-southern and western portions of Indiana and records of many bores which have been sunk in those regions, have led me to believe that the majority of the drill holes sunk therein in search of gas and oil failed to reach Trenton limestone, the rock formation which produces the most of the gas and oil in this State. This failure to sink the bores deep enough was due to several causes, chief among which is the great difference in the strata overlying the Trenton limestone in those portions of the State from those overlying the same formation in the main gas and oil-producing areas. In the latter areas the Niagara limestone of the upper Silurian age and the Hudson River limestones and the Utica shale of the Lower Silurian, are the only formations to be pierced by the drill between the drift or surface and the oil and gas-bearing Trenton. In the central-southern and western portions, especially the latter, a number of formations which are wholly absent in the

main gas and oil field, intervene between the surface and the top of the Niagara limestone. The drillers employed during the gas and oil excitement of 1887 to 1895 to sink the bores in these regions were, for the most part, from the gas fields. Their knowledge of geology was small, and in many instances, after passing through a shale which resembled the Utica, and which they doubtless thought was that formation, they called the underlying rock "Trenton limestone," and soon abandoned the bore as barren. The shales which they had pierced may have been any one of a half-dozen carboniferous shales, or, what is more likely, the black Genesee shale, no one of which occurs in the main gas field.

Again, strong flowing veins of salt water were struck in a number of the bores, and the local companies, whose members were paying for the drilling, became alarmed at the extra cost necessary to case off such water, and often abandoned the bore before reaching Trenton. In a number of instances in the southwestern counties, the Carboniferous limestones and Huron sandstones which in places, as Loggootee, Birdseye, Terre Haute, etc., are oil and gas bearing, were not even reached, though they lie 900 to 1,400 feet above the Trenton. Wherever a bore was thus abandoned without reaching Trenton, all the money spent was wholly wasted, there being neither negative nor positive results. Moreover, much territory was condemned as non-productive without being given a fair test.

The foregoing statements are not made because I believe that gas or oil in paying quantities will eventually be found in the Trenton limestone of southern and western Indiana, for I have no reasons for such a belief. Neither have I reasons for believing the contrary. If the earlier bores had of a certainty reached Trenton and proven barren, then negative evidence would have been available. The one fact which I do wish to impress upon the citizens of the regions mentioned is that much of their territory has not been properly tested. Another and more important reason for the statement is to induce companies who sink future bores to see to it that nothing stops the drilling before Trenton limestone is reached, or, rather, before that formation has been pierced at least 100 feet. Beyond that depth there is little possibility of finding either gas or oil. A contracting driller of experience can easily and without great expense case off any salt water which may give

him trouble. An accurate record of the thickness of each formation passed through, together with a small vial of the drillings of each, will aid much in determining the horizon which the drill is piercing at any depth, and such record and samples should always be kept.

In contracting for the drilling of oil wells to the Trenton limestone in all parts of Indiana aside from the main field, a written contract should always be made with the driller to sink the bore a certain number of feet, with the privilege of stopping before the distance designated, if so desired, or of going beyond it at a certain stipulated price per foot. The contract should never be worded "to drill to Trenton rock" or "100 feet into Trenton rock," as a dispute is very likely to arise as to that formation. Inside the main field the different formations are well known, and the experienced driller knows within a few feet the distance at which the Trenton will be found. Outside that field, he is apt to be confused, especially if he has to pass through formations not represented in the main field, which he will have to do if the drilling is being done any distance to the south or west. If it is not possible for the parties who desire the drilling done to determine approximately the distance to Trenton limestone, information regarding that point can be obtained in this office. The distance to be drilled should always include 100 feet into the Trenton, as either gas or oil is likely to be found up to that depth. Bores in untested territory which are to be sunk 1,500 or more feet in depth should begin with holes at least 12 inches in diameter, so as to allow the insertion of several sizes of casing if necessity requires. Oftentimes in such bores a stream of water is struck unexpectedly, or a cave of shale or other soft rock occurs, making a new casing necessary. If the hole has been started too small, it often happens that no additional casing can be inserted. It then has to be abandoned or else reamed down, the latter being a tedious and expensive process. By beginning with a large opening there is often much saving of both time and expense.

THE MAIN TRENTON ROCK OIL FIELD OF INDIANA.

The area of Indiana at present producing Trenton rock petroleum in commercial quantities occupies a portion of nine counties northeast of the center of the State, viz.: Adams, Wells, Hunt-

ington, Grant, Blackford, Jay, Madison, Delaware and Randolph. As shown on the accompanying map, it may be said to comprise about 1,350 square miles, being included within an oblong strip of territory 52 miles long by about 26 miles wide, extending from the Ohio-Indiana State line. westward to the western limits of Liberty township, Grant County, and from Warren, Huntington County, south to Summitville, Madison County. This territory comprises all or a part of each of the following civil townships: Monroe, Blue Creek, Jefferson, Wabash and Hartford, Adams County; Nottingham, Chester, Jackson, Liberty and Harrison, Wells County; Salamonie, Jefferson and Wayne, Huntington County; Van Buren, Washington, Franklin, Center, Monroe, Mills, Jefferson, Fairmount and Liberty, Grant County; Washington, Harrison and Licking, Blackford County; Penn, Jackson, Bear Creek, Wabash, Knox, Miami and Wayne, Jay County; Monroe, Randolph County; Washington, Center and Liberty, Delaware County; Van Buren, Boone and Monroe, Madison County. Of these, Monroe Township, Randolph County, and Center and Liberty townships, Delaware County, lie some distance outside the main field, but it is probable that in a year or two they will be connected with it by the finding of productive territory in the intervening area. Aside from this main field, Trenton rock oil is produced in limited commercial quantities in small areas in Allen, Wabash, Miami, Hancock and Marion counties.

The surface of the main area now yielding Trenton rock oil in Indiana was originally one great plain, with only occasional small undulations to break its monotony. This plain has been eroded in many places by the streams, which in the past have been much larger than at present. Wherever bluffs or hills are found they are but the results of such erosion. But few outcrops of rock occur within the oil field, and they are found only along the streams, where the water has eroded deep channels through the drift and boulder clay, everywhere covering the oil territory to a depth of from 50 to 250 feet. These outcrops belong to the Niagara group of the Upper Silurian Period.

The formations passed through by the drill in all parts of the field before the Trenton limestone is reached are, therefore, as follows: Drift, Niagara limestone, Hudson River limestone, Utica shale. In the eastern half of the field an average section, show-

ing the thickness of each formation passed through would be about as follows:

1. Drift	125 feet
2. Niagara limestone	150 feet
3. Hudson River limestone.....	425 feet
4. Utica shale	300 feet

In the western portion of the field the average bore shows:

1. Drift	175 feet
2. Niagara limestone	325 feet
3. Hudson River limestone	310 feet
4. Utica shale	200 feet

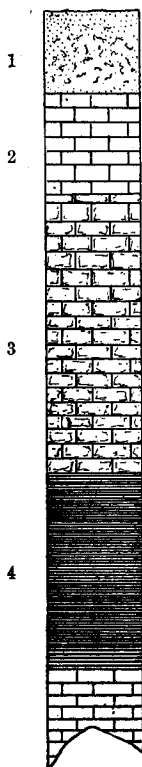


Fig. 2.
Eastern.

Throughout the Indiana field an eight or ten-inch drive pipe is forced down through the drift to the Niagara limestone. The fresh water usually found in the Niagara is cased off by an iron tube $5\frac{5}{8}$ or $6\frac{1}{4}$ inches in diameter, which reaches from the surface to the soft blue Hudson River limestone underlying the Niagara. This second limestone and the Utica shale beneath it contain no water. The Trenton is everywhere overlain with the soft, dark colored Utica shale which forms an impervious cover through which neither gas nor oil can escape. From the bottom of this shale the drill passes at once into the hard crust of the Trenton limestone. Two "pay streaks," or porous layers, are usually found in the Trenton, and it is only in them that oil occurs. The first or upper one is usually 15 to 25 feet below the top of the Trenton; the other is 15 to 25 feet below the bot-

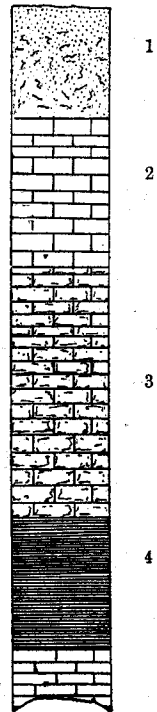


Fig. 3.
Western.

tom of the first. While the Trenton rock in Indiana varies in known thickness from 470 to 586 feet, the porous portions containing oil are usually found only in its upper fourth. It has for the

most part been found useless to drill into the Trenton more than 100 feet, since of the 20,000 and more bores which have been put down in the State but few have found oil or gas below that depth. Within the past year several bores have been sunk in Delaware County which have developed a pay streak at 260 to 300 feet below the top of Trenton. It may be possible that in limited areas such deep bores will prove productive, but this can only be ascertained by future drilling.

In the well records given on subsequent pages the length of the drive pipe represents the thickness of the drift. By subtracting the number of feet of drive pipe from the number of feet of casing the thickness of the Niagara limestone may be ascertained. The distance from the bottom of the casing to the top of Trenton represents the combined thicknesses of Hudson River limestones and shales and Utica shale. The driller calls both of these formations "shale," usually distinguishing them by the terms "blue" and "brown," or "black." The average operator and driller pays little attention to the names of the rock formations passed through, but can tell to an inch how much iron has been used in the bore. The records as given are practically the only ones kept in the field.

THE OIL MAP.—The accompanying map of the main Indiana oil field is the third issued by this Department in recent years. The first, showing the exact area tested up to January 1, 1897, was issued in the 1896 (21st) Report of this Department. The field then embraced but 400 square miles. This map, enlarged and modified so as to show the field as it was on January 1, 1901, was published in the 1900 (25th) Report. The area had then increased to 900 square miles. The third and present map brings the field up to January 1, 1904, and embodies an area of 1,350 square miles, not including a large portion of Madison, Delaware and Randolph counties, which were added to embrace the Parker-Selma pools. Comprised within this 1,350 square miles are many sections which are as yet non-productive, not having been fully tested, owing to the high gas pressure which still exists. Over much of this undrilled territory oil will eventually be found, and the seeming gaps now shown on the map will be obliterated.

During the year 1903 quite an area of producing territory was added to the field. This addition was not due to any notable strike, but to gradual development along the margins of known productive

territory, notably in Washington and Fairmount townships, Grant County; in Bear Creek and Wabash townships, Jay County, and in Blue Creek and Monroe townships, Adams County.

ADAMS COUNTY.

lies adjacent to the Ohio State Line and south of Allen, east of Wells and north of Jay counties. It is 24 miles in length from north to south, and 14 miles in breadth, comprising therefore an area of 336 square miles. The surface is comparatively level, but is well drained by the St. Mary's and its tributaries in the northern half, and the Wabash and its tributaries in the south. Three railways pass through the county—the G. R. & I., from north to south; the T., St. L. & W. (Clover Leaf), and the Chicago & Erie, from east to west—the three having a common junction point at Decatur, the county seat. The population of the county in 1900 was 22,232, as against 20,181 in 1890.

The elevations in feet above tide of the principal railway stations in the county are as follows: Berne, 849; Ceylon, 849; Curryville, 842; Decatur, 800; Geneva, 840; Monmouth, 788; Monroe, 822; Peterson, 817; Pleasant Mills, 799; Preble, 813.

Only the southern third of Adams County has as yet produced petroleum in commercial quantities. The townships of Hartford and Wabash, in the southwestern corner of the county, possess the oldest and best wells; while Jefferson, Blue Creek and Monroe have, in recent years, yielded quite a number of producers. During the year 1903, 317 bores were sunk for oil in the county, as against 291 in 1902. Of these, 30, or 9.4 per cent., were dry. The decrease in dry holes for the year was five, and the percentage of decrease, 2.6. The average initial output of the 287 productive wells was 15.1 barrels, as against 23 barrels in 1902.

Hartford Township.—The southern two-thirds of this township has in the past proven quite productive of oil. No territory of importance has been added to the producing area since the former map was issued. Test bores on the Shephard and Cusac leases, south half of section 16, sunk in 1903, came in as very light producers. The recent wells in sections 24 and 28 are to be classed as only fair, most of them coming in at 5 to 20 barrels each. The most successful operations in the township during the year were

on the J. A. Watson farm in section 34, where four wells, out of ten drilled, came in with an initial output of more than 100 barrels each.

Wabash Township—Quite an area of territory, marked as untested on the former map, has become productive during recent years. The southwest quarter of section 7 has a few fair wells to its credit, while the southeast quarter of 12, the west half of 13 and the east half of 14 have each a number of light producers.

The south half of 20 has yielded some good wells and the west half of 22 some light ones. The territory in section 30, just west of Geneva, formerly producing only salt water, is now fairly productive. The west half of section 32 now has a number of good wells within its limits, several of which came in with an output of between 60 and 125 barrels. The west halves of 33 and 35 are lightly productive, the remainder of the township being as formerly shown. The lobe, or "deep drive," passes from northeast to southwest diagonally across Wabash township, and has, up to the present, prevented drilling in a number of sections which will doubtless produce much oil in the future.

Jefferson Township.—This township comprises but 24 square miles of congressional township (25 N., 15 E.), the two eastern tiers of sections of the congressional township, being a part of Mercer County, Ohio. The first producing wells in the township were opened up in sections 19, 20, 29, 31 and 32, in 1900. Since then a number of fair to good wells have been drilled in other parts of the township, and its entire area will in time doubtless become productive.

In 1903 two good wells were completed on the Johnson lease in section 4, and lighter ones on the Miller and Hunzicker farms. A dry hole was finished on the Hill lease in section 9; and a test, but little better, on the Bedout farm, south half of 10. The south half of 15 yielded one or two fair wells, but those in the southeast quarter of 16 came in light. Two dry holes were drilled on the north half of 20, but the southeast quarter of that section has a number of fair producers. Several 5 to 30-barrel wells, completed in the north half of section 21, on the Verney, Beeler and Young leases; the top of Trenton being found at 1,065 feet. The north half of 22 yielded one dry hole and three or four fair producers, while tests on the Foster and Reynolds leases in section 34 came in

light. The remaining sections of the township are to be classed as shown on the map.

Blue Creek Township.—This township lies north of Jefferson, and like it contains but 24 square miles. Of these parts or all of seven are at present yielding oil.

In 1903 a test on the Cummings farm, in section 8, came in dry, while No. 2, on the Oakley farm in 9, started at only five barrels, with a good supply of gas. A test on the Tague lease, in 16, yielded only gas, but some fair wells were finished on the west half of 15. No. 4 on the D. Studebaker lease in section 31 came in dry, though surrounded on all sides by good wells. A dry hole was also drilled on the Pruden lease in section 29.

Monroe Township (26 N., 14 E.)—All developments in this township have been made since the former map was issued. While a number of the 36 sections included in its area have been tested, but four are at present producing oil in commercial quantities.

On the south half of section 22 several wells have been completed on the Habegger lease, which started at 5 to 20 barrels. The No. 4 on the lease was a dry hole, while a test on the Schug lease adjoining started at 25 barrels. Three bores have been drilled on the Lehman farm in the southwest quarter of section 23, which started at 25, 10 and 5 barrels respectively. A second dry hole was drilled on the Eley farm in section 27, the first having been drilled in 1897. The Baxter lease in 29 has yielded a number of fair wells, while the Causey lease on the northeast quarter of 36 has furnished an extension westward of the noted pool in 31 Blue Creek township. Six bores sunk on the lease in 1903 all came in as fair producers, one of them starting at 125 barrels.

St. Mary's Township.—Two bores sunk on the J. L. Case farm in section 27, this township, came in dry, while another on the Smith lease in 34 yielded a large amount of salt water and about four barrels of oil.

WELLS COUNTY

lies south of Allen, west of Adams, north of Jay and Blackford, and east of Huntington and Grant counties. It comprises an area of 367 square miles, 112 of which are included within the known productive oil territory. The surface of the county is level or gently rolling. The average altitude above sea level is about 850

feet. The Wabash River flows diagonally across the county, entering it on the eastern side, a little below the center, and flowing in a northwesterly direction. The Salamonie flows across the southwestern corner in the same direction, and these streams, with their numerous smaller tributaries, furnish an abundance of running water, and, in most townships, an ample system of drainage.

The soils of Wells County are above the average in fertility. Made up of a mixture of ingredients derived mainly from the decaying rocks of the far north, ground fine and thoroughly mixed as they were by the mighty glaciers which brought them to their present resting places, they contain all the necessary constituents for the growth of the cereal crops, and therefore do not require an annual outlay for artificial fertilizers. Corn and wheat yield enormously in the southern and western portions of the county, and the majority of the farmers were in good circumstances long before the drill revealed that another resource which had been stored since the old Silurian days lay far beneath the surface of the soil they tilled.

Two railways—the Toledo, St. Louis & Western (Clover Leaf) and the Ft. Wayne, Cincinnati & Louisville—pass entirely through the county, while the Chicago & Erie touches its northern border. The Muncie, Hartford & Ft. Wayne electric line, paralleling the Ft. W., C. & L. Railway, is in course of construction, and will be finished in 1904, thus adding to the excellent transportation facilities already existing. The population of the county in 1900 was 23,499, as against 21,514 in 1890.

The elevations of the principal railway stations of the county above sea level are as follows: Bluffton, 835; Craigsville, 850; Keystone, 862; Kingsland, 856; Liberty Center, 848; Murray, 853; Poneto, 849; Tocsin, 837; Uniondale, 814.

Wells County contains the oldest oil producing area of the State, and for a number of years ranked first in production of petroleum, but since 1901 has been exceeded by Grant. However, the townships of Nottingham, Chester and Jackson still rank as among the most productive territory in Indiana. As few dry holes are drilled in them as in any other similar area, and a large number of new productive wells are each year added to those already existing. Outside of the townships mentioned but small areas in Liberty and Harrison townships have as yet proven productive, and it is not

likely that much oil will be found in the county north of the present limits shown on the map, though the greater part of Liberty township may become light productive territory.

Developments in Harrison Township (26 N., 12 E.) in 1903.—

In this township but four bores were sunk during the year. One on the Quick lease in the southwest quarter of section 29, and one each in sections 25 and 28, developed dry holes. The fourth, on the J. E. Ballentine farm, southeast corner of the southwest quarter of 32, was drilled 300 feet into Trenton, and made about two barrels when shot. It was soon abandoned, and at the present writing there is not a producing well in the township.

Developments in Liberty Township (26 N., 11 E.) in 1903.—

Isolated wells on a number of sections in the vicinity of Liberty Center have come in as light producers since the former map was issued, and some of the sections in this vicinity may do better in the future.

In the northwestern part of the township, section 7 has developed four light wells and several dry holes. The production is on the Thompson lease, in the southwest quarter, and is from a part of the pool opened up just to the west in section 12, Salamonie township, Huntington County. The four wells were yielding 17 barrels a day on November 1, 1903, the last one having been finished in April. A dry hole has been sunk on the southeast corner of the same lease, and another on the Messburg farm on the same section. Two light wells have been finished in section 17, one on the northeast, the other on the southwest quarter; and one or two in the southeast quarter of 18. A 30-barrel producer was completed on the Davis lease, southeast corner of 19, the remainder of the section being untested. The southwest quarter of 21 and the south half of 28 have also yielded light producing wells, the top of Trenton being found at a depth of 1,014 feet in the southeast of 28. Five or six light wells have also been drilled on the southeast quarter of 29. The west half of 30 has become fair territory, 10 or more wells having been completed on it, but the east half has developed only a salt water producer on the southeast quarter. No. 6 bore, on the J. B. Munsey lease, in 31, started off at 85 barrels on December 15. its record being as follows:

Drive pipe	40 feet
Casing	270 feet
Top of Trenton	930 feet
Total depth	1,000 feet

Other leases on the same section are fair average producers. Section 32 may still be classed as fair territory, but the only wells so far drilled in 33 are light.

Developments in Nottingham Township (25 N., 12 E., and a part of 25 N., 13 E.) in 1903.—This township still maintains its record as a producer, and but few changes are necessary in the former map, where most of the productive territory was classed as good. A dry hole has been sunk on the northwest quarter of section 2, and several fair wells have come in on the Stout lease in the southwest quarter of 3. The producing portions of 4 are light; the bores on the northeast and southwest quarters coming in dry. The west half of 5 is not developed, while the wells on the east half are all light producers, as are also those on the developed portions of 6 and 7. Section 8 remains good territory, and the northwest quarter of 9 may now be called the same, the southeast quarter being lighter. The north half of 10 has been recently drilled with fair results, but 11 and 12 are unproductive. In sections 7 and 8, to the east, the only drilling has resulted in a dry hole or two on the southeast of 7 and a good showing on the C. Bierie in the southwest of 8. Just below these sections a dry hole has been sunk on the northwest of 17, and another on the southwest of 18, the south half of 17 having been wrongly marked as productive on the former map. Section 13 is also nonproductive. The northeast quarter of 14 is undrilled. The Trenton is found low and yielding salt water only on the Kirkwood lease, while bores on the south half of the section have been either dry or water producers. All of 15 except the southeast quarter is fair territory. Section 20, southeast of Domestic, has not held up, the new wells coming in light. The salt water wells, formerly marked on the northeast of 19, caused the abandonment of that quarter section for a time, but it was afterward taken up and the wells drilled deeper, when they came in as good producers. The northwest quarter of the section does not rank as high as the rest. The remainder of the sections in the township remain as marked on the former map. As a proof that the old territory still promises

much to the operator, four wells sunk in 1903, on the Engle lease, in the southeast quarter of 32, started off at more than 100 barrels each.

Developments in Chester Township (25 N., 11 E.) in 1903.— This township has been more than holding its own in recent years. The former undrilled area in the northern portion has, for the most part, proven productive; while but a small proportion of the new bores in the older territory came in dry.

Section 1 and the northeast quarter of 2 are as yet undeveloped. The west half of 2 contains some light wells, while the southeast quarter is better. Almost all of 3 has become lightly productive. A test bore on the Speece lease, in the northwest corner, struck a vein of "blue lick" water at 1,027 feet. The northwest quarter of 4 is fair territory, the rest light. Some excellent wells were drilled in on 6 and 7 during the year. One on the Shadle lease, southwest quarter of 7, is said to have made 200 barrels the first day, 400 the second and 190 the third. The west half of 9 and the northwest quarter of 10, marked as undrilled on the former map, have become fairly productive, as has also the greater part of 11 and 12, and the west half of 16. The remainder of the township may be classed practically as on the former map.

Developments in Jackson Township (25 N., 10 E.) in 1903.— This township ranks next to Nottingham in its output of oil. But few of the older wells have been abandoned, and all of the undrilled area of the former map has come in as fairly productive. Many of the sections there marked as light or fair, are now classed as fair or good.

On the Huffman lease, south half of section 1, much trouble has been experienced with fresh water, which flooded a number of the wells and caused their abandonment. This mishap was due to some poor wells, whose casing had been pulled, not being properly plugged. Section 5 has increased its rating to fair, while all wells on 6 belong to the same class. One on the Allen lease, southwest quarter of 7, started at 200 barrels, and the whole section is up to the average. The northwest quarter of 8 has only a dry hole to its credit, but the remainder of the section is fair territory; as is also the south half of 9. The west half of 18 has come in as light, but the northwest quarter of 19 has some fair wells to its credit. Section 20, marked as light on the former map, has increased its

standing. The wells are lasting, and most of them start in at 20 to 40 barrels. An average record in the northwest quarter of 20 shows:

Drive pipe	153 feet
Casing	385 feet
Top of Trenton	989 feet
Total depth	1,045 feet

The first pay is struck at about 1,012 feet, and there is no water before shooting. Section 22 has also increased its output and become fair to good territory. A 160-barrel well was finished on the northwest corner of 24 during the year. The west half of 25 has been fair territory, while 26 now ranks with 27 and 28 to the west. The northwest quarter of 26, containing 21 wells having, according to the pipe line statements for 14 months, a settled production of 65 barrels, together with some undrilled leases in Randolph County, was sold for \$75,000 on October 15, 1903. Some changes for the better have been made in the southeast and northwest quarters of 29 and the northeast of 30. Section 31 has been drilled over in recent years with fair results. A bore on the Palmer lease, east half of the northwest quarter, was finished in October, with an initial output of 125 barrels, its record being as follows:

Drive pipe	130 feet
Casing	340 feet
Top of Trenton	985 feet
Total depth	1,045 feet

The first pay, struck at 1,015, was 18 feet thick. The northeast quarter of 32, formerly bearing only salt water, has recently developed a number of fair wells; while the remaining sections of the township, for the most part, rank high as shown on the former map.

HUNTINGTON COUNTY.

comprises an area of 385 square miles, lying west of the counties of Allen and Wells and north of Wells and Grant. The general surface is similar to that of the counties already noted—a level plain, unmarked by any prominent hills or elevated points, the average elevation being about 780 feet above the level of the

sea. The Southern third of the county is drained by the Salamonie River, the central and northern thirds by the Wabash River and its tributaries.

The soil of the county is mostly of glacial origin, varying much in constituents and quality. In most places it is underlain by a stiff, tenaceous clay which retains the surface water and necessitates artificial drainage. Where properly drained it yields large crops of the cereals and grasses. The alluvial soils of the extensive areas of bottom lands along the Wabash and Salamonie Rivers are above the average in fertility, and their crops aid largely in giving Huntington the rank which it holds among the better agricultural counties of northern Indiana.

As in the other counties comprising the oil area of Indiana, the only outcrops of rock are those of the Niagara formation. In the vicinity of Huntington, the county seat, large quantities of lime are burned from this rock, and the quality of the product has given it a reputation second to none in the State.

Two railways, the Chicago & Erie, and the Wabash, cross the county, the former from the northwest to southeast, and the latter from northeast to southwest, while the T., St. L. & W. (Clover Leaf) cuts across the southeastern corner. The Fort Wayne and Southwestern Traction Line parallels the Wabash Railway across the county. The population of the county in 1900 was 28,901, as against 27,644 in 1890.

The elevation in feet above tide of some of the principal railway stations in the county is as follows: Buckeye, 858; Huntington, 741; Markle, 814; Warren, 831.

The area of Huntington County producing oil in commercial quantities is practically limited to the southern halves of Salamonie, Jefferson and Wayne townships, along the southern border of the county. Some of the sections in this area rank high as producers, the average initial production and length of life of the wells equalling any similar area in the petroleum field of the State. It is not probable that the area of productive territory in the county will ever be found to extend any distance north of the townships mentioned, though it may, in time, cover the greater portion of their northern halves.

Developments in Salamonie Township (26 N., 10 E.) in 1903.—Operations in this township have been confined to sections 12,

13, 19, 20 and 25 to 36, inclusive, though isolated bores in other sections have produced a showing of oil. On the southeast quarter of 12 two dry holes and two wells which started at 15 and 35 barrels have been drilled, while the only bore on the northeast quarter was dry. The top of Trenton in the last mentioned bore was found at 1,027 feet, while an average record of the bores on the southeast quarter showed:

Drive pipe	58 feet
Casing	385 feet
Top of Trenton	1,007 feet
Total depth	1,087 feet

The only drilling in section 13 was on the McElhaney lease, northeast quarter, where a 30-barrel well was completed in March, and a lighter one later in the year.

The field opened up in section 19, just west of Warren, in 1900, has not held its own, the new bores having a decreased initial output. The southwest quarter of 20 has on it a few light wells, but the remainder of the section has been condemned by several dry holes. Sections 25 and 26 remain as shown on the former map, while all of 27 and 28 may be classed as lightly productive. The south half of 29 is undrilled, while the north half has developed only salt water and dry holes. The northeast quarter of 30 has some fair wells, but a number of dry holes have been drilled on the other portions of the section. All of 31 has become fair territory, some high-grade producers having been finished on the north half during the year. The southeast of 32 contains nine fair wells, but bores on the remainder of the section have mostly come in dry. Section 33 contains a number of light wells, except on the northeast quarter, which is untested. One light producer has been finished on the northeast quarter of 34 since the former map was issued; the remainder of the section and 35 and 36 remaining as before classified.

Developments in Jefferson Township (26 N., 9 E.) in 1903.—This is the best productive township in Huntington County. The wells mostly come in as fair to good producers, and hold up for a long time. The greater portion of the north half of the township is still operated for gas by the Huntington Light and Fuel Company.

One or two bores on the northeast of section 16 have made a good showing of oil, but are not operated. A dry hole has been drilled on the southwest corner of the section. In 17 a bore on the northwest quarter developed only salt water, while 18 is undrilled. Section 19 has developed a number of light wells, the southwest quarter averaging better than the rest. The northeast quarter of 20 is fair territory, the remainder of the section light.

The Pike Oil Company controls several hundred acres of leases in this region, including the northeast of 20 and the northwest of 21. On the Weaver farm, in the latter quarter section, two fair pumping wells were drilled several years ago, and in 1903 they and 160 acres of leases were bought by the Pike Company for \$4,000. Three bores have since been sunk by the company on the Anderson farm, in the northeast of 20. A record of No. 2, which started at 120 barrels, is as follows:

Drive pipe	267 feet
Casing	478 feet
Top of Trenton	985 feet
Total depth	1,040 feet

The first oil was found at 26 feet in Trenton, and a second pay, 11 feet thick, at 35 feet in. A new bore on the Weaver farm in the northwest of 21 resulted in a big salt water well which yielded, with the water, about 15 barrels of oil per day. The southwest of 21 is covered by virgin forest and is unleased, while the east half of the section, as well as 22, 23, 24 and the north halves of 25, 26 and 27 are unproductive. A dry hole has been bored on the Griffith lease in the southwest of 23, and two of the same kind on the Taylor lease in the southwest of 24. The south halves of 25, 26 and 27 have yielded a number of fine wells. A 200-barrel producer was finished in October on the Holman lease in the northeast quarter of 28, which was making 20 barrels when a month old. The northwest quarter is undrilled, while the south half contains a number of fair wells. All of 29 has developed into fair territory, there being nearly 40 producers on the section. The northeast quarter of 30 is unleased. The south half contains a number of fair wells, while on the northwest quarter there is one light well which has never been pumped. An average bore on the Sparks farm, southwest quarter, showed the following record:

Drive pipe	199 feet
Casing	489 feet
Top of Trenton	1,001 feet
Gas pay	1,012 feet
First oil pay	1,025 feet
Second oil pay	1,045 feet
Salt water	1,059 feet
Total depth	1,064 feet

The east half of section 31 contains 25 oil wells, whose output is above the average. The northwest quarter is undrilled, while the southwest quarter has a number of fair producers. Section 32 has developed into good producing territory. The Troy Oil Company controls the whole section, and on November 1st had 68 producing wells thereon. The oldest of these had been producing four years, and the net production was about four barrels each on the date mentioned. A record of an average bore on the section shows:

Drive pipe	200 feet
Casing	450 feet
Top of Trenton	1,004 feet
Total depth	1,059 feet

Gas is usually found at 15 to 24 feet in the Trenton before the oil is struck. The former is just about sufficient in quantity to operate the field.

Section 33 is probably the best in the township. On December 1st there were 48 producing wells on its area, with an average production of 7 barrels each. In this section the average record shows:

Drive pipe	250 feet
Casing	450 feet
Top of Trenton	925 feet
Total depth	1,025 feet

The north halves of 34 and 35 have become fair territory, as has also all of 36.

Development in Wayne Township (E. $\frac{2}{3}$ of 26 N., 8 E.) in 1903.
—The greater part of this township is fair gas territory. Most of the productive oil sections are distant from railway facilities, and hence the operation is light for at least five months of the year. Being on the border of the field, many of the new wells partake

of the "wildcat" variety, and the percentage of failures is greater than inside known productive limits. But eight sections in the southeast corner of the township have as yet proven anyway productive, though a few bores with a fair showing have come in in other localities.

A well on the A. E. Billiter farm, near Mt. Etna, on the southeast quarter of section 1, was completed in 1902, and produced at first a heavy flow of gas and a good showing of oil. In August, 1903, it was put to pumping and made 15 barrels the first day. This well is farther north and northwest than any other in the main Indiana field. It is on the edge of a "deep drive," 340 feet of drive pipe being necessary. Dry holes have been drilled on the northeast quarter of 9 and the corresponding quarter of 10, while 11 and 12 have produced much gas and a showing of oil in some bores. Three light producers have been finished on the Cramer lease, northeast quarter of 15. A bore on the Wilson lease, southwest quarter of 16, came in as a dry hole, with the following record:

Drive pipe	108 feet
Casing	525 feet
Top of Trenton.....	991 feet
Light gas pay.....	1,006 feet
Salt water	1,041 feet
Total depth	1,101 feet

On the Parrott lease, northeast quarter of 23, two bores were producing about 15 barrels of oil in November, the record of No. 2 being:

Drive pipe	331 feet
Casing	525 feet
Top of Trenton.....	993 feet
Gas and oil pay.....	1,007 feet
Second oil pay.....	1,029 feet
Total depth	1,053 feet

In No. 1, 600 feet east, the drive was but 208 feet. The most of the section is light productive territory, the southwest quarter being undrilled. All of 24 and 25 may be classed as light productive territory, the Searles farm in 24 showing up better than the rest. The Bond farm, northeast quarter of 26 has some fair producers to its credit, but the remainder of the section is as yet

mainly gas producing, as are also sections 27 and 28. On the Hawkins lease in the southeast corner of 33 a 10-barrel well was finished in September, and another of similar output is located on the southwest of 34. The northeast quarter of 35 has developed several fair producers. No. 3, on the Price farm, had the following record:

Drive pipe	229 feet
Casing	500 feet
Top of Trenton.....	1,009 feet
Gas pay	1,020 feet
Salt water	1,030 feet
First oil pay	1,035 feet
Total depth	1,099 feet

When completed it pumped nothing but salt water the first day. The second day it made 35 barrels of oil; the third, 37 barrels; the fourth, 40 barrels, and the fifth, 60 barrels. The remainder of section 35 contains a number of light wells, while all of 36 has become fair productive territory.

GRANT COUNTY,

in which the most westward extension of the Indiana oil field is located, lies west of the counties of Wells and Blackford, and south of Huntington and Wabash counties. It comprises an area of 416 square miles, the surface of which is, for the most part, level or slightly undulating, though in the vicinity of the Mississinewa River many hills, due to erosion, and from 50 to 100 feet above the level of the river bed, are found.

The Mississinewa enters the county near its southeastern corner, and, flowing in a northwesterly direction, leaves it on the northern border, six miles east of the northwestern corner. In the early history of the county it was navigable for flatboats, which were loaded at Marion and transported, via the Wabash and Ohio rivers, to New Orleans. It and its tributaries drain the greater part of the county; but the western tier of townships is drained by Pipe and Grassy creeks, and the northeastern corner by Black Creek, a tributary of the Salamonie River.

The soils of the county are mostly of drift origin, and for the most part are fertile, though in some localities a lack of necessary drainage has rendered their tillage unprofitable.

The transportation facilities of the county are excellent, the T., St. L. & W. (Clover Leaf); the Michigan Division of the Big Four, the P., C., C. & St. L. and the C., C. & L. railways passing entirely through it, and having a common junction point at Marion, the county seat. Besides these, the C., I. & E. crosses its southwestern fourth, while the Union Traction Company's lines operate between Marion, Anderson and Indianapolis. The population of the county in 1900 was 54,693, as against 31,493 in 1890, while that of Marion was 17,337, as against 8,769. This notable increase was due almost wholly, either directly or indirectly, to the gas and petroleum developments brought about in the county during the decade in question.

The elevations in feet above tide of the principal railway stations in the county are as follows: Fairmount, 880; Fox, 817; Herbst, 851; Jonesboro, 848; Landessville, 864; Marion, 811—814; Miers, 823; Roseburg, 845; Sims, 857; Swayzee, 859; Sweetsers, 844; Upland, 939; Van Buren, 840.

Within recent years, Grant County has come to be the banner petroleum producing county of the State. At the same time the city of Marion has forged to the front as the principal oil center. In 1903 the county yielded more than one-third of all the petroleum produced in Indiana; while the number of new bores sunk was more than twice as great as in any other county. By the close of the year, the townships of Van Buren, Washington and Center had been pretty thoroughly tested. Over most of their area, however, there is room for many new wells, which, in the near future, will undoubtedly be sunk on leases already partially developed. In this way the output of these townships will be kept up, and possibly increased, for a number of years. The greater parts of Mill, Monroe, Fairmount and Jefferson townships will also develop into good oil territory as soon as the prevailing gas pressure is reduced. Monroe and Jefferson townships at present afford as good promise for future production as any within the State. Franklin township is on the down grade and its future output will be light, as will also that of the greater part of Liberty township.

Developments in Van Buren Township (25 N., 9 E.) in 1903.—This township, in the northeastern corner of Grant County, comprises one of the oldest and best known oil producing districts of

the State. The first oil well in Grant County was drilled in the outskirts of the town of Van Buren in 1890. From that time up to the present the drill has been kept almost constantly going in Van Buren township, until its area has been pretty thoroughly gone over. The results have been above the average, the township ranking with Nottingham and Jackson, of Wells County, as a reliable producer. The new developments of the year 1903 were mainly in the two southern tiers of sections, most of which were shown as undrilled on the former map, though many bores were sunk on active leases in all parts of the township. The condition of the roads in winter in the south half of this township and in most of Monroe is deplorable, and greatly lessens the development for several months.

The southwest quarter of section 7 has developed into good territory. On the Sanderman lease of 80 acres are 18 producing wells, the last of which was completed in November with an initial output of 150 barrels. A record of its bore was:

Drive pipe	160 feet
Casing	400 feet
Top of Trenton.....	927 feet
Total depth	1,027 feet

The 18 wells were producing 70 barrels a day on January 1st, 1904.

The south half of section 8, marked as untested on the former map, has become good territory. On the E. Korporal farm the No. 9 bore, completed in December, started at 150 barrels, and was making 45 barrels at the end of two weeks.

The northwest quarter of section 18, unmarked on the former map, has developed into fair territory, while the east half of section 20 has produced a number of good wells. The whole of section 21 has become fair territory, as has also the southeast quarter of section 24. Sections 25, 26 and 27 are uniformly light, the wells coming in from 5 to 20 barrels each. The east half of 28 and the northwest and southeast quarters of 29 are better, and may be classed as fair, as may also all of section 30, the south half of the latter section being as yet undrilled.

In the lower tier of sections, that portion of 31 which has been tested is light. The northwest quarter of 32 is fair, the remainder light. Much trouble has been experienced with deep drives in the

southeast quarter of the section. The whole of sections 33 and 34 may be classed as fair territory. One of the best wells finished in section 34 in 1903 was drilled in on the M. Dillman farm, starting at about 110 barrels. The deep drive covers part of the southeast quarter of the section and, as elsewhere, renders the drilling difficult. The north half of 35 is light, the south half fair, the R. J. Reed lease of 20 acres in the southwest quarter, being above the average. The northwest quarter of 36 is light, the remainder, as far as tested, being salt water or gas territory. The other sections of the township are mainly classed as shown on the former map, there having been but little change. The wells on the northern two-thirds of the township have come in with a larger initial production than those on the southern third, and, for the most part, have held up remarkably well. Many bores will have to be sunk in the township before all the territory therein is developed as it should be.

Developments in Washington Township (25 N., 9 E.) in 1903.

—The year 1903 proved that this township is destined to take high rank as an oil producing center. Enough drilling had previously been done to remove it from the "wild cat" area, and as the season advanced the greater portion of the township as far west as the Huntington pike was pretty thoroughly tested. West of that thoroughfare the drills have, on account of high gas pressure, revealed but little of importance. The results of the season's work in the township were equal to the expectations. While no phenomenal strikes were made, most of the wells were above the average in initial output.

Taking up the area in detail, we find that section 1 may be classed as fair, except the northeast quarter, which is light. All of 2 has been proven fair, the southwest quarter showing up better than the rest. Not much drilling has, as yet, been done on the southeast quarter. Section 3, as far as drilled, is light except the west half of the southwest quarter, which is better. The only bore sunk on the B. H. King lease, north half of the northwest quarter, resulted in a dry hole.

A fair average lease in this territory, which is operated carefully on a moderate capital, is that of the "Poor Rut Oil Co.," J. R. Bennett, Superintendent, on the E. J. Hunt farm of 160 acres, southwest quarter of section 2. This farm, up to 1902,

was considered gas territory, and was so marked on the former maps. The first bore was finished for oil on June 1, 1902. Up to October 1, 1903, nine wells had been completed on the east half of the quarter section, and three on the southwest quarter. They are located 600 feet apart and the twelve are operated by one power. Gas is used for fuel in both pumping and drilling, enough being yielded by the wells on the lease for this purpose. All the wells started at about 20 barrels each, but soon settled to an average of 4 barrels which they were doing in October. On the northeast quarter of the quarter section the drift runs about 260 feet in thickness, necessitating that amount of drive pipe. On the southeast quarter of the lease it increases to nearly 400 feet, while on the southwest quarter it is but 250 feet. An average well on the lease shows the following record:

Drive pipe	300 feet
Casing	500 feet
Top of Trenton.....	980 feet
Total depth	1,055 feet

Two pay streaks are found, the upper being 30 to 35 feet and the lower and most productive 55 to 63 feet in Trenton. Each pay is about 10 feet in thickness. Between the two, at a depth of about 45 feet in, a screw, in most of the bores, develops salt water which rises about 300 feet in the well. This is easily pumped down, a two inch pipe serving to carry all of it from the twelve wells. The company, up to October 1, 1903, had about \$30,000 invested in the lease, and was averaging \$1,000 a month income above the one-seventh royalty and cost of operation.

On the E. E. Hewett lease, west half of the southwest quarter of section 3, one mile west of the Hunt farm, a record of bore No 1 was as follows:

Drive pipe	199 feet
Casing	504 feet
Top of Trenton.....	1,004 feet
Gas struck at	1,014 feet
First oil pay	1,019-1,040 feet
Salt water	1,040-1,045 feet
Second oil pay	1,055-1,079 feet
Total depth	1,079 feet

The well was a fair producer, as were several others on the same farm.

The east half of section 4 has developed a number of light wells, but west and immediately south of this, the gas pressure is, as yet, too strong to try to operate for oil, so that no drilling has been done in sections 5 to 10 inclusive, nor on the west half of 11. The east half of 11 and all of twelve are fair territory, the H. M. Creviston farm, northeast quarter of 11, and northwest quarter of 12 having yielded a number of wells above the average in initial production. The No. 7, finished July 28, had the following record:

Drive pipe	250 feet
Casing	455 feet
Top of Trenton	1,014 feet
First pay	1,026 feet
Salt water	1,073 feet
Total depth	1,077 feet

After shooting with 160 quarts, the well started in at 60 barrels.

All of section 13, just northwest of Landessville, and comprising part of the town lot development of that place, may be classed as good territory. On the Elizabeth Cory lease, west half of the northwest quarter, ten wells had been drilled up to October 1st. An average record of these was as follows:

Drive pipe	104 feet
Casing	460 feet
Top of Trenton.....	1,001 feet
Total depth	1,079 feet

In a number of the wells but one pay streak was found. Most of them came in with an initial production of 35 to 50 barrels. The wells sunk on section 14 have, up to the present, proven light, while those on 15 are fair producers. The only producing well on 16 is on the L. W. Smith farm, south half of the northwest quarter, where the Marion Gas Co. drilled a well for gas, but found the gas-bearing rock barren. Concluding to drill the well deeper they went 65 feet into Trenton rock and struck oil, the pay streak being about 20 feet thick. The well was then shot with 200 quarts, and a great flow of gas was the result. The well, on January 1, 1904, was making about five barrels of oil while pumping against a heavy gas pressure. It is considered that it has opened up some new territory, as there is not a well nearer

than two miles, and very little water to contend with. The record of the bore was as follows:

Drive pipe	220 feet
Casing	470 feet
Top of Trenton.....	930 feet
Total depth	1,000 feet

Section 17 is undrilled. On the west half of the southeast quarter of section 18, near the north border of the H. Cretsinger lease, two light producers have been finished. The record of No. 1 was as follows:

Drive pipe	221 feet
Casing	450 feet
Top of Trenton.....	970 feet
Total depth	1,032 feet

The remainder of 18 and all of 19 are undrilled. The only developments on 20 are on the W. Bocoek farm, west half of the northeast quarter, where a 20-barrel well was finished October 1st, the bore having the following record:

Drive pipe	210 feet
Casing	450 feet
Top of Trenton.....	978 feet
Total depth	1,023 feet

On the G. & M. Bocoek farm, southwest quarter of section 21, a bore drilled for oil in June came in as a 1,000,000 foot gas well. The southeast quarter of the section is also gas producing, while the northwest quarter is undrilled. On the south part of the E. W. Creviston farm, in the northeast quarter are several fair producing oil wells. A portion of section 22 has proven fairly productive, especially the northeast quarter, where No. 4, on the C. Sears farm, came in as a 100 barrel producer in September. The record of its bore is as follows:

Drive pipe	318 feet
Casing	455 feet
Top of Trenton	1,018 feet
Total depth	1,061 feet

The few wells drilled on the south half of the section showed lighter. Section 23, as far as drilled, is fair territory, while the west half and northeast quarter of 24 are good. The northeast

of 25 has proven fair territory; the south half has, as yet, produced only gas. However, deep drives have prevented much drilling, the drift proving 440 or more feet thick. Only dry holes have been found on the southeast of 26. On the B. Smith lease a bore was sunk 325 feet into Trenton, but developed nothing except a little gas at 70 feet in. The southwest quarter of the section is fair territory, as is also the north half of the northeast quarter. The remainder of the section is, as yet, light and gassy. The southeast quarter of 27 is fair, the remainder generally light. On the northeast quarter of 28 a bore was started for oil December 21, 1902, on the E. Conn farm; at 100 feet gravel containing an abundant supply of fresh water was encountered. At 250 feet, a deposit of what the drillers called "red mud" was struck. It is a tough, sticky mud, almost impossible to drive through. The record of the well is as follows:

Drive pipe	286 feet
Casing	420 feet
Top of Trenton.....	987 feet
Struck gas at.....	1,000 feet
Total depth	1,074 feet

The well proved to be a big gas producer, yielding 2,000,000 feet a day for 20 days, with no showing whatever of oil. At the end of that time it was shot with 160 quarts, when a pocket of oil near the bottom of the bore was evidently broken into, as the fluid rose 20 feet above the top of the derrick. The pressure immediately decreased from 180 to 80 pounds. The well made 24 barrels the first day and settled down into a fair producer. It is one of eight on the lease, all of which started with much gas. The northwest quarter of 28 is undrilled. The east half of the southwest quarter has some fair wells, while the southeast quarter has yielded only gas and dry holes. Only the east half of 29 has been drilled. A bore on the Kinney lease on the northeast quarter, came in dry, while the southeast quarter has produced several light wells. Sections 30, 31 and 32 are untested. A dry hole has been drilled on the southwest quarter of 33 and a very light producer on the northwest quarter. The east half is untested. All of section 34 is fair to good territory. On the H. Blinn farm, in the southwest quarter, seven producing wells are in operation, an average record being as follows:

Drive pipe	300 feet
Casing	455 feet
Top of Trenton.....	998 feet
First oil pay.....	1,014 feet
Second oil pay.....	1,035 feet

A small amount of water is found between the pays, as on the Hunt lease in the north part of the township, already mentioned. The Chas. Brown farm, in the southeast quarter of the section, has furnished eight wells, Nos. 2, 3 and 7 coming in at 60 barrels, or better, each. The gas supply is just about sufficient to furnish fuel for pumping and drilling. The Hawkins lease, on the northeast quarter of 34, has also seven or eight fair producers. The record of No. 7 being as follows:

Drive pipe	173 feet
Casing	440 feet
Top of Trenton.....	997 feet
First oil pay.....	1,027 feet
Second oil pay.....	1,054 feet
Total depth	1,070 feet

It is to be noted that there is quite a difference in the thickness of drift between the northeast and southwest quarter sections. Section 35 is not so good, the east half being, as yet, mostly gas territory. The Williams farm, on the center of the north half, has produced several light wells and the Howard, in the southwest quarter, a number of fair ones. The south half, as well as the northeast quarter, of 36, has yielded only light wells, while three dry holes have been drilled on the northwest quarter.

Developments in Monroe Township (24 N., 9 E.) in 1903.—As an oil producer this township has not as yet been thoroughly tested, mainly for two reasons: 1st. The gas pressure has been too high in most sections. 2d. No railway passes through its area and in winter and spring but little hauling of oil well supplies can be done over the mud roads. However, it is slowly coming to the front, and there is little doubt but that in a few years it will rank with its neighbors on the east and north. Its bounds lie wholly within known productive territory, and such wells as have been sunk have staying qualities. With the going of gas, oil is sure to be found over most of its area in good paying quantities.

Joshua Strange, of Arcana, was the pioneer oil operator in Monroe township. He sank the first well on the northwest quarter of section 15 in 1892. It came in as a dry gas well without a showing of oil. The second well, on the southwest quarter of 10, was finished in October, 1895. It was drilled only 25 feet into Trenton, when the oil rose 600 feet in the bore. The top of Trenton was struck at 987 feet. The third well was on the middle of the north line of the northeast quarter of 15. It was finished in December, 1895, and was at first thought to be a light gas well; but on standing open one night it started to flow oil and flowed for two years before it had to be pumped. The fourth well was on the middle of the west line of the northeast quarter of section 15 and was finished in 1897. It sprayed a little oil but was not pumped until 1900. The fifth well, on the southwest corner of the northeast quarter of 15, came in as a light gasser in December, 1898, but soon began to flow oil over the top of the derrick. By that time Mr. Strange realized that he had a small oil field on his hands and began to operate it in the proper manner. Nos. 4 and 5 were put to pumping in 1900, and No. 3 was flowed by heads. Before any pumping was done, however, he had produced 3,000 barrels by flowing alone. The Ohio Oil Company had meantime put in a pipe-line from Van Buren, five miles to the north, to take care of the product. The surplus gas was piped to Landessville for house consumption. In 1901 Mr. Strange sold his five wells and 440 acres of leases to the National Oil Company for \$12,000, retaining a one-eighth royalty on future production. In October, 1903, there were 26 producing wells on the property. During one year, July 1, 1901, to July 1, 1902, the west half of the northeast quarter of 15 produced \$24,000 worth of oil at market prices.

Taking up the sections of Monroe in detail, we find that the east half of 1 is fairly productive; the southwest quarter light, while the northwest quarter contains two gas wells and a dry hole. Section 2 is also light. During the year a number of old gas wells were drilled deeper on the northwest quarter, but came in with only a two to five-barrel production. A dry hole has been drilled in the corner of the southwest quarter. The Hodgson lease, which comprises the greater part of the south half, has not yet been tested. The only drilling on section 3 has resulted in three fair

wells on the north half of the northwest quarter, and one light one on the east half of the southwest quarter. The north half of 4, although in the deep drift and requiring 400 or more feet of drive pipe, has produced a number of fair wells, and the southeast quarter some light ones. The southwest quarter is untested, the west half of the southwest quarter being as yet unleased. The greater part of 5 is also untested. The northeast quarter has yielded some fine producers and the north half of the northwest quarter a few light ones. Section 6 has produced three or four fair wells on its west half, but the east half has, as yet, shown only gas. In section 7 two light wells have come in on the north half; the south half and all of 8 being untested. The greater part of 9 is yet producing gas, but some light oil wells have been found on the north half of the northwest quarter, and on the east half of the southeast quarter. Section 10 is also gas territory, though one or two light producing oil wells are on the southwest quarter. The greater part of the north half is as yet unleased. The northwest quarter of 11 is undrilled; the remainder of the section contains a number of light wells in which the gas pressure is still high. The deep drive occurs in the southwest quarter, where the best output has been obtained. All of 12 is as yet light territory, though a number of the bores presage better results when the gas subsides. The record of a bore on the W. L. Thompson farm, just north of Jadden, showed:

Drive pipe	425 feet
Casing	430 feet
Top of Trenton.....	990 feet
Total depth	1,050 feet

An old preglacial stream, called by drillers the "Lob," had cut its way down, almost through the Niagara limestone at this point, rendering the deep drive necessary through the drift, which had filled up the channels. The Smith farm, on the southeast quarter of section 13, has yielded some fair wells, one, finished in October, producing 70 barrels the first day. The remainder of the section is undrilled. The northeast and southwest quarters of 14 are undrilled; the southeast quarter contains some light wells and the northwest a number of fair ones. Section 15 has been previously mentioned. It has produced more oil than any other sec-

tion in the township, but this has been mostly found in the north-east quarter. The southwest quarter of the section is yet light producing on account of the gas pressure. Section 16 has not been drilled for oil but furnishes gas from two or three bores.

A light producer and a gas well have been finished on the north-east corner of 17 and a fair producer and a dry hole on the north-west corner. On the Chas. Nelson farm, west half of the southwest quarter of the section, a well was drilled for gas in November. No gas was found at the depth where usually struck, but at 60 feet in Trenton both oil and gas were found, the latter having a pressure of 180 pounds and being too great in quantity to allow the development of the oil. The record of the bore was as follows:

Drive pipe	240 feet
Casing	420 feet
Top of Trenton.....	930 feet
Total depth	1,010 feet

In section 18 the only producing wells are on the south half of the northwest quarter, the remainder of the section is yet producing too much gas for development. Drilling for oil on 19 has been confined to the A. Drake lease in the southwest quarter, where a light well or two was finished. In 20 but one light well has been completed, and it is near the south line of the section. Sections 21 and 22 are undrilled for oil. On the Wood farm, northeast quarter of 23, four or five wells were finished during the year, one of which started at 50 barrels and the others at about 10 barrels each. A few light wells have been found on the north half of 24, the south half being untested. In 25 a well on the Kiser farm, northeast quarter, which had yielded gas for two or three years began to show oil in the spring of 1903, and when put to pumping produced about 10 barrels a day. A number of other light producers were finished in the section during the year. Sections 26 to 35 inclusive, where drilled, have, as yet, yielded only gas. In the southeast corner of 36 a number of small producers and one which started at 25 barrels were drilled in during the year on the B. F. Bish farm. Several bores on the C. Brown farm, in the southwest of 34, just north of Upland, were finished in August and showed oil with the gas. The latter had a pressure of 140 pounds. Enough of the bores drilled in

the south half of Monroe township have proven sufficiently productive to warrant the belief that when the gas is exhausted the region will yield oil in good paying quantities.

Developments in Center Township (Sections 1 to 24 inclusive, 24 N., 8 E.) in 1903.—That portion of this township east of the city of Marion has been pretty thoroughly tested. The year 1903 saw a large number of bores go down within its bounds, the most of which resulted in fair to good producing wells; thus opening up an area of territory which had hitherto been supposed to be barren. But little drilling has been done in section 1. The Conn lease, northwest quarter, has furnished a dry hole; while the south half has four light producing wells. Section 2 contains 30 or more fair producing wells, those on the southwest quarter being above the average. The record of the bores in the section ran about as follows:

Drive pipe	220 feet
Casing	430 feet
Top of Trenton.....	930 feet
Total depth	1,010 feet

The south half of 3 may be classed as fair, while the northeast quarter is good. No. 1, on the Thos. Myers farm was one of the first wells in the Marion field. It was drilled in 1899, and showed some oil but had about 200 pounds gas pressure and was not successfully operated until 1902. Up to the present ten wells have been completed on the lease, all of which are productive. The No. 9, finished in August, 1903, made 200 barrels the first 24 hours.

Section 4 has proven to be a spotted area. The Levi farm, southeast quarter, contains nine fair producing wells, and the owner has received as high as \$300 per month royalty from them. The Riley and Bowman leases in the northeast quarter have also several fair producers, but those on the Barley farms are light. Three large salt water wells, which were abandoned after pumping for a year or two, have been drilled on the Coon lease. One of the first wells to show oil in the Grant County field was on the William Brinker farm in the northwest quarter. It was drilled about ten years ago by the Mississinewa Gas Company. In 1900 the company put a separator on the well, had a 25 barrel tank set and ran several tanks of oil. They finally drilled the well in and shot it but it never paid for operating. The southwest

quarter of the section is untested, and west of that no drilling has been done in the northern tier of sections, Nos. 5, 6 and 7 being within the city limits and fair-grounds. The north half of 8 developed a few wells which came in at about 10 barrels. The southwest quarter of 9 is better, but the remainder of that section has shown up light. All of 10 is fair territory with the exception of the southwest quarter. On the east half of this quarter a dry hole was bored, the record being as follows:

Drive pipe	62 feet
Casing	393 feet
Top of Trenton.....	963 feet
Total depth	1,076 feet

The greater part of section 11 has proven above the average in productiveness. Two 75-barrel wells were finished on the section during the year. On the T. J. Neal farm in the south half of the section, four wells have been yielding for three years and were still doing 3 barrels each per day in October. The southwest quarter of 12 is undrilled; the remainder of the section has produced only light wells. All of 13 may be classed as fair territory. A 100-barrel producer was finished on the Phillips lease and a better one on the J. R. Nelson farm during the year. The most of section 14 may be classed as light, the majority of the wells coming in at 10 barrels or thereabouts. On the Carriger lease in the northeast quarter of the section a record of No. 4 was as follows:

Drive pipe	169 feet
Casing	449 feet
Top of Trenton.....	999 feet
Total depth	1,069 feet

Section 15 is better, the west half ranking high. Nine wells on the Van Vactor farm in the northwest quarter were making 75 barrels daily in October. The Ratcliff lease, just south, had also nine or ten producers the average record of which was:

Drive pipe	75 feet
Casing	400 feet
Top of Trenton.....	972 feet
Total depth	1,058 feet

The east half of section 16 developed the first producing well in the Marion field. A number of others have since been drilled but are, for the most part, small producers. Sections 17 and 18, most of which lie within the city limits, have developed a number of light to fair producers during the year. On the Eli Thomas farm, in the southeast corner of 18, a bore finished in December started in at 50 barrels. Several dry holes had previously been drilled within half a mile of it. The record of the bore was as follows:

Drive pipe	190 feet
Casing	410 feet
Top of Trenton.....	960 feet
Total depth	1,020 feet

The north half of 19 is light territory, the remainder of the section being either dry or undrilled.

On the grounds of the Soldiers' Home, in the northeast quarter of section 20, the United States government is operating three or four fair producing wells. Six or seven bores have been drilled on the grounds but some of them as yet produce only gas.

The west half of 21 is light to fair territory with some gas. The east half, especially the northeast quarter, is better. On the south half of this quarter the Griffin lease has developed into one of the best in the Marion field. It was first drilled in 1900, when three bores were sunk 50 feet into Trenton. They resulted in light producers. In 1903 these were drilled in 30 feet additional, a second and more productive pay being passed through. Several new bores were also finished, one of which started at 125 barrels. The records of Nos. 1 and 5 were as follows:

	No. 1.	No. 5.
Drive pipe	160 feet	220 feet
Casing	440 feet	400 feet
Top of Trenton.....	930 feet	940 feet
Total depth	1,014 feet	1,020 feet

The north half of 22 is also high grade territory. The Futrell farm, on the northwest quarter, after being abandoned for both oil and gas, was released and nine wells sunk on it in 1902 and '03. Three of these started at 75 barrels or more each. Most of the wells had but a light showing before being shot, but became

good producers afterward. The south half of the section is not so productive. The only bore on the north half of 23 resulted in a dry hole. The south half is fairly productive. Section 24 may be considered light. As in most other parts of the Grant County field there is yet room for many more bores in Center township and the territory can not be said to have been fully developed until they are sunk.

Developments in Franklin Township (24 N., 7 E.) in 1903.— This township lies just west of Marion, and only a small portion of it has been found to be productive. This is mainly in what is known as the West Marion Town Lot development, in sections 11, 12 and 13, where about 90 producing wells were averaging three barrels each in October.

This territory was mainly drilled in 1901 and '02 and while a number of fair wells were finished, it is doubtful whether enough oil was sold to bring back the money invested. The results in both Peru and West Marion have proven that in Indiana, at least, town lot operations are not a shining success. Extra precautions must be taken to prevent damage to adjoining properties, and but few wells can be operated by one power on account of the lots being leased by different companies. A correspondent of the Oil City Derrick correctly sized up the situation in this field in March, last, as follows: "The town lot operators who have been attempting to make the West Marion field represent an elongated pepper-box cover are now having time to think it over, and some of the results of their work are apparent. What was once the liveliest portion of the Grant County field is no longer shining as an example of commemorative industry—in fact, West Marion has gone the way of every other town lot development and those who come out on the good side of a bank account will be fortunate.

"During 1902 there was an air of activity about the West Marion field which indicated that it would long hold a prominent position in Grant County reports. Then it was a common monthly occurrence for the pipe-line company to run 50,000 barrels of oil from the field, and some months it went even higher than this. A survey of the pool during the past week revealed some interesting information. As nearly as can be learned, there are 296 wells in that portion of Franklin township extending southward to Mill and westward as far as operations go. Not two-thirds of these

wells have been operated throughout the winter, and at the present day it may be accurately estimated that the production is not running over 875 barrels per day, less than half the runs when the field was new last summer. Some of the operators in the field might have hired one fireman to tend the boilers on half a dozen leases, so closely were they planted. A majority of the wells are included within the area of one section, one mile square, and are located on lots hardly large enough to accommodate a derrick.

"This is the only portion of the Grant County field which is not at present showing a revival of activity after the cold weather. While many of the leases are being gotten into shape for pumping, there is a noticeable lack of new work—and this is not due entirely to the fact that operators haven't the inclination, but in most cases they can not find unoccupied land."

In section 1 some fair producers have been drilled in on the south half, and some light ones on the northwest quarter since the former map was finished. The northeast and the southwest quarters of 2 each have a number of light wells, but the remainder of the northern tier of sections has produced nothing worth noting. Section 11 may be classed as light territory, while the wells drilled in on 12 during the year mostly started at 10 to 30 barrels.

The first well west of Marion was finished on the Sohn lease in 13 in 1901, and the section proved for a time an excellent producer, but most of the bores sunk in 1903 were below the average in initial output and a number of them were dry holes. On the P. Kiley lease, in the southwest quarter, ten wells were averaging a total production of 30 barrels per day in October. An average record of them was as follows:

Drive pipe	80 feet
Casing	375 feet
Top of Trenton.....	917 feet
Total depth	1,062 feet

A dry hole or two was completed on the farm during the year. The northeast quarter of 14 is light, the remainder of the section being barren. A bore drilled 300 feet into Trenton on the Wilcutt lease in the southwest quarter of 15 came in dry. The remainder of the township has produced nothing worth mentioning.

Developments in Mill Township (Sections 25 to 36 of 24 N., 8 E., and 1 to 12 of 23 N., 8 E.) in 1903.—This township, lying southeast of Marion, contains only 24 square miles. It is composed of parts of two congressional townships and hence the sectional numbers are confusing. Most of the drilling for oil in the township was done in the years 1902 and '03. The bores, while showing much gas, were fewer of them dry than in 1901, and enough oil was found to denote that the greater portion of the area will eventually be light to fair productive territory.

Sections 25 and 26, in the northeast corner are as yet credited as gas producing, though but little drilling has been done on the two sections. On the County Infirmary tract, northwest quarter of 27, is one light oil well and one dry hole, the remainder of the section being untested. Section 28 may be classed as fair, though a few dry holes have been opened on its northern half. An extension of the known field was opened up on the E. Thomas farm, northwest quarter of 29, during the year, when a 40-barrel well was finished, but the Wright farm, just north, has produced three dry holes. The north half of 30 has furnished seven or eight light producers; the southeast quarter one gas well, and the northwest corner a dry hole. Another dry hole was drilled on the northeast corner of 25, Franklin township, the two stopping developments in that direction. Section 31, northwest of Jonesboro, is undrilled. The west half of 32 is light territory but the east half is fairly productive. Five wells on the Metzler lease, finished in 1901, were making four barrels each in October, 1903. Two or three dry holes were finished on the Schrader lease, southeast half of the section, but several fair producers both preceded and followed them.

The most of section 33 lies within the limits of Jonesboro and Gas City. The northwest quarter of the section is fair, but wells drilled between the two towns have come in light or as water producers. East of Gas City, sections 34, 35 and 36 have not been tested except for gas. The A. M. Swain farm, on the southeast quarter of section 1, near the east-central border line of the township, produced some fair wells during the year, in territory before considered good for gas only. An average record of these wells was as follows:

Drive pipe	150 feet
Casing	340 feet
Top of Trenton.....	935 feet
First oil pay.....	995 feet
Second oil pay.....	1,015 feet
Total depth	1,055 feet

Section 2 is yet considered gas territory. A dry hole was drilled on the southeast quarter of 3, and as yet the section is unproductive. Section 4 is mainly occupied by the town of Jonesboro. Three dry holes were finished on the Johnson and Jay tract in the southwest quarter, and two light producers a little farther west. Section 5 has proven a very spotted area. A number of dry holes, a few wells and some big salt water pumpers were finished on it during the year. Much trouble has been experienced in drilling several of the wells on account of irregularities in the drift. On the A. S. Jones farm in the northwest quarter a record of the average bore is:

Drive pipe	140 feet
Casing	380 feet
Top of Trenton.....	930 feet
Total depth	1,010 feet

The east half of 6 is light territory, while the west half yields only gas. Section 7 is as yet untested. A number of bores have been sunk on 8 with varying results. On the E. Russell farm, in the northeast quarter, a 45-barrel well was finished in April, its record being as follows:

Drive pipe	70 feet
Casing	350 feet
Top of Trenton.....	925 feet
Total depth	1,042 feet

It was producing 15 barrels in October. The west half of the quarter section is light. The Knight leases on the southwest quarter are fair producers. The southeast quarter is untested. Some dry holes have been finished on the northwest quarter of 9, and a light well or two on the northeast quarter; the south half of the section, as well as all of 10, is undrilled. The northeast quarter of 11 produced two or three fair wells during the year. One on the M. J. Duling lease started at 100 barrels. Others on the same

tract showed much gas and little oil, but the latter will doubtless come when the pressure is lowered. The territory in the region is mainly under lease by large gas companies, which will probably operate it for oil when the lighter fluid is exhausted. A light well or two was finished on the southeast quarter of 11 and a dry hole near the center of the northern half. The Mason farm, in the north half of 12, developed a 30-barrel well during the year, but the gas pressure in other bores sunk in the section was too great to permit of their successful operation.

Developments in Jefferson Township (23 N., 9 E., and Sections 1-6, of 22 N., 9 E.) in 1903.—Up to 1903 this township was one of the big gas producing areas of the State. During the year a number of wells, in different parts of the area began to show oil with the gas, and it will be but a year or two until the greater portion, if not all of the township becomes productive oil territory. The gas pressure in all the wells about Upland on January 1, 1904, was about 140 pounds. T. N. Barnsdell, of Marion, has put in a gas line between Marion and Hartford City and is prepared to take care of all the surplus gas, thus giving the oil men a chance to pump their wells. About 40 strings of tools were in the field on the date mentioned between Gas City and the Renner Stock farm in section 6, Licking Township, Blackford County.

In the southwest quarter of section 3, Jefferson township, just southwest of Upland, a 10-barrel well was finished in October. A bore on the Chas. Brown farm in the northwest quarter of the same section came in as a big gas well with a showing of oil. In section 4 two light oil wells and two gas wells have been drilled in on the Safe Glass Co.'s property and a light oil well on the T. Myers farm in the southwest quarter. Section 5 is as yet gas territory. All of 6, except the northeast quarter, is producing oil; four or five wells on the Parks farm, southwest quarter, starting at 30 to 40 barrels each. An old gas well on the S. Johnson farm was drilled deeper and produced 20 barrels the first day. The north half of 7 produced a 90-barrel well on the J. Johnson lease, and some lighter ones on the H. P. Wilson farm, and a well on the J. Johnson farm, northwest quarter of 8, came in with a fair showing. Sections 8 to 16 are as yet gas producing. Bores on the Fergus lease, near the center of section 17 and the Duling farm, northwest quarter of 19, showed the following records:

	No. 1 <i>Fergus.</i>	No. 4 <i>Duling.</i>
Drive pipe	100 feet	162 feet
Casing	365 feet	375 feet
Top of Trenton.....	886 feet	925 feet
Total depth	911 feet	953 feet

These bores and others in the two sections were gas producing, but their records will show the future oil operators in the region what he has to drill through.

A test well on the E. J. Byall farm, southeast quarter of section 21, finished in August, pumped for a time five barrels of oil against a heavy gas pressure. On the southwest quarter of the same section the Carter lease developed three oil wells and a gas well, the former starting in at 10 to 25 barrels each. Another test on the J. W. Little farm, southeast quarter of 28, was at first thought to be barren, but after drilling 85 feet into Trenton a pay streak 15 feet in thickness was encountered. After shooting with 200 quarts, a gas pressure of 160 pounds developed, but the well produced 60 barrels of oil the first day. It was then shut down on account of the gas. The record of the bore was as follows:

Drive pipe	100 feet
Casing	420 feet
Top of Trenton.....	920 feet
Total depth	1,020 feet

In the southeast corner of the township there are two producing wells on the Millhollin farm, northeast quarter of section 1, which are making about five barrels a day. One of them is a big salt water well, pumping through a three inch pipe. A dry hole has also been drilled on the southwest quarter of section 2.

Developments in Fairmount Township (Sections 13 to 36 of 23 N., 8 E., and 1 to 6 of 22 N., 8 E.) in 1903.—This township first began to show oil in 1902. Most of its area had been under lease for years to glass companies and to corporations under contract to furnish gas to manufacturers. As the gas supply gradually failed a number of the old wells were drilled deeper and when shot and cleaned began to produce oil in paying quantities. The year 1903 showed a great development in the township and proved that its best paying portion is in the southwest corner, where three or four sections have an output above the average. The territory

has proven rather "spotted" but the fair to good wells have held up their production. The greater part of the township will in all probability produce oil in the near future.

On the Duling lease, northeast quarter of 13, in the northeastern corner of the township, eight bores have been completed, but one of which was productive of oil; the remainder being gas wells. An average record showed:

Drive pipe	175 feet
Casing	414 feet
Top of Trenton.....	941 feet

Most of the bores were sunk only 40 feet in on account of the high gas pressure. A number of gas wells are also located on the northeast quarter of 14, but as yet the section shows no oil. Sections 15 to 18 inclusive, have not been drilled for oil. In the southwest quarter of 19 several light wells have been finished, while a dry hole and light producing one are on the southeast quarter. Sections 20 to 23, inclusive, are yielding only gas as yet. The G. E. Duling lease, in the southwest quarter of 24, yielded two light producers which started at about 15 barrels each, but which, after filling a couple of tanks, had to be shut down on account of gas pressure. The record of No. 2 was:

Drive pipe	166 feet
Casing	410 feet
Top of Trenton.....	944 feet
Total depth	1,045 feet

On the Leach farm, in the south half of 25, just north of Fowlerton, a well was drilled in 1901, but was not put to pumping until July, 1903, when it produced two tanks in 40 days. Another bore or two on the same farm came in as light producers. Sections 26 to 28, inclusive are, as yet, unproductive of oil. The Fairmount Glass Works finished a light producer and a gas well on its own property in 29. Section 30 has proven a spotted area. The northeast quarter is undrilled, being a part of Fairmount. The south half of the Seal farm on the northwest quarter has produced four or five light wells. The north half of the same farm has several dry holes. The Winslow lease on the southwest quarter is light producing, but the Oakley on the southeast is better. The first well started at 200 barrels, and held up for sev-

eral weeks, but the next three or four yielded only 5 to 12 barrels initial output. On the Galloway lease of 10 acres in the east half of the northeast quarter of 31, three wells were drilled which were producing about 90 barrels a week in October. An average record of them was:

Drive pipe	25 feet
Casing	380 feet
Top of Trenton.....	930 feet
First oil pay.....	965 feet
Second oil pay.....	995 feet
Total depth	1,030 feet

A number of fair producers were also finished on the Bell and Myers leases, in the west half of the northeast quarter. Bores in the northwest quarter came in light. The southeast quarter produced a dry hole, the southwest a 35-barrel well. Two dry holes were drilled in the southwest quarter of 32 and a gas well on the northeast quarter; while the only bore sunk on 33 was also gas producing. Sections 34, 35 and 36, and section 1 in the southeast corner of the township are as yet classed as gas territory. The south half of section 2 has yielded some fair producing wells, several of which started in at 25 to 40 barrels. The west half of 3 has produced a number of light wells, but the only test on the east half came in dry.

Section 4 has produced more oil than any equal area in the township, but the best wells have been on the south half. On the N. Reif lease of 20 acres in the southwest quarter, three producing wells and two dry holes have been drilled, the average record being:

Drive pipe	98 feet
Casing	380 feet
Top of Trenton.....	966 feet
First oil pay.....	994 feet
Second oil pay.....	1,027 feet
Third oil pay.....	1,051 feet
Total depth	1,071 feet

In the dry holes the Trenton was found very fine and hard. The first producer on the lease was an old gas well which began to show oil in January, 1903. It was then drilled deeper and shot, when it yielded seven tanks of oil the first eight days, or an average of 190 barrels per day.

On the W. H. Fellows farm of 40 acres, in the northeast quarter of the southwest quarter of 4, seven wells were finished during the year, all but one of which were productive, starting in at 40 to 125 barrels each. The average bore showed:

Drive pipe	104 feet
Casing	385 feet
Top of Trenton.....	974 feet
First pay	1,008 feet
Second pay	1,060 feet
Total depth	1,076 feet

The first well was finished in February and the first oil shipped April 1st. The owner, up to October 1st, had received \$1,300 for his royalty of one-sixth, and on that date was averaging \$300 a month. No. 1, on the A. J. Leach farm just south, made a tank a day for 20 days, bringing in the owner \$4,000 for his one-sixth royalty. No. 2 on the same lease started at 90 barrels, while Nos. 3, 4 and 5 were light. The surplus gas from the pool was being piped to Fairmount, but the back pressure had lowered the oil output of a number of the best prospective wells. The texture of the pay streaks in the pool varied from coarse-grained and porous to fine-grained and close, and the output of each well varied accordingly. On the A. R. Dillon farm in the north half of the section, the first well drilled started at 110 barrels, but in two months was down to a 10-barrel producer.

Section 5 is more spotted. The northeast quarter has developed only dry holes, while the Keever farm in the northwest quarter has a 150-barrel well and one or two light ones to its credit. The first wells in this "pool" were drilled in on the Sluder farm in the west half of the southeast quarter and the farm contains six fair producers. The quarter section is fair territory, some good wells having been drilled on the Underwood leases. The Wood farm near the center of the section has proven light. Section 6 has only one or two light wells and a dry hole to its credit. The latter was drilled on the Sell lease, northwest part of the southeast quarter. On the C. Dean lease, a little farther north are several fair producers, No. 3 of which showed the following record:

Drive pipe	25 feet
Casing	280 feet
Top of Trenton.....	945 feet
Total depth	1,038 feet

This bore, when shot, made a tank of oil in eight days.

Developments in Liberty Township (23 N., 7 E., and Sections 1-6, 22 N., 7 E.) in 1903.—The greater portion of this township lies along the western edge of productive territory. Only its eastern and southern portions have yet produced oil in commercial quantities. During the year a dry hole was completed on the northeast quarter of section 12, and two light producers on the southeast of 24. The east half of 25 has produced some fair wells. About a dozen were drilled on the M. L. Gaddis lease where the top of Trenton was found at 940 to 950 feet. The Hodson lease, a little northwest, yielded ten wells, nine of them being producers; and the John Seal farm, in the northeast corner of the section, five which were above the average. A bore on the Davis lease in the southeast quarter of 26 resulted only in a small amount of gas. Tests on the Coomler and Rich leases in the northeast quarter of 27 resulted in dry holes, which stopped drilling in that direction. Drilling in 36 has been confined to the northeast quarter. Two light producers and one which started at 60 barrels were completed on the R. Lindley farm in the northeast corner, but two bores on the Cox lease just to the west came in dry. On the Brookshire lease, in the northwest quarter of section 1, in the southeast corner of the township, a bore was drilled for gas in 1901, which partially filled with oil, but yielded neither gas nor water. In November, 1903, it was drilled deeper and started with an output of 25 barrels. Its record was as follows:

Drive pipe	80 feet
Casing	380 feet
Top of Trenton.....	945 feet
Total depth	1,010 feet

This well was the farthest southwest of any producing oil in the main Indiana field on January 1, 1904. A gas well on the Call lease, southwest quarter of section 3, has shown signs of oil for some time, but has not been drilled deeper into Trenton in search of it.

Pleasant Township.—A test bore, one and a quarter miles northeast of Jalapa, on the D. Steuben farm, northwest quarter of section 10, Pleasant township, Grant County was finished in December, and came in as a light producer. A previous test sunk in the same vicinity in 1901 made a good showing, but was drilled in too deep, and the oil drowned out by salt water.

Sims Township.—Two bores have been sunk on the King lease in the northwest quarter of section 12, Sims township, Grant County, in both of which a small quantity of oil was obtained. The pay was found from 88 to 98 feet in Trenton. One of the wells was drilled 141 feet in and struck a large salt water vein. It was pumped three months and then plugged and the lease abandoned. A half tank of oil was obtained from the two wells.

During the year 1903, 1,383 bores were sunk for oil in Grant County, or nearly twice as many as in any other county in the State, Wells County standing second with 735 bores to its credit. Of the 1,383, 94, or 6.8 per cent., were dry. The average initial output of the producing wells was 15.1 barrels as against 18.5 barrels in 1902. The number of bores sunk in the county was 333 more than in 1902, while the number of dry holes was 14, or 3.4 per cent., less than in that year.

BLACKFORD COUNTY

comprises but 167 square miles, embraced in four civil townships. It lies west of Jay, south of Wells, east of Grant and north of Delaware counties. The surface is for the most part level or slightly rolling, the only hills being due to the eroding action of water. The soil, like that of the surrounding counties, is fertile, being of glacial origin and containing, therefore, all the constituents needed by the cereals and grasses. The principal products are the standard cereals, wool and live stock.

The Salamonie River flows diagonally across the northeastern township and with its tributaries drains the northern half of the county; while Lick-Creek, a tributary of the Mississinewa, drains the southern half.

The Fort Wayne, Cincinnati & Louisville Railway crosses the county from north to south, and the Pittsburgh, Cincinnati & St. Louis from northwest to southeast, the two crossing at Hart-

ford City, the county seat. The former is paralleled by the Muncie, Hartford City and Fort Wayne Traction line. The population of the county in 1900 was 17,213 as against 10,461 in 1890, the increase being mainly due to the oil and gas developments over its area during the interim.

The elevations in feet above tide of the principal railway stations in the county are as follows: Hartford City, 887-901; Mill Grove, 931; Montpelier, 867; Renner, 907.

About two-thirds of the county is at present producing oil, Washington township, in the northwest quarter, ranking among the best productive territory in the State. Harrison township contains as yet much gas territory. Montpelier, near its northern boundary, being the closest railroad town to the rich fields of the southern part of Wells County has, for a number of years, been one of the principal oil centers of the Indiana field. From it most of the drillers and operators of Wells and Blackford counties draw their supplies, and several Eastern companies which manufacture such supplies have branch houses located in the town.

Developments in Harrison Township (24 N., 11 E. and Sections 6, 7, 18, 19, 30 and 31, 24 N., 12 E.) in 1903.—This township comprises 42 square miles, 27 of which are producing oil in commercial quantities. But few changes are necessary in the three northern tiers of sections on the new map. Some abandoned territory in sections 3 and 4 has been released and proven profitable.* Section 6, in the northwest corner, has developed into fair territory in recent years; while the south half of 7 has become good, a second pay streak having been found in the later bores at a depth of 60 to 70 feet in Trenton. The wells in 8 have fallen from good to fair producers. The southeast quarter of section 10 embraces the only unleased area in the northern part of the township, the owner holding out for a larger royalty or bonus than has been offered. A dry hole was drilled in the northwest quarter of 14 and a gas well on the Blount lease just to the east. The northwest quarter of 17 remains undrilled and the southwest quarter contains but a few light wells. The gas pressure is still high in section 18, registering

*See ante p. 93, under "Condemned Territory."

140 pounds on the Hart lease in October. However, some fair wells were finished on the area during the year and the whole section may now be classed as fair. A number of bores have been sunk on 20, but for the most part they have proven very light or dry. The only production is from two light wells on the west half of the northeast quarter. Sections 21 to 24 have not, as yet, proven much better. The north half of 21 has a few light wells and the southwest quarter three dry holes, while two gas wells and a few dry holes are the only results of drilling in 22. In 23 one gas producer and in 24 two dry holes have been sunk in recent years. Sections 25 to 30 are still, for the most part, gas yielders. In 25 there is one small oil producer on the Jackson lease in the southeast corner, and in 26 one of a similar kind in the southwest quarter. Section 31 has developed a number of fair producing wells, though two dry holes have been sunk on the northeast quarter. On the Woodward lease, northwest quarter, one well started at 75 barrels and held up for three months, then gradually dropped to 7 barrels. Its record showed:

Drive pipe	275 feet
Casing	380 feet
Top of Trenton.....	980 feet
Total depth	1,060 feet

The first pay was struck at 37 feet and the second at 70 feet in Trenton. The bore is located just on the edge of the "deep drive."

Sections 30 to 36 inclusive are to be classed as dry or salt water territory. The only productive bore in them was finished in January, 1903, on the east half of the southwest quarter of 32. Here, on the Martindale farm, a bore was sunk which developed a large vein of salt water at 50 feet in Trenton. After pumping five days the water began to color up and the well made six tanks of oil in a month and averaged 40 barrels a day for six months. Its record showed:

Drive pipe	135 feet
Casing	315 feet
Top of Trenton.....	975 feet
Total depth	1,025 feet

Four dry holes were soon bored just around it and a light gas producer was finished 600 feet to the west.

Developments in Washington Township (24 N., 10 E.) in 1903.—This township has a record for bringing in good producers in unexpected localities. A number of them were finished in 1903, and the township produced more oil than all the rest of Blackford County. Developments since the last map was issued have made necessary a number of changes in the then productive sections, while a number then marked as untested have become producers.

The wells in section 1, the south half of 2 and all of 3 and 4 have dropped down from good to only fair average producers, the initial output being much lower than when the area was first opened up. All of section 6 has become fair territory. A bore on the C. Woodward lease in the northwest quarter came in as a 150-barrel producer and made 100 barrels a day for more than a week. All of section 7 has produced fair average wells. Bores sunk in recent years have reduced the standing of 10, the northeast quarter being classed as light, the remainder as fair. The south half of 11 has changed from barren to fair producing territory. Section 12 has fallen back, most recent bores coming in light and reaching a settled production of 2 barrels per day in a week. The older wells in 13 are slowly being abandoned, but the new ones are coming in with a fair average initial output. Section 14 has been pretty thoroughly tested. Some good wells have been finished on the southwest quarter, but the remainder of the section is light and some of the wells yet show a high pressure of gas when first completed. The bores over the greater parts of 15 and 16 come in as fair producers, those on the southeast quarter of each section being lighter. On the Harold farm, southeast of 16, the average record shows:

Drive pipe	200 feet
Casing	365 feet
Top of Trenton.....	970 feet
Total depth	1,050 feet

There are six wells on the farm which came in as 5 to 8-barrel producers and dropped to a settled production of 2 barrels per day in a month. Section 17 has become good territory, ranking up with 18 on the west. No. 2 on the J. Futrell farm, west half of the northeast quarter of 18, proved to be the banner oil well

of Blackford County in 1903. It was finished September 25th and started at 275 barrels. The first 32 days that it was pumped it yielded 36 tanks, or a total of 9,000 barrels, for which the company operating it received \$11,970. Of this one-sixth, or \$1,995, went to the farm owner as royalty. The well, on January 1, 1904, was producing 35 barrels per day. Its bore showed:

Drive pipe	442 feet
Casing	444 feet
Top of Trenton.....	1,016 feet
Total depth	1,081 feet

Good paying sand was found from 20 feet in Trenton to the bottom, or a pay streak 45 feet thick, a very unusual occurrence in the history of the Indiana oil industry. Not over 10 barrels of water a day was pumped from the bore. The latter probably struck the center of a small area or pool of very porous Trenton, in which the oil had accumulated. Section 19 remains as before marked. The famous well drilled in on the E. C. Storms lease, west half of the southeast quarter of 19, in 1898, which started at 350 barrels or more and pumped a tank a day for several months, finally went off into salt water and was abandoned for 18 months. In April, 1903, the lease was bought by a new company, the well cleaned out, and put to pumping with a gas engine. It pumped only water until September 15th when the fluid began to color up, and for two months it made 60 barrels of oil a day. The record of its bore was:

Drive pipe	180 feet
Casing	365 feet
Top of Trenton.....	972 feet
Total depth	1,033 feet

Other abandoned territory on section 19 has been recently redrilled with good results. (See p. 93.) Section 20 remains light, but 21 has become one of the best areas in the township. A bore on the J. B. Scott lease started in at 300 barrels and was making 180 when it was six days old. Another bore on the same farm came in at 180 barrels. The bores on 22 usually come in as fair producers, 15 to 40 barrels each, but settle down rapidly to 3 to 5 barrels. The northeast quarter of 23, marked as gas territory on the former map, has developed some fair wells,

but the remainder of the section is light, as is also all of 24. The "deep drive" covers most of 25. The southwest quarter has proven barren. The bores on the other quarters come in as light producers with a quantity of gas. Section 26 has developed into fair territory. The "deep drive" covers a part of 27, but most bores sunk through it on this section have proven fair producers. No. 1, on the H. Carrull farm, west half of the northeast quarter, was commenced in April and not finished until July, trouble being experienced in landing the drive-pipe on the Niagara stone. The drive in this bore was 455 feet and no casing was used, as the Niagara was but two feet in thickness. In the deep drives in this vicinity much trouble is experienced with boulders between 200 and 350 feet below the surface, and also in passing through a sticky red clay below the boulders, which reaches to within 15 feet of the limestone. The well started at 60 barrels when completed. The southwest quarter of 27 is lighter, as is also the adjoining southeast of 28; the remainder of the latter section being better. On the Long lease, southwest quarter, are 15 bores, 12 of which are producing oil, two gas, and one dry hole. An average bore shows:

Drive pipe	185 feet
Casing	365 feet
Top of Trenton.....	965 feet
Total depth	1,045 feet

All were drilled in 1903, and the 12 producers were averaging five barrels each in October. Sections 29 and 30 are mostly light. Several bores have been abandoned in the northeast quarter of 30. Section 31 and the greater part of 32 are as yet gas territory. The northeast quarter of 32 has developed a dry hole and two light wells. The wells on the north halves of 33, 34 and 35 are fair; those on the south halves are generally light producers. The southeast quarter of 35 and most of 36 have, as yet, produced only gas.

Developments in Licking Township (23 N., 10 E. and Sections 1-6, 22 N., 10 E.) in 1903.—This township has, up to the present, proven a great disappointment to oil operators. It was thought, after the Hartford City pool was opened up in 1900, that a wide extension of good productive territory would be ulti-

mately developed south and southwest of that city, but the drill has, so far, failed to locate it. Most of the bores sunk have come in dry, as water wells or as small producers. The pool in the northwest part of the Hartford City limits had the history of all other town-lot pools. While some good wells were opened, their production rapidly dwindled and, as but two or three could be hitched to one power, all but six or eight of them were finally abandoned. While 70 per cent. of the wells in the pool probably paid out, not over five per cent. made a profit. The best lease in the pool was the 40 acres of Widow Downey. On it five bores were sunk, two of which came in dry. From the other three, located on five acres of the lease, \$70,000 worth of oil was sold, and the three, when four years old, were still producing 25 barrels a day in November, 1903. Such results, more than anything else, show the gambling feature of the oil industry in Indiana.

Taking up the productive area of Licking township by sections, we find that section 1 is a spotted area. One big salt water well on the north side of the S. Carrell lease made 100 barrels a day for a time, but on the south side of the same farm only gas has been found. All of 2 and three-quarters of 3 are light territory; the northwest quarter of the latter section being better. The east half of four contains a few light producers, but only a few light gas wells have been drilled on the west half and on 5.

The Renner stock farm of 540 acres, comprising the greater part of 6, has recently developed three wells, the average initial output of which was about 15 barrels. A gas well on the Townsend farm, southeast corner of the same section, was recently drilled deeper and shot when it made 10 barrels of oil and a fair supply of gas. No. 2 bore, on the same lease, came in as a 5-barrel producer. A small oil well has been drilled on the Rogers lease, northeast quarter of 7, and some gas wells with a showing of oil on the Smith, in the northwest quarter. Section 8 is unproductive, while 9 has only a few light wells on the northeast quarter. The north half of 10 comprises the Hartford City pool, and may yet be classed as fair. The Johnston Window Glass Company, drilled in a dry hole and a 5-barrel well on its lots in this area in 1903. The northeast quarter of 11 may be classed as light, while 12 and 13 as yet produce only salt water. One or two very light producers have come in on the

northeast quarter of 14, but all bores on 15 have proven barren. The east half of 16 is light productive territory and a small well has recently been finished on the Johnson lease in the northwest quarter of the same section. Several gas wells on the southeast of 17 have sprayed oil from time to time, but as yet there is no producing well on the section. A test well on the Stanley farm, northeast quarter of 18, came in as a 6-barrel producer and two gas wells on the Williams, northwest quarter of 19, contain more or less oil which has not been pumped. Section 20, as yet, has shown no signs of oil, but a gas well on the Chapman farm, northwest quarter of 21, has sprayed it in quantity. On the Swift lease, southwest quarter of 22, are several light wells, and on the Drayer, southeast quarter, a bore drilled for gas came in as a 50-barrel producer. In section 27, just south, two bores were sunk, one of which yielded a small amount of oil while the other was barren. Tests on the Moonan farm in the southeast quarter of the section yielded gas only. The remaining sections of the township are wholly unproductive of oil, though a number of them still produce gas.

Developments in Jackson Township (23 N., 11 E.) in 1903.—Although this was counted one of the best gas producing townships in the State, but a few sections in the northwest corner have yielded oil. Where the gas has been exhausted, salt water seems to have taken its place. Therefore the chances of successful drilling for oil over the greater part of its area seem at present very slight.

In section 5 two dry holes have been drilled in the northwest quarter, while a bore sunk 250 feet into Trenton, on the Taylor lease near the center, developed only a little gas. Section 6 has produced a number of light wells. Four on the Hemminger, in the northeast corner, came in with an initial production of 10 barrels and soon dropped to 3 or 4 barrels. On the Hiatt farm, on the northwest quarter, are four big salt water wells, each pumped with a separate power and with a three-inch tubing to carry off the water. The four, in November, were making about 30 barrels per day. An average record shows:

Drive pipe	116 feet
Casing	320 feet
Top of Trenton.....	965 feet
Total depth	1,023 feet

The Stroble lease, in the southwest quarter of 6, has developed two dry holes and two light wells. One light producer has been finished on the northeast of 7, the remainder of the section being barren. A test on the Wingate farm on the south half of 10 brought a bountiful supply of salt water at 35 feet in the Trenton; while another on the southwest of 14 came in wholly dry. A bore which showed a large quantity of oil was finished on the Wentz farm, southwest of 17, but it was plugged on account of a too bountiful output of gas. Two gas wells were also sunk on the southwest quarter of 18 during the year. The remainder of the township is either untested or gas territory.

JAY COUNTY

comprises an area of 370 square miles, lying adjacent to the Ohio State line, south of Adams and Wells, north of Randolph and east of Blackford and Delaware counties. The surface of the county is gently rolling or nearly level, and the soil of most portions proves very fertile where properly drained and tilled. The Salamonie River flows through the county from southeast to northwest and drains its western and southern halves. The Wabash River touches its northeastern corner and through its tributaries drains the townships of Wabash, Bear Creek and Jackson.

The G. R. & I. Railway, passing north and south through the center of the county, crosses the L. E. & W. main line, running east and west, at Portland, the county seat. The P., C. & St. L. crosses the southwest corner of the county, passing through the thriving towns of Dunkirk and Redkey, so that the facilities of transportation in all directions are excellent. The population of the county in 1900 was 26,818 as against 23,478 in 1890.

The elevations above sea level of the principal railway stations in the county are as follows: Blaine, 930; Briant, 869; Brice, 924; Como, 949; Dunkirk, 946; Portland, 909; Powers, 991; Redkey, 966.

During the year 1903 Jay County forged rapidly to the front as an oil producer. Quite an area of new territory was opened up in Wabash and Bear Creek townships, while several light

producing wells in Wayne and Noble townships bring a portion of their area within the limits of future prospective territory. But few leases have been abandoned in the county since the former map was issued, and most of these abandoned leases have been released and are being redrilled. During the year 213 bores were sunk in the county as against 94 in 1902, a gain of 127 per cent. Of the 213 bores, 33, or 15.5 per cent., were dry, the percentage showing a decrease of 5.5 from the previous year. The average initial output of the new wells in the county was 13.4 barrels as against 14.1 in 1902.

Developments in Wabash Township, Sections 3 to 10, 15 to 22 and 27 to 34 (24 N., 15 E.) in 1903.—This township comprises only 24 square miles, in the northeastern corner of Jay County. The area of producing territory in southern Jefferson township, Adams County, shown on the former map, has been extended southward, and covers parts or all of seven sections in Wabash township. Several fair producing wells have been finished in the north half of section 4 and some lighter ones in the north half of 5. Section 6 and the east half of 7 is fair productive territory, while the west half of 7 has yielded a number of good wells. The average bore in these sections shows:

Drive pipe	40 feet
Casing	290 feet
Top of Trenton.....	1,025 feet
Total depth	1,115 feet

A number of light to fair producers have come in on the north half of 8 and one or two on the southwest quarter. A dry hole was bored on the Bricker lease, northwest quarter of section 17, and another on the Miller lease in section 30. The northeast quarter of 18 is light territory, but the west half of the section is better, as is also the northwest quarter of 19. In sections 18 and 19 the drive pipe runs from 80 to 300 feet, the top of Trenton being found at about 1,040 feet.

Developments in Bear Creek Township (24 N., 14 E.) in 1903.—Of the 36 square miles embraced in this township, 17 are at present producing oil in commercial quantities. Quite an area of new territory was opened up in the northeast corner of the township during the year.

Section 1 and the north half of 2 embrace some fair productive territory, but the south half of 2 is lighter, tests on the Macklin and Bloom leases in that area coming in dry. A few light wells are yielding on the southeast quarter of 3, the remainder of the section being undrilled. The west half of 4 has some fair wells to its credit, but all new bores recently sunk on section 5 have proven light; while those on 6 are coming in only as fair producers. A bore on the southeast quarter of 6, completed November 6th, yielded quite a quantity of gas instead of oil, the rock pressure starting at 130 pounds, but soon falling to 20 pounds. The record of the bore shows:

Drive pipe	115 feet
Casing	238 feet
Top of Trenton.....	1,087 feet
Total depth	1,157 feet

The portion of 8 marked as undrilled on the former map at present contains some light to fair wells, while a test on the Chaney lease on the southeast quarter of 9 started at 5 barrels. The northeast quarter of 10 produced one or two light wells during the year, as did also the northwest of 11. Several fair producers have been finished on the northwest and southeast quarters of section 12. An average bore of these shows:

Drive pipe	40 feet
Casing	260 feet
Top of Trenton.....	1,034 feet
Total depth	1,107 feet

The pay streak is struck about 15 feet in Trenton and is usually softer and more porous than in the counties to the west.

The wells on the east half of 13 and the northeast quarter of 24 are light to fair producers. The west half of 16 and the east half of 17 are now producing some oil, though at one time a number of dry holes were drilled on them. A test bore on the Bishop farm, northwest quarter of 20, showed up dry, as did another on the Francks lease in section 26 near West Chester. The remaining sections of the township remain either undrilled or as shown on the former map.

Developments in Jackson and Penn Townships (24 N., 14 E. and 24 N., 13 E.) in 1903.—But few changes are necessary

in the old map in these two townships. The north half of Jackson still retains its record as the best productive territory in Jay County, while the southern half remains very spotted. Recent bores in section 6 have proven light. Some of these are on the south half, hitherto undeveloped. Section 7, being in the deep drive, is yet untested. A dry hole was sunk on the Williams, southeast quarter of 8, during the year. The east half of 9 is now fair territory, while the south half of 13 has come in with several good wells. A dry hole was drilled on the northwest quarter of 15; while a test on the Ganey lease, north half of 25, was a 5-barrel producer. A dry hole was also completed among some gas wells in the northeast quarter of 32, but the southeast quarter of that section is now lightly productive, as is also the southwest of 33. A light well has also been finished in the southeast quarter of 36.

The territory in Penn township has, in the past, been distant from railway facilities, and many farms which doubtless contain oil beneath their surface have, for that reason, not been tested. A new railway has just been completed from Camden (Pennville) to Portland, which will doubtless prove a factor in causing more extensive operations in that portion of Jay County.

The lob or "deep drive" runs through both Jackson and Penn townships, and renders drilling very tedious and often expensive. It is not uncommon to use 400 or more feet of drive pipe in a number of the bores sunk in it before striking limestone. As a result, the region of the lob has been avoided, but since the wells hitherto sunk near it have mostly come in as fair to good producers the present high price of oil will doubtless lead operators to take the risk, and a number of the untested sections in Penn township will in the future become productive. But few bores were sunk in the township during the year. Two tests on the Gray farms, west half of 12, proved dry, as did another on the Brown lease, southeast quarter of 14. Old gas territory in the southeast quarter of 27 produced a fair well or two; as did similar territory in the southeast quarter of 30. With the exception of three wells in Pike township, the four townships above mentioned comprise the only area in Jay County at present producing petroleum in commercial quantity. A number of test bores sunk in other portions of the county during the year were

as follows: In Wayne township, sections 5, 6, 10, 21, and 26, had a bore or two sunk on them, all of which made a showing of oil, sufficient to insure more extended operations in the future.

In Noble township a bore sunk on the southwest quarter of section 27 developed a small well. In Pike township, the three wells on the Ware and Lush leases in sections 8 and 9, sunk in 1901, are still producing 4 or 5 barrels; while a test put down on the northeast quarter of section 34 has recently come in as a small producer.

During the latter part of the year four or five fair producing wells were finished near Redkey, on sections 24, 25 and 36, Richland township. Two of these on the W. Barnell lease, southwest quarter of section 24, started at 25 barrels each, their record showing:

Drive pipe	135 feet
Casing	285 feet
Top of Trenton.....	964 feet
Total depth	1,040 feet

It is probable that a large portion of this township may become productive in the future, thus serving to connect up the Jay County territory with that now yielding oil in Monroe township, Randolph County.

According to records gathered by Benjamin Fulton, one of the most experienced operators in Jay County, he gives it as his opinion that "There is a ridge of Trenton lying between Redkey and Portland and between Redkey and Camden or Pennville, which seems to be too high for oil. Every well around the edges of this ridge where the Trenton was found as low as 950 feet, showed indications of oil. However, where the Trenton was found at shallower depths, nothing but gas was obtained. This ridge comes within three miles of Portland on the west and southwest, and at Portland Trenton is found at 985 to 990 feet; four miles south of Portland at 1,050 feet, and two and a half miles northwest and two and a half northeast of Portland, at 1,030 to 1,045 feet. In section 27, Noble township, Trenton was found at 1,045 feet. In section 21, Bear Creek township, at 1,040; in section 25, Jackson township, at 1,030; in section 24, Green township, 970 to 980. From this data of depth. I will

go on record that the oil field will extend eventually clear through Wabash, Bear Creek, Noble, Wayne, Pike, Jefferson and Madison townships in Jay County, and connect up with a new field that will open up in Randolph County."

MADISON COUNTY

lies south of Grand and west of Delaware and Henry counties. It comprises an area of 460 square miles, the surface of which is level or gently rolling. The drainage is to the southwest by way of White River, which crosses the county from east to west near its center, and has numerous tributaries permeating all portions of its area.

The railway facilities of the county are ample, the Michigan Division of the Big Four passing through it from north to south while the Cleveland Division connects Anderson, the county seat, with Muncie and Indianapolis. The P., C., C. & St. L. crosses the county diagonally from northwest to southeast. The Chicago and Southeastern (old Midland) crosses the county from east to west near its center and the L. E. & W. runs across its northern third. Besides these, the lines of the Union Traction Company run in various directions from Anderson.

The discovery of natural gas over much of its area about 1885 led to a rapid growth in its wealth and population. The towns of Elwood, Alexandria, Summittville and Frankton in the northern half, which had before ranked only as country villages, rapidly assumed the size and prerogatives of cities, while Anderson, the county seat, almost doubled in size. The phenomenal growth of these places in ten years may be seen by the following comparative table of population:

	1890.	1900.
Alexandria	715	7,221
Anderson	10,741	20,178
Elwood	2,284	12,950
Frankton	520	1,464
Madison County	36,487	70,470

The elevations in feet above sea level of the principal railway stations in the county are as follows: Alexandria, 855; Anderson, 854-894; Chesterfield, 907; Elwood, 862; Florida, 881; Frankton, 834; Gilman, 901; Orestes, 871; Pendleton, 847; Summittville, 879.

Only the northern third of Madison County has produced petroleum in paying quantities; and that only in limited areas in Boone, Van Buren and Monroe townships. In the first two mentioned the developments were mainly during the year 1903, but about Alexandria, Monroe township, a number of wells have been producing since 1898. These three townships have been large gas producers in the past, and there is little doubt but that they will develop many paying oil wells in the near future. Outside of their area the chances of opening up productive territory in the county seem small.

Developments in Boone Township (Sections 7 to 36, 2 N., 7 E.) in 1903.—In this township I could learn of but two bores in which oil had been obtained. One on the Howard lease, north-east quarter of section 9, is said to contain several hundred feet of oil. It was sunk for gas and penetrated the Trenton only 32 feet, the top of that formation being struck at 972 feet. One-half mile west, in the northwest quarter of the same section, a well on the J. Campbell lease has been pumping a small quantity of oil for some months, and in October had filled nearly a tank.

Developments in Van Buren Township (Sections 7-11, 14-23, 26-35, 22 N., 8 E.) in 1903.—This township has up to the present produced oil only in the northern tier of sections; 7-11, next to the Grant County line, and in 21, just east of Summittville. In the northeast quarter of section 8, several bores, yielding only gas, were sunk on the Sluder lease in a vain endeavor to extend the Fairmount township, Grant County pool in that direction. The C. S. Wood farm, in the southeast corner of 10 developed one or two light wells, but three bores sunk on the C. M. Leach lease in the northwest quarter found gas alone.

Quite a pool of fair productive territory has been opened up in section 11. The wells mostly came in good for 10 to 30 barrels initial output, though a few of them were better. About 30, scattered over the section, were completed by October. An average record ran about:

Drive pipe	180 feet
Casing	380 feet
Top of Trenton.....	978 feet
Total depth	1,062 feet

In section 20, near Summittville, a dry hole was located on the Vardeman lease. In 21, just east of that town, several productive wells and dry holes have been drilled. The Crystal Glass Company owns two of the producers. No. 1 was drilled for gas on a town lot of their property in the northwest quarter of the section in April, 1902. It came in as an oil producer, starting at 120 barrels. At the end of two months it was cleaned, when it made 175 barrels for a few days. The Standard put in a line and piped the oil to Montpelier. The output gradually decreased, and after producing about 8,500 barrels the well ceased to yield. A record of its bore showed:

Drive pipe	140 feet
Casing	400 feet
Top of Trenton.....	951 feet
Total depth	1,077 feet

The first pay was found 40 feet, and the second between 70 and 80 feet, in Trenton. The second bore of the same company, half a mile east on the northeast quarter of the section, was finished in October, 1903, and started at 50 barrels, but was down to 3 barrels in two weeks. A bore 1,500 feet northwest of No. 1 was sunk 165 feet in the Trenton but was dry. Another a little farther northwest, on the Cowgill lease, in the southeast quarter of 17, was also dry.

On a town lot just south of the schoolhouse, in the eastern limits of Summittville, a bore sunk for gas in 1902 began to show oil and in the spring of 1903 was drilled deeper and shot. It started at 120 barrels and produced 11 tanks, when it ceased to yield. Its bore showed:

Drive pipe	120 feet
Casing	440 feet
Top of Trenton.....	940 feet
Total depth	1,042 feet

A dry hole was drilled 50 yards west and another 300 yards northeast, while a small producer was finished 50 rods east which was making 5 barrels a week in October. This shows the spotted nature of the Trenton in the section. Scattered bores sunk over the remainder of Van Buren township have developed only gas; though most of them have been drilled only a shallow depth into the Trenton.

Developments in Monroe Township (Portions of 21 N., 8 E. and 21 N., 7 E.) in 1903.—This is the township in which Alexandria is located, and in the immediate vicinity of that place a number of wells have been producing since 1899. The high gas pressure has interfered greatly with their operation and the drilling of a number of dry holes has not added prestige to the region. As a consequence a large number of the wells first in operation have been abandoned. However, a number of light producers were finished in the township during the year, so that the annual output of the field has been maintained.

In section 10, one bore which yielded 50 barrels, natural flow, the first day, was finished on the Hughes lease, while others on the same farm came in very light, or dry. A dry hole and a small well or two were completed in the northwest quarter on the Baker lease, and a fair well in the northeast quarter on the Markle farm. The latter, when finished in August, started at 50 barrels and was down to 10 barrels by January 1st. One or two bores in the northwest of 13, just west of Alexandria, were dry or very light. On the southwest of section 15, four miles east of Alexandria, a test on the Swindell farm in comparatively new territory came in for 75 barrels. The southeast quarter of 17 produced two fair wells and a dry hole. A test on the Miller lease in the northeast quarter of 22, (21 N., 7 E.) started at 50 barrels, while a second bore is said to have been a little better. Two or three fair wells and a dry hole were also finished on the northeast quarter of 29. Of the 34 bores finished in the township during the year, 14, or 41 per cent., were dry; while the 20 producing wells had an average initial output of but 9 barrels, so that the Alexandria field was not remarkable for its record during the year. The output of the field by months during 1903 was as follows:

PRODUCTION OF THE ALEXANDRIA, INDIANA, OIL FIELD BY MONTHS FOR THE YEAR 1903.

	<i>Barrels.</i>
January	16,742
February	17,382
March	22,903
April	18,760
May	22,424
June	22,717
July	25,914

August	26,345
September	25,214
October	26,505
November	24,310
December	22,667
Total	271,883

On the William Shafer farm, southwest quarter of section 24, Duck Creek township, three and a half miles east and four miles north of Elwood, The Pittsburgh Plate Glass Company drilled a well in October, 100 feet into Trenton rock. It came in with an initial production of 20 barrels. The well has since been shut down, as the company claims that it did not pay to operate it. On the same farm, 500 feet south, the same company drilled a well 300 feet in the sand. They found gas and a little oil at 65 feet, but nothing from there on, and the well was abandoned. The record of its bore showed:

Drive pipe	36 feet
Casing	228 feet
Top of Trenton.....	938 feet
Total depth	1,238 feet

DELAWARE COUNTY,

comprising an area of 399 square miles, lies east of Madison, north of Henry, south of Grant and Blackford and west of Randolph and Jay counties. Its soil is of drift origin and very diversified, but is, for the most part, noted for its fertility. White River crosses the county from east to west a little south of the center, and together with its tributaries drains the southern two-thirds. The Mississinewa, flowing in a northwesterly direction, crosses the northeastern fourth and, with its tributaries, furnishes ample drainage for the northern third.

The transportation facilities of the county are most excellent. The Cleveland Division of the Big Four; the Lake Erie & Western; the Chicago, Cincinnati & Louisville, and the Ft. Wayne, Cincinnati & Louisville, all intersect at Muncie, the county seat, and from that point diverge in all directions. Besides these, the Chicago, Indiana and Eastern from the northwest and three interurban traction lines, two running west, and one north, have their terminals in Muncie.

The discovery of natural gas over the larger portion of Delaware County and a consequent increase of large and important manufactories, led to a rapid growth in population. The increase from 1890 to 1900 of the three larger towns, as well as of the county, is shown as follows:

	1890.	1900.
Muncie	11,345	20,942
Albany	571	2,116
Eaton		1,567
Delaware County	30,131	49,624

The elevations in feet above tide of the more important railway stations in the county, are as follows: Albany, 939; Cammack, 931; Daleville, 910; De Soto, 956; Eaton, 910; Gilman, 901; Muncie, 950; Oakville, 1,008; Reeds, 929; Royerton, 928; Selma, 1,005; Shidellers, 911; Yorktown, 924.

While Delaware County is not, as yet, noted for its output of petroleum, it promises much for the future. Washington township, in the northwestern corner, has been producing more or less since the first wells came in near Gaston in 1897. The gas pressure in that part of the county has, however, for the most of the time since, been too high to permit of the lawful securing of the oil. Liberty and Delaware townships east and northeast of Muncie have been the scene of extensive operations for several years, while more recently, that portion of Center township just northeast of the city limits has developed a number of producers. All the area tested in these three townships seems, however, to be very spotted territory, and up to the present the chances of securing a dry hole or a fair producing well are about equal. The field is remarkable in that three or four bores sunk during the year developed a pay streak rich in oil at 240 or more feet in the Trenton. Isolated bores in other sections of the county have from time to time developed a fair showing, and the greater part of the northern half of the county will eventually produce more or less oil. But it is doubtful if the industry in Delaware County ever reaches the magnitude it has assumed in Grant, Wells, Blackford and other counties, to the north and northeast.

Developments in Washington Township (Sections 7-36, 22 N., 9 E., and 12, 19, 24, 25 and 36, 22 N., 8 E.) in 1903.—The first producing wells in this township were drilled in on the W.

H. Broyles lease, northeast quarter of section 36 (22 N., 8 E.) in the fall of 1897. They produced large quantities of both gas and oil, and were closed by injunction on March 12, 1898. Four wells, located on adjoining farms to the south were closed at the same time. The three wells on the Broyles lease struck Trenton at 940, 935 and 933 feet respectively. In October, 1900, Howland & Company put down a fourth well, 24 rods north of No. 2, striking Trenton at 937 feet. In order to shut off the gas they used ten-inch drive pipe and six and a quarter inch casing. Inside of the latter, five and five-eighth-inch casing was used clear down to the oil. Two pay streaks yielding gas were found, the first 25 to 45 feet, the second 65 to 80 feet in. The inner casing was sunk to a depth of 1,019 feet, or below the gas "pay." A packer was put in below the gas and one above. Below the gas, 18 feet of oil rock was found, the oil being raised through two-inch tubing without waste of gas. The outfit was quite expensive, but, was, for a time, fairly successful, the output of the well being about 40 barrels daily, which flowed by heads. An arrangement was utilized by which enough gas for running the engines was secured from the supply held between the packers. After the well had been pumped a while the oil became partially exhausted for a distance around the foot of the bore and the gas found its way down and up inside of the tubing, the experiment thereby proving a failure. Mr. Broyles received from Howland & Company \$2,000 bonus and one-sixth royalty for 82 acres of his farm, and the same amount for a second 80 acres, from the American Window Glass Company, the latter company agreeing to pay also \$100 per year for each gas well drilled, from which the gas was piped away for use. Most of the bores since sunk on the lease have proven small gas producers.

The only new bores sunk in the township in 1903, were on the north half of section 12 (22 N., 8 E.), where eight were finished on the Couch and Richards farms. Much trouble was experienced in some of them with both salt water and gas. Seven of the eight came in as producers, the average initial output being 12 barrels. The best of the wells started at 25 barrels, while one bore yielded only gas. This is an eastward extension of the pool in the northeast corner of Van Buren Township, Madison County.

Developments in Delaware Township (Sections 1 to 25, 21 N., 11 E.) in 1903.—The first producing oil well sunk in this township was finished in 1901, on the Krohn farm, southwest quarter of section 11, and a mile southwest of the town of Albany. Trenton rock was struck at 925 feet and penetrated 50 feet. The bore yielded 60 barrels of oil and a large amount of salt water the first day it was pumped. Two other bores sunk in 1901 in the same vicinity proved dry.

During the year 1903, 17 bores were finished in the township. Of these nine, or 53 per cent., came in dry. The eight producers had an average initial output of 21 barrels each. Two dry holes were completed on the Brammer lease in the northwest quarter of 18, but a third bore, sunk 306 feet in Trenton, made 85 barrels the first day and was good for 50 barrels when a month old. Its record showed:

Drive pipe	28 feet
Casing	294 feet
Top of Trenton.....	921 feet
Total depth	1,227 feet

A dry hole was drilled on the Bartlett farm, in the south half of 2. The north half of 4 has produced several fair wells and the southwest quarter one or two light ones. Of two bores sunk on the Davis farm, northeast quarter of section 6, one, finished in November, started at 12 barrels, and on January 1st was making half as much. Another, 600 feet north, developed salt water, 40 feet in Trenton and did not pay to pump. The average record showed:

Drive pipe	44 feet
Casing	337 feet
Top of Trenton.....	940 feet
Total depth	1,000 feet

Test bores on the northeast quarter of 5 also came in light, while others on the Bartlett lease in the southeast of 13 produced only gas. The best strike of the season in the township was on the D. Michael farm, northeast quarter of 15, where a test bore finished on November 3d, started without shooting, at 160 barrels, and for 35 days pumped natural 70 barrels per day. It is said that no oil was struck until the drill had pierced Trenton 240 feet. A record of the bore was as follows:

Drive pipe	40 feet
Casing	370 feet
Top of Trenton.....	920 feet
Total	1,195 feet

This big strike in territory hitherto unproductive and at so great depth in Trenton caused much excitement among the oil fraternity, and by January 1st, five other bores were drilling on the same lease, and four on adjoining tracts. One of these, located 800 feet north and east of the Michaels well, on the E. Black lease, southeast quarter of section 10, came in as a 100-barrel producer, its record being as follows:

Drive pipe	27 feet
Casing	310 feet
Top of Trenton.....	921 feet
Oil pay	270 feet
Total depth	1,232 feet

Another test on the Peterson farm, southeast quarter of section 18, came in as a 25-barrel producer, while two or three bores on the Dowell lease, southeast of 22, were light or dry. A test on the Williamson farm, in 23, showed only gas, as did another on the Payton farm, in the northwest of 30.

Developments in Center Township (Sections 1-25, 20 N., 10 E., and 31-36, 21 N., 10 E.) in 1903.—Operations in this township were wholly on sections 1, 2, 11, 12, 35 and 36, just north-east of Muncie. On this area 13 bores were sunk, 7 of which came in dry, while 6 had a total initial output of 126 barrels, 100 of which was yielded by a single well.

In section 36, northeast corner of the township, one light producer and a dry hole were finished on the McCormick lease, and a light one on the Reed farm just west, while a test on the Sears lease came in dry. What was at first a dry hole, but which after shooting became a million-foot gas well, was finished in the southeast corner of 35, its record being:

Drive pipe	47 feet
Casing	350 feet
Top of Trenton.....	920 feet
Total depth	1,015 feet

On the north half of the southwest quarter of section 1 the big well of the district was finished about August 1st. It was on

the E. E. McGalliard farm, where three or four light wells had been previously drilled. It started at 12 barrels an hour and made 1,800 barrels in seven days, but by September 20 was down to 35 barrels a day. A record of its bore showed:

Drive pipe	42 feet
Casing	341 feet
Top of Trenton.....	969 feet
Total depth	1,011 feet

Another bore, 600 feet south, was a dry hole, while another the same distance northwest developed a pay streak but four feet thick and came in as a 5-barrel producer. Two others on the Shirey lease, just north, were both dry. This is a good illustration of the spotted character of the territory in this region. In section 2, just to the west, a bore on the Crews lease also came in dry with the following record:

Drive pipe	30 feet
Casing	328 feet
Top of Trenton.....	907 feet
Total depth	949 feet

A big salt water vein was tapped at 25 feet in Trenton and the bore was soon after abandoned. Two light producers were finished south of the Crews on the southeast quarter of 2 and a salt water well on the Watt lease, northeast of 12. In the latter salt water was found at 20 feet in Trenton and a stronger vein at 90 feet in. Drilling was continued to 140 feet in, with the hopes of striking an oil pay, but without results. In a bore on the Haney lease, northeast quarter of 11, it is reported that the Utica shale was a reddish brown in color. The Trenton was pierced 417 feet, and it is claimed that a pay streak was struck at 202 feet in, and after shooting there was 100 feet of oil in the bore, but the latter caved and the well was abandoned.

In this Center township area about the only pay is found 18 to 30 feet in Trenton and it runs about 15 feet thick. It is, for the most part, fine and gritty. If no accidents occur, a well can be completed ready for shooting in 12 days, but the majority of them take 15 or more days.

Developments in Liberty Township (Sections 1-25, 20 N., 11 E., and 31-36, 21 N., 11 E.) in 1903.—This township furnishes most

of the production in Delaware County. In 1903, 81 bores were sunk within its limits, 28, or 34 per cent. of which were dry. The 53 productive wells had an average initial output of 21 barrels, but the greater part of the total initial production was from six or eight big wells.

Dry holes were sunk on the northeast quarter of section 36 and on the northwest quarter of section 1. A few light wells were finished on the south half of 3, while a test on the southeast quarter of 6 came in barren. The county farm, on the southeast quarter of section 8 has proven one of the best productive areas in the township. The first oil well completed on it was an old gas well which was drilled deeper and shot in 1901. It started in at 35 barrels and additional bores were at once sunk around it. On October 1, 1903, there were 11 producing wells and three dry holes on the farm. The producers were making a total of 70 barrels a day. The cost of operation was \$125 per month. The records of a salt water bore and the No. 11 producer, both of which were completed in 1903, show:

	<i>Salt water well.</i>	<i>No. 11.</i>
Drive pipe	76 feet	55 feet
Casing	333 feet	343 feet
Top of Trenton.....	914 feet	917 feet
Total depth	969 feet	975 feet

Two light producers and a big salt water well have been finished on the northeast quarter of section 8. On the Abergast lease, northeast quarter of 9, an old gas well began to show oil in 1899. It had been sunk but 20 feet in Trenton, but was drilled 50 feet in and shot, when it produced a small amount of oil. As there was then no pipe-line to carry away the oil, the well was abandoned after about 100 barrels had been pumped, most of which was wasted. In 1903 a second bore was sunk 600 feet east, which produced a large amount of salt water and some oil. If it had been shot and put to pumping it might have developed into a fair well. A dry hole was finished on the Hindman lease, southwest quarter of 9, during the year.

The Schrack farm, southwest of 12, furnished one big oil well, two light ones and a gas well in 1903. The big well started at about 180 barrels. An average bore on the lease shows:

Drive pipe	85 feet
Casing	335 feet
Top of Trenton.....	976 feet
Total depth	1,030 feet

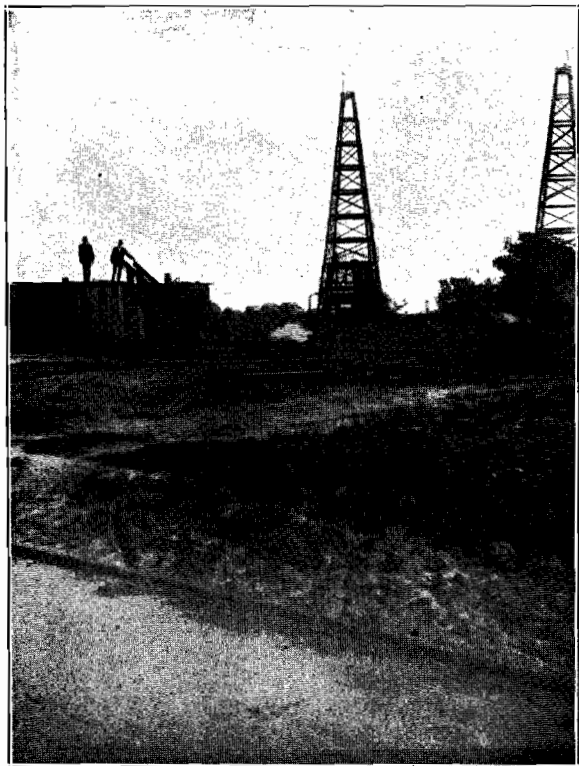
Test bores on the Jones farm, northwest quarter of 13, and on the Patty lease, southwest quarter of the same section, came in barren. The latter was a big salt water well and its record showed:

Drive pipe	95 feet
Casing	352 feet
Top of Trenton.....	980 feet
Total depth	1,013 feet

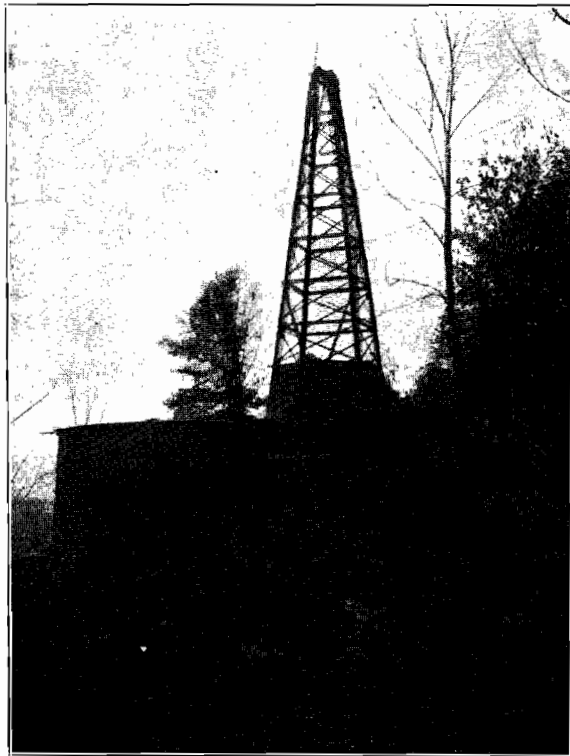
Section 14 has proven the leading producing area in the township. The L. Winget lease, near the center of the section, had, on October 1st, six wells producing an average of 200 barrels daily. The No. 3, finished July 16, started at 200 barrels and on October 1 was still yielding 75 barrels. A record of Nos. 3 and 4, 300 feet west, follows:

	No. 3.	No. 4.
Drive pipe	104 feet	97 feet
Casing	350 feet	364 feet
Top of Trenton.....	984 feet	988 feet
Total depth	1,040 feet	1,035 feet

Two pay streaks were encountered, the first 14 feet, the second 27 feet in Trenton. Gas is used for fuel while drilling and gas engines for pumping. The lease averaged a tank a day between July 16 and October 1. On the Winget, Anderson, Black and Dunkin leases, embracing an area of one-half square mile, five companies were operating December 1st. All these leases were developed in 1903, the nearest producing wells previous to that date being one and a quarter miles east. The Anderson farm of 40 acres, just north of the Winget, was sold by the owner for \$5,000 early in the season. The buyers, up to October 1st, had sunk on it five producing wells which, on that date, were yielding 65 barrels a day. The Dunkin lease west of the Winget, yielded three or four small producers, as did also the Black lease in the south half of the northwest quarter of 14. A bore completed in the northeast corner of the section was also good for only five barrels. A dry hole was finished on the Sweeny lease, north half of southeast quarter of 15, while the Campbell and



WELLS ON THE WINGET LEASE, EAST OF SELMA, IND.



KITTERMAN WELL, NEAR BIRDSEYE, IND.

East farms on the west half of 16 had several light wells to their credit. The top of Trenton in this section is found at about 938 feet. An old gas well on the Burt lease north half of 17, was drilled deeper and started at 10 barrels, but two others found salt water only. A test on the Graham lease, northeast of 18, was light, but No. 1 on the Guthrie lease just west, developed a 35-barrel producer, while No. 2 started at 150 barrels. Records of their bores showed:

	No. 1.	No. 2.
Drive pipe	65 feet	61 feet
Casing	321 feet	330 feet
Top of Trenton.....	886 feet	890 feet
Total depth	1,172 feet	1,161 feet

The principal pay streak of oil in the two wells was found at 42 feet in Trenton.

Just south of Smithfield in the southwest corner of 22, the F. M. Cannaday farm has developed four fair producers, the average record of which shows:

Drive pipe	80 feet
Casing	338 feet
Top of Trenton.....	940 feet
Total depth	1,017 feet

Two dry holes have been finished on the southwest quarter of 27, while a light producer was finished on the Williams farm in the northeast quarter. The first well to show oil in Liberty Township was on the Cecil farm in the northeast quarter of 28. A gas well began blowing off oil in 1900 and was drilled 80 feet into Trenton and shot. Before shooting, the oil is said to have stood 300 feet deep in the bore, but it came in as only a 5 barrel producer. Soon after this, a bore sunk for gas on the Z. T. Dunkin lease just to the south, yielded 15 barrels of oil when completed. The third bore in the field was on the F. M. Cannady lease in 22. At 35 feet in Trenton a large salt water vein was tapped but the bore started at 50 barrels. The Cecil lease at present contains three, and the Dunkin lease five or six, fair producers. One of these, sunk in 1902, started in at 135 barrels, and produced the usual excitement of a rich strike in comparatively new territory. It was near the corner of the farm, and four bores sunk within 300 feet in different directions came

in dry. Just west of the Dunkin and Cecil leases, several light producers have been developed on the A. R. Lennon farm, an average record showing:

Drive pipe	124 feet
Casing	340 feet
Top of Trenton.....	972 feet
Total depth	1,051 feet

The depth to which the wells are sunk in the Selma field is governed very largely by the appearance of the drillings from the Trenton. Salt water is often found 30 to 40 feet in, and a rather close white sand at about that depth warns the driller of its probable proximity. If there are no signs of water, the drill is often sunk 75 to 100 feet into Trenton. Where the territory is productive, two pay streaks are almost always found, one 15 to 20 feet in, the other 30 to 37 feet. A pipe-line station has been put in by the Indiana Pipe Line Company, just west of Selma, from which the oil from Center and Liberty townships is piped to a larger station at Montpelier, Indiana. The Republic Iron & Steel Company, of Muncie, which is operating a number of the largest producers in the Selma field, has use for all the surplus gas produced from its wells, and so is not bothered as are some of the other oil operators by the gas pressure. When gas at a low pressure is put into a pipe line for factory use it is often forced or held back, and so lessens the output of oil. A pump which will force the gas from a single well into a lead pipe can be had for \$75. If used in connection with the oil pump, it will remove the back pressure of gas and so allow the ready production of the oil.

From what has been said about the different parts of the Delaware County field, it will be seen that the oil appears to be in little pockets or pools. No productive area of any size has as yet been found. As one of the leading operators said, "the territory is as spotted as a leopard's back, and the spots are very far apart."

The following table shows the number of barrels of oil piped from the Muncie-Selma-Parker oil field by months for the year 1903:

PRODUCTION OF THE MUNCIE-SELMA-PARKER, INDIANA, OIL FIELD BY MONTHS FOR THE YEAR 1903.

January	15,108
February	19,639
March	25,268
April	21,714
May	39,155
June	56,159
July	58,474
August	56,667
September	55,914
October	57,597
November	49,632
December	54,204
Total	509,531

RANDOLPH COUNTY

comprises an area of 450 square miles lying next to the Ohio State line, and south of Jay, north of Wayne and east of Delaware and Henry counties, Indiana. The surface of the county is generally level or rolling, but the area which it embraces is one of the most elevated in the State, its southern part forming the principal watershed of eastern Indiana. The numerous streams which rise within its bounds flow in every direction. Both White-water and White rivers have their sources within the county, the tributaries of the former draining the southern third and those of the latter the central third, while across the northern third flows the Mississinewa, which is also fed by numerous small streams.

The soil of the county is, for the most part, a heavy clay enriched by the vegetable accumulations of ages. The clay, being of drift origin, is composed of the debris of many different formations which contains all the elements necessary for plant food. Wheat, corn and grass are the leading productions; the cereals and live stock furnishing the principal income of the agricultural classes.

The county is supplied with the best of transportation facilities. Two divisions of the Big Four Railway cross it from east to west, one near its center, the other across the southern third. The G. R. & I. bisects it from north to south and the P., C.,

C. & St. L. cuts across its northeastern fourth, while the C., C. & L. touches its southwestern corner. The population of the county in 1900 was 28,653, as against 28,085 in 1890.

The highest land in Indiana is on the middle ridge near Bloomingsport, on the "Summit" between Green's Fork and Martindale Creek, where the elevation on the Peoria Division of the Big Four has been found to be 1,234.4 feet above sea level. Some of the hills south of this point are estimated to be 50 feet higher, so that 1,285 feet is approximately the highest level in the State. The elevations of the principal railway stations in the county are as follows: Carlos, 1,208; Crete, 1,181; Deerfield, 1,004; Farm-land, 1,037; Harrisville, 1,101; Johnson, 1,177; Losantville, 1,128; Lynn, 1,162; Modoc, 1,174; Parker, 1,023; Ridgeville, 982; Saratoga, 1,044; Snow Hill, 1,174; Stone, 1,034; Union City, 1,102; Winchester, 1,089; Woods, 1,183.

Monroe township, on the western border of Randolph county, has developed a number of productive oil wells in recent years some of which have had an output equal to any in the State. The territory has, however, proven to be very spotted, the number of dry holes equaling or exceeding those with an output sufficient to pay for pumping. Isolated bores in White River and Stony Creek townships have also developed small producing wells. From present indications the future production will probably be limited to the northeastern third of the county, which comprised the former principal gas yielding area within its bounds.

Developments in Monroe Township in 1903.—This civil township comprises a part of four different congressional townships and the numbers of the sections are, therefore, very confusing. It embraces the south halves of sections 29 and 30 and all of 31 and 32 (21 N., 13 E.); sections 5 to 8 and 17 and 18 (20 N., 13 E.); the south halves of sections 25 to 29 and all of 32 to 36 (21 N., 12 E.), and sections 1 to 5 and 8 to 17 (20 N., 12 E.). In the north part of the township a gas well was finished on the Thornburg farm in section 27, while a test on the Wood lease in section 32 came in dry. The Keever lease, south half of 33, has a number of fair producers to its credit; while the Boots farm to the west and the Wood lease to the north each possess several light wells. A bore or two on 34 came in light, while a test on the McGunnigal in 35 developed a dry hole. The south-

east quarter of section 3 has yielded a few fair producers, but tests on other parts of the section were barren. The east half of 4 is first-class territory; the Bennett lease on the southeast quarter having yielded a number of big wells. No. 1, when finished May 22, was apparently dry, but when shot with 400 quarts began to flow and produced 200 barrels the first day and 3,000 barrels the first month. Its record shows:

Drive pipe	99 feet
Casing	337 feet
Top of Trenton.....	965 feet
Total depth	1,068 feet

The Trenton is said to be in thin strata or layers and has the color of whitewash on the bailers. By the first of October the well had settled down to 12 barrels per day. No. 2 Bennett at first showed a little gas, but no oil. A shot of 400 quarts caused it to start at 250 barrels; while No. 3 also came in as apparently barren, but yielded 150 barrels after shooting. Nos. 4 and 5 on the same lease were dry.

The west half of 4 has produced only light gas wells or dry holes. Several light wells have been found on the Meeks lease, southeast of 5, and the northeast of 8, but a number of dry holes have been drilled with them, and those sections are considered poor property.

Section 9 is the most noted area in the field. The famous "Cecil gusher," probably the best well drilled in Indiana in 1903, is located in the midst of a number of others on the east half of the southeast quarter. It was No. 10 on the E. E. Cecil lease, finished May 2, 1903, when it started at 420 barrels, and averaged more than 300 barrels a day for four months. The oil was almost wholly free from water, so much so, in fact, that it became necessary at times to run water into the tanks and steam it in order to get rid of the sediment. A two-inch pipe was taxed to its full capacity to take the oil from the pump to the tanks, and on September 23 a three-inch pipe was put in and the well made 20 barrels an hour for several days. The well was pumped on the beam, 40 strokes to the minute, and a stand of 3 tanks was necessary to take care of its production. A record of its bore showed:

Drive pipe	136 feet
Casing	346 feet
Top of Trenton.....	1,007 feet
Total depth	1,047 feet

The top of the oil pay was found at 1,025, and a continuous pay streak 22 feet thick was passed through to the bottom. The top of Trenton in this particular lease seems to be very uneven, the drill showing it to be in waves or crowded anticlines. Bore No. 13, on the southeast corner developed the Trenton at 974 feet, while 40 feet east, on the adjoining lease, it was found at 960. In No. 10, the big well, it was found lower than in any other bore, being struck at 1,007 feet. No. 9 well, on the same lease, finished April 4, started at 320 barrels and was making 65 on October 1. On the same date there were 15 wells on the E. E. Cecil farm of 143 acres, and eight on the Z. Cecil lease, just to the west. On the latter lease the first bore, finished in July, 1902, made two tanks in 27 hours, but soon dropped to a 25-barrel producer. The record of No. 3 on this lease was exactly the same as No. 2 on the E. E. Cecil, showing:

Drive pipe	120 feet
Casing	345 feet
Top of Trenton.....	965 feet
Total depth	1,015 feet

The 23 wells on the two leases were producing 900 barrels a day on October 1st, and several good ones were drilled later in the year. On the northeast quarter of 9 the wells are fair producers, but those on the west half of the section are light. The southwest quarter of 10, just east of the E. Cecil lease, contains some fair wells, but tests on the remainder of the section are either barren or water wells. A gas well was finished on the Grove farm in 11, and the only producing well in the section, located on the southwest quarter, is light.

A test drilled on the Macy farm, section 12, just north of Farmland, came in dry, as did another on the Mason farm in section 14. The Ezra Cecil lease in 15 developed two producing wells and three dry holes during the year. One of the wells started at 45, the other at 125 barrels. A half dozen wells on the north half of 16 are light producers while one or two other bores in

the section are dry. Two old wells on the Scott lease in 17 and one new one finished in 1903 have an output of 3 to 5 barrels a day.

The above comprises the development in the famous Parker field up to January 1, 1904. It will be seen that four or five sections produce practically all the oil in the township. The results of the drilling during the year showed that 116 bores were sunk in the Parker field. Of these 42, or 36 per cent., were dry. The 74 producers had an average initial output of 45 barrels. Fourteen of the producers in sections 4, 9 and 15 started in at 100 barrels or more each, their total initial output being 2,100 barrels, or 150 barrels each. The other 60 producing wells had an average initial production of 20 barrels each. The field is thus seen to be very spotted and one well tests only a location. Public attention has been called to the big wells, but the dry holes and small producers have been seldom mentioned.

Developments in Stony Creek Township During the Year 1903.

—This township lies just south of Monroe on the western side of the county. But few bores have, as yet, been sunk within its limits. A test on the McIntire lease, section 19, three-quarters of a mile west of Macksville, started at five barrels, while another on the N. Knobe farm, in section 30, south of Macksville, struck the top of Trenton at 984 feet. This formation was then pierced 99 feet before a pay streak was encountered. This was seven feet thick, and the total depth of the bore 1,084 feet. It came in as a three-barrel producer. A dry hole or two was completed on the Swingley lease south of Windsor, on the northeast quarter of section 32, and another on the Anderson farm in section 36.

Developments in White River Township in 1903.—This is the township in which Winchester, the county seat, is located. Some light producers have been finished on the Clayton farm in section 9, three miles northeast of Farmland, but they developed much gas with the oil. A test on the A. Brown lease, six miles south-east of Winchester, developed a light showing of oil and some gas, the record of the bore being:

Drive pipe	227 feet
Casing	335 feet
Top of Trenton.....	1,113 feet
Total depth	1,214 feet

Two bores on the Pickett farm, two and a half miles southeast of Winchester, southwest quarter of 23, were finished in October and started in at about 20 barrels each. Their average record shows:

Drive pipe	85 feet
Casing	226 feet
Top of Trenton.....	1,091 feet
Total depth	1,156 feet

By January 1, 1904, they had produced 900 barrels of oil, and the indications of the new pool were sufficient to cause the Indiana Pipe Line Company to put in a line to them. A third bore on the same lease was a light producer, as was also one on the Hunt lease, in the south half of the same quarter section. The only other producing well in the township on January 1st, 1904, was on the E. Owens farm, northeast quarter of section 35, four miles southwest of Winchester, which yielded 100 barrels the first two weeks after its completion.

Developments in West River Township During the Year 1903.—Eight or ten test bores sunk in this township during the year resulted in dry holes or light gas wells. The only one showing oil was on the B. T. Olwin farm, in section 29, which yielded about two barrels a day after it was finished. Dry holes were drilled on the Haynes, Macy and Fletcher farms, section 20; on the Johnson farm, section 9, on the Lumkins farm, in 17, and on the Hawkins in 30.

A bore on the Courtner lease, section 25, Greene township, came in dry during the year, as did also several tests in Nettle Creek township; notably on the Clevenger and Lindsay farms in section 15. Outside of Monroe township all bores as yet sunk in Randolph County have been thousand to one shots and 95 per cent. of them have proven losing ventures.

ISOLATED AREAS PRODUCING TRENTON ROCK PETROLEUM OUTSIDE THE MAIN INDIANA FIELD.

IN WABASH COUNTY.

The only productive area in this county has been in Noble township, on the west side where, in the vicinity of Kellar's Station or Rich Valley, a number of wells have been yielding

oil since 1897. During the year 1903 but four bores were completed in this area. Of these one was dry and the others came in as two to five-barrel producers.

In Waltz township, in the southwestern corner of the county and next to the Grant County line, a number of bores have been sunk in recent years by the Marion Gas Company, primarily in search of gas, one or two of which had a showing of oil. One, finished in April, 1903, on the Farley lease, northwest quarter of section 4, struck Trenton at 1,015 feet and developed an oil pay with a good showing at 1,035 feet. This continued for 23 feet, when a strong vein of salt water was encountered which filled the bore to within 100 feet of the surface. There being no gas for fuel and coal having to be hauled 8 miles from the nearest railway station, the well was never pumped. Another bore two miles farther north came in dry. A quarter of a mile west of the big gas well at Somerset a big salt water well was drilled in section 33, Waltz township, the vein of water being struck at 80 feet in Trenton. A bore which showed a trace of oil was also finished on the Garst lease in section 28, while dry holes were opened on the southeast of 23, and on the Hawkins farm in 25. Near Treaty, on the Big Four Railway, in Liberty township, three small producing wells have been opened, but no data is available as to their output or record.

IN MIAMI COUNTY.

The Peru oil field which created such a furor when opened in 1897, is practically a thing of the past. It was, in the main, a "town lot" development and the derricks on Flax Hill in places stood so thick that, in some instances, they had only a board fence between them. Thirty or more companies were drilling at one time within the city limits and a number of them finished as many as five wells and never sold a tank of oil. The rock was very porous and some of the wells were big producers, but so many on so small an area soon drained the reservoir. Of the 356 which were sunk, less than 30 are still in operation and the production has dropped from 50,000 barrels a month to less than 2,500. The best well in the pool, that on the Artis lot, started at 400 barrels a day and is still making 20 barrels. But two or three of the first companies in the field made any money, and more than a

quarter million of dollars was sunk by the unsuccessful ones. For a time the boom added much to the prosperity of Peru, as that sum was mainly put in circulation among its inhabitants.

A new pool was opened up in Erie township, three miles east of Peru, in 1898, which for a time had a vigorous growth, but its limits were soon defined and no new territory in that vicinity has recently been found. No bores were sunk in Peru, and but two in Erie township in 1903; both being on the Butts lease, where the majority of the best wells had previously been found. One developed a dry hole and the other came in as a five-barrel producer. The combined output of the Peru-Erie township-Rich Valley fields, in 1903, was but 63,838 barrels, distributed among the months as follows:

PRODUCTION OF THE PERU-RICH VALLEY TRENTON ROCK OIL FIELDS BY MONTHS FOR 1903.

January	4,790
February	4,874
March	5,456
April	4,556
May	4,695
June	6,526
July	5,904
August	5,855
September	6,117
October	5,511
November	5,823
December	3,731
Total	63,838

IN ALLEN COUNTY.

It was thought for a time that quite a pool of productive territory would be opened up near New Haven, Adams township, Allen County, but the results have not realized the expectations. A well drilled on the John Hartzell farm, northeast quarter of section 14 in 1899 made a fair showing of oil, but a second bore resulted in a dry hole. In February, 1903, a third bore was finished about 100 feet from No. 1, and came in as an 8-barrel producer, its record showing:

Drive pipe	96 feet
Casing	700 feet
Top of Trenton.....	1,440 feet
Total depth	1,496 feet

Quite a quantity of salt water was pumped with the oil. Two bores were drilled on the Mull lease adjoining that of Hartzell, one of which came in dry while the other started at three barrels. A dry hole was also finished on the Rouullo farm in the same neighborhood, and another on the G. Doctor lease in section 33, which stopped further drilling in the township. A pipe line was laid from the two producers to New Haven, and 1,072 barrels of oil shipped from them during the year.

A test bore on the Dickason farm, section 3, Monroe township (29 N., 15 E.) in the southeast corner of Allen County, was drilled in October and came in with a large showing of oil and a big supply of gas. By accident the latter caught fire just before the drilling was completed and destroyed the derrick and burned to death the tool dresser. The tools were lost in the bore and at last accounts had not been recovered. One or two other very light wells had previously been completed in the vicinity. A mile west of Baldwin, in section 33, Jackson township, Allen County, a test bore was finished in October, which started at at about 18 barrels. The top of Trenton was reached at 1,402 feet. Still another bore, completed on the Amspaugh farm, section 3, Jackson township, is said to have started with an output of 12 barrels per day.

IN HAMILTON COUNTY.

The only producing territory in this county is in Fall Creek township, in the southeast corner, near Fisher's Station, where several producing wells were sunk in 1900 and 1901. A number of dry holes have since been put down around them, four of which were drilled in 1903. The output of the producers for the entire year was 5,294 barrels. The pool is, as yet, a small one, and at present the chances of its increase in size seem remote.

IN MARION COUNTY.

The output of the Broad Ripple field in Washington township, Marion County, has been gradually decreasing for several years. No new bores were sunk in 1903, while three or four of the former producers were abandoned. The production of the Broad Ripple pool by months for the year 1903, was as follows:

OUTPUT OF THE BROAD RIPPLE, INDIANA, OIL FIELD BY MONTHS FOR THE YEAR 1903.

	<i>Barrels.</i>
January	491
February	486
March	357
April	1,135
May	1,059
June	799
July	534
August	727
September	559
October	668
November	724
December	587
Total	8,126

COST OF A PRODUCING WELL IN THE MAIN INDIANA OIL FIELD IN 1903.—On account of the increase in the price of lumber and iron tubing and piping, the cost of a producing well in the Trenton rock field of Indiana has slightly increased in recent years. A careful estimate of the average cost of drilling and fitting up the first productive well on a lease was made in both the Marion and Parker-Selma portions of the field in October, 1903. These estimates resulted as follows:

	<i>Marion.</i>	<i>Parker-Selma.</i>
Rig or derrick.....	\$420	\$425
Drilling	625	560
Drive pipe	160	120
Casing	165	110
Shooting	125	140
Tubing and pumping outfit.....	225	205
Power house and power.....	500	500
Two tanks	180	170
Belting and lead lines.....	125	125
Incidentals	100	100
Total	\$2,625	\$2,455

In the above estimate the price of drilling is put at 50 cents a foot plus the cost of fuel, which is extra and averages about \$50 per well; that of 8-inch drive pipe at \$1.05 in the Marion field and \$1.10 in the Parker-Selma; 5½ casing at 37 cents in Marion and 32 cents in Parker-Selma; tubing at 15½ cents; sucker rods at 4½ cents in Marion and 3 cents in Parker-Selma; pumping

jack, \$12, and shooting at 70 cents a quart; these being the ruling prices in the two fields. The incidentals include the cost of necessary teaming and the expenses (livery hire, board, etc.) of the operator or field manager while overseeing the work. The second well on the lease will cost about \$1,200 less, as the rig, tanks, power house and power can be used for both wells, though there will be a loss of \$125 in tearing down and rebuilding the derrick. It is not customary to build a power house until three or four producing wells have been finished on the lease, but if not built, an engine and boiler for pumping must be purchased for each productive well, which will cost \$325 to \$450. With the advanced methods of pumping by which oscillating pull wheels, rods, etc., are used, 20 or more wells can be connected to one power, and the cost of production be thereby greatly decreased.

No two wells in the field cost the same. One reason for this is that the length of drive pipe necessary is so variable, ranging from 25 to 450 feet. The number of feet of casing necessary also varies greatly in different parts of the field. In the Jay County field, the average well on a 10-well lease costs about \$1,500, while in Grant and Huntington counties it runs about \$1,750. Some operators use but one or two derricks on such a lease, putting in their stead, as fast as removed from a newly drilled productive well, a set of "derrick poles," costing from \$10 to \$15. Others leave the derrick over each well. These are often blown down or burned, thus causing a loss of \$300 to \$400. In many portions of the field an extra charge of 25 cents a foot is made by the driller for all drive pipe above 100 feet; and often also an extra charge of 25 to 50 cents for every foot over 50 feet into Trenton rock. The cost of the lead lines and surface rods on a lease will increase proportionally to the number of producing wells. In 1903 the price of a 2-inch lead line pipe was 13 cents, and of 3-inch, 24 cents a foot in the Indiana field; while that of surface rods was $4\frac{1}{2}$ cents per foot.

It has been claimed by promoters of Kansas oil properties that the cost of drilling in the Kansas field is much less than in Indiana, but the figures given out by the "Kansas Derrick" do not bear out this statement. According to that paper "The average depth of the Kansas well is 850 feet, and drilling costs 85 cents

a foot. The actual expense of completing and fitting up a producing well is about as follows:

850 feet drilling at 85 cents.....	\$722 50
40 feet 8¼-inch casing at 63 cents.....	25 20
300 feet 6¼-inch casing at 51½ cents.....	154 50
700 feet 5-inch casing at 38½ cents.....	269 50
Shooting well	45 00
Tubing, 850 feet at 14 cents.....	119 00
Pumping outfit for walking beam.....	22 00
Sucker rods, 850 feet at 4¼ cents.....	38 25
250-barrel tank, set up.....	160 00
Teaming	45 00
Total	\$1,625 95

“The above figures are made up from actual basis on which material is purchased by the operators, and are sufficiently conservative, and to them should be added the expense of the party having the operations in charge. If a field manager, his salary and expenses must be taken into consideration, or if the party owning the lease is looking after the work, his board at \$2.00 a day, buggy hire for getting to the property and other incidental expenses will foot up quite a considerable sum, not less than \$50, and before the well can be put in service with other wells on the lease, if a pumping plant is installed, the cost of connecting up with the power must be considered, and also the proportionate cost of the pumping plant on the basis of the number of wells it is required to pump. As the wells are drilled almost entirely by machines, the expense of a derrick, which runs from \$300 to \$450 in the Eastern oil fields, is not included.”

The above estimate does not include the cost of a power house, which has been added to the cost of an Indiana well, and includes the cost of but one tank, where two are absolutely necessary unless the pumping be stopped until the one tank can be emptied when it is full. Neither does it include the cost of lead lines and surface rods which is comprised in the Indiana estimate. If we add, therefore, to the estimate of the Derrick, \$500 for power house, \$160 for second tank (the price quoted by the Derrick); \$125 for lead lines, etc., and \$60 more for incidentals, we have a total of \$2,470, which is equal to, if not greater than the cost of the first Indiana well. It is far wiser for those who are trying to induce capital to locate in any oil field, to give

figures which can be relied upon, rather than to try to convince people that the work can be done for one-half or two-thirds of the necessary outlay.

COST OF OPERATING A LEASE.—The cost of operating an oil lease after the production has been established need not be more than \$100 per month, the salary of the pumper being \$60, and the cost of fuel about \$40. A dozen, or even 20 wells can, however, be operated almost as cheaply as one after they have been connected with the power. An extra pumper may have to be employed, but otherwise no additional expense is entailed.

Where the plant has been established, it will pay to pump as low as two or three wells, even if the yield is only two barrels each per day, provided the price of oil is as high as it was throughout the year 1903.

The estimate of expense and income from three two-barrel wells, after deducting the royalty of one-sixth, is as follows:

Income per month—

150 barrels of oil at \$1.15 (average price in 1903).....	\$172 50
Salary of pumper	\$60 00
Cost of fuel.....	40 00
	100 00

Net income per month..... \$72 50

With six two-barrel wells on the lease, the income would be \$345, and the expense \$100, a net gain of \$245 per month.

From what has been written it will be seen that the cost of drilling and operating a lease in the Indiana Trenton rock field is as low or lower than elsewhere in the eastern United States for the following reasons: (a) The wells are comparatively shallow, the Trenton limestone in most instances being struck at less than 1,000 feet. (b) It is seldom that more than 150 feet of drive pipe and 400 feet of casing are necessary. (c) On account of a comparatively level surface a large number of wells can be connected to and pumped with one power. (d) Gas for fuel or for running gas engines is as yet available in many parts of the field, and if not present, coal is as cheap as in any other locality. (e) Transportation facilities are excellent, a system of pipe lines permeating all parts of the main field.

According to some of the leading operators, it costs 60 cents a barrel to produce oil on the average lease in the main Indiana

field. Whatever is received above that sum is net profit. If the lease is small the cost is much greater in proportion. Oil at \$1.00 or more per barrel, therefore, brings a good price and a fair profit.

Whatever the price, the profits will depend largely upon the way the property is managed. Success as an oil operator depends upon the same watchful energy as brings success in any other business. One's pumps should be kept steadily at work so as to get all the oil possible. The drilling tools, lead pipes and pumping machinery should be kept in good repair; especially in late autumn should they be thoroughly overhauled and put in prime condition for the winter months. If the lead lines are left above ground or are but shallowly buried, they often freeze and burst. A poorly managed lease is liable to be tied up for a month or more on this account; while a neighboring lease which has everything in good shape for the winter produces nearly its normal output of oil.

To properly and profitably develop a lease the wells in average territory should be put down at intervals of 720x680 feet, which will bring eight wells on each 80-acre tract. In exceptionally good territory 10 bores can, with profit, be sunk on 80 acres, bringing them 551 feet apart each way. Above all, one should be on the look-out for overflow and leakage. Much of what would otherwise be profit in oil property is allowed to go to waste. Finally, if the property is inside the limits of productive territory, the successful oil man is he who lets other people do the wildcatting, and who follows where they lead.

NECESSITY OF GOOD ROADS IN OIL TERRITORY.—Good roads are necessary to the opening up and thorough development of any productive oil territory, and the sooner the farmer finds this out, the greater will be the income which he will derive from his royalty. The iron pipe, tubing and derrick timbers are all of heavy weight, and if the lease is some distance from a railway and the roads leading to it are of mud, as they are apt to be for four or five months if not graveled or macadamized, operations on the lease will necessarily be suspended for that length of time. Many a farm inside of productive territory in Indiana has not been drilled because the operator has noted that the roads leading to it would compel him to suspend developments from

November to April. He can not afford to be idle five-twelfths of his time, and so operates those leases along pikes over which he can haul his necessary supplies. The farmers living in the oil belt, who are receiving or might receive large sums in royalty for their oil, should, therefore, see to it that their farms are accessible at all times.

SOME BIG INDIANA OIL DEALS IN 1903.—The gradual rise in the price of Indiana Trenton Rock Oil from 43 cents per barrel in 1897 to \$1.31 in 1903 has led to a corresponding increase in the price per barrel paid for settled production on leases which have been partly developed. In 1897 a company which had a lease of 160 or more acres with three or more fair wells on it could get only about \$300 per barrel, daily settled production, for the property. In 1903 a thousand dollars per barrel, average daily production, was not an unusual price. More money has been made by many Indiana operators in thus partially developing and selling their leases to the larger companies than in any other way. In such a transaction the lease, which costs little or nothing in the beginning, but which has been proven productive by the test bores sunk on various parts of it, is counted the most valuable part of the property. It bears the same relation to the latter that a long term franchise bears to the assets of a street railway or other corporation.

Several noteworthy oil deals were made during the year 1903. In February the Senior Oil Company, of Bluffton, Indiana, sold its holdings in Randolph County, consisting of 1,224 acres of leases and five producing wells, for \$225,000. The new owners, being Missouri capitalists, adopted the name "The St. Louis Oil Company," and immediately started in to spend \$100,000 in the development of their property. The latter included the famous Cecil lease near Parker City, on which some of the biggest wells of the season were finished. Starting in with a daily production of only 260 barrels, by the end of the year they had 28 producing wells on the leases and an output of 1,100 barrels daily.

In the fore part of the year the Superior Oil Company sold its holdings in Grant and Huntington counties, consisting of 900 acres of leases and about 40 producing wells, for \$120,000.

About the same time the Barnes Oil and Gas Company, of Marion, sold to some St. Louis parties 648 acres of leases, mostly in Grant County, and 15 producing wells, with a daily output of 45 barrels, for \$50,000.

On June 1st, the Phoenix Oil Company, of Hartford City, sold 6,000 acres of leases, mostly in Washington township, Blackford County; on which were 90 producing wells with a 250-barrel net daily production, for \$300,000. The new company immediately drilled in 50 new wells, and by November 1st had an output of 500 barrels daily.

A fortnight later the Ohio (Standard) Oil Company purchased the property of the Central Oil Company, in Grant, Wells and Huntington counties, consisting of 1,700 acres of leases, 147 producing wells, and 400 barrels net daily production, for \$280,000 cash.

One of the largest deals of the year which, however, was in part a pooling of holdings, was that of the American Window Glass Company to the Columbia Oil and Gas Company, of Pittsburg. This sale was consummated October 1st, and by it 40,000 acres of leases in Blackford, Grant, Delaware, Jay and Hancock counties were turned over to the new company. On the leases were 149 producing oil wells, having a net daily output of 600 barrels, besides numerous gas wells and other holdings. The price paid was \$2,000,000, and it is said that another half million will be at once spent in improving the property and sinking new wells, 400 of which will be put down as rapidly as possible.

STATISTICS OF THE INDIANA TRENTON ROCK OIL FIELD FOR THE YEAR 1903.

The year 1903 maintained its record and set a new high water mark in the history of the Indiana Petroleum Industry. The price of Indiana oil was above the dollar mark during the entire year, while from October 17th to the end of the year it sold for a higher figure than ever before. As a consequence, the operators were stimulated to use their best endeavors to increase the output. New work went on rapidly and the number of bores

sunk was greater than in the preceding year, while the output far exceeded that for any previous year. Starting the year at \$1.10 per barrel, it fell to \$1.08 on January 21st, and the next day to \$1.06, the minimum price of the season. On March 26th it was raised to \$1.09 and on April 22d to \$1.11. This price it held until May 16th, when it dropped to \$1.09, at which figure it was sold until July 16th. Then a slow but steady increase in price set in until it reached a maximum of \$1.33 on December 9th, which it held for 20 days. It then dropped to \$1.31, the price at which it was selling on December 31st. The average price per barrel for the year, taking both time and amount received into consideration, was \$1.14 as against 85.6c in 1902.

The total production of Trenton rock oil in 1903 was 9,161,331 barrels which, at the average price of \$1.14 3-20, brought into the State \$10,457,659. Compared with 1902, this was a gain of 1,625,770 barrels, or 21.6 per cent., as against a gain of 31.6 per cent. in 1902. However, on account of the high average price, the amount received by the producers was \$4,007,219, or 62.1 per cent. more than in 1902.

The first of the following tables gives a complete record of the monthly production of petroleum from the Trenton limestone fields of Indiana for the 13 years beginning January 1, 1891, and ending December 31, 1903. This does not include the amount used in the field for fuel and other purposes; or that wasted by the burning of tanks or the leaking of pipes, but only that shipped or piped by the companies who purchase the oil from the operators. The second table shows the annual production, the average yearly price and the total value by years for the same period:

I. TOTAL PRODUCTION OF TRENTON LIMESTONE PETROLEUM IN INDIANA FROM 1891 TO 1904, BY MONTHS.

(Barrels.)

MONTH.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
January	6,171	15,841	111,824	259,000	300,568	365,582	290,746	317,014	297,291	353,451	425,140	554,038	651,355
February	5,981	18,946	96,025	232,107	230,559	241,743	309,922	272,780	220,440	302,493	384,735	460,073	568,789
March	5,159	24,794	134,549	282,376	310,303	386,586	341,961	325,201	290,257	364,590	432,922	573,412	724,969
April	4,973	26,184	146,493	287,330	352,077	395,032	328,779	310,034	325,774	381,804	447,261	579,711	680,921
May	5,757	31,033	186,939	321,502	397,001	417,963	340,023	311,208	344,831	426,363	482,118	635,752	751,348
June	8,136	40,888	209,616	333,479	403,569	434,167	369,803	320,477	334,282	446,492	481,807	633,452	809,438
July	10,809	49,203	221,666	327,349	434,376	422,968	375,249	314,861	329,086	437,087	506,065	696,911	831,006
August	11,603	56,109	248,353	345,031	420,132	407,238	371,921	332,777	347,621	466,127	523,106	697,040	838,615
September	16,500	66,034	245,615	319,588	409,169	415,675	362,528	326,264	332,283	418,716	519,087	672,611	857,117
October	19,029	95,699	252,568	339,424	393,153	394,283	408,179	319,490	326,781	467,521	532,960	725,973	873,160
November	20,801	129,270	245,607	304,030	373,789	337,331	430,958	300,644	326,802	406,684	510,788	656,467	778,323
December	21,715	144,067	236,038	337,450	361,436	362,164	423,069	300,457	332,266	441,347	479,485	650,131	796,291
Totals	136,634	698,068	2,335,293	3,688,666	4,386,132	4,680,732	4,353,138	3,751,307	3,807,714	4,912,675	5,725,474	7,535,561	9,161,331

II. PRODUCTION OF TRENTON ROCK PETROLEUM IN INDIANA FROM 1891 TO 1904, WITH VALUE.

	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
Total production (barrels of 42 gallons)	136,634	698,068	2,335,293	3,688,666	4,386,132	4,680,732	4,353,138	3,751,307	3,807,714	4,912,675	5,725,474	7,535,561	9,161,331
Total value at wells of all oils produced, excluding pipeage	\$54,787	\$260,620	\$1,050,882	\$1,774,260	\$2,807,124	\$2,954,411	\$1,871,849	\$2,228,276	\$3,331,750	\$4,740,731	\$4,775,045	\$6,450,440	\$10,457,659
Value per barrel	\$0 40	\$0 37	\$0 45	\$0 48	\$0 64	\$0 63	\$0 43	\$0 59½	\$0 87½	\$0 96½	\$0 83½	\$0 85½	\$1 14 ¾

From the first of the above tables it will be seen that the largest production of Trenton rock petroleum in Indiana in any one month was in October, 1903, when 873,160 barrels were brought to the surface. The total production of Indiana Trenton rock oil for the twelve years reached the enormous sum of 55,172,755 barrels, which sold for \$42,757,834, or an average of \$3,289,064 per year.

In the third table there is shown the number of wells completed in Indiana by months from June, 1891, to January, 1904.

III. NUMBER OF WELLS COMPLETED IN THE INDIANA TRENTON LIMESTONE OIL FIELDS FROM 1891 TO 1904, BY MONTHS.

YEAR.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1891							6	6	15	15	15	8	65
1892	11	13	18	13	17	19	17	30	25	52	33	47	295
1893	20	30	31	36	45	47	47	55	27	72	56	76	542
1894	90	103	103	80	110	107	84	123	100	107	97	85	1,189
1895	61	45	81	111	122	153	132	140	129	106	102	85	1,267
1896	76	90	86	136	148	150	113	121	70	58	66	66	1,180
1897	41	35	40	47	49	52	60	45	55	89	119	54	686
1898	41	23	29	43	38	55	53	80	72	82	92	86	694
1899	75	48	68	64	87	99	77	104	106	118	106	105	1,057
1900	113	67	98	148	165	163	158	155	135	152	118	108	1,580
1901	111	72	81	121	167	171	167	169	184	207	220	132	1,802
1902	176	113	169	182	247	297	288	279	323	295	320	243	2,932
1903	168	178	233	236	331	408	377	387	337	366	375	290	3,686
Total													16,975

From this table we learn that 754 more bores were sunk for oil in the Trenton rock fields of Indiana in 1903 than in any previous year. In 1902 the gain over 1901 was 1,130. The great majority of new bores were sunk in already proven territory by companies whose members were content to sink fair producing wells and develop what oil they could beneath their leases rather than seek far and wide for new territory which might produce a "gusher."

From the table it may also be learned that up to January 1, 1904, 16,975 bores had been drilled in the Trenton rock fields

of Indiana for oil alone. On that date there were 12,098 producing wells in the fields, as against 8,963 on January 1, 1903, a gain of 3,135 for the year. By subtraction it may be learned that of the total number of bores sunk for oil in the Trenton rock fields of the State, 4,877 have proven dry or have been abandoned as non-productive. The number abandoned in 1903 was 175, or 116 less than in 1902, while the number of dry holes drilled during the year was 376, or 66 less than in 1902. Of the total number of bores sunk in 1903, 10.2 per cent., or 4.9 per cent. less than in 1902, were dry.

On October 15, 1903, there were approximately 11,370 producing wells in the Trenton rock fields of the State. The production of oil for the entire month of October was 873,160 barrels, or an average of 2.48 barrels per well, for each day of the month. On December 15th there were 11,980 productive wells in the field. The output for the month of December was 796,291 barrels, or an average of 2.14 per well per day. The average output per well is always less during the winter months than during other seasons of the year. An average for the year would probably be about 2.35 barrels per well per day, a seemingly small amount yet totalling more than nine millions of barrels for the field for the year. These figures go to prove that the days of the gusher are practically over in the older portions of the main field where most of the bores were sunk. It is better for the practical producer that this is true. A well starting at 200 barrels or more a day creates an excitement and a rush for territory that, in the end, proves harmful to all concerned. Large bonuses are paid out and big risks taken which are foreign to territory whose wells are small but sure producers. As has been stated in my former reports, one large well will not make any man a fortune; twenty small ones may in time. The yield of the large producer will quickly grow much less; that of the twenty small ones will hold out for a long time. There is yet room for thousands of wells in the known productive territory. At present prices, eight to ten wells pumped by one power and yielding on an average but one and a half barrels each per day, will prove a paying investment.

The following table shows the number of producing wells, number of dry holes, total bores and average initial production of

wells drilled in each of the Trenton rock oil producing counties of Indiana in 1902 and 1903:

COUNTY.	Producing Wells, 1902.	Producing Wells, 1903.	Dry Holes, 1902.*	Dry Holes, 1903.*	Total Bores, 1902.	Total Bores, 1903.*	Percentage of Dry Holes, 1902.	Percentage of Dry Holes, 1903.	Average Initial Pro- duction of Pro- ductive Wells, 1902.	Average Initial Pro- duction of Pro- ductive Wells, 1903.
Adams	256	287	35	30	291	317	12.	9.4	23.	15.1
Allen	0	2	0	2	0	4	0.	50.	0.	2.5
Blackford	283	353	75	41	358	394	21.	10.4	15.7	11.1
Delaware	27	74	50	48	77	122	65.	39.3	15.8	20.7
Grant	942	1289	108	94	1050	1383	10.2	6.8	18.5	15.1
Hamilton	1	0	7	1	7	100.	12.	0.
Huntington.....	141	302	23	10	164	312	14.	3.2	22.	19.4
Jay.....	74	180	20	33	94	213	21.3	15.5	14.1	13.4
Madison	41	46	54	19	95	65	56.8	29.2	13.6	8.
Marion	2	0	0	0	2	0	0.	0.	3.	0.
Miami.....	3	1	4	1	7	2	57.1	50.	11.6	5.
Randolph	26	78	33	50	59	128	55.9	39.	23.1	43.
Wabash	2	3	0	1	2	4	0.	25.	7.5	3.
Wells	689	695	40	40	729	735	5.5	5.4	17.1	14.
Totals.....	2487	3310	442	376	2929	3686	†24.5	†27.3	†15.1	†14.2

*These columns include bores sunk for oil which yielded gas.

†Denotes average.

From the table it will be seen that the average initial production for the year in the entire field fell off slightly, being 14.2 barrels per well as against 15.1 barrels in 1902.

The older producing counties have by far the best average record for the year, Huntington leading them all with an average initial output of 19.4 barrels, while its percentage of dry holes was but 3.2. Grant and Adams tied in average initial production, but the former holds the better record in dry holes, yielding but 6.8 against 9.4 per cent. for Adams. Wells holds its own remarkably well and stands next to Huntington in its low percentage of dry holes, while its average initial output was but 1.1 barrels less per well than that of Grant and Adams. Randolph led them all in average initial output, but nearly tied with Delaware for first place in the production of barren wells. From

a careful study of the table one can learn many other facts regarding the relative importance of each county in the field.

CORNIFEROUS ROCK PETROLEUM.

The Corniferous formation is the lowest or oldest division of the Devonian system in Indiana, being represented in the State by sandstones with a maximum thickness of 20 feet, which are thought to correlate with the Schoharie group of New York, or by limestones 5 to 65 feet in thickness correlated with the Upper Helderberg. The waters in which the materials of the Corniferous limestone were deposited were clear and comparatively pure and in them sponges, corals, crinoids, trilobites and lower animal forms existed in great profusion. From the lime secreted by these marine forms the upper and purer beds of the Corniferous rock are mainly composed; and from the slow destructive distillation of the animals themselves a part of the oil contained in the formation was doubtless derived. The rocks of the Corniferous formation comprise the surface rocks of the State over a strip 5 to 40 miles in width, extending from the Ohio River at Jeffersonville north and northwestward to the vicinity of Logansport and Monticello. The outcrop of the eastern margin of the Corniferous passes through the following counties: Eastern Clark, Western Jefferson, Eastern Jennings, Central Decatur, Eastern Rush, Northeastern Hancock, Central Hamilton, Western Tipton, Southwestern Howard, Eastern Carroll and Eastern Cass. West of that margin the Corniferous is found either on the surface or underlying the later formations in all the counties. North of the Wabash River at Logansport, especially in Jasper and Laporte counties, the Corniferous has also been found in a number of deep bores sunk for oil, but on account of the thick mantle of overlying drift its exact limits are unknown.

Immediately above the Corniferous, west of its surface exposure, there is always found a thick bed of blackish or brownish shale, known as the Genesee or New Albany shale. This ranges in known thickness up to 195 feet and forms the necessary impervious cover which has retained the oil of the Corniferous in the parent rock. The Genesee shale is formed largely of the spores of low forms of fresh water or brackish marsh plants

known as Rhizocarps which flourished in vast numbers during the time the materials afterward compressed into the shale were being deposited. The shale is rich in bitumens derived from the destructive distillation of the spores of these ancient Rhizocarps. When kindled it will burn until they are consumed, and it is, therefore, by the uninitiated, often mistaken for coal. These bitumens are, by natural processes sometimes separated from the shale and in the form of gas or petroleum are collected in reservoirs in it or in the underlying Corniferous formation. Much of the oil now being obtained from the Corniferous rocks may thus have entered that formation from the overlying shale.

Petroleum in commercial quantities has been found in the Corniferous rocks of Indiana at Terre Haute, Vigo County, in the vicinity of Birdseye, Dubois County, and northwest of Medarysville, Jasper County. The territory opened up at each of these points is, however, limited in area, and the output, except at Terre Haute, small in quantity.

THE TERRE HAUTE POOL IN 1903.—No new bores have been sunk in Terre Haute in recent years. The famous Phoenix well on a lot near the center of the city, still remains the oldest and best oil well in the State. Finished in May, 1889, it has produced an average of more than 1,000 barrels a month for 15 years. Its output last year was 11,553 barrels, which was sold by the owners mostly to local consumers, though a quantity was shipped in tank cars owned by the operators. Four other wells at Terre Haute are yielding oil, but only one, that operated by A. B. McWhinney, in any quantity. During the year it produced 2,113 barrels, an average of about six barrels a day; while the other three wells yielded a total of only 274 barrels during the year.

The total output of the Terre Haute wells by months during the year 1903, was as follows:

PRODUCTION OF CORNIFEROUS ROCK OIL AT TERRE HAUTE, INDIANA, BY MONTHS, FOR THE YEAR 1903.

	<i>Barrels.</i>
January	1,448
February	879
March	1,384
April	1,350
May	944
June	1,375

July	835
August	1,135
September	1,358
October	1,044
November	836
December	1,352
Total	13,940

There is little doubt but that a large quantity of oil occurs in the Corniferous rocks beneath the city of Terre Haute and vicinity, else the yield of the Phoenix well could not have been so uniform and long continued. The porous area or reservoir containing the oil must, however, be narrow, and this bore probably struck it at just the right point to get the best results. Some people who know little or nothing of the geology of Indiana believe that the Phoenix well struck a crevice which extends to the main oil field of the State. Such belief is of course preposterous, as the Corniferous rock which contains the oil at Terre Haute outcrops before the main oil field is reached, and is not pierced by any bore sunk in that field. Moreover, it is a younger and much thinner formation than the Trenton limestone, and for that reason there is little chance of developing an oil output near Terre Haute in any way comparing to that of the main Indiana field.

DEVELOPMENTS IN THE VICINITY OF BIRDSEYE IN 1902 AND 1903.—During the autumn of 1902 and the spring and summer of 1903 a number of bores were sunk for oil in the vicinity of Birdseye, a town in the southeastern corner of Dubois County. In some of the bores quite a quantity of oil was developed in the Corniferous limestone, but the wells were sunk too far apart, one from another, to pump with profit. As a consequence the field, as yet, counts for but little in the petroleum industry of the State.

The first bore put down was on the Henry Eckert lease in the southwest quarter of section 24 (3 S., 3 W.), six miles south of Birdseye in Perry County. The Southern Oil Company of Evansville, Indiana, sunk this bore on account of supposed "surface indications" in the way of seepage, and seum of oil on nearby springs. It is also alleged that the late Prof. Edward Orton, of Ohio, had predicted that oil would be found in this region. The bore was finished in September, 1902, at a cost of \$2,600, with the following record:

Drive pipe	40 feet
Casing	595 feet
Top of pay	1,010 feet
Total depth	1,030 feet

In a limestone between 300 and 400 feet below the surface there was a small showing of a light colored oil, which was also found in most of the bores afterward sunk in the vicinity. The well, when finished and shot with 160 quarts, was put to pumping and made 15 barrels of oil a day for two days and then slowly settled to 3 barrels at the end of two weeks. It was being pumped with the contractor's power, and as he wished to remove it to another location, the pumping was stopped and has not been renewed; the oil produced still being in the tanks in October, 1903.

The strike, like all others of any consequence in a new field, attracted much attention, and thousands of acres of leases were at once secured within a radius of 10 miles. A number of new bores were at once begun, the second well finished being on the Gerhard Gellhausen lease, a mile and a quarter southeast of the first, in the southeast quarter of section 26 (3 S., 3 W.). It came in as a salt water hole without a showing of oil and with the following record:

Drive pipe	10 feet
Casing	725 feet
Total depth	1,280 feet

The third bore, sunk by the original company, was on the C. Hartwick farm in the northeast quarter of the southwest quarter of 19 (3 S., 2 W.), about one-half mile east of No. 1 Eckert. It was finished in March, 1903, coming in, it is claimed, as a better producer than No. 1, its record being as follows:

Drive pipe	60 feet
Casing	600 feet
Total depth	1,040 feet

The roads in the vicinity being extremely bad, no tank was on the ground, so the contractor pumped the well for three hours into the nearby creek, and estimated its output at 60 barrels. However, the company, being new in the oil business, were looking for a "big well" of the gusher variety. They did not consider

the new well good enough to put in a special power to pump, so, leaving the rig and pump, they started their No. 4 bore. This was in Dubois County, on the J. C. Kitterman lease in the northeast quarter of 36 (2 S., 3 W.), about one and a half miles southeast of Birdseye. Here a bore was started on the side of a bluff of Anderson Creek instead of on the level land of the valley of that stream; the theory of the field manager being that there was a crevice in the underlying rock of the valley which had caused the stream to follow its present bed. Wishing to avoid this supposed crevice, the well was located on an almost inaccessible spot, 50 feet above the level lowland. It was finished in May, 1903, and proved to be the best well at any time completed in the field; its record showing:

Drive pipe	92 feet
Casing	702 feet
First pay	981 feet
Total depth	1,000 feet

The oil pay streak was 19 feet thick; and when the first screw was finished the oil stood 400 feet in the bore. As the pay was very porous the well was shot with but 60 quarts. The shot caused the casing to collapse and it was six weeks before the well was cleaned and put to pumping. It then made 35 barrels the first day, 20 the second, 10 the third, and settled down to a 5-barrel producer at the end of three weeks. No pipe line or other means of transportation being present, the well was closed down ready for pumping and remains in that condition, the derrick, etc., still in place.

No. 5 bore of the Southern Oil Company was No. 2 on the Hartwick lease, located in the northwest of the northwest of 19 (3 S., 2 W.), one-third of a mile northwest of No. 1 Hartwick. At a depth of 995 feet the oil pay was found, but was only five feet thick. The oil rose 40 feet on the stem, but salt water soon developed and drowned it out. The well was not shot, and was abandoned after the casing was pulled.

A sixth bore was sunk by the Southern Company on the southeast quarter of section 23 (2 S., 3 W.), three-quarters of a mile northwest of Birdseye. It was completed in November, 1903, and came in as a small producer.

In addition to the six bores sunk by the Southern Oil Company, six others were put down by the Ohio (Standard) Oil Company, in the Birdseye field, as follows:

No. 1. On Mart. Eckert lease, southeast quarter of 15 (3 S., 3 W.), Dubois County, about five miles southwest of Birdseye. Top of pay at 1,015 feet. Came in as a 15-barrel well and pumped 36 hours.

No. 2. On Dixon lease, northeast quarter of 3 (4 S., 3 W.), Perry County, two and a half miles from Siberia postoffice. Drilled to a depth of 1,600 feet. No showing of oil.

No. 3. On Chanler & Brown lease, southwest quarter of section 3 (3 S., 3 W.), Dubois County, two and a half miles southwest of Birdseye. When completed started at 30 barrels, but dropped to nothing in a short time.

No. 4. On Bombolaski lease, northeast of 22 (3 S., 3 W.), 600 feet south of No. 1 Eckert. Dry hole.

No. 5. On Jackson lease, southwest quarter of section 12 (3 S., 3 W.), Dubois County. Came in as a good gas well but with very little showing of oil. On attempting to drill deeper, salt water came in with a rush and drowned out the gas.

No. 6. On the Kiser lease, south half of section 16 (2 S., 2 W.), Crawford County, about three miles northeast of Birdseye. Came in with fair showing but not enough to pay for pumping.

On October 14, 1903, five of the wells put down by the Ohio Oil Company had been abandoned, while the No. 1 Eckert was still standing, as finished, with a quantity of oil in the tank.

In addition to the 12 bores above mentioned, the Highland Investment Company of Chicago, put down another on the Marion Eckert farm, southwest of 14 (3 S., 3 W.), 500 feet east of the Ohio Company's No. 1 Eckert. This bore developed a fair showing of oil, and after shooting was pumped several days into the tank of the Ohio Company's well to the west.

From the above account it will be seen that of the 13 bores sunk to date in the Birdseye field, seven came in as light to fair producers, three as dry holes, one as a gas well and two with a small showing of oil. If the seven producers, or even three or four of them, had been put down close enough together to connect with one power, there is little doubt but that they would have produced a large quantity of oil. Being most of them several miles

apart, and with no pipe line in the field, it would not pay to pump them with separate power. The Southern Oil Company should have drilled its second and third wells on the Eckert lease where its No. 1 was located, and its fifth and sixth wells on the Kitterman lease adjoining its No. 4. If the latter had been sunk 300 feet south, on the level bottom land of Anderson Creek, it would doubtless have been as good a producer, and a half dozen or more wells, if necessary, could have been connected up with it. It never pays, when one has a fair well completed, to go a mile or two away in search of a "gusher." As it is, \$50,000 or more have been sunk by the three companies in the field, and not a dollar's worth of oil has been sold.

The pay streak in which the oil is found in the Birdseye field is a bluish gray limestone, coarsely crystalline in structure. Pieces from the Kitterman well contain a number of small globular cavities, partially filled with crystals of calcite. The oil bearing stratum is usually found 10 to 15 feet below the top of the bed of limestone in which it occurs. Immediately overlying the latter is a bed of soft, black to brown shale, 10 to 40 feet in thickness. There is no doubt but that the latter is the Genesee shale which, as above mentioned, overlies the Corniferous in the western two-thirds of the State. The limestone containing the pay streak differs in color and structure from the Trenton, and also effervesces more freely. It is without doubt the Corniferous limestone, the samples being identical in structure and color with the outcrops of Corniferous in Clark County.

The oil produced in the Birdseye field was examined for the Southern Oil Company by the chemist of the St. Louis Sampling and Testing works, who reported on it as follows:

COMPOSITION OF CRUDE OIL FROM BIRDSEYE, INDIANA.

"Light oils below 150° C.....	17.4 per cent.
Illuminating oil between 150° and 300°.....	26.9 per cent.
Lubricating oil above 300° C.....	42.2 per cent.
Residuum	13.3 per cent.
	100 per cent.

"Began to distill at about 45°C. Ceased to distill at about 350°C. Specific gravity, 0.850 at (16°C.).

“The analysis shows it to be a very good grade of petroleum for the manufacture of light oils (naphtha, gasoline, etc.), and illuminating oil. The percentage of light oils being 17.4 per cent. and of illuminating oil 26.9 per cent. and with the method now employed of destructive distillation or ‘cracking’ the percentage of illuminating oil would be largely increased to upwards of 60 per cent. but at the expense of much of the lubricating oil. The residuum amounting to 13.3 per cent. consists mainly of coke.”

BORE AT TASWELL, CRAWFORD COUNTY, INDIANA.—During the winter and spring of 1903, the Highland Investment Company, of Chicago, sunk a bore in search of gas or oil near the eastern limits of the town of Taswell, eight miles east of Birdseye, on the Southern Railway. Since this bore was put down in hitherto untested territory, I include the following account of it which was kindly furnished me by Mr. A. L. Nestlerode of Chicago, the field manager of the company: “Beginning at a point 810 feet above sea level we used but 12 feet of drive pipe, when we struck a bed of sandstone, and from that point went through slate and sandstone alternately to a depth of 254 feet, where we struck a bed of Carboniferous rock nine feet thick. At a depth of 272 feet we struck a similar bed of the same thickness. We found no limestone until we arrived at a depth of 425 feet. From this point we had alternate layers of slate and limestone to a depth of 830 feet, where we struck another layer, 45 feet thick, of the Carboniferous rock. At a depth of 975 feet we cased the bore with 6½-inch casing, but at 1,123 feet we struck a very heavy flow of salt water. We continued drilling, and at a depth of 1,300 feet put in a string of 5½-inch casing just 1,300 feet in length, and had a dry hole from this point on. We expected to strike the Trenton rock somewhere about 1,325 feet, but at a depth of 1,310 feet we encountered what the drillers at Birdseye called ‘shale’ but which was black limestone with considerable pyrites of iron in it, and so hard that the drill had to be dressed at every screw. At a depth of 1,460 feet we struck what the Birdseye drillers called ‘Trenton Rock.’ It was the formation in which they found their oil, but we had only a very strong smell of oil, while a white substance looking like refined oil gathered on the surface of the water. Our contractor, who was a Trenton Rock driller of northern Indiana, insisted that we had as yet struck neither shale nor Trenton

rock, but at a depth of 1,565 feet we struck an elegant brown shale. This continued to a depth of 1,690 feet where we encountered the actual Trenton rock and drilled into it 100 feet, or a total depth of 1,790 feet. In drilling through the Trenton rock we again encountered the refined looking oil and an odor that greatly excited us, for it smelled just as if each bailer full of the material was full of the real petroleum, but we got neither gas nor oil. We did not shoot the well, a fact which we now keenly regret."

It would appear from the above statement that the distance between the Corniferous and Trenton limestones at Taswell is but 230 feet. However, I saw no sample of drillings from the well, and hence can not vouch for the accuracy of the statement that the formation in which the drilling stopped was Trenton limestone.

BORE IN LANE TOWNSHIP, WARRICK COUNTY, INDIANA.—A bore was sunk in the spring of 1903 on the Riley Wilson lease, northeast quarter of section 8 (4 S., 7 W.), a mile and a quarter south of Scalesville, Warrick County; and 13 miles northeast of Boonville, the county seat. Its record was as follows:

Drive pipe	40 feet
Casing (6¼ in.).....	980 feet
Casing (4¼ in.).....	1,045 feet
Total depth	1,168 feet

The last drilling was in a white sandstone, which had been pierced 34 feet when a strong salt water vein was tapped which filled the bore. The diameter of the latter was too small at the beginning to admit of farther casing, hence the well was abandoned before reaching Trenton, and with no trace of a productive "sand." It is claimed that five veins of coal, varying in thickness from 4 to 11 feet, were encountered in the bore; one of them being a 7-foot vein of cannel coal.

THE JASPER COUNTY OIL FIELD IN 1903.—Since 1899 a number of shallow bores in Jasper County have been producing more or less petroleum. A full account of the history of this field was given in the report of this Department for 1900.

The oil is found in a limestone which, without doubt, is a continuation of the Corniferous limestone formation at present producing oil in the Canadian fields, and at Terre Haute, Indiana;

the limestone being easily recognized throughout a large area of southern Michigan and western Indiana, but being entirely absent in the eastern and central portions of the latter state. The formation is nearest the surface in the section of Indiana which has since developed into the Jasper County oil field, and is found in the most productive portions of this field at approximately 100 feet below the surface.

In eastern Jasper, western Pulaski and the counties to the northward, the New Albany or Genesee brown and black shales immediately underlie the drift and are encountered in sinking wells for water. As already noted, these shales are rich in bitumens, both oily and gaseous. The Corniferous limestone or oil-bearing rock, underlying this shale in the productive area of Jasper County, is a hard gray limestone which, in a number of test wells which have been drilled through the formation, has been found to be approximately 40 feet in thickness. The upper 20 feet, however, constitutes the oil producing portion of the limestone, and in this 20 feet are found several bands or pay streaks of porous rock which enlarge into crevices with considerable regularity. These crevices are often lined with pyrites of iron and lime crystals. Crevices have been found in quite a number of the producing wells which were two or three feet in thickness. In case a well, while being drilled, encounters one of these crevices, it will often produce a considerable quantity of oil without a shot of nitroglycerine, but almost without exception it has been found desirable to place a torpedo of about 20 quarts in such a position in the formation as to cover 10 or 12 feet of rock, the result invariably being to greatly increase the well's production. One of the large glycerine companies has a magazine in this district and provides the Jasper County producer with the necessary explosive.

The usual formation encountered in drilling a Jasper County well is as follows: Drift, consisting of sand, clay and loam, 50 feet, under which is encountered a bed, 45 to 55 feet in thickness, of close-grained black shale which forms an impervious cover for the Corniferous limestone reservoir. This black shale or slate does not cave in drilling, it thus being necessary to use but a short length of drive pipe to shut off the drift formation. The operators use for this purpose 5½-inch casing, and by driving it a sufficient distance into the black shale shut off the surface water. With

the usual form of portable drilling machine employed in the Jasper County district, an expert crew has completed a bore in the remarkably short time of 23 hours actual drilling time, it thus being evident that the cost of a well is a very small sum.

The oil obtained is unlike any other product found in the Ohio and Indiana oil districts, it being of a black or very dark green color and of a gravity which ranges from 17 to 21. Its thickness and low gravity is, without doubt, largely due to the shallow depth at which it is found, the more volatile portions having long since escaped through their overlying formations. The oil on examination is found to have a cold test of about 7 degrees F. and a fire test of over 400 degrees. It has a good viscosity test, and is universally used throughout the Jasper County district for lubricating purposes. It is associated with a strong sulphur water of which a large amount is usually encountered whenever a crevice is penetrated. There is usually but little gas found in the district except immediately upon the completion of a new well, when, for several days following, a considerable quantity of gas is often discharged.

An analysis of a sample of the Jasper County oil was made for Mr. E. T. Mudge, of Chicago, by Mariner & Hoskins of that city, who reported on it as follows:

“ANALYSIS OF CRUDE PETROLEUM FROM THE JASPER COUNTY, INDIANA, OIL FIELD.

Specific gravity.....	0.928 or 20.8° Beaume
Cold test.....	7° F.
Flashing point.....	410° F.
Fire test.....	437° F.
Sulphur	1.26 per cent.
Asphaltic matter.....	2.90 per cent.

“This oil contains no light oils, and it is not possible to fractionate it, except in a vacuum apparatus. It is, in fact, with the exception of a small amount of asphaltic matter, a desirable lubricating oil, and it is unusual to find less asphaltic matter, than that reported, in crude lubricating oils. It might be added, therefore, that this oil contains approximately 97 per cent. of lubricating oil.” *M. & H.*

Statements from numerous engineers who have given the oil thorough tests as a lubricant all certify to its high standard for that purpose.

The Federal Oil and Asphaltum Company, of England—the Byrd Syndicate of my former report—on January 1st, 1904, had 302 completed wells in the Jasper County field. Of these they were pumping but 80, and were delivering about 125 barrels of oil per day to the Indiana Asphaltum Company, at Asphaltum, a station on a branch or spur of a railway which penetrates the main field. This station is 12 miles south of Kersey, a junction point on the I. I. I. Railway. At Asphaltum a refinery capable of utilizing 300 barrels daily of the crude oil was completed in September, 1903. Lubricating oil and asphalt are the only two products of the refinery. Several grades of the lubricating oil are made. The residue or asphaltum has a high melting point and it is sold mainly for roofing purposes. The oil is first pumped from the producing wells into central tanks and then run to the refinery. In the winter season it has to be hauled in tank wagons on account of its viscosity. About 6,200 barrels were in stock when the refinery was completed, this being very nearly the total production of the field up to that date. The Indiana Asphaltum Company was paying \$1.10 per barrel in the open market on January 1st, 1904, but their contract price with the English company was for a less sum.

The Jasper County oil is all produced in a small area in Gillam township, the wells of the Federal company being mainly located on the south half of section 29; the southeast quarter of section 32 and all of section 33 (31 N., 5 W.). Aside from this area, E. T. Mudge had 46 wells, 12 of which were pumping, in section 28 of the same township. The average output per well in the summer season is about $1\frac{1}{2}$ barrels. The best well in the field is said to be No. 6 Gifford, which averaged, when pumped, six barrels per day for nearly three years. The Asphaltum company secured 2,050 barrels of stored oil, the output of this well to September, 1903.

There is probably no oil field in the world in which the expense of development is as low as in the Jasper County district. The oil formation lies at an extremely shallow depth, and the area which has been found to be petroliferous seems to be fairly uniform in character, resulting in few wells which are non-productive.

HURON SANDSTONE PETROLEUM.

Within recent years petroleum has been found in commercial quantities in a sandstone in southwestern Indiana. From the record of the bores and the appearance and structure of the oil-bearing rock, the latter is probably one of the sandstones of the Huron Group.* This formation or group comprises the uppermost or latest rocks laid down during the Lower (Sub) Carboniferous period. It is composed of three beds of limestone with two intervening beds of sandstone, their combined thickness reaching a total of 150 feet. The Huron comprises the surface rock over a strip 2 to 15 miles in width, which covers a part of eight counties in southwestern Indiana, as follows: Western Crawford, eastern Perry, central and northwestern Orange, eastern Martin, western Lawrence, eastern Greene, western Monroe and central Owen. Immediately overlying the Huron to the west is the Mansfield sandstone or "Millstone Grit," a massive sandstone, ranging up to 150 feet in thickness, which is the basal formation of the Carboniferous rocks of the State.

A typical section of the Huron group, exposed near Foote's Spring, Orange County, southwest quarter of section 11, (1 N., 2 W.), obtained by Mr. Kindle for the Twentieth report of this Department, was as follows:

Slope with Mansfield sandstone fragments.....	18 feet
Upper Huron limestone	15 feet
Upper Huron sandstone	35 feet
Middle Huron limestone	16 feet
Lower Huron sandstone	30 feet
Lower Huron limestone	6 feet

Of the sandstones of this group, which comprise the formation yielding the oil, Mr. Kindle says: "These beds, which are separated by the Middle Huron limestone, vary widely in thickness and in lithological characters. They are composed of strata of sandstone of medium coarseness, buff to light gray or white in color. In many places, iron in the form of limonite concretions occurs in the massive sandstone. Thin seams of coal, three to six inches in thickness, are found in them at some localities. Beds of shale, sometimes in part replace the sandstones."

*For a full discussion of this group see the 27th Ann. Rept. of this Dept., pp. 71 et seq.

Oil in commercial quantities has been found in the Huron sandstone near Loogootee, Martin County, and near Princeton, Gibson County.

THE LOOGOOTEE PETROLEUM FIELD.—In 1899 and 1900, 26 bores were sunk to one of the Huron sandstones near Loogootee, in search of gas or oil. Of these, 3 produced oil, 10 gas, the remaining 13 being dry. The results showed that in that region the productive stratum of sandstone is not to be relied upon. It does not appear to be continuous, but is in pockets. It varies much in thickness and also in closeness of texture, in some places being soft, quite porous and productive; in others hard, close-grained and barren. In an account of the Loogootee field, written in the spring of 1901, I gave it as my opinion that, on account of its pockety nature and thinness the supply of oil from any given area of the productive sandstone near Loogootee will never equal that from any similar area of the main Trenton limestone field of northeastern Indiana. Subsequent operations have borne out this opinion. Two producing bores, sunk in 1901, started at seven barrels each, while one in 1902 was dry. The records of the producing wells in the vicinity of Loogootee showed:

Drive pipe	15 to 20 feet
Casing	480 feet
Top of oil sand.....	473 to 524 feet
Total depth	485 to 543 feet

The pay streak in which the oil occurs is a fine to coarse-grained drab colored sandstone, varying in thickness from 3 to 14 feet. A number of the wells are still yielding a large amount of gas, while several wells, formerly gas producing, now have a small output of oil. In November, 1903, nine wells were being pumped in the Loogootee field, the total daily output being but six barrels. Three of the wells were on the Cannon farm, northwest quarter of section 30, Perry township, three-quarters of a mile southeast of Loogootee; the other six on the Larkin lease, southwest quarter of section 19, a half mile southeast of the town. The total output of the wells for the year 1903, according to figures furnished by the Indiana Pipe Line Company, was 1,459 barrels.

THE PRINCETON PETROLEUM FIELD IN 1903.—For a number of years it has been thought that petroleum existed in commercial quantities in the vicinity of Princeton, the county seat of Gibson

County. Small deposits of asphaltum encountered in several places in a deep coal mine operated near that city led to the belief that the more volatile petroleum would eventually be found. Finally, in 1901, the Interstate Gas & Oil Company was organized and began the sinking of a deep bore on the Brownlee farm, southeast corner of section 1 (2 S., 11 W.), one-half mile north of the corporate limits of Princeton. It was first intended to drill to the Trenton limestone, but the surface opening was too small and the caves in the shales passed through too numerous to permit the reaching of that limestone. The drill passed through alternating layers of shale, coal, fire-clay, limestone, etc., and after reaching a depth of 1,453 feet the bore was abandoned, mainly on account of a bad cave in the shale. A deposit of asphaltum, said to be six feet in thickness, was struck at a depth of 450 feet and fair showings of oil at 850 and 995 feet.

After the abandonment of the well a new company, styled the "Hoosier Prospecting Company" was organized, mainly for the purpose of developing the deposit of asphaltum, which it was thought was of sufficient size to be valuable. Leases on 700 acres of land just west of Princeton were obtained and a bore started which developed into the first productive oil well in the Princeton field. It was located on the southeast quarter of section 2 (2 S., 11 W.), one and a half miles west of Princeton, and finished May 25, 1903. The strata passed through were alternating layers of sandstone, limestone, shale and coal, varying in thickness from 1 to 134 feet. All belonged to the Upper Carboniferous series of rocks. Five veins of coal were pierced, one of which, nine feet in thickness, was struck at a depth of 785 feet. The depth of the well to the top of the oil bearing sandstone was 871 feet. The record of the bore, in the vernacular of the oil man, was:

Drive pipe	60 feet
Casing	802 feet
Oil pay	871 feet
Total depth	907 feet

When finished, the oil rose nearly to the top of the bore, but the well was not put to pumping for several months.

A second bore was soon begun on the same lease, 800 feet north-east of No. 1, but was not completed until August. Its record showed:

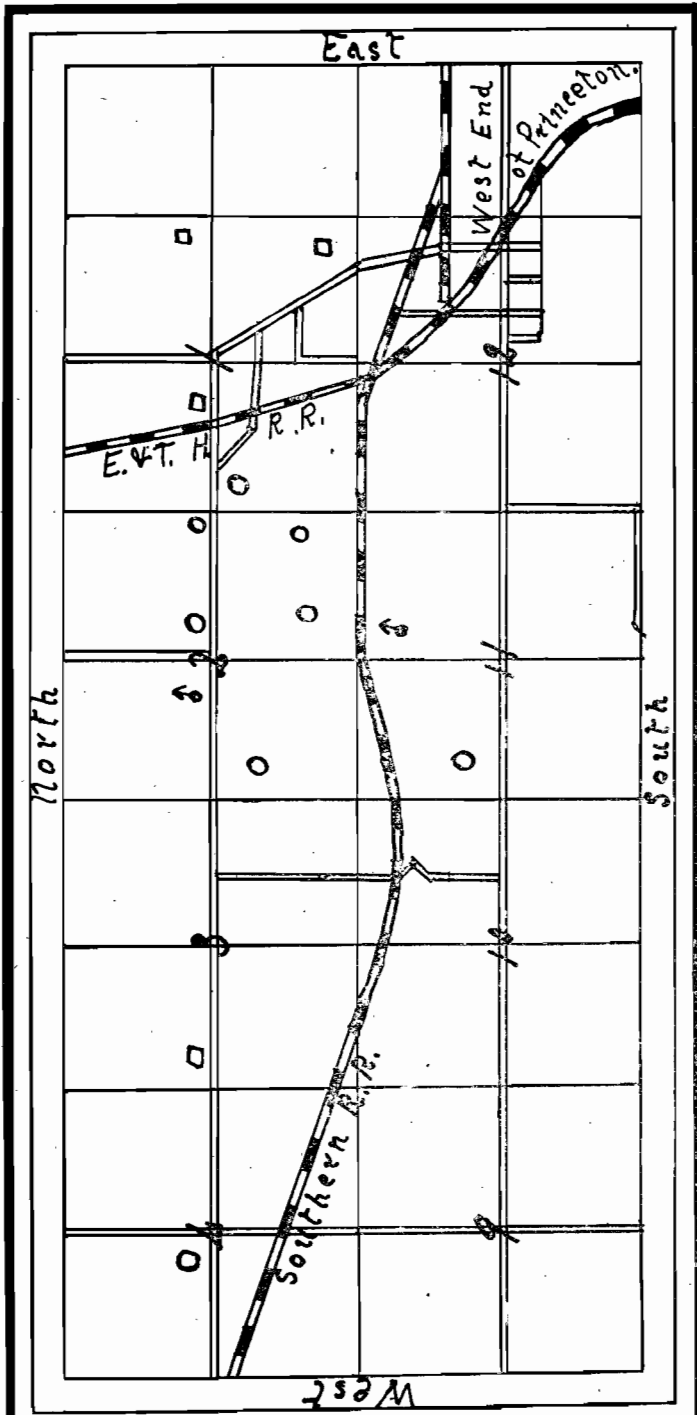
Drive pipe (10-in.).....	40 feet
Casing (8-in.)	60 feet
Casing (6 $\frac{3}{4}$ -in.).....	584 feet
Casing (4 $\frac{7}{8}$ -in.).....	804 feet

The shale immediately overlying the oil pay in No. 1 was continuous, and 62 feet in thickness, but in No. 2 there were two strata of nonproductive sandstone in this shale before the oil pay was reached. One 10 feet in thickness was found 20 feet in the shale. The second, five feet thick, was 35 feet below the top of shale. The third layer of sandstone had the upper 12 feet barren, but the lower six feet proved to be quite rich in oil. Quite a quantity of gas was also present and sprayed the oil above the top of the derrick. A light shot was used, and the production started at 25 barrels per day. The well flowed naturally for some time and was put to pumping about September 15. On October 13 the two wells on the lease were producing about 9 barrels of oil a day.

The bringing in of a second productive well was heralded far and wide, and caused an influx of oil operators from every direction. The country was scoured for leases, and by the middle of October 16 companies had been organized and a half dozen derricks were up. The third well completed was on the Woods lease, northwest corner of the southwest quarter of section 1. It produced quite a quantity of gas and about eight barrels of oil.

Before the end of the year the Ohio (Standard) Oil Company had completed two bores on the Mumford, south half of the northeast quarter of 2, one of which started at 25 barrels, but settled to eight-in about ten days. In it the top of the oil-producing sand was found at 913 feet, and the oil between 918 and 930 feet. There was 47 feet of this first sand stratum, the lower portion of which was barren. Then followed a layer of shale, eight feet in thickness, below which was another layer of sandstone, 48 feet thick. At a depth of 1,088 feet a strong vein of salt water was encountered and the drilling stopped. No. 2 well, a quarter of a mile west, was a light producer, starting at about ten barrels.

A bore on the Downey lease in the southeast corner of the northwest quarter of section 2 produced quite a quantity of gas, but was practically barren of oil. A dry hole was drilled just east of the cemetery north of Princeton, in the northeast quarter of



The Princeton Oil Field on Jan. 1st 1904.
 O=Productive Oil wells. □=Dry Holes. ⌘=Gas Wells.

section 1, and another on the Howe lease, close to the E. & T. H. Railway, in the northwest quarter of the same section. Of two bores just south of the Southern Railway, in the north half of section 11, one on the Emerson farm resulted in a small producer, while the other, on the Woodham lease, yielded a quantity of gas.

The best well in the field, up to January 1, 1904, was No. -1 on the Geiser lease, northwest quarter of the southwest quarter of 2. When shot it flowed 75 barrels for a day or two, but soon settled down to a 20-barrel producer. Its record showed:

Drive pipe (10-in.).....	60 feet
Casing (8-in.).....	80 feet
Casing (6 $\frac{1}{4}$ -in.).....	600 feet
Casing (4 $\frac{7}{8}$ -in.).....	800 feet
Top of oil sand.....	908 feet
Total depth	978 feet

A bore on the Kelch lease in section 27, White River township, five miles northwest of Princeton, came in dry. A light well was finished on the Blair farm on the southeast corner of the northwest quarter of section 4, and a dry hole on the Mauch lease in the southwest corner of the northwest quarter of section 3 (2 S., 11 W.). An important test bore put down on the Rogers lease, northeast quarter of section 27 (1 S., 12 W.), nine miles west of Princeton, produced only a small amount of gas. From the above it will be seen that operations to the close of the year 1903, resulted in eight producing wells, six dry holes and two gas wells. About a dozen rigs were up for new wells in various parts of the territory on January 1, 1904, and the field will doubtless be thoroughly tested before the close of that year.

The oil of the Princeton field is found in a bluish gray sharp-grained sandstone, which is doubtless one of the Huron sandstones immediately underlying the Mansfield sandstone or Millstone grit. The formation is the same as that in which the Loogootee oil occurs, 45 miles to the northeast. At Loogootee the top of the oil-bearing stratum is found at an average depth of about 500 feet below the surface, while at Princeton the average is approximately 890 feet, showing a dip of nearly nine feet to the mile between the two points. The records of the wells in the vicinity of Princeton show a local dip in the oil-bearing sandstone of a little more than five feet to the mile to the southwest. The later

wells sunk in the Princeton field have found the best productive portion of the sandstone 25 to 40 feet below the top. Much trouble is experienced with the numerous shales passed through, as all of them are soft and friable and very likely to cave. For this reason most of the wells have to be cased nearly to the top of the productive sand.

The oil found in the Princeton field is darker and thicker than that yielded by the Trenton rock. It registers 31° Beaumé and its percentage of illuminants is low; the quality being such that the price was reduced from \$1.31 to 96 cents per barrel about January 1, 1904. The Indiana Pipe Line Company has built a loading rack for tank cars and an 800-barrel storage tank on the Miller lease, west of Princeton. From this point lead pipes are put down to the producing wells as fast as finished. During the month of December, 1903, 992 barrels were shipped from the field.

While the area of productive territory about Princeton will doubtless be found to cover a number of square miles, the output of the field will never, in my opinion, be very large. The oil-producing sand is too thin and pockety to yield many big wells, and the output of those completed will rapidly diminish. The history of the field will, in all likelihood, be a repetition of that at Loogootee, where the conditions confronting the operator were practically the same.

* * *

Adding to the output of the Trenton rock petroleum fields, that produced by the Corniferous limestone at Terre Haute, and by the Huron sandstone at Loogootee and Princeton, we find the value and total production of petroleum in Indiana in 1903 to be as follows:

	<i>Barrels.</i>	<i>Value.</i>
Trenton rock oil	9,161,331	\$10,457,659
Corniferous rock oil	13,940	15,913
Huron rock oil	2,451	2,797
Total	9,177,722	\$10,476,369

As one travels through the oil district of the State a sense of the greatness of the industry grows rapidly upon him. One might study it for years and yet not master its every intricacy. He

finds a vast system of pumps, tubes and pipes drawing a stored liquid from the depths of the earth, and transporting it hundreds of miles to distant refineries, there to be separated into parts, each of which serves as a basis for articles of manifold kinds for the use of man. Depending upon this industry are several thousand men—rig-builders, drillers, tool dressers, pumpers, pipemen, gaugers, etc.; each class performing a special duty and all working in harmony for the advancement of the common industry. Yet the resource itself is seldom seen, except where it overflows in waste, even by the army of workmen who are engaged in its production.

In a study of such resources as coal, clay, building stone, etc., one can see the strata *in situ*, note their arrangement, measure their thickness and study in detail their relation to their surroundings; but in an area covered so deeply with drift as is the main oil field of Indiana, and where the resource in question is contained in a rock formation nowhere exposed to view within the State, the difficulties in the way of a proper presentation of the subject are many. The records of the formations passed through by the bores had to be obtained from drillers and operators, many of whom had little geological knowledge. Moreover, their records were scanty in detail, noting, as we have seen, little else than the number of feet of drive pipe and casing used, the depth at which the Trenton rock was found and the total depth of the bore. However, I found them at all times willing to place at my disposal such knowledge and records as they possessed, and to them I am indebted for such records as are included in the report.

To James McCormick, of Hartford City; Alex. McDonnell, of Montpelier; Albert Stevens, E. F. Aldrich and Geo. E. Scott, of Muncie; Chas. A. McLain, of Parker City; L. C. Davenport, W. H. Mandeville, C. M. Miller and W. A. Kunkle, of Bluffton; Benj. Fulton, of Portland; Jas. E. Hardison, of Geneva; B. A. Kinney, L. A. Von Berin, Fred Foreman, J. R. Bennett, Joshua Strange and R. J. Heald, of Marion; L. H. Legler, of Evansville, and Harry Kurtz, of Princeton, I am under special obligations for services rendered, both in the field and since my return therefrom.