benefit in enabling engineers to arrive at the steam-making capacity of their coals.

$$Q = 14632 \times C + A \times \text{volatile matter} \times B.$$

Where A equals 23,400 when volatile combustible is equal to from 2 to 15 per cent of total combustible,

A equals 20,000 when volatile combustible equals from 15-30 per cent. of total combustible,

A equals 17,100 when volatile combustible equals from 30.35 per cent. of total combustible.

A equals 16,200 when volatile combustible equals from 35-40 per cent. of total combustible.

Where Q equals industrial value of coal for steam-making purposes, and where

B equals .64 when fixed carbon equals 82-90 per cent. of total combustible,

B equals .65 when fixed carbon equals 74-82 per cent. of total combustible,

B equals .662 when fixed carbon equals 68.74 per cent. of total combustible,

B equals .551 when fixed carbon equals 50-60 per cent. of total combustible.

In reviewing this formula I may say I was guided in its construction by the fact that the heating value of the volatile combustible is a constantly changing quantity, but remains constant in accordance with its composition of the elements, and that these elements occur in practically fixed proportions, determined by the total volatile combustible matter in the coal. With this formula and the proximate analysis before us, we are readily enabled to determine which of two coals are likely to be the most economical and best suited to the conditions under which combustion must take place, and will, I hope, be found useful by my hearers in enabling them to arrive at the real value of any sample of coal placed before them for their examination and opinion.

In presenting his paper Mr. Thompson said the present mode of determining the efficiency of boilers and furnaces was somewhat crude. We can with a little practice determine the heat-producing value of the coal we are using, but we want to trace that heat. We, as engineers, get the quantity of water that we have evaporated and made into steam, and we call that efficiency, but it does not give us the information that we actually require. We want to know, if there is a loss, where that loss occurs. Let us trace it out in this way: We start by knowing the maximum quantity of heat that the coal will give; we then collect a sample of our fuel gases and ascertain the composition of them, and from that composition we are enabled to know the exact quantity of air that has been admitted to the furnaces. We are then enabled to determine the exact quantity of carbonic oxide that has been formed during combustion, and if we take and examine our ash and still continue our analysis we are enabled to determine the exact quantity of combustible matter that still remains in the ash, because none of our furnace or grate bars are perfect enough to give nothing but pure ash. We have first the composition of the gases, we have then the quantity of air admitted, we have the heat lost through the formation of carbonic oxide, or heat lost through imperfect combustion.

Mr. Milne: The determination of the heat value in coal is generally done by three methods; first, chemical analysis; second, by combustion in a coal calorimeter; and third, by actual burning under the boiler. There is some doubt as to the correctness of chemical analysis. The coal calorimeter is certainly, I think, the most correct method of arriving at it, but if the two experiments are properly conducted—the chemical analysis and the combustion in the coal calorimeter—the results do not vary very much; but at the same time, when you test a sample of coal, or take a variety of samples from the coal pile and mix them all up and burn them in the coal calorimeter, that does not say the coal that we are going to get for that day is of the same quality, because, although you are getting coal from the same mine, you will get good and bad cars of coal. I do not see, even if we determine the exact value of the heating properties of that sample or set of samples, that it is going to be of very much value to us. There is an instrument—probably my friend Mr. Thompson is acquainted with it; it is invented by a Mr. Thompson and is used by the North British and some of the leading railways in the Old Country—which I think it might be advisable to describe. It gives you the heating value of coal at once, almost without any calculation. You take a gramme or two grammes of coal; after you have powdered it up, put it in a vessel and put in a certain amount of oxygen, you immerse this little combustion chamber in 966 grammes of water, or double that quantity if you are using two grammes of coal, and if that amount of water is raised one degree Fahrenheit, then that would indicate that we have one pound of water evaporated or boiled off into steam for the raising of the water one degree Fah. If you raise that 10 degrees, it is equivalent to 10 lbs. of water boiled off. If you want to find the thermal value of the coal you are testing you would simply take your 1,934 grammes—that is the amount of water—multiply that by the rise in temperature, and divide by the number of grammes of coal you are burning; that would give you the exact heat value in the coal. I think that is the simplest method, and it is accurate enough for all practical purposes.

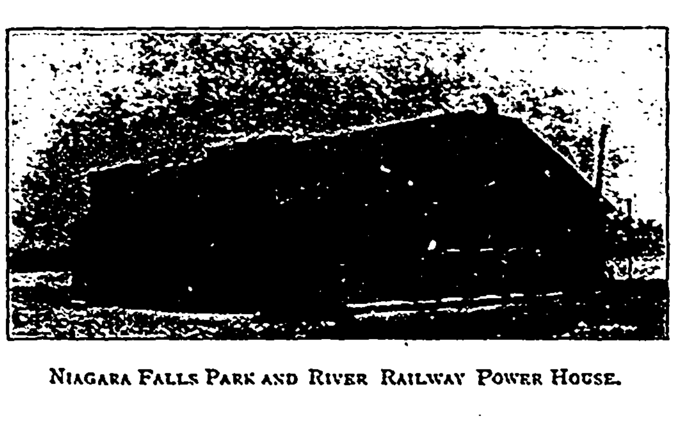
Mr. Thompson said he knew the instrument referred to, but did not consider it reliable. In dealing with so small a quantity of fuel the metal itself absorbed enough heat to lead one astray. He did not say the instrument was useless, but the average engineer is not able to use it. As to the value of a calorimeter, he heard that during last year the Royal Electric Company saved some 6,000 tons of coal, and the Street Railway Company saved a large amount. Now, wouldn't it pay large concerns like those, where they are turning over thousands of dollars' worth of coal every year, to give their engineer the apparatus whereby he could intelligently determine the value of the fuel, and also determine how to use that fuel? The use of a calorimeter is a delicate operation, and is liable, even with the Thompson calorimeter, to give a great deal of error. He then described his own method as follows: I take a large quantity of coal and grind it up, and so intermix it that I get as nearly an average sample as possible; then I go to the other side of the pile and make from 15 to 25 analyses and get as nearly as possible a fair average analysis of the coal in question, and it is surprising how these analyses will vary. No intelligent engineer would go and take the best coal he could see; he would make an effort to get as nearly as possible an average sample, then the making of the proximate analysis becomes an easy matter. They are more liable to get correct results from a chemical analysis than the average engineer is from the use of a Thompson calorimeter.

Mr. Wickens said these ideas were right for a large plant, but the average engineer is not expert enough at such delicate tests to get correct results. A firm burning say $2,000 worth of coal a year, hardly pays enough for an engineer of such ability. The ordinary engineer goes at it in a thumb-handed way, but he is often as near right as the scientific man. He doubted whether there was an expert in one of our colleges who could declare that he was absolutely correct. He finds he has to allow for this and that, and it is partly guess-work.

Mr. Wright said it was nice to be able to determine the exact value of a sample of coal, but before that can be of value to the large coal user it will be necessary to concoct a scheme to compel the mining companies to send in the same kind of coal that we get in the sample.

THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

At the convention of the National Electric Light Association at Niagara Falls, N.Y., in June, there were a number of Canadians well-known in electrical circles on both sides of the line. Among them were noticed F. C. Armstrong, Toronto, T. A. Badger, jr., Quebec; E. B. Biggar (THE CANADIAN ENGINEER), F. A. Bowman, New Glasgow, N.S.; John Carroll, Montreal, Prof. C. A. Carus-Wilson, Mon-



NIAGARA FALLS PARK AND RIVER RAILWAY POWER HOUSE.