SUPERVISOR OF NATURAL GAS.

OFFICE OF SUPERVISOR OF NATURAL GAS,
INDIANAPOLIS, IND., January 1, 1892.

To Hon. S. S. Gorby, State Geologist, Indianapolis, Ind.:

SIR—In conformity with the provisions of the statutes of Indiana, relating to the supervision of natural gas and the inspection of gas wells and gas plants, I have the honor to submit to you the following detailed report of the transactions of this department for the period commencing March 16, 1891, to and including January 1, 1892.

This report is not as full and complete as you may have a right to expect, or as I could wish, for the reasons hereinafter mentioned.

I entered into the discharge of the duties of this department on the 16th day of March, 1891.

These duties have been so many and so various, and as no provisions were made for any assistance in the work, I have been unable to cover the entire field within the limited time I have had for the work.

Another disadvantage, under which I have labored, has been the want of proper instruments and appliances for testing wells, in order to determine their pressure and volume. However, I can assure you that this part of the work can hereafter receive proper attention, as the department has lately been supplied with a complete set of gauges and other appliances necessary for making the tests required.

I consider the duty of inspecting machinery and piping, used in plants furnishing gas to consumers, one of the most important of any I have to perform.

The safety of life and property requires that the machinery for handling this fuel should be kept in the best condition. So far but few accidents have occurred, and these have been caused by defective house plumbing. In a large majority of the plants I have inspected I have found them to be in a condition to give safe and satisfactory service to their consumers. In only two instances have I been compelled to condemn any part of the plant, and in both of these cases I found the managers preparing to substitute new machinery.

As the piping and machinery, which is now comparatively new, becomes old and worn the necessity for careful supervision and frequent inspections will become more apparent.

The law prohibiting the burning of natural gas in flambeaus is obeyed in the greater number of localities. The exceptions are to be found in parts of Madison, Grant and Howard Counties, and possibly, in rare cases, elsewhere.

The local officers charged with the enforcement of the laws appear to have given little, if any, attention to this statute.

This has been, and is, a source of great and needless waste, and should be stopped.

The conditions of some of the pipe lines extending over parts of the field is bad. In some of them leaks can be found at almost every joint. Especially is this true in what is known as the "farmers' plants." These lines have been laid down hastily, and by inexperienced men, which will account for their condition.

In my next report I hope to be able to give you more fully the condition of the pressure and volume, as well as many other facts which I have been unable to reach at this time.

Respectfully,

E. T. J. JORDAN,
Supervisor of Natural Gas.

THE GAS AREA

The area of the gas field of Indiana is very much larger than that of any other developed at this time, It embraces the counties of Grant, Howard, Tipton, Hamilton, Madison, Hancock, Delaware, Blackford, Henry and Rush. Adjoining these gas has been found in paying quantities in parts of Marion, Shelby, Decatur, Franklin, Dearborn, Fayette, Wayne, Randolph and Jay counties. This constitutes the main gas belt of the State, and is practically continuous. Inside of this belt but very few well have been drilled that have not furnished more or less gas.

Within this area, the eastern portions of Hamilton, Tipton and Howard Counties, together with the counties of Grant, Madison, Blackford, Delaware and Hancock, the largest wells have been found. Prof. S. S. Gorby, State Geologist, in the 16th Report of the Geology of Indiana, has very fully described this area. Accompanying his report is a carefully prepared map fixing the boundry of the territory I have mentioned. Since that report was written many wells have been drilled by prospectors around the borders of this area, and in other parts of the State, seeking to discover new fields, or to extend the boundaries of the main field. While some show of gas has been discovered in some of these wells, and hopes have been raised that their efforts were in the right direction and would ultimately lead to suecess, yet by far the larger number has ended in what is known as "dry holes"—that is, no gas has been obtained. Not enough gas has been obtained to necessitate the enlargement of the boundaries of the map to which I have referred. In a word, no new fields have been discovered, either contiguous to the main field or in any other part of the State. In some portions of the area included in this map, the flow of gas has always been weak, and is now practically exhausted. Especially is this true in the localities of Lawrenceburg in Dearborn County, Brookville in Franklin County, Connersville in Fayette County, and Portland in Jay County. In fact the wells in the localities I have mentioned are considered so nearly valueless that they have not been returned for taxation, and the greater number of them have been abandoned.

The leaving out of these places, which lie on the east and southeast of the belt, would be the only change that I would suggest in the map as

it now appears. Outside of this main belt, gas has been obtained at Auburn in Dekalb County, Vernon in Jennings County, Salem in Washington County, Francisville in Pulaski County, and at several points in Harrison County. This last field extends across the Ohio River into Kentucky. In all these places the field has been limited in territory and in flow. These localities are not now thought to be worthy of a place in the consideration of the gas areas of the State.

The boundaries of the gas areas of Indiana are so irregular that it has been difficult to arrive at the exact number of square miles included. Probably the nearest estimate is in round numbers, five thousand square miles. This includes all the territory in which a well will produce any gas. Of this great expanse, probably twenty-five hundred square miles were originally underlaid by gas in quantity sufficient to produce wells of the first class.

The gas field of Indiana is many times larger than the field of any other of the gas producing States. In fact it is a great deal larger than the total gas producing area of Ohio and Pennsylvania combined. A very important feature, and one that gives to Indiana a decided advantage in reference to this product over the States I have named, is that the producing territory is practically one continuous field. Whenever the drill penetrates Trenton rock anywhere within the boundaries defined, a flow of gas may be expected in quantities sufficiently large to justify the expense of connecting the well to a pipe line. A failure to do so has been the rare exception.

This is not true of Ohio and Pennsylvania. In those States it has been shown that there are many small fields without any apparent connection with each other. The total areas in the two gas-producing States I have mentioned only aggregate a few hundred square miles, while in Indiana, the continuous territory that has been developed, and the finding of gas reduced to an absolute certainly, amounts, as I have said, to five thousand square miles. This fact alone adds greatly to its value in the production of this fuel.

I consider this condition of the field in this State as one of very great importance in estimating the permanency of the supply. It will readily be seen that, taking only this one condition into account, the supply in Indiana must, of necessity, be many times larger than that of Ohio and Pennsylvania.

The area of the gas-field is not the only condition that must be considered in estimating its productiveness or the permanency of the supply. The source from which gas is obtained is an important factor. The field may be extensive, and yet the source of the supply at any given locality, or in the entire field, may be subject to such conditions as will limit the production. The source of the supply in the main field of Indiana is the Trenton limestone. This rock is reached, in the greater part of the field,

at a depth of eight hundred feet to ten hundred and fifty feet, the depth of any given well being governed by the surface elevation. The following is a list of the more important localities, and the depth at which Trenton rock was reached:

DEPTH OF TRENTON ROCK.

Broad Ripple	860 feet.
Anderson, Well No. 1	850 feet.
Anderson, Well No. 2	814 feet.
Alexandria	889 feet.
Fairmount	934 feet.
Frankton	840 feet.
Greenfield	985 feet.
Union City, Well No. 1	1,165 feet.
Fountaintown, Well No. 1	976 feet.
Auburn	1,933 feet.
Jonesboro	910 feet.
Kokomo, Well No. 1	934 feet.
Kokomo, Well No. 2	905 feet.
Muncie	878 feet.
Noblesville	845 feet.
Pendleton	859 feet.
Ridgeville	981 feet.
Shelbyville, Well No. 1	837 feet.
Shelbyville, Well No. 2	865 feet.
Winchester, Well No. 1	1,008 feet.
Winchester, Well No. 2	1,029 feet.
Winchester, Well No 3	1,058 feet.
Thorntown	1,204 feet.
Van Buren	960 feet.
Elwood	930 feet.
Lapel	888 feet.
Camden	990 feet.
Dunkirk	950 feet.

Trenton rock is subject to two conditions as regards the production of gas. The first condition is its thickness. By this I mean the gas-bearing portion. The gas-bearing portion of the Trenton limestone in this State varies much in thickness, and this variation is not, apparently, according to any system or law, but is very irregular, and may be encountered in any part of the field. A few instances have been reported where the gas-rock was found to be not more than one foot thick. I will not, however, vouch for the correctness of the measurements upon which these reports are based I rather believe that the flow in some instances was so weak, owing to the density of the rock and other conditions present, that it was impossible to obtain an accurate measurement.

The greatest thickness that has been discovered is about forty feet. There can be no mistake as to the point where the gas begins to flow,

but the drillers may not be so accurate in regard to the point where the increase in the flow stops. As a usual thing no measurement of the flow is taken, and it is left to the eye and ear of the driller to judge when the increase in flow ceases. Exact information upon this point has been hard to obtain, as by far the greater number of wells have been drilled by contracts, and the contractors have been interested only in completing their work, and have not taken the pains, or even possessed the necessary appliances to make accurate measurements. From the meager information that it has been possible to obtain as to this condition of the rock, it may be safe to assert that the thickness of the gas-bearing rock in a large portion of the Indiana field is not equal to the same rock in the Ohio field, or to the aggregate thickness of the different gas-bearing sands that are found in the wells of Pennsylvania. But this is not true of many parts of the territory, notably in Madison, Grant and Blackford counties. In these localities the thickness of the gas-strata compares favorably with that of other gas-fields. However, the lack in this respect in the Indiana gas-rock is many times more than equaled by the extent of its area. These two conditions, area and thickness, when considered together in estimating the productiveness and value of the field, make a very favorable showing.

The density of the rock is another and very important condition to be considered. The more porous the condition of the rock, the more storage there is for gas, and the faster will be the flow through the rock; while in the denser portions the storage capacity is limited and the flow is obstructed. The thickness of the rock being equal, the wells that penetrate the more porous portions of the rock will produce the most gas.

Porosity, then, is to be considered as a very important condition. This is found, like the thickness, to vary very materially in the different portions of the field, and often in the same locality, and is not governed by any known law or system. Porosity and thickness govern the production of any given well or locality. When the greatest porosity is found in connection with the greatest thickness, there we have the best producing wells. In regard to this condition it may not be possible or fair to compare the productiveness of the field under consideration with gas-bearing sands of Pennsylvania. Under no condition could the Trenton limestone be found as porous as the sands I have named, consequently the wells of Indiana could never reach the enormous flow that has been shown in some of the monsters of the Murraysville and other fields of Pennsylvania. It may be argued here, however, that, our resources being so much larger, owing to the large area of the field, the flow of gas, although limited somewhat by the density of the rock, may be of much longer duration, and in the end we will have derived more benefit. It stands to reason that while great porosity will give a larger flow, yet there will be quicker

exhaustion of a given supply, and the short life of the field will prevent a perfect utilization of the product.

In the Ohio field, as has been before mentioned, the source of the gas is the same as in Indiana, with some unimportant exceptions. In regard to density, it appears, from the information at hand, that the condition of the Trenton rock in that field does not vary in any material degree from the rock in the Indiana field. As the field there is so limited in extent, perhaps there is a larger area of rock showing the greatest porosity, in proportion to the entire territory, than is to be found in Indiana. The rock in the Ohio field shows at different points different degrees of density, and, as it appears in Indiana, is not subject to any known law. It is not unreasonable that this should be true, as the fields lie almost contiguous, and the Trenton of Indiana is a continuation of the same rock in which gas is found in Ohio. I do not wish it to be understood that the gas-producing area of these two States is continuous; in fact, they are separated by quite an extent of territory in which no gas has been developed, or, if found at all, has been in such limited quantities as to be of no practical value, and hence not worthy of mention in consideration of the field. In this intervening territory the Trenton rock either lies so low as to be filled with salt water, to the exclusion of gas, or the density is such as will entirely obstruct its flow.

There is one more condition to be considered in estimating the value of a field or of individual wells in the production of gas. This is the initial pressure, commonly called rock pressure. By this is meant the pressure exerted by the gas upon the rock in which it is contained. The only means that we have of ascertaining this pressure is by drilling into the gas rock. The pipe that connects this reservoir with the surface will, when closed, contain gas in the same state of tension that exists in the rock. The pressure is determined by a steam-gauge attached to the pipe. This is sometimes called the closed pressure of the well, and it ranges in amonnt from 1 to 1,000 pounds to the square inch. In all the great gas fields the rock pressure ranges from 300 to 750 pounds, and beyond the latter figure it very seldom rises. In shale gas wells the pressure seldom rises to 100 pounds, the ordinary range being from 25 to 75 pounds. As to what it is that originates this force three answers have been given, but for none of them has it been claimed that they are well-defined theories. They have been thrown out as suggestions.

One answer is that the rock pressure is derived from the expansive nature of the gas. In support of this statement, it is claimed that solid or liquid materials in the reservoir are supposed to be converted into gas, as water is converted into steam. The resulting gas occupies many times more space than the bodies from which it was derived, and in seeking to obtain this space it exerts the pressure which we note.

The second explanation, or theory, is to the effect that the weight of

the superincumbent rocks is the cause of the high pressure of gas in the reservoirs. In this explanation, the term *rock pressure* is considered to be descriptive of a cause as well as of a fact.

The third theory advanced to account for the rock pressure of gas is entirely different from those already given. It claims water pressure in the gas rock as the cause of the flow. By this theory gas is made artesian in its flow. Each of the theories, or suggestions, has its adherents, but none of them have been expanded into anything like an elaborate or balanced statement.

I shall leave to the scientists the task of finding out the true and satisfactory explanation. I have only introduced these theories in connection with this condition of the development of gas for the purpose of suggesting thought which may lead to the discovery of new facts, or to a more full account than can now be given of the facts involved.

Proceeding with the comparison of the great gas fields, it may be said that in Pennsylvania the original rock pressure was 750, in Ohio 450, and in Indiana 325 pounds to the square inch. These figures have been greatly reduced by the exhaustion of the fields. Especially is this true in the first two States named, and it is also true in many portions of the Indiana field.

Of this I shall have more to say in another part of this report. My object at present is to describe the natural condition of the field, and to compare it with other fields, as to its productiveness. Rock pressure tells nothing of the productiveness of a well when taken by itself. Wells, in any field, are quite likely to have the same closed pressure, no matter what their production may be. That is, when locked in, all such wells will reach the same pressure on the gauge. One well reaches it instantaneously, or in a very short time. In another the pressure increases slowly for hours, but at last it gets to the same point that the stronger well reached in a minute.

If the element of time be combined with the element of closed pressure, an approximate estimate can be made as to the production of a well. It is obvious that a well that gains 100, 200 or 300 pounds in a minute, has a much larger productiveness than a well that gains 5, 10 or 20 pounds in the same interval.

The only scientific system of measuring the flow of gas wells is based on the open pressure of gas, and by means of it the strongest as well as the weakest well can be determined by a simple and single measurement that can be executed in a few seconds at most.

If the theory of artesian pressure be accepted, other things being equal, the rock pressure will be greatest in the deepest wells. The deeper the well, the longer the water column. Other things being equal, the rock pressure will be greatest in those districts where the gas rock rises highest above sea level in its outcrops. The 750 pounds of rock pressure in

Pennsylvania gas wells, as contrasted with the 400 pounds pressure of the Findley wells, and the 325 pounds of the Indiana field, can be accounted for on this principle.

If this theory be true, and it has by far the greatest number of adherents, then the productiveness of the Indiana gas field does not suffer by comparison of the rock pressure, as shown in the different gas fields, when this condition only is considered. In other words, Indiana could show as great a production within a given area as either Ohio or Pennsylvania, providing the other conditions were equal, notwithstanding the fact that her wells show only 325 pounds rock pressure, as against 450 pounds and 750 pounds shown in the States named.

The disturbance of strata in its effects upon the accumulation of gas is a subject that has been discussed ever since the discovery of gas in this country upon a large scale. Geologists have concluded that the disturbed condition of the strata in many, if not all, of the gas producing districts, has modified the distribution of gas to a very material extent.

The occurrence of gas in any district has, in nearly every instance, been found to be connected with more or less marked irregularities of structure. The facts observed in the different oil and gas fields are susceptible of but one explanation, and that is that the accumulation of gas is modified by the structural arrangement of the rocks. In other words, structure is a vital element in the accumulation of gas.

I shall not enter into a description of the structural arrangement of gas bearing rocks of this field at this time. I do not consider it necessary to do so, as they have been very carefully and exhaustively treated of in this connection by Prof. Maurice Thompson and Prof. S. S. Gorby in the 15th and 16th Reports on the Geology of Indiana. Their reports were made after the most careful and painstaking surveys. The reader is referred to these reports for accurate descriptions of the structural arrangement of the Trenton limestone, together with the overlying rocks within the gas field of Indiana. Dr. A. J. Phinney, of Muncie, Indiana, has given much time and attention to the geology of the gas fields of the State, and has written a very careful and elaborate report on the same, which may be found in the latest report of the United States Geological Survey.

RECAPITULATION.

The conditions which are essential to and govern the production of gas in any field are area, thickness, density, initial pressure and structural arrangements. It is evident that the field in which the largest area is combined with the greatest thickness, the most porosity, together with the highest initial pressure and greatest disturbance of structure, is the most productive. Where all these conditions are present in their most favorable form, abundance and permanency of this valuable fuel is assured.

Whenever any one or all of them are lacking in any considerable degree, then the value of a field as gas producing territory is diminished proportionately. These conditions must all be present to some extent if we would expect to find a flow of gas. A careful observance of these conditions, which are so vitally essential to the existence of gas in any territory, will be of vast importance to the prospector who is seeking to develop new fields. If these things had been known or understood in the first years of gas development in Indiana, as well as the other gas producing States, vast amounts of money, together with needless expenditure of time and labor, might have been saved. The search for gas would have been systematical, and confined to those fields where the vital conditions were present. Even yet, within the State, wells are being drilled in localities in which careful surveys have shown that the requisite conditions are not present, and, in consequence of their absence, gas can not be obtained. However, these things are being better understood. Practical men have been devoting their best thoughts to the subject, and have been making careful observations. By so doing they have obtained a better knowledge of the source of the gas, in its location and conditions. Money, time and labor have been saved thereby. The driller knows where to locate his well, and he can tell, with reasonable certainty, the exact depth he will have to reach in order to find gas. He can also judge from the texture of the rock penetrated whether his well will be a large producer or not.

It is true that within the field "dry holes" are sometimes obtained. However this is only the very rare exception. In such cases it is always found that one or more of the conditions are wanting. Generally in such wells the rock is too dense in its structure to permit the flow of gas, although all of the other conditions may be present. Such spots, as I have said, are rare within the field, and the area of each is very limited. In many cases large producing wells have been developed in close proximity to these failures. The failures within the field, at the present development, are confined to a few spots of small areas.

The facts that have been obtained in the development of the Indiana gas-field are enough to establish the wonderfully productive character of the Trenton limestone that underlies the territory. The gas-rock proper, in most of the field, is very open in grain, as a rule. It occurs in beds of varying thickness, as has been stated. The gas-rock is of as good quality, and is found in nearly as great thickness, in large portions of this field, as has been developed in the other great gas-fields. In explanation of the great production of this gas-field, it is suggested that the best quality of rock is more continuous than in other fields. In a word, the Indiana gas-field possesses all of the requisite conditions that go to make up a large production, and some of them in a marked degree. As an illustration of this, I would again call attention to the

vast area of the gas bearing rock, an area that covers, as before stated, at least five thousand square miles of continuous productive territory. In consideration of this condition, I venture the statement that it is the horizontal rather than the vertical extension of the gas-rock to which the great production is owing.

All of the conditions favorable to the largest production of this valuable fuel exist in the Indiana field. Vast amounts of gas have been developed and utilized. Almost equally vast amounts have been wasted in various ways. Of this reckless waste that has been practiced in the field, and its probable effect on the permanency of the supply, I shall have something to say in another part of this report.

Taking the conditions as they are found combined in this field, as I have endeavored to show them, and especially considering the vast lateral extent of the rock, I think that Indiana can, with consistency, claim the most productive gas area in the known world.

CONDITION OF THE GAS FIELDS.

In the foregoing pages of this Report, I have endeavored to describe the gas field of Indiana. In that description I have shown that the field possesses all the conditions that are necessary to the production of this valuable fuel. I have shown that the field is of vast extent, greatly exceeding in this respect that of any other field known, and that the density of the gas bearing rock in the greater portion of the territory is favorable to the largest production. The only conditions in which this field suffers in comparison with other fields is in the vertical depth of the productive portions of the rock and the initial pressure. Viewing the field as a whole in regard to its capacity for the production of gas, I may say that the loss in productiveness from the last two conditions named is more than equaled by its vast lateral extent.

Taking all these things into consideration, there may be claimed for the gas field of Indiana a greater productiveness than that of any other field that has yet been developed. The developments, as shown in hundreds of wells with outputs of from two millions to twelve and fifteen millions of cubic feet in twenty-four hours, together with still other hundreds of a lesser flow, go to prove the claim. Such were the conditions and capacity of the field when gas was first discovered in September, 1886. That it has suffered by mismanagement, and that the full benefit of its productiveness has not been realized, is plainly evident to every thoughtful observer.

Ignorance of the condition necessary to and in connection with the production of this fuel, and a mistaken idea that it was a perpetual product, led to this mismanagement. Closely following the first discovery, gas was developed in many different localities in the territory.

In each of these places excitement immediately ran to the highest pitch. Thousands of people visited the wells every day and night. Excursion trains ran almost daily bringing visitors to view the various "wonders." This continued for many weeks in most of the localities, during which time the wells were allowed to stand open and thousands of millions of cubic feet of this valuable fuel was allowed to escape, or was burned for the benefit of the multitudes of sight-seers. Not only was the gas wasted and consumed in this prodigal and senseless manner, but what was worse, the fact that this free, open flow was maintained at the wells for weeks, and in some cases for months, so relieved the rock pressure, that not only wells subjected to this extraordinary draft, but the entire area was permanently injured by the introduction of salt water. This would not have been the case, and the production would have been much larger, if these first wells, as well as many subsequent ones, had not been subjected to such a heavy and unnecessary draft.

Another thing that was practiced during the early discoveries of gas in this field was the overestimation of the capacity of the wells. To some extent this is done yet by boomers and speculators in real estate. Many of the newspapers published in the gas belt have been guilty of the grossest exaggerations in publishing the capacities of the wells in their different localities. This was deplorable from the fact that it not only deceived manufacturers and others desirous of investing in gas industries, but when later and more correct estimates and measurements were made too great a falling off was shown, which led to the belief in a too rapid decrease in the production. I maintain that if proper measurements of the output of all wells had been taken and published, and if the supply had not been drafted on so heavily, and a sufficient back pressure maintained to prevent the introduction of salt water, that many parts of the field would not show the heavy decline in pressure and volume that is now apparent. Some wholesome laws are already in operation, having for their object the preservation of gas and the protection of wells. Much good has already been accomplished by their observance. The burning of this valuable fuel in immense flambeaus all over the field during the early developments was one of the most senseless and wasteful of the many extravagances practiced. The cities and towns within the field, as well as the farms and country roads in many places, were lighted up with these miniature gas wells. In most instances they were allowed to burn day and night. Millions of feet were daily consumed in this wasteful manner, and a heavy and unnecessary draft from this cause maintained on the field, without adequate return. This is now prohibited by law, which I am glad to know is carefully obeyed in the greater part of the field, yet there are localities where it is disregarded and this criminal waste and injury maintained.

I would recommend that such laws be enacted as will prevent gas companies and all other owners and operators of gas wells from drafting their wells to the point of reducing the initial pressure below what may be shown to be the "danger line" in their respective localities, or to the point of admitting salt water into the wells.

This "danger line" is shown not to be uniform throughout the field; that is, a back pressure which would be sufficient to prevent the introduction of liquid in one part of the field would not do so in the other places. This law should be so modeled as to meet the conditions in this respect as they are found in the different localities within the field.

I would also recommend the passage of a law regulating the packing of wells. A large number of wells have what is known as wall packers. By this is meant that the packer and tubing is anchored to the wall of the well in the shales, in many instances as much as four and five hundred feet from the bottom of the well. Incalculable injury is, in nearly every case, done by this method. The gas, after its release from the Trenton rock, permeates every portion of porous rock that forms the wall of the well below the point at which the well is packed. It spreads itself laterally through every crevice and opening that is found, and thus an enormous waste is maintained.

In many parts of the field we find gas escaping through the earth and bubbling up through the water in the streams and in water wells. In some instances the escape into water wells has been so strong that the wells have been closed in, and the gas piped into the houses adjoining and found sufficient for domestic consumption.

All this may be attributed to the insufficient packing of the wells in the vicinity. The great upheaval of earth and rocks, and the explosion which followed in the vicinity of Waldron, Shelby County, which occurred August 11, 1890, was due to the gas escaping through the shales and below the packers from the wells at Waldron and St. Paul. The gas escaping laterally through the shales collected in subterranean reservoirs until the pressure became so great as to cause the upheaval.

The waste from this cause has resulted in vast injury to the field in different localities, by reducing the pressure and the consequent introduction of salt water.

Well owners should be required, in packing their wells, to extend the tubing to the bottom of the well and place the packer at the top of the Trenton rock. I am aware that this can not be done in all cases, as the wall is in such a condition at the top of the rock that the packer will not hold. Especially is this true in wells that have been "shot." But in these wells it should be required that the packer be placed as near the rock as can be made to hold, thereby reducing the exposure to escape laterally to the minimum.

When the gas is released from the Trenton rock by the penetrating of the drill, every precaution should be taken to secure it. This should be done not only for utilization, but to prevent injury to the field.

It is admitted by many scientists, and others who have had much practical experience, and who have given the matter careful thought, that salt water is the final death of gas wells. Salt water, petroleum and gas are found in the porous Trenton rock in the following order: Salt water being the heaviest seeks the lower levels, or is held there by pressure. Whenever oil is present it is found immediately above the salt water, and gas, the lightest of the three, occupies the highest portion of the porous rock. This is the order in which they are found under the initial pressure. When this pressure is reduced by the gas being allowed to escape through the open wells, this salt water rises into that portion of the rock from which the gas escaped and into the well. This also permits it to flow into the adjacent field and shut off the gas which would otherwise flow into this well, or if any still continues to flow, it is greatly retarded by the water through which it must pass.

There has frequently been observed what are known as pulsations in gas wells. By the term pulsations, it is meant that the gas flows at intervals. This is caused by the column of water becoming so great as to entirely suppress the flow, until the gas accumulates in the reservoir in sufficient quantity to lift the overlying water, when it will burst forth apparently with great energy and force. This flow will continue for a time, only to be overcome and partially shut in by the water. It is thus that the struggle continues, the water gradually and surely encroaching on the field. Each succeeding pulsation becoming weaker, the interval of flow shorter, while the time necessary to the accumulation in the reservoir grows longer, until finally the column of water is too great to be lifted by the accumulated gas in the diminished reservoir, and the well is pronounced exhausted and abandoned. Salt water, under the conditions that have been superinduced by the escape of gas, and too great a reduction of the initial pressure, has destroyed not only the well under observation, but more or less of the adjacent field. Many wells in the field have been abandoned from this cause, and many others show so much salt water that their production has been greatly diminished. In nearly every instance the present condition of the wells can be traced to excessive overdraft, either by allowing the well to stand open, to too great a consumption, or to insecure packing.

This exhaustion of gas wells can be postponed, if not prevented, if they are not subjected to such excessive drafts, by which their pressure is reduced to such an extent as will permit the salt water to rise in the wells, or escape into the adjacent fields. To any thinking mind it is evident that serious injury has been done to the gas field of Indiana, in a majority, if not all, of the localities where gas has been procured. I

am glad to know, however, that the people in the gas area are at least partially awakened to the injury that is being done, and that wells are now packed and closed in as soon as possible after being drilled in, and that an open flow is not permitted, except on rare occasions when it is necessary to take an observation or measurement.

But wells are still being subjected to dangerously heavy drafts, though not in the unnecessary manner above mentioned. The dangerous drafting now being done is by requiring wells to supply a much larger consumption than their capacity will with safety permit. This is done, in a great many instances, by ignorant management.

I have found that a great many of the companies and individuals who are furnishing gas for consumption proceed right along attaching more consumers without having any kind of a measurement to ascertain the capacity of their wells, and without making any tests of the condition of their supply. Some are too greedy in their desire to make money in the gas business and look upon the drilling of additional wells to supply increased consumption as an unnecessary expense.

There is but one ending to this short-sighted policy, and that is a failure of supply, by reason of the overdraft, and the introduction of liquid into their wells, and they are at last, however unwilling they may be, compelled to drill more wells than they otherwise would have done, by reason of the local field being more or less filled with salt water.

In every case that has come under my observation, in which there has been a partial or total exhaustion of wells, I have found, upon inquiry into the history of their management, that they have been subjected to overdraft, either by having been allowed to stand open, or by being compelled to supply too great a consumption. I have found also, a very few wells that have not been subjected to these abuses. These showed but very little, if any, signs of failure. Notably among these was well No. 1, at Eaton, in Delaware County. This was the pioneer gas well of Indiana, having been drilled in September, 1886. This well has been in constant use ever since it came in, but not having been at any time overtaxed, it was, when I examined it in June, 1891, practically as strong as ever. It showed a rock pressure of 315 pounds, was entirely free from salt water, and although it was connected with the line in such a way, that with the instrument I had with me, I could not measure the volume, yet it gave every indication that the flow was as strong as ever.

I mention this as an example of a well that has been properly cared for, and the result of such management, and I am firmly of the opinion that a very large majority of the wells in our gas belt would show the same results with the same management.

It is held by most scientists that gas is not being generated at the present time in any appreciable quantities, and certainly not in quantities sufficient to meet the enormous drain that is being made on the different

fields to-day. This being true, the necessity for husbanding the supply in every conceivable way becomes apparent. It certainly is to the interest of every consumer to make the product last as long as possible. Waste or prodigality in the use of this most valuable fuel becomes at once a crime against the public good. "The greatest good to the greatest number," should be kept in view in the use and management of this fuel.

The condition of the field at the present time shows only too plainly the inevitable results of the mismanagements, and the prodigality that has been practiced. The final failure of the product has been hastened, all too rapidly. This is shown by the diminished initial pressure, and by the presence of salt water. The volume of a well decreases with its loss of rock pressure, but the rate is not the same. If a well is heavily taxed, its volume goes down faster than its pressure. In some of the older centers, the well owners and consumers have awakened to the fact that a failure is fast approaching, and are endeavoring to stop the criminal waste. But it is surprising and discouraging, after all the experience that has been accumulated, to see the same wasteful policy practiced in some of the new centers.

The discovery of a store of fuel and power of this character was so surprising and unexpected that it is no wonder that to those who were so favored it seemed for awhile that it was inexhaustible. Nor is it any wonder that wanton waste was in progress on every side, and that any nice regard for economy seemed as foolish as it was futile.

This state of things is passing away, and the warnings that the supply of this precious stock of heat and power is limited are so plain that no one can any longer fail to recognize them.

The language of Professor Orton, State Geologist of Ohio, in regard to some of the vicious features of the system by which gas was introduced as a fuel into the towns of Ohio, will apply with equal force in Indiana, where the same system has been in vogue, and I can not do better than to quote him. He says: "The system by which gas has been introduced as fuel into the towns by both public and private corporations has, unfortunately, had some vicious features, in some respects, from the beginning. The consumer is charged, not for the amount of gas he uses, but in a general way for the amount that he is able to use by the service with which the company supplies him.

The gas meters in use at the beginning of this experience were not adapted to the natural supply, and their expense stood in the way of their adoption. Charges were thereupon based by the companies upon the size of the burners which they supplied to individual consumers. These burners are technically known as mixers. The openings by which the gas escapes are measured in given fractions of an inch. The mixers in common use are known as 3, 5 and 7. The diameter of the aperture in No. 3 is three thirty-seconds, in No. 5 four thirty-seconds, and in No.

7 five thirty-seconds of an inch. The amount of gas that passes through these mixers depends upon the pressure which is maintained upon it. This whole system of disposing of gas has already been characterized as a vicious one. The objection to it lies in this fact, viz.: that the consumer is under no adequate motive to economize. He is in danger of even making himself uncomfortable by overheating his house in the endeavor to get the worth of his money. The current complaints as to the extraordinary heating power of natural gas have their root in this system. There is no more need of warping and racking a house through the effects of heat by natural gas than by any other fuel. But the fact of its steadiness is made to contribute easily to this result. It can be maintained, day in and day out, without abatement, and it is this fact that mainly leads to this overheating.

The whole system of burning gas is, however, in a very crude state. A small fraction of the heat produced by combustion is at present made available for use. By means of the best appliances now known, the consumption of gas could be reduced to less than one-half, and perhaps to less than one-third of what is now used, without trenching upon the required amount of heat.

The remedy for the evil complained of, viz., extravagance in the use of gas, can be effectively reached by the introduction of meters. Meters have now been constructed for this specific purpose, and they certainly ought to be introduced into all cities and villages, unless the very small villages situated directly in the gas-fields shall be exempt. When a proper price is placed on gas, and when each consumer is obliged to pay for what he uses, an adequate motive to economize will, for the first time, be brought into operation."

Such is the language of one who has had better opportunities for observation and has given the subject more careful thought than most of the writers on this subject. What is true of the system of consumption in Ohio, and other fields that have come under Prof. Orton's observation, is equally true of the system in the Indiana field. I heartily endorse what has been said, and commend it to the careful consideration of all who are interested in economy in the use of gas.

In view of the evident signs of failure which are plainly to be seen in the older gas centers in the field, it is to the common interest of the gas companies and the consumers that these results be attained as soon as possible.

While I have referred to the evident signs of failure that is shown in many localities of the Indiana gas field, in order to call attention to the injuries that have been done by the mismanagement and waste that has been practiced, I would not be understood as saying that the field is exhausted by any means. There are large areas yet to be drawn from;

many new centers can yet be developed. Even in the first areas developed wells are being brought in that show nearly the old-time production. Wells that have been abandoned as worthless have been, after intervals of rest, and by being retubed, and by the aid of separators, found productive.

If proper management of the field by the enforcement of wholesome laws, and if economy in the use of gas is everywhere insisted upon and produced, I believe that there is yet a great future for the natural gas interests of this State, and that the last days of natural gas in Indiana may be its best days. If, on the other hand, the wasteful policy that has been practiced shall be maintained, there is sure to be, at no very distant day, an entire failure and great disappointment.

Prof. Orton so clearly expresses what I believe to be true, in regard to the use of gas as a fuel, that I can not do better than to give his conclusions and to urge their careful consideration:

"*First.* Natural gas finds its highest and most valuable use as domestic fuel. It is here that it does its greatest good to the greatest number. In all our dealings with it this fact should be kept constantly in view. To maintain it for the longest period for this service is our highest interest in relation to it.

"*Second.* If there is any use for which gas should be sold below the price of the fuel which it supplants it is the use in cooking stoves. The less fortunate members of the communities should be the favored ones in this regard. For the gas used in heating there is no occasion to make the price below the cost of coal; neither is there any justifiable demand for a discount on gas bills increasing according to the number of fires supplied. If a sliding scale is introduced it might, perhaps, better be made to slide the other way, charging consumption beyond the average at a higher rate.

"*Third.* An advance in price on the part of all municipal corporations for all the uses they undertake to supply is their proper policy. The price at which they have furnished it hitherto leads to the undervaluing and the wasting of the gas. The supply will do towns more good by serving them longer if they are required to pay a higher price for the gas.

"*Fourth.* All gas should be sold by measured volume. Meters and gauges ought to be introduced everywhere. No adequate motive to economize can be brought to bear on many consumers until they are obliged to pay at a proper rate for what they use.

"*Fifth.* Next to domestic use, the use of gas in the production of steam power is to be counted the most suitable application of it. Comparatively small amounts of it are required for this purpose, and great convenience and economy result therefrom. The most skillful user of it will find a rate of fifty feet to one-horse power sufficient, but the use of

more than eighty feet to one-horse power should not be allowed, even if the user is willing to pay for it.

"*Sixth.* Of the various manufacturing uses in which the gas is applied as a fuel proper, glass making has probably the best rights. It contributes larger returns to the community in the shape of wages than other like industries. While its introduction into some parts of the gas field has been greatly overdone, and while much of it has been accomplished by the exercise of a mistaken policy, it should be maintained as long as possible. To this end economy should be everywhere enforced. The window glass works might, perhaps, be required to introduce coal into their furnaces for melting, at an early day, reserving the gas for the stages of flowing and flattening.

"*Seventh.* From certain uses to which gas is now largely applied, it should be at once entirely withdrawn. It is a great wrong to the community to allow it to be used in the burning of common building brick, and in calcining limestone. These processes consume large quantities of gas and make no returns except to their owners. For these uses wood and coal are good enough.

"The industry that consumes gas in by far the largest amount is iron working. It is a grievious mistake on the part of any community or company to allow a rolling mill access to its gas field. An ordinary mill uses as much gas every day as several thousands of families would consume, and the returns to the common good by such an application are small compared with any other way of using gas. Even though a rolling mill stands ready to pay as much per thousand feet as the small consumers pay, it ought not to be supplied. If it is willing to do this, it shows that there is not enough charged for the gas. It may be to the interest of the gas company to get its money back rapidly, it is true, but the community has interests, if not rights as well, that should not be overlooked in relation to this supply. The State interferes when an oil or gas well is left without being plugged, or when a gas well is allowed to blow into the air without use. Why? Because these precious stocks of mobile power are fitted to do good to great numbers of the people and no man has a right to take any action by which they shall be needlessly wasted. A like reason could, perhaps, be found for forbidding entirely the use of gas for the rough work that has been named above.

"*Eighth.* Natural gas is merely a transient phase of the stored power of the earth. It is folly to talk of its taking anything like a permanent place in the work of the world. The claim that it can springs only from enthusiasm or sciolism. There is, in reality, but little of it, and this is found in but limited regions and can not last long whenever its utilization is undertaken by the eagar and masterful activities of our day.

"*Ninth.* Natural gas has a very important work to do. It should prepare

the world for something much better than itself. It is giving an object lesson to great communities as to the advantages of gaseous fuel, and it can hardly be that this lesson will be given in vain.

"The exemption from the soot and dust inseparable from the burning of bituminous coal in our cities, and the positive addition that gaseous fuel makes to the comfort and convenience of the entire community, when used as a domestic fuel and as a source of steam-power, are results in themselves too valuable to be abandoned when these small and treacherous stocks of buried power are exhausted. The conversion of the coal now burned in a large city into gas before being used would result in an immense economy in fuel, besides affording the incidental advantages alluded to above, and this economy of stored power is an object to which the civilized world will soon be obliged to address itself in good earnest."

ECONOMIC USE OF NATURAL GAS.

Natural gas is most important in building up the manufacturing interests of any locality producing it. A review of the manufacturing industries located within the gas area of Indiana since its first development will show its appreciation by manufacturers.

These embrace manufactories engaged in the manufacture of straw board, straw paper, wood pulp and wood paper; steel works, foundries, nail mills, bar and bolt works and bell foundries; plate glass, window glass, fruit jars and bottle factories; crayon factories, fruit canning factories, excelsior mills, saw mills and flouring mills; brick and tile factories, and many other industries, in which a vast amount of capital is invested and thousands of hands are employed. At Anderson, Muncie, Marion and Kokomo are located a number of large concerns, which have changed these cities from quiet commercial places to bustling manufacturing centers. But the location of manufactories has not been confined to the places mentioned. A number of the smaller towns within the gas area have secured one or more large manufactories, and many of these places have shown a phenominal growth. Among these may be mentioned Greenfield, Noblesville, Tipton, Elwood, Alexandria, Pendleton, Carthage, Hartford City, Eaton, Spiceland and Dunkirk. In addition, many towns which lie outside but adjacent to the boundaries of the gas territory are using this fuel extensively for manufacturing purposes. Prominent among these are the cities of Richmond, Fort Wayne, Huntington and Peru. A marked prosperity has attended the development of this valuable fuel within the State. All classes of people have shared in this prosperity.

The summary of manufactories given below is not complete by any means, for the reason that I have not had sufficient time to collect the statistics.

Many new manufacturing enterprises are still being located, and evidence of continuous if not greater prosperity is manifest to the most casual observer.

Prominent among these may be mentioned the location of the DePauw Plate Glass Works at Alexandria, in Madison County. When completed this concern is intended to be the largest of its kind in the world. Many capitalists are locating their manufactories in the smaller towns, in order to reach the undeveloped portions of the gas field without the expense of putting in long and costly pipe lines. For this reason the smaller places will participate in the prosperity now enjoyed by their more pretentious neighboring cities.

GLASS MANUFACTORIES.

Number of window glass manufactories	10
Capital invested in window glass factories	$487,500
Number of pots in window glass factories	135
Number of employes in window glass factories	764
Number of boxes (50 ft.) daily output	1,765
Number of plate glass manufactories	2
Capital invested in plate glass works	$1,000,000
Number of employes in plate glass works	1,000
Number of pots in plate glass works	80
Daily capacity in square feet	9,000
Number of fruit jar, bottle and opalescent glass factories	9
Capital invested in fruit jar, bottle and opalescent glass factories	$271,000
Number of pots in same	92
Number of employes in same	719
Number of lamp chimney manufactories	2
Capital invested in same	$120,000
Number of pots in same	50
Number of employes in same	750
Daily capacity, cases	1,000
Total number of glass factories	23
Total capital invested in glass factories	$1,878,500
Total number of employes in glass factories	3,233
Total number of pots in glass factories	360

IRON MANUFACTORIES.

Number of wire nail manufactories	1
Capital invested in same	$500,000
Number of employes	300
Manufactories of steel rod, steel wire and wire nails	1
Daily capacity of steel rod mill, tons	100
Daily capacity of steel wire mill, tons	75
Daily capacity nail mill, kegs	1,500

Number of nail manufactories	2
Capital invested in same	$350,000
Number of employes in same	300
Daily capacity of nail mills, kegs	900
Number of foundries	3
Capital invested in foundries	$75,000
Number of employes in foundries	102
Value of annual product	$85,000
Knife and bar works	1
Capital invested in same	$50,000
Hands employed in same	50
Value of annual product	$100,000
Bolt works	1
Capital invested in the bolt works	$250,000
Hands employed in same	100
Amount of daily product, pounds	15,000
Rolling mills	1
Capital invested in rolling mill	$200,000
Number of employes	100
Estimated value of product annually	$500,000
Knife and shear works	1
Capital invested	$33,000
Hands employed	30
Amount of daily product, dozens	15
Bit works	1
Capital invested	$40,000
Hands employed	75
Daily product, bits	1,000
Novelty hardware works	1
Capital invested	$26,000
Number of hands employed	50
Estimated value of annual products	$100,000
Malleable iron works	1
Capital invested	$210,000
Number of employes	600
Estimated value of product annually	$1,200,000
Total number of iron manufactories	13
Total amount invested	$1,524,000
Total number of employes	1,107
Estimated value of product annually	$4,500,000

BELL FOUNDRIES.

Number of bell manufactories	1
Capital invested	$30,000
Number of employes	40
Value of annual product	$40,000

STRAW BOARD AND PAPER MANUFACTORIES.

Total number of factories	5
Total capital invested	$750,000
Total number of employes	416
Daily product, tons	108

WOOD PULP WORKS.

Total number of factories	4
Total capital invested	$390,000
Total number of employes	283
Daily product, tons	85
Value of annual product	$325,000

BRICK AND TILE MANUFACTORIES.

Total number of factories	9
Capital invested	$295,000
Number of employes	245
Annual product, brick (tile not estimated)	41,750,000

WOOD-WORKING MANUFACTORIES.

These include wagon factories, skewer factories, hoop factories, handle factories, butter-tub factories, planing and saw mills, etc.

Total number of factories	16
Total amount invested	$230,800
Total number of employes	270
Value of annual product	$832,000

EXCELSIOR MANUFACTORIES.

Total number of factories	6
Total amount invested	$38,500
Total number of employes	75
Total daily product, tons	45

FLOURING MILLS.

Total number of mills	5
Total amount invested	$80,000
Total number of employes	168
Total daily product, barrels	375

MISCELLANEOUS MANUFACTORIES.

Total number of factories	12
Capital invested	$266,000
Total number of employes	727
Amount of annual product	$500,000

GRAND TOTAL.

Total number of mills and manufactories	94
Total amount of capital invested	$5,478,800
Total number of employes	6,564

GAS PLANTS.

One of the duties of my office is to inspect all gas plants and appliances connected therewith that furnish gas for consumption in town and country places that are not provided with local inspectors.

This provision of the law is made for the protection of life and property and to secure the health and safety of the consumers, and the public generally. This I consider to be one of the most important duties of my office.

Natural gas being so destructure in its results, when not properly handled and confined, and the lives and health of so many consumers depending upon the proper appliances used to distribute it, make the discharge of this duty of the utmost importance. I regret to say that the furnishing of gas to consumers in many of the smaller towns within the gas belt is in the hands of men who are utterly ignorant of the product which they handle, and of the machinery which they use.

In many towns the owners of the plants seem to think that it is only necessary to lay their mains, put in a reducing station, and attach consumers. They do not seem to realize that the regulator is the only barrier between the consumers and the 250 or 300 pounds of initial pressure, and that this regulator requires constant care and attention. Imagine the results of letting such an enormous pressure into the stoves of the consumers, and this is liable to occur at any time, if the line has not the proper attention. In so many towns, I have found pipes leaking at almost every joint, and the stations a mass of rusty iron. The wonder with me is that accidents have not been of more frequent occurrence.

I attribute the small number of accidents that have taken place to the fact that the regulators have been in use only a short time It is to be hoped that before the time when the gas machinery now in use becomes old and worn, the owners and managers will acquire sufficient knowledge to enable them to handle this dangerous fuel in a manner that will insure safety to the consumers.

I have found only two plants in which the regulators were in such a bad condition that I was compelled to condemn them. The first was at Arcadia, in Hamilton County, and the other at Van Buren, in Grant County. In both of these places, however, the owners were already preparing to substitute new machinery.

As the mains and machinery of the gas plants become old and worn, their inspection should be rigidly enforced. Too many lives are in danger to permit any carelessness in this matter. The avarice or mistaken economy of the owners and managers of gas plants should not be allowed to endanger the consumers.

In connection with the inspections of gas wells and plants, I have endeavored to collect as much information in regard to this product and its use as was possible. In many places, however, very little information could be obtained. In most cases no accurate records of the wells had been kept, and the wells were closed in such a manner that it was impossible to test their pressure or their volume, with the appliances then at my command. In making my inspections, I have been uniformly treated with courtesy by the owners and managers, and every assistance has been given me in this work.

BLUFFTON.

The wells that supply this city are situated seventeen miles south, near Camden. The system of reducing stations and regulators, together with the careful oversight given by this company, make it one of the safest plants that I have inspected, and calculated to give satisfactory service.

PRICES OF GAS.

Bluffton Light and Fuel Company.

Cook stoves per month, November to May	$2 20
Cook stoves per month, May to November	1 50
Heaters per month	3 00
Capital invested	100,000
Number of wells in use	6
Number of wells abandoned	2
Number of stoves supplied	1,400
Number of boilers, total 300 horse power	11

TEST OF PRESSURE TAKEN JUNE, 1891.

	Closed.	Open in 2-Inch Pipe.
No. 1.	298 pounds	3 pounds.
No. 3.	312 pounds	7½ pounds.
No. 5.	310 pounds	4 pounds.
No. 6.	295 pounds	16 pounds.
No. 7.	295 pounds	12 pounds.

TEST OF PRESSURE JUNE 1, 1891.

	Closed.	Open in 2-Inch Pipe.
No. 1.	295 pounds	3 pounds.
No. 3.	290 pounds	7¾ pounds.
No. 5.	295 pounds	8½ pounds.
No. 6.	300 pounds	18¼ pounds.
No. 7.	302 pounds	13½ pounds.
Number of miles of pipe		28½
Size of mains, wrought iron.		6 and 8 in.

MUNCIE.

Plant of the Muncie Gas Company.

Paid up capital	$81,925
Number of wells	20
Number abandoned	1
Number of fires	3,000
Price per cook stove	50 cts. to $1
Price per heater	$1.40
Number of miles of pipe in the city	33
Number of miles of pipe in the country	5
Size of pipe	3 in. to 10 in.

Besides that supplied for domestic consumption this company supplies a number of manufactories. They use the Dresser and the Armour packer, and put their packers as near to the Trenton rock as practicable.

The system of gasometers and regulators used on the lines of this company can not but render the service of gas to their patrons absolutely safe and satisfactory.

The managers of this company have spared no expense in making their plant one of the best in the State.

ALEXANDRIA.

The People's Natural Gas Company owns one well, "The Jumbo." They supply one hundred houses and one brick yard. The houses are supplied at $5.00 per year.

ELWOOD.

The Citizens' Natural Gas and Mining Company owns two wells.

Number of stoves supplied	100
Number of houses supplied	45
Price of perpetual house rights	$50.00
Miles of pipe line	10
Paid up capital	$5,000

PRIVATE WELLS NEAR ELWOOD.

Marion Plackard, six miles east	One well.
Alva Favors, two miles east	One well.
Louis Heffner, three miles north	One well.

Elwood Natural Gas and Oil Company.

Number of wells	4
Depth to Trenton rock	930 feet.
Depth in Trenton rock	20 to 45 feet.

The first well drilled by this company stopped when seven feet in Trenton rock with a strong flow of gas. Four years later the packer was taken out and the well drilled thirty feet deeper, the result of which was that the capacity of the well was more than doubled.

Number of miles of three inch pipe	10
Price of cook stove per month	$0.50
Price of heater per month	1.00

PORTLAND.

Citizens' Gas, Oil and Mining Company.

Capital invested	$20,000
Number of wells in use	4
Number of abandoned wells	1
Depth in Trenton rock	5 to 20 feet.
Number of stoves	460
Number of boilers, total 100 horse power	3
Price to cook stove per month	$1.25
Price to heater per month	1.50
Number of miles of pipe line	25
Size of pipe, iron	2-in., 3-in.

The wells of this company are located eight miles southwest from Portland. The original rock pressure, as reported to me by the manager, was 315 pounds, but that it had been drawn down to 150 pounds. The original volume was from 500,000 feet to 2,000,000 feet, which had decreased from twenty to thirty per cent. I had no means of verifying this statement, but am inclined to believe that it is correct.

PORTLAND.

Portland Natural Gas and Oil Company.

Capital invested	$70,000 00
Number of wells at Portland	5
Number of wells at Camden	5
Number of stoves	1,000
Number of boilers, total 125 horse power	4
Price to cook stoves per month	$1 25
Price to heaters per month	$1 50
Capacity of wells at Camden, feet	2,500,000

These wells when closed in showed 310 to 315 pounds pressure, and a line pressure of 250 pounds.

The lowest pressure in the Camden field last winter was 286 pounds.

The wells at Portland are almost worthless, owing to their being filled up with salt water.

CAMDEN.

Pennville Natural Gas and Oil Company.

Capital invested	$4,725 00
Number of wells	1

Section of Well.

Drift, sand and gravel	40 feet.
Niagara limestone	145 feet.
Hudson River limestone and Utica shales	747 feet.
Trenton limestone	34 feet.
Capacity of well, cubic feet	1,500,000
Number of stoves	400
Prices for two stoves per year	$15 00
Number of miles of pipe line	10
Size of pipe, iron	1½ to 4 in.

Well drilled in August, 1887.

Besides supplying gas for domestic use, this well furnishes gas for power and heating purposes to one woolen mill with a fifteen horse power boiler, and one grist mill with a sixty horse power boiler. This well has been dry from the first until last winter, when, under a heavy draft, it showed considerable salt water and some oil. But when the draft was relieved, and the pressure allowed to run up, it became dry again.

I had no means for closing the well in, but took the pressure with the line open. Result, 285 pounds.

CONNERSVILLE.

Connersville Natural Gas Company.

Capital invested	$200,000 00
Number of wells	3
Length of main line, miles	26
Size of pipe, steel, inches	6
Length of mains in city, miles	12
Number of stoves	1,600

Besides that supplied for domestic use, this company furnishes for heating purposes to three furniture manufactories, two carriage manufactories, one foundry, one laundry, one machine shop and one flour mill.

The wells are located near Carthage, in Rush County.

Connersville has six wells in the town and vicinity, four of which are in use at present, and are owned by private parties. These wells furnish only a small amount of gas.

Prices.

Cook stove per month, November to April	$2.00
Cook stove per month, April to November	1.25
Heaters, per month	3.00

MILLROY.

Smith & Dorste, Owners of Plant.

Capital invested	$5,000
Number of wells	4
Number of stoves	64
Price to cook stoves, per month	$1.50
Price to heaters, per month	1.50

Record of Well.

Drift	30 feet.
Niagara limestone	80 feet.
Hudson River and Utica shale	765 feet.
Total depth to Trenton rock	875 feet.

These wells are located in townships 12 and 13 north and range 9 east.

Besides these wells there are two others owned by private individuals that supply about twenty-five stoves.

The wells in this locality showed at first 310 pounds pressure after being closed for twenty-four hours. I had no means of testing the pressure, but am confident, from the report of the owners, that there has been a decrease in the pressure.

ORESTES, MADISON COUNTY.

J. M. Powell, Proprietor.

Capital invested	$3,000
Number of wells	1
Number of stoves supplied	45

This well also supplies two boilers, one of 8-horse power and one of 125-horse power.

The owner claimed that this well showed 330 feet pressure when first drilled.

In connection with this well there are two miles of pipe line.

The prices are $1 for stoves and $125 for perpetual right.

REDKEY.

North Mercer Natural Gas Company.

Capital invested	$15,000
Number of wells	2
Depth of Trenton rock	979 feet.
Depth in Trenton rock, No. 1	41 feet.
Depth in Trenton rock, No. 2	31 feet.

Small amount of salt water in well No. 1. This well was shot. Well No. 2 was not shot, and, although ten feet deeper in the rock, has remained perfectly dry.

Number of miles of pipe line, 2-inch	9
Number of stoves supplied	500

Also, six boilers, aggregating 145-horse power.

Prices.

Two stoves, per year	$14.25

Reported 340 pounds pressure when first drilled.

When I tested the wells in June, 1891, the pressure was 315 pounds.

MONTPELIER, BLACKFORD COUNTY.

Montpelier Gas, Oil and Mining Company.

Capital invested	$8,000
Number of miles of piping	2½
Size of pipe	2 inches.
Number of stoves	350
Price for two stoves, per year	$15.00
Number of wells	3
Depth to Trenton rock	980 feet.
Depth in Trenton rock	20 feet.
Depth of Drift	30 feet.

These wells show so much oil that a separator is used at each well.

ALBANY, DELAWARE COUNTY.

Albany Petroleum and Natural Gas Company.

Capital invested	$5,000
Number of miles of piping	12
Size of pipe	3 inches.
Number of wells	1
Line pressure	260 lbs.
Number of stoves	300
Price per house	$12.00
Depth to Trenton rock	930 feet.
Depth in Trenton rock	14 feet.
Depth of Drift	12 feet.

Plant in fair condition.

Citizens' Natural Gas Company.

Capital invested	$2,300
Number of wells	1
Number of miles of piping	5
Size of pipe	1 and 2 inches.
Depth to Trenton rock	936 feet.
Depth in Trenton rock	76 feet.

When at a depth of fifty feet in Trenton rock very little gas was shown.

The stock is divided into shares of fifty dollars each. Each shareholder gets free gas. To outside consumers twelve dollars per house is charged.

Home regulators are used.

This well was tested September 10th, 1889, as the record shows, by George M. Smiley.

Rock pressure, pounds	338
Open flow in 2-inch tubing, pounds	23
Cubic feet in twenty-four hours	3,275,500

When closed the pressure raised to 338 pounds in three minutes.

DUNKIRK, JAY COUNTY.

Dunkirk Gas Company.

Capital invested	$15,000
Number of wells	2
Number of stoves	600
Line pressure, pounds	293
Price per two stoves per year	$15
Price per three or more stoves per year	$18

This company also furnishes gas to three factories, one flouring mill, one brick kiln, one tile factory, one excelsior factory and one hoop factory.

HARTFORD CITY.

Hartford City Natural Gas and Oil Company.

Capital invested	$25,000
Number of wells	3
Number of stoves	1,200
Price per month, cook stove	75c
Price per month, heater	$1
Number of miles of pipe line	15
Size of pipe, inches	1½ to 4
Depth to Trenton limestone No. 1, feet	952
Depth in Trenton, feet	32

Plant in fair condition.

Well No. 2 was drilled in 1888.

These wells have been in constant use since they were drilled. On July 9, 1891, well No. 1 showed 300 pounds live pressure. When closed in it showed 315 pounds in two minutes. Well No. 2 showed 250 pounds line pressure. These wells are not connected, but supply different parts of the plant.

On account of not being able to disconnect the wells, the open flow could not be taken.

However, Mr. R. M. Carter, the president of the company, to whom I am indebted for valuable information, told me that there was no perceptible diminution in the volume of gas produced.

EATON, DELAWARE COUNTY.

Eaton Mining and Gas Company.

Capital invested	$10,000
Number of wells	2
Number of stoves	325
Depth to Trenton limestone, feet	920
Depth in Trenton, feet	30
Original capacity of well No. 1, cubic feet	2,500,000
Original capacity of well No. 2, cubic feet	3,000,000
Number of miles of pipe line	5
Size of pipe, inches	2

Besides that supplied for domestic use this company furnishes gas to one flouring mill, one excelsior factory, one hoop factory, and one handle factory.

Well No. 1 is the pioneer gas well of Indiana. It was first drilled in 1875 or 1876 by George W. Carter and W. W. Worthington to a depth of six hundred feet. Their object was to prospect for coal and other minerals. Some shale gas was found, but the enterprise was abandoned. In 1886 this old well was reopened and drilled to its present depth, at which a strong flow of gas was obtained.

Mr. A. H. Crannell was the contractor, and he enjoys the distinction of having drilled the first gas-well in Indiana.

VAN BUREN, GRANT COUNTY.

Arcana Gas Company.

Number of wells	1
Number of miles of pipe line	20
Size of pipe	1 to 2 inches.
Number of stoves supplied in town	100
Price for two stoves and two jets for one year	$15.00

This well also supplies a number of farm houses.

This well is located five and one-half miles south of town.

Some oil is shown.

I found this plant in bad condition. The line was leaking at nearly every joint, and the regulator was broken and worthless. However, the company had procured and was preparing to put in a new regulator.

GREENTOWN, HOWARD COUNTY.

Greentown Natural Gas, Oil and Mining Company.

Capital invested	$11,000.00
Number of wells	2
Number of miles of pipe line	8
Size of pipe	1 to 4 inches.

Number of stoves supplied	450
Price for two stoves per year	$16.00
Depth in Trenton limestone	30 feet.

The managers claim that these wells originally showed 330 pounds initial pressure.

In addition to furnishing gas for domestic use, this company furnishes fuel to one flouring mill, one elevator, one heading factory, one stave factory, one brick kiln and two saw mills.

SHARPSVILLE, TIPTON COUNTY.

Sharpsville Gas and Oil Company.

Capital invested	$6,000.00
Number of wells	1
Number of miles of pipe line	2½
Size of pipe	1 to 4 inches.
Number of stoves supplied	200
Price for two stoves per month	$1.25
Depth of Trenton limestone	975 feet.
Depth in Trenton	8 feet.

October 11, 1891, this well showed a line pressure of 260 lbs.

This well, in addition to the domestic consumption, supplies one flouring mill and one canning factory.

CICERO, HAMILTON COUNTY.

Cicero Gas and Oil Company.

Number of wells in use	1
Number of stoves supplied	270
Price per month, cook stoves	$0.75
Price per month, heaters	1.00
Number of miles of pipe line	6
Size of pipe	2 and 3 inches.
Depth to Trenton limestone	976 feet.
Depth in Trenton	18 feet.
Lime pressure	250 lbs.

The plant is in good condition.

This company made two failures. The first well flowed oil and salt water in such quantities as to render it worthless. The second well showed a very small flow of gas. This company has obtained a very large flow of gas in a fourth well, since I inspected their plant.

RICHMOND.

Richmond Natural Gas Company.

Capital invested	$635,000.00
Number of wells	21
Length of pipe line	46 miles.
Length of mains	30 miles.
Size of pipe	3 to 8 inches.
Number of stoves supplied	5,500
Price per month, cook stoves, November to April	$3.33
Price per month, cook stoves, April to November	1.39
Price per month, heaters	4.16
To manufactories, by meter, per 1,000 cubic feet	.10
To domestic consumers, by meter, per 1,000 cubic feet	.15

The wells of this company are located at Chesterfield, in Madison County.

LAPEL, MADISON COUNTY.

Lapel Natural Gas and Oil Company.

Capital invested	$10,000
Number of wells	1
Depth to Trenton limestone	888 feet.
Depth in Trenton	24 feet.
Number of stoves supplied	240
Price per month, cook stoves	$0.60
Price per month, heater	.80
Length of pipe line	6½ miles.
Size of pipe	1 to 3-in.

In addition to the domestic consumption, this well supplies three boilers aggregating 200 horse-power.

August 7, 1891, this well showed a line pressure of 262½ pounds.

HARTFORD CITY.

Peoples Gas Company.

Capital invested	$6,500
Number of wells	2
Length of pipe line	4 miles.
Size of pipe	2 to 3-in.

One hundred and thirty franchises are supplied at $50.00 each.

NEWCASTLE.

Enterprise Natural Gas Company.

Capital invested	$50,000
Number of wells	5
Length of pipe line	21 miles.
Size of pipe	4 to 6-in.
Number of stoves supplied	1,300
Prices, cook stoves, per month	$1.25
Prices, heaters, per month	1.40

This company obtains the greater part of its gas from five wells, eleven miles northwest. A number of wells were drilled at and near the town with poor results. Well No. 5, near the fair ground, was the best. This well measured 927 feet to Trenton limestone, and 68 feet in the rock.

ALEXANDRIA, MADISON COUNTY.

Alexandria Mining and Exploring Company.

Capital invested	$6,000
Number of wells	2
Drift	28 feet.
Original initial pressure	325 lbs.
Number of stoves supplied	600
Price to cook stoves per month	$0.50
Price to heaters per month	.75
Length of pipe line	5½ miles.
Size of pipe	1 to 3 inches.
Trenton below sea level	40 feet.

In addition to that supplied for domestic consumption, this company furnishes gas to one stone quarry, one flouring mill, one window glass factory of ten pots capacity, and one boiler and pump station.

FORTVILLE, HANCOCK COUNTY.

Fortville Natural Gas and Oil Company.

Capital invested	$5,000
Number of wells in Hancock County	2
Number of wells in Hamilton County	1
Length of pipe line	3 miles.
Size of pipe	2 to 4 inches.
Number of stoves supplied	200
Price of two stoves per year	$10.00
Line pressure	260 lbs.
Depth to Trenton limestone	974 feet.
Depth in Trenton, Well No. 1	17 feet.
Drift	212 feet.

One tile kiln and three boilers are supplied by this company. The plant is in good condition.

The wells were drilled in the latter part of the year 1887.

FORTVILLE, MADISON COUNTY.

J. S. Merrill, Proprietor.

Number of wells in Hancock County	1
Number of wells in Madison County	1
Length of pipe line	6 miles.
Size of pipe	1½ inches.
Number of stoves supplied	100
Line pressure	275 lbs.
Depth to Trenton rock	950 feet.
Depth in Trenton rock	33 feet.

The wells were drilled in February, 1889.

PENDLETON, MADISON COUNTY.

Pendleton Natural Gas Company.

Capital invested	$6,000
Number of wells	4
Number of stoves supplied	900
Prices per month to cook stoves	70 cents.
Prices per month to heaters	95 cents.
Depth to Trenton limestone	835 to 876 feet.
Depth in Trenton	25 feet.
Initial pressure, August 6, 1891	298 pounds.
Length of mains	40,000 feet.
Size of mains	1½ to 6 inches.

This company, in addition to that supplied for domestic use, furnishes fuel to one glass factory, one paint mill, one tile factory, the Pendleton Manufacturing Company, and one flouring mill. The plant proved to be one of the best constructed in the State. The system of mains and regulators is such as to give perfect control over the gas.

ARCADIA, HAMILTON COUNTY.

Arcadia Natural Gas, Oil and Mining Company.

Capital invested	$8,500
Number of wells	2
Length of mains	5 miles.
Size of mains	1 to 4 inches.
Number of stoves supplied	300
Prices per month to cook stoves	$0 75
Prices per month to heaters	1 00
Depth to Trenton limestone	960 feet.
Depth in Trenton	12 feet.
Line pressure	200 pounds.

The wells were drilled in 1887.

The plant was inspected August 8, 1891.

This company also supplies one boiler, 60-horse power, one brick kiln, one tile kiln and one elevator.

On inspection I found this plant in bad condition. The regulator did not control the pressure. I condemned it and ordered the company to place a new one on the line.

ARLINGTON, RUSH COUNTY.

Arlington Natural Gas Company.

Capital invested	$5,000
Number of wells	3
Length of mains	2 miles.
Size of mains	2 to 4 inches.
Depth to Trenton limestone	860 feet.
Depth in Trenton	16 feet.
Depth in Trenton in well No. 1	24 feet.
Number of stoves supplied	115
Price to cook stoves, per month	$1.10
Price to heaters, per month	1.40

Well No. 1 has shown salt water from the first.

GREENFIELD, HANCOCK COUNTY.

Greenfield Gas Company.

Capital invested	$50,000
Number of wells	5
Length of mains	15 miles.
Size of mains	2 to 6 in.
Price per stove per month	$0 50
Number of stoves	1,200

Peoples' Gas Company.

Capital invested	$10,000
Number of wells	3
Price of perpetual franchise	$100
Depth to Trenton limestone	975 feet.
Depth in Trenton	20 feet.
Length of mains	5½ miles.
Size of mains	2 to 4 in.
Number of franchises	225

MAXWELL, HANCOCK COUNTY.

Maxwell Natural Gas Company.

Capital invested	$3,500
Number of wells	1
Length of mains	3 miles.
Number of stoves	200

Price per month to cook stoves	$0.75
Price per month to heaters	1.00
Depth to Trenton limestone	1,002 feet.
Depth in Trenton	13 feet.
Initial pressure when first drilled	325 pounds

The plant is in good condition.

This well was estimated at 4,500,000 cubic feet in twenty-four hours when first drilled, and has not as yet shown any signs of failure.

MANILLA, RUSH COUNTY.

Manilla Natural Gas Company.

Capital invested	$7,000
Number of wells (only one in use)	2
Number of stoves supplied	89
Price per month to cook stoves	$1.25
Price per month to heaters	$1.50
Depth to Trenton limestone	865 feet.

CARTHAGE, RUSH COUNTY.

Carthage Natural Gas Company.

Capital invested	$9,100
Number of wells	4
Depth to Trenton limestone	800 feet.
Depth in Trenton	20 to 30 feet.
Length of mains, miles	5
Size of pipe	2 to 4 inches.
Price per month to cook stoves	$0.75
Price per month to heaters	$1.00

Initial pressure when first drilled, 300 to 315 pounds.

These wells would reach their pressure in three minutes.

Two "dry holes" were drilled in this vicinity within one mile of good wells.

CHARLOTTSVILLE, HANCOCK COUNTY.

Charlottsville Natural Gas Company.

Capital invested	$5,500
Number of wells	1
Number of stoves supplied	300
Price per month to cook stoves	$0.75
Price per month to heaters	$1.00
Line pressure October 24, 1891	265 pounds.
Length of mains	4½ miles.
Size of pipe	2 to 6 inches.
Volume, cubic feet	2,500,000

Plant is in good condition.

RUSHVILLE.

Peoples Natural Gas Company.

Capital invested	$3,500
Number of wells	5
Length of pipe line and mains	18½ miles.
Size of pipe	4 to 6 inches.
Number of stoves supplied	675
Price per month to cook stoves	$1.00
Price per month to heaters	1.50

Wells situated in the north part of the county, near Carthage.

RUSHVILLE.

Rushville Natural Gas Company.

Capital stock	$100,000 00
Number of wells	6
Length of mains, miles	22
Size of pipe, steel	2 to 8 inches.
Number of stoves supplied	1,200
Price per year to cook stoves	$18 00
Price per year to heaters	$20 00

Wells situated near Carthage, ten miles distant.

Plant in excellent condition.

WALDRON, SHELBY COUNTY.

Waldron Gas, Oil and Water Company.

Capital invested	$7,500 00
Number of wells	3
Number of stoves supplied	100
Price per month to cook stoves	$1 25
Price per month to heaters	$1 50
Depth to Trenton limestone	830 feet.
Depth in Trenton	30 feet.
Initial pressure	275 pounds.

No salt water and no sign of failure.

This plant is in excellent condition.