them, whereas, with an oil lamp, he usually sees the obstruction at the same instant that he tumbles over it.

There are now some dozens of forms of Acetylene bicycle lamps on the market; he would presently show you several which had been found to answer all requirements. As already stated they are not suited for indoor use, but for out-of-doors, where the rider leaves the smell of the polymerized gas behind him, they are very satisfactory. Acetylene is also being largely used for carriage lamps, the same principle as in bicycle lamps being adopted, namely, the water is dropped on to the carbide, and the flow regulated by a valve.

At the first introduction of Acetylene we naturally started with the burners in use for coal gas! But very quickly discovered that they were not suitable for Acetylene, as, owing to the heat of the gas, the tips very quickly got almost red hot and the gas polymerized at the tips, the orifices choked up, and the householder was surrounded with smoke and soot. It took a long time to discover a method of obviating this difficulty, but at last it was found that, by burning the gas in a Bunsen burner and using a double jet, impinging the two flames one on to the other to get one flat one, the trouble was entirely got over. The illustration you now see represents the burner we have adopted for general household lighting. Even this burner will choke up if it is not carefully adjusted, and the pressure of the gas properly regulated. It is absolutely necessary that Acetylene should be burned in these atmospheric burners, and at a pressure of at least two inches of water. The pressure is regulated, of course, by the distance of the generator from the burner and by the weight of the holder.

When the gas was first introduced experts pointed out that very small pipes would be necessary for installing it, but the speaker had found this to be erroneous. In all the houses we have fitted in the last twelve months we use practically the same sized fittings as for coal gas. This prevents unequal pressure in different parts of the house. It is absolutely necessary to have a good supply of gas where the leads break away from the main pipe.

Acetylene is now used for heat and power purposes. For heat we use an ordinary Bunsen ring with a burner that can be regulated at the point of ignition. It is very similar in construction to the ordinary Bunsen, with this difference, that a smaller quantity of gas is used to the same volume of air.

You will, most of you, no doubt have noticed in the technical journals mention of the fact that acetylene is now being largely used for railway carriage lighting. Messrs. Pintsch, of Berlin, who are the manufacturers of the well-known Pintsch gas plants, have made exhaustive experiments in this branch of acetylene lighting, with the result that, on their recommendation, the German Government have adopted for use on the railways a mixture of acetylene with Pintsch gas. The proportions used are three parts of oil gas to one part of acetylene, and a compressing plant for the purpose of producing the mixture has been erected at Berlin. This plant has a capacity of 21,180,000 cubic feet of gas, and will consume upwards of 3,000 tons of carbide per annum. The mixed gas has an illuminating value double that of Pintsch gas. A large number of the stations on the German railways are lighted with pure acetylene, and on some of the French trains pure acetylene is used. The Queensland Government is now trying a series of experiments for lighting up their trains with acety-

lene, results of which I shall look forward to with interest.

In an article published in London Engineering, December 8th, 1898, the present position of the acetylene industry is shown to be one of great importance. According to the writer of this article there are now in the United States 4 carbide factories; in Canada, 1; Great Britain, 3; France, 10; Germany, 4; Switzerland, 4; Italy, 3; Spain, 1; Sweden, 1; Belgium, 1; and building, there are in the United States, 2; Canada, 1; Great Britain, 1; France, 4; Germany, 1; Switzerland, 3; Spain, 1; Bosnia, 1; Norway, 1. You will notice that such out of the way countries as Bosnia have their carbide factories, whereas in Australia there are none. The Australian prides himself on being thoroughly up-to-date, but as far as the carbide industry is concerned, he is about three years behind the times.

In the introduction of this business we have been seriously hampered by the false, and he feared malicious, statements as to its danger. According to these reports the least tap on the generator, the faintest trace of acetylene in a room, or a sudden rise in temperature would blow the building to pieces. In fact, so frightened were the public a short time ago, that at one demonstration given hardly anyone would come into the building, and a large number of people in the town refused to come into the street in which the building was situated. However, people are gradually getting over their fears, and no doubt in the near future the general public will look on the dangers of acetylene with the same indifference as they now regard those of coal gas, kerosene, and electricity. Acetylene itself is non-explosive. But, like all other illuminating gases, when mixed with air it becomes highly so. It is not, therefore, safe to go

into a room with a light to look for a leak; if you do you run the same risk as in looking for coal gas leaks. Authorities differ as to the explosive range of acetylene. Dr. Cowles states that any mixture containing from three to eighty per cent. of acetylene to air is explosive. Dr. Bunt puts the explosive range at from three per cent. to forty per cent. Professor Lewes states that a light applied to a mixture of three per cent. or eighty per cent. of acetylene with air, will propagate combustion throughout the entire mass, but so slowly as not to attain the dignity of an explosion. For all practical purposes the explosive limit, in the opinion of this authority, can be taken at three per cent. of acetylene, the higher limit being of no practical importance, as so large a volume, of acetylene is never likely to be present in the air. A mixture of acetylene and air attains its maximum of explosiveness with ten parts of air to one of gas; ordinary coal gas forms explosive mixture with air between six and twenty-nine per cent. of gas to air, and one part of coal gas to nine parts of air gives the maximum of explosiveness. You will, therefore, notice that it requires a less percentage of acetylene than of coal gas to make an explosive mixture with air, but as a set off against this a far smaller proportion of acetylene than of coal gas is required to produce a given amount of light. As a matter of fact it is hardly possible to get an explosive mixture with acetylene in ordinary household lighting. A twenty-five candle power acetylene burner passes only half a foot of gas per hour against about six feet passed by an ordinary coal gas burner. Thus if an acetylene burner were left on in a fair sized room it would require days for a sufficient quantity of gas to accumulate to form an explosive mixture, even if the room were quite air-tight. In an ordinary ventilated room

the gas might be left on indefinitely; the small amount of acetylene that would pass through the burner would escape through the ventilators far too quickly for an explosive accmuulation to be possible. This the speaker had proved practically several times by leaving a burner on in a room for three days continuously and then going in with a light, no explosion resulting. Several private consumers have accidentally made the same test. In one case a man turned the gas off at the generator and left a light burning in a small room. There was no occasion to enter this room again for two days, and then the man went in with a light; there was a very strong smell of gas, but no explosion took place. Then again there is less liability of explosion in case of damage to the pipe if acetylene is used. When a pipe carrying ordinary coal gas is damaged there is the gas works at the back of the leak and the escape continues till the leak is discovered and stopped, whereas if a hole is knocked in an acetylene pipe the generator quickly empties itself and no more gas can escape till the consumer makes a fresh supply, which he is not likely to do until he has found and stopped the leak.

Another point in favour of acetylene is its strong, penetrating odour, the least leak is smelt all over the house, and this, although the quantity of gas escaping may be far too small to light. This remarkably penetrating quality of the gas requires that the fittings used must be of first-class quality, and is undoubtedly a great safeguard to consumers of the gas.

You will readily see from the foregoing that if the generator is so constructed that no air is admitted when charging, there is very little danger of explosion at the generator, and the only other dangers of explosion are those which attach themselves equally to coal and other illuminating gases.

Again, it has been confidently asserted that acetylene is very poisonous. This also is a false statement. Acetylene is not so poisonous as coal gas. The British Medical Journal of March 12th, 1898, contained an article on this subject in which it was stated that coal gas was far more poisonous than acetylene, as also was water gas in poisoning by water or coal gas, the journal states: the individual dies asphyxiated owing to the carbon monoxide entering into stable combination with the haemoglobin of the blood, from which it is difficult to disassociate, but where a person breathes an acetylene atmosphere he becomes asphyxiated simply by the absence of oxygen, so that the moment he is brought into the open air the symptoms of suffocation ought, theoretically, to at once decline.

Acetylene is now largely used for magic lanterns. The lantern used here this evening is lit by acetylene; you will notice that for brilliance the light compares to great advantage with oil light. It has a great advantage over the oxyo-hydrogen light in the ease with which it can be manufactured. It is not quite so brilliant as the oxy-hydrogen; but those who have had anything to do with lanterns know that the latter light is a source of constant trouble and annoyance. It takes some hours to prepare the oxygen and then the limes and the bags require constant attention. With acetylene you have just to drop the carbide down the tube and there is no further trouble.

Acetylene has a great future before it for photographic purposes. It is quite possible to arrange a group of burners in front of a reflector so that the operator can get first-class portraits with from two to three seconds' exposure. He had himself made first-class negatives with acetylene which could not be distinguished from those made in daylight. In New

Zealand he had fitted up several installations for photo engraving work. Acetylene compares to great advantage with any other light for this work. The photo engraver when using the electric arc has great trouble with the shadows. The arc giving its light as it does at one point, throws shadows of different lengths, and although this is to a certain extent obviated by using two arcs, there is always the double shadow to contend with. By means of a group of acetylene burners properly arranged it is quite possible to make photo blocks equal to those made in daylight. Acetylene is also used in New Zealand for printing bi-cromate films on zinc. A first-class impression can be taken with about seven minutes' exposure. This is of acetylene gas works for a few hundred pounds, and great assistance for newspaper work, as it enables the up-to-date newspaper to have its blocks in print within a few hours after a public event has taken place.

The incandescent mantle has recently been adapted to acetylene. He had not yet time to give this branch of acetylene lighting a fair trial, but there is little doubt that the incandescent mantle will be largely used in economising the gas.

At present the industry is greatly hampered in Australia by the fact that all carbide has to be imported. High manufacturers' profits, high rates for freight, insurance and packing have to be paid, which brings the price of the gas nearly up to that of other illuminants. However, we hope in a very short time to be making the carbide in Australia, and to be able to retail it at about two pence per pound. This means a light equal to coal gas at one and sixpence to two shillings per thousand feet.

He did not expect that acetylene would make very considerable headway in the large towns and cities

that are already supplied with coal gas and electricity, but the field for acetylene is enormous in the country districts. A small town can be supplied with an Acetylene gas works for a few hundred pounds, and one man is sufficient to look after the whole installation. Thus, country residents will be as well supplied with artificial light as their city friends. There is a prevailing idea that acetylene can only be supplied by having a generator for each building, but reference to the gas periodicals of various countries shows that acetylene is now being supplied by meter, and through mains the same as coal gas. By the last American mail he received advice that Dietrich, the gas king of America, had fitted up one town in Indiana with acetylene, and intends to take up the coal gas plants in twenty-six other towns, and to replace them with acetylene plants. The ind stry is so new, and advances are being made so rapidly, that it is difficult to collect the latest details, especially at this end of the world.

Owing to the simplicity with which the gas is generated from the carbide, a large number of people have rushed into the business as inventors of generators; the majority of these gentlemen are without any practical knowledge of the gas, and the result is that many of the generators at present on the market are not only useless but absolutely dangerous. The English patent office has now upwards of three hundred patents filed for acetylene generators, and still they keep coming in. You will notice by the illustrations shown you this evening that some of these generators are very intricate—in fact they require an engineer to understand them. There is absolutely no necessity for all this display of ingenuity—the point to be studied is simplicity. It stands to reason that if the machine is to be attended

to by an unskilled person there must be no complicated operations to perform. The gas is extremely liable to polymerize, and therefore it is absolutely necessary that the pressure shall remain constant. If a form of generator is used in which the pressure constantly varies, the burners will assuredly choke. This is a most important point which the majority of generator manufacturers entirely overlook. If the pressure falls below two inches of water the atmospheric burners cease to be atmospheric, because there is not sufficient pressure of gas to draw the atmosphere in, and the result is that the burners quickly carbonize; this means that the householder will be annoyed by soot falling in the room. None of these troubles arise, if the generator gives a regular pressure, and the gas made cold. He wished to impress this point on you particularly, that heat must be avoided both in the generator and at the burner. Therefore, if at any time you have to inspect an Acetylene generator, first of all test it for heat; if any part of the generator feels warm, reject it at once. No amount of cooling afterwards will bring the gas back to its normal condition. In some of the generators shown you, you would notice that very elaborate apparatus is provided for cooling. This extraordinary care to cool the gas after it has been spoiled is very much like locking the stable-door after the steed has been stolen.

In household lighting he had found great trouble with existing fittings. In a large number of cases, houses are built by the jerry builder, and the gas fittings are put in anyhow; when we come to instal Acetylene in these houses we find leaks everywhere. The consumer watches his generator slowly falling and vainly tries to stop the waste, but after a house has been built and fitted with pipes, it is a difficult

job to get at all the leaks. We strongly recommend those who are building and who intend to instal Acetylene to put in iron fittings, and to have the work done properly at the start; by this means they will be saved much trouble and annoyance.

The waste lime from the generator is of great value to the agriculturist or the country settler. It makes a very good white wash, is excellent as a disinfectant or as a manure, and it is very useful as a spray for fruit trees. The French scientists are now experimenting with carbide of calcium as a cure for phylloxera. One enterprising firm whom we recently fitted up have found buyers for their waste at a shilling per bucket for refrigerating paint.

When acetylene was first introduced a large amount of attention was paid to the manufacture of the gas in liquid form, and we were told in glowing terms by would-be inventors that in this form several months' supply of the gas could be stored in a small steel cylinder, easy of transport and ready for immediate use. The idea was certainly very attractive, but unfortunately it was very quickly discovered that liquid Acetylene was highly explosive. It explodes almost as easily as nitro-glycerine, and is therefore not fit to be placed in the hands of unskilled persons. It was a most unfortunate thing for the Acteylene gas industry that the liquid form of the gas was ever introduced. Nearly all the accidents that have occurred with Acetylene have been in connection with it. He considered that it will take years to recover the ground that has been lost through the introduction of liquid Acetylene, for of course the public have not taken the trouble to distinguish between the different forms. Fortunately the use of liquid Acetylene, has now almost entirely ceased.

As a motive power Acetylene is yet in its infancy;

at the present price of carbide it is not economical for this purpose, and owing to the large proportion of carbide it contains, some difficulty is experienced in using it for gas engines. He had yet made no experiments with the gas for power purposes, as the demand for carbide for lighting is far greater than the supply. There is no doubt that when the price of carbide is brought down to about two pence per pound Acetylene will have a high value for motive power.

Several attempts have been made on the Continent to manufacture carbide by other methods than by electricity, but up to the present these attempts have failed. Attempts have been made, too, to produce the requisite electrical energy by other than water power, but these, too, have had to be abandoned. In Germany works which started with steam power had to close up and remove their plants to localities where water power was obtainable. In America all the carbide works are run by water power. In Australia there seem to be no sites suitable for manufacturing carbide by water power, but in New Zealand there are a large number where carbide could be made to supply the world if necessary, enormous volumes of water, dropping in some cases five or six hundred feet, being found close to lime and coal, and with good harbours almost within a stone's throw. From estimates that have been made it is certain that carbide can be produced in New Zealand as cheap, if not cheaper, than in any other part of the world. The speaker had been told that there are one or two sites in Tasmania which would be suitable, but he had no personal knowledge of them. In a prospectus recently issued by the Company with which he was associated, it was stated that carbide could be made in New Zealand for £8 per ton. He had little doubt, however, that when the works are up carbide will

be turned out at a less figure even than this, owing to the improvements which have recently been made in the details of manufacture. When he tells you that we could sell far more carbide than we can at present get hold of for over £30 per ton, you will see that the prospects of the business are fairly satisfactory.

His Company intends shortly to offer a reward for the best available site for the manufacture of carbide, and he hoped that the day is not far distant when a lecturer on Acetylene gas can be supplied with Australian made carbide.

He had to thank you for the attention you have given this evening, and should be pleased to show you a few experiments and to reply to any questions on points which you may wish to have further explained.