excellent briquets without the use of additional binding composition. So moisture has some advantage in this respect, but in the process of manufacture two-thirds of the water is squeezed out, so it has only 10 per cent., which is about equal to ordinary coal. In Germany a large proportion of the people use lignite briquets as their principal domestic fuel and the industry has grown to be immense. In the United States of America experiments have been carried on by the government, and it has been proved that briquets can be made out of the poorest fuel, but each kind requires to be treated in a particular way. North Dakota lignite possesses similar qualities as Saskatchewan fuel, perhaps it is a little superior. Experiments have been carried on to ascertain what can be made of lignites.

The main reason why lignites are not found to answer in ordinary stoves, or under steam boilers, is because the grates are not designed for that purpose. Lignite, besides containing water, has a low percentage of fixed carbon, and a high proportion of volatile matter. So, when it is used in ordinary grates, it is found to be too flashy, and the draught is often too feeble.

In the first place, we will see what has been achieved by using lignite for steam boiler heating. There are a number of 250 horse-power boilers, sterling water tube type, installed in connection with the Williston irrigation scheme, and one of these boilers was set aside for practical experiments with lignite as fuel. A special furnace of a semi-producer type was built, lignite was fed onto the grate and there converted into gas. The gas then passed through a combustion chamber, where a quantity of hot air was mixed with it, and most of the gaseous combustible was burned. The gas then worked about the tubes and heated the water, on its way out it also heated the air tubes, where the air was heated for the furnace. The fire grate had rooking bars and a quantity of cold air was admitted under the grate bars to keep them cool and to prevent clinker from fusing onto them. There are many interesting points which could be referred to, but I am omitting them. Continuous tests were made, and it was found that the combination of boilers and furnace gave good results with North Dakota lignite. Steam could be made with fuel efficiency of 55 per cent. to 58 per cent. of the heat in the coal, and no difficulty was experienced in obtaining the full capacity of the boiler. The results obtained compared very favorably with those in average plant when the heat available to the boiler is considered.

Another way of using lignites is by making them into briquets. The development of briquet manufacture has been very great during the last few years. On the important coal fields of South Wales, in England, Germany, and the United States, waste fuel, amounting to millions of tons, has been utilized in this manner, with profit to the capitalists and to the communities. The United States Bureau of Mines carried out a large number of experiments. They installed a German machine, designed to make briquets solely by means of high pressure of 14,000 to 28,000 pounds per square inch. This press may be described as a square pipe, into which the crushed lignite is placed and a plunger forces it through. The pipe tapers at the middle and the lignite, as it was forced through, was reduced in size and was polished and smoothed by the heated sides. Lignites from Dakota and other States were experimented upon. Some samples were found to be incapable of being made into satisfactory briquets without some binding material, whilst others proved to be all that could be desired. The conclusions arrived at by the authorities were, that lignite ignited readily, made a hot fire, and burned freely until it was consumed. Little shaking or poking of the fire was necessary to obtain maximum efficiency. The loss of unburned fuel through the grate was from 6 to 8 per cent., which was not excessive, and could be reduced by using suitable grates. In these experiments the lignite was crushed into ⅜ in. diameter or smaller. Dakota lignite was found to be tougher than the rest. It was then dried and afterwards mixed and run into the pressing machine.

These briquets were tested to see how they would stand knocking about and exposure to the weather.

It is stated that lignite briquets can be made for $1.50 per ton; this does not include the cost of the fuel. Among the advantages to be obtained, it is stated that lignite briquets give about 50 per cent. more heat than the raw material; they will stand handling, and will resist weathering much better than the raw fuel. There would be a saving of about 20 per cent. on the freight charges.

Lignite can be made into gas. There are two ways of doing this, namely, by means of the ordinary gas-works plant, and also by means of producers.

Prof. Babcock, of the North Dakota University, carried out interesting experiments in connection with making gas. He had a small plant consisting of a retort bench, condensers, scrubbers, washers, purifiers and holder. These were constructed for the special purpose of seeing what could be done with lignite.

In an ordinary gas-works, the roal is placed in a fire-clay retort, which it like a pipe with one end closed up and the other connected to a pipe to take away the gas. When the retort is sufficiently full a lid is fastened on and no air is admitted. The retort is built in brickwork over a furnace which is heated to a temperature of about 2,200 deg. Fahr. The coal is burned in the hermetically sealed pipe and the smoke has to force its way up through the ascension pipe to the various parts of the work. This, of course, is a very simple description of a gas-making process; it is much more scientific and technical, but for our present purposes I am eliminating everything which might tend to make the process difficult to understand.

When Prof. Babcock was experimenting with lignite he found that it was not necessary to maintain such a high heat, he found 1,200 to 1,400 deg. Fahr. to be ample, so less fuel is required to fire the retort. The smoke that is discharged consists of tar, vapor, and gas. The tar and vapor are removed by means of condensers, scrubbers and washers. The gas is purified by means of lime and other materials, and then it was passed into the holder for use. It was found that the unpurified gas had about two-thirds the value of good coal gas, but when it was purified it was three-quarters as good. Tar and ammonia was also obtained and about half a ton of coke. The gas burned in an ordinary burner without smoking, and could be used like ordinary coal gas, but a greater quantity had to be used to get the same result. One ton of lignite yielded about 11,000 cubic feet of gas, which is about the same as with good gas coal.

The coke obtained, however, was not suitable for use in its ordinary condition, so Mr. Babcock made briquets of it by mixing pitch with it and passing the mixture through a machine. These briquets gave results equal to anthracite which I consider excellent.

With gas producers, air is admitted, so the gas is not of the same quality as when it is made in ordinary gas-works plant. In the suction producer, after a fire has been kindled and the engine started the suction of the engine causes enough gas to be generated as is required, but as lignite has not yet been used to any great extent I will not dwell on this class of producer longer.