(editor's note: This paper was transcribed from a handwritten cursive copy with various difficulties. For a perfect rendition, the reader might wish to consult the original, itself a copy, in the volume entitled *Literary Club Papers 2*, 1886 – 1887 June 5, '86 to May 21, '87)

Natural Gas

So prolific has been the nineteenth century in useful inventions and discoveries, and so like a revelation, in many instances, does the product of combined inventive genius and mechanical skill appear, that the question, What is the greatest human invention? or What the most useful human invention? –find no answer in which we can all agree. It is common to hear the steam engine, the railway, the telegraph, or the telephone mentioned, each as being the acme of human inventive skill; and, indeed, when we contemplate the beneficial changes wrought in human society by these inventions, they are, each and all, entitled to unbounded admiration. And yet the terms "progress" and "improvement," the modern significance of which is exemplified in such inventions and their results designates something, the true measure of which can be had only by reference to that condition of affairs which preceded it and this previous condition of affairs, in turn, when we desire to fix its value as an integer in human progress, is fairly to be measured only by reference to what preceded it; and is not to be belittled by any comparison with that which followed.

Therefore, the specifications of the German ethnographer, Dr. Peschel, in his work on "Volkerkunde" (Ethnography) appear to be not without reasonable foundation, when he suggests as the greatest human invention, not any of the wonders of modern skill, but an invention or discovery of our aboriginal, prehistoric ancestors; namely, artificial production, the maintenance and use of fire.

Conceive for a moment the condition of aboriginal man, ignorant of the use of fire; for a permanent abode he is limited to the neighborhood of the tropics, and for sustenance he is limited to the raw products of nature; while all the metals, and all their numberless uses are as a sealed book to him. Contrast with this the world of possibility, which opens up with the knowledge of how to produce, maintain, and use fire, and we may have some conception of the wonderful stride and human progress, which was made in the acquisition of that knowledge. Is it any wonder, therefore that the ancients conceived this to be the knowledge derived directly from the gods? And that they should figure Prometheus, whose name signifies "forethought" gaining secret admission into Heaven by reason with his intimacy with Minerva, the Goddess of Wisdom, and there lighting his torch at the chariot of Helios, the Sun, in order to bring down the fire to man? Truly, is not Prometheus, both in his name of Forethought, and in the magnificent discovery which is attributed to him, the Prince of all inventors?

And perhaps we might add, will not the typical inventor of today, in the trials, disappointments, and ingratitudes which proverbially beset him, be able to discern a portion of that wrath which, as the condign fate of his arch-inventor, Prometheus, foreshadows, – is visited upon those who curiously pry into the divine secrets of nature, and publish them in letters patent to mankind.

These reflections suggest themselves in view of the rapidly increasing use, in Ohio, of a novel fire-producing agent. The adaptation of "natural gas" to domestic and manufacturing uses, is rapidly revolutionizing the domestic and commercial habits of a portion of our people: and the stir and interest which this circumstance has excited, the strong attraction for capital which it has developed, indicate that the importance attributed to fire as one of the elemental factors of civilization, has not been exaggerated.

Natural gas, as such, is by no means a recent discovery. It has been known, and to a limited extent has been in use, in different parts of the world for a long time. In China, it has been used in a small way for centuries. On the shores of the Caspian Sea are burning gas wells, which were the object of superstitions in the days of the Romans.

In the United States, probably the first use of natural gas was at the town of Fredonia, New York where a gas spring was discovered in 1821, and the village illuminated with it. As compared, however, with the utilization of natural gas now accomplished in the manufacturing district which lines the upper Ohio from Pittsburgh to Wheeling, all of these previous instances appear to be mere experiments.

Without considering the conflicting scientific speculation with regard to the origin and nature of the natural gas supply, it is thought that a brief statement of the improved methods of supplying and using it, which now obtain on the upper Ohio, will not be without interest; and especially so in view of the fact that a large and very productive supply of this fuel is now being developed in north-western Ohio, about Findlay and Lima; and within the past week, the presence, at least, of this gas in the County of Hamilton has been demonstrated.

While isolated instances of the use of natural gas have multiplied in the territory about Pittsburgh, during the past ten years, it is only within the past three years or since 1883, that its use has become at all general. Experience has demonstrated that a supply of this fuel underlies the whole district of western Pennsylvania. The territory which has proved especially productive is that about Murrysville in Westmoreland County, 15 miles east of Pittsburgh, and that about Hickory, in Washington County, some 20 miles south-west of Pittsburgh.

In 1883, a line of pipe was laid from Murrysville to Pittsburgh, and it was demonstrated that the gas could be successfully carried over that distance, and utilized as fuel. This event marks the beginning of its general use as a fuel, in Pittsburgh and the adjacent territory. The details of obtaining and supplying natural gas may perhaps be best illustrated by a brief description of a single enterprise, and for this purpose we will take That of "The Royal Gas Company of Philadelphia." –The first step in such an enterprise is the acquisition of the natural gas privileges from the owners of the land. This means the exclusive right to board for gas within the tract described, and a right to use so much of the surface as may be necessary for the operation of the wells. This right is evidenced by what is termed a lease, –consideration for which may be either cash money, a royalty on the product, or both. Capitalists usually desire to have these privileges over a considerable territory, which involves the obtaining of a great many such leases, from the different land-owners, and the exercise of a great amount of small diplomacy to obtain that end. The shrewd and plausible gentlemen who usually attend to the details of this business are designated in the expressive vernacular of the native as "lease-jumpers."

The Royal Gas Company is the owner of the gas privileges over a territory of some 2400 acres in the neighborhood of Hickory. They have here four gas wells, all productive. The wells are bored by the use of a heavy drill, just as is customary in boring for oil. An iron pipe extends from the mouth of the well to the top of the derrick, and through it, the gas not used is allowed to escape into the air, or, the gas being ignited at the top of the pipe, the well presents the appearance of an immense torch, with a flame from 25 to 50 feet in length, swaying in the air. The Royal Company has use for only two of its four wells, so that the gas of the other two is continuously escaping. The two in use are connected by a pipeline 17 3/4 in length, through which the gas is conducted to the Ohio River at Steubenville. The pipe used for the purpose are not the ordinary cast iron gas pipe used in our streets for illuminating gas, but are of rolled or wrought iron, and with screw joints. This is necessitated by the great pressure under which the gas is expelled from the well, which, in the case of the Royal Company is 100 pounds to the square inch although in many instances it largely exceeds that, and is always so great that it is not unusual to utilize this pressure in running the steam engine at the wells by simply turning the gas into the steam-chest, instead of steam. The pipe used in this line is ten inches in diameter, and in lengths of 19 feet from joint to joint. It is buried in a ditch three feet deep, and run as nearly as may be in a straight line, avoiding abrupt ascents or declivities. This pipe line terminates on the bank of the Ohio River, opposite Steubenville, in a building which contains the mechanical devices for regulating and controlling the gas supply, and the pressure gauges which indicate the change in pressure. It is worthy of note that the gas which exerted a pressure of 100 pounds to the square inch at the well, exerts, after it has passed through the 17 3/4 miles of pipe, a pressure of 60 pounds only. At this building also, to are located two eight inch stand-pipes, some 74 feet in height, at the top of which a huge flame is usually fluttering in the air, the surplus gas being disposed of in this way. From this point the pipe-line crosses the Ohio River, being sunk in a ditch some five feet deep in the bed of the river, and anchored in its place by iron hooks or staples driven into the ground.

On the Ohio shore it connects with the system of pipes or service mains laid in the streets of Steubenville. This system consists of two parts, – a high and a low pressure system. The high-pressure system completely encircles the town, like a letter O, so that there is no dead point in it where the pressure can accumulate, for the pressure of natural gas is cumulative; that is, if obstructed, the pressure constantly increases; and in the case of these wells, experimental obstructions have raised the pressure on the gauges to 200 pounds to the square inch. The pipes of the high-pressure system are eight inches in diameter, all tested after laying, to a pressure of 80 pounds. It is from the high-pressure system that the glass-houses, furnaces, and manufacturing establishments draw their supply of fuel.

Within this circle of high-pressure pipe, and connected with it at almost all cross streets, is the net-work of low-pressure pipes, six inches in diameter, from which the supply of gas for domestic purposes is obtained. These pipes also are tested after laying, to a pressure of 14 pounds to the square inch; but the pressure in them is reduced by a system of automatic regulator valves, to four ounces per square inch. There has been laid, during the past summer, 12 3/4 miles of this system of pipe, in the streets of Steubenville.

It will be readily understood that an enterprise of this character can only be conducted by gentlemen who are very forehanded in the matter of cash; for all the expense of the entire

plant has to be incurred before any return is realized. This expense consists in the acquisition of the gas privileges; the boring of the wells, the acquisition of right of way for the pipe line; the acquisition of privilege to lay pipe in the streets of the town.

The cost of 17 3/4 miles of ten inch wrought iron pipe, and the cost of 12 3/4 miles of six and eight inch wrought iron pipe, together with the cost of laying, also the cost of the regulating machinery and the great number of automatic regulating valves which it is necessary to use. The fact that with all the uncertainty of a continuance of the supply, men are found who are ready to volunteer the use of their capital in such an enterprise, is indicative of the value of natural gas from a business stand-point.

The above, though necessarily a brief and imperfect description, may yet serve to give some idea of the extent and character of a natural gas plant. It remains to mention a few interesting facts connected with the use of the gas itself.

At first, let it be observed that little or no change or expense is involved in adapting any ordinary furnace, grate, or stove to the use of gas. Take, for instance the ordinary furnace under a battery of boilers. All that is done is to clean out the coal and ashes from the furnace. In their stead a half dozen fire-brick are set up under the front part of the boilers at a convenient distance from the mouth of the jets by which the gas is delivered through the furnace doors. The gas being ignited, the flame plays on the loose fire-brick and they are soon at a red heat.

In like manner, an ordinary grate is adapted to the use of gas, but with little change or expense. The first step is to thoroughly clean out the ashes and dust from the basket and fire-place, and the soot from the back wall. The back wall is then thoroughly whitewashed, and the basket or grate put in its place. In the bottom of the basket is placed a flat, hollow iron box, called the burner. The gas-pipe, passing underneath the hearth, introduces the gas into the burner, from below; and a device known as a “mixer” provides for the admission of air into the burner at the same time with the gas. In the flat top of the burner are perhaps a dozen small perforations where the gas escapes and is ignited. On top of the burner is piled a bed of broken fire-brick, which are soon heated to a red heat. A stop-cock in the floor immediately in front of the hearth, regulates the supply of gas so that the fire can be maintained at any required degree of intensity for an indefinite time; and the intensity can be raised or lowered in a second.

We have described the manner in which an ordinary grate is adapted to the use of gas; but the gas consumer is by no means limited to such an arrangement. On the contrary, the fashionable thing is to do away with the grate and fender altogether. A pair of andirons is substituted in their place, and a terra-cotta back log, or a pile of such logs made of colored clays, so as to resemble the natural wood, receive the gas flame, and radiate the heat. A copper, brass, or porcelain vessel filled with water, hangs from the crane, and serves to replenish the moisture of the room, which, without such arrangement is soon exhausted by the steady, and intense heat of the gas fire. Natural gas, as a fuel, has, in every respect the great advantage over coal: it is cheaper to the consumer, by one half; it dispenses with the labor usually devoted to heating; it is infinitely cleaner than coal; it can be regulated with the greatest possible ease and exactness.

In the manufacture of glass, the two points of cleanliness and constancy of temperature

are of such importance, that those establishments having natural gas at their service, have a decided advantage in production of better wares; so that natural gas has become almost a necessity in business. The most serious objection to natural gas has been its dangerous character. But this, it would seem, is rapidly lessening, with the increased experience and knowledge of those who handle it. The insurance companies do not require any increased premium for insurance, when natural gas is used. The board of underwriters has adopted a code of regulations, and all that is required of property owners, is a certificate from the gas company that the pipes on the premises are in accordance with the regulations, and have been tested to a pressure of ten pounds. As to the matter of expense, it must be understood that no meter is used to determine the quantity consumed. The consumer pays a stipulated price for each furnace, grate, stove, etc. per year, and is then at liberty to burn as much or as little gas as he may choose.

Undoubtedly, natural gas as a fuel, is a great improvement over any other class of fuel heretofore used. Its undeniable superiority to coal is shown by the fact that in the very heart of a coal-mining district it has almost entirely displaced coal, as a fuel. In the city of Pittsburgh alone, the decrease in the consumption of coal, by reason of the substitution of natural gas in its stead, amounts to 10,000 tons, daily or more than 3,500,000 tons yearly. Yet it must be admitted that there is one very weak point apparent in the natural gas supply; viz., the great uncertainty which overhangs the question of its continuance. The flow does stop, and has stopped, in the very best of wells. Various schemes are adopted to meet this objection. The principal one is that adopted by the Royal Gas Company. In addition to the two wells, which now supply their customers, they have two other producing wells, the product of which is now being lost, but which are ready to be utilized at any time, in case the wells in use should fail. In addition to this again, they have three other wells drilled to within a few feet of the gas rock, or about 2300 feet deep, And are drilling two others. The purpose of this is to have them as a resource in case the producing wells give out. A few hours drilling will make any of them producing wells. Another scheme is to confine the gas in the well allowing it to flow only when wanted; but attempts of this kind have not met with complete success.

The people of the upper Ohio however, have one argument, which, from a business stand-point does largely counteract this objection of uncertainty. In case the gas should finally give out then, undoubtedly, the next best fuel is coal. This latter they have in abundance. It underlies their entire territory. Therefore manufacturing establishments may be safely started there with the idea of using the gas; for as long as the gas holds out, they can distance any other competition: when the gas fails they will at least be on a par with the most favored of their competitors.

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