Vol. 9
No. 5

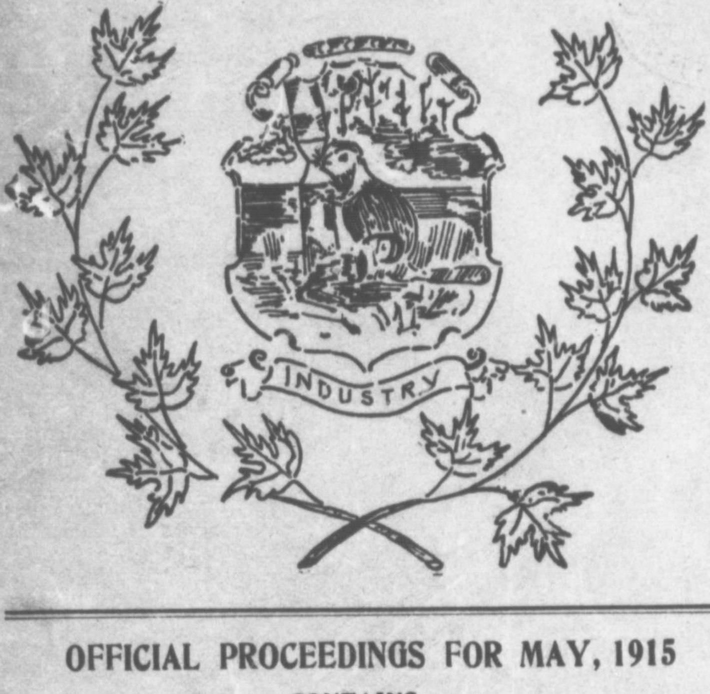
TORONTO, CANADA, MAY, 1915

$1.00 per year
15c. per copy

JAS. WRIGHT,
President

C. L. WORTH,
Sec-Treas.

THE CENTRAL RAILWAY AND ENGINEERING CLUB OF CANADA



OFFICIAL PROCEEDINGS FOR MAY, 1915

CONTAINS:--

REPORT OF MAY MEETING

AND

PAPER ON "SMOKE PREVENTION"

"The Hanlon Locomotive Sander"

Reliability first of all
Economy is bound to follow

B. J. Coghlin Co., Limited, Agents - Montreal

Hanlon Locomotive Sander Co. - Winchester, Mass.

Dougall Railway Varnishes

Steel car Liquid Primer and Paste Surfacer (for both wooden and steel cars). We will gladly send you full particulars of the Dougall 15-day Formula, and 7-day Formula (for hurried work).

You should have the details of these systems handy for reference—write to-day.

The Dougall Varnish Co. Limited, - Montreal

Associated with Murphy Varnish Co., U.S.A.

Gold Medal—World's Exposition, Brussels, 1910

EKERT PROCESS
TRADE RADIUM MARK
PAT IN CANADA 1907

VALVE DISCS

"PRACTICALLY INDESTRUCTIBLE"

For long and satisfactory service, nothing to equal them has ever been made

Manufactured solely by

GUTTA PERCHA & RUBBER, Limited

Toronto, Montreal, Winnipeg, Calgary, Vancouver

Go To The Leading House

For all kinds of HARDWARE, IRON, and METALS
SILVERWARE, CUTLERY, and SPORTING GOODS

RICE LEWIS & SON, Limited, - TORONTO

New Premises - Victoria Street
(Just above King Street.)

NORTON JACK — NORTON JOURNAL JACK

NORTON BALL BEARING JACKS

For all Classes of Service

Standard on the Leading Railroads.
Send for Complete Catalogue showing 50 styles,
8 to 70 tons capacity.

MADE IN CANADA by

A. O. NORTON, Limited Coaticook, Quebec

SAFETY ELECTRIC LIGHT
Axle Driven Dynamo
Long Lamp Life

PINTSCH MANTLE LIGHT
A Cent a Burning Hour
Long Mantle Life

SAFETY CAR LIGHTING FIXTURES
Artistically Designed
Economically Maintained

The Safety Car Heating & Lighting Co.

2 Rector St., New York

Chicago Philadelphia Washington Boston St. Louis San Francisco Montreal

---

For Sale

. . The Central . .
Railway and Engineering . . . . Club . . . .
OF CANADA

OFFICIAL PROCEEDINGS

Vol. 9
No. 5

TORONTO, CAN., May 26th 1915

$1.00 per year
15c. per copy

OFFICERS, 1915.

Honorary President

R. PATTERSON,
Master Mechanic, G.T.Ry., Stratford

President

JAS. WRIGHT,
General Foreman, Gurney Foundry Co., Toronto.

1st Vice-President

W. C. SEALY
Master Mechanic, G.T.Ry., Toronto.

2nd Vice-President

C. D. SCOTT,
Gutta Percha and Rubber Co., Toronto.

Executive Committee

T. J. WALSH,
Chief Engineer, High Level Pumping Station, Toronto.

E. LOGAN,
General Foreman, G.T.Ry., Toronto.

G. BOYD,
General Fire Extinguisher Co., Toronto.

A. W. DAVIS,
Locomotive Foreman, G.T.Ry., Stratford.

J. B. ROBB,
Canuck Supply Co., Limited, Toronto.

JAS. DOUGLAS,
Gurney Foundry Co., Toronto.

GEO. SMITH,
High Level Pumping Station, Toronto.

Secretary-Treasurer

C. L. WORTH,
Chief Clerk, M.M. Office, G.T.Ry., Toronto.

Auditors

D. CAMPBELL,
Storekeeper Consumers' Gas Co., Toronto.

A. W. DURNAN,
Representative Rice Lewis & Son, Limited, Toronto.

GEO. BOYD,
General Fire Extinguisher Co. Toronto.

Reception Committee

N. A. DAVIS,
J. H. MORRISON,
J. WALKER,
G. D. BLY
GEO. BALDWIN,
H. G. FLETCHER,
T. B. COLE,
E. A. WILKINSON,
J. S. GRASSICK,
A. E. TILL,
W. M. MCROBERT,
J. M. CLEMENTS,
A. M. WICKENS.
H. GOODES.

Past President

1907 W. KENNEDY, Master Mechanic, G.T.Ry.
1908 W. R. MCRAE, Master Mechanic, Toronto Ry. Co., Toronto.
1909 C. A. JEFFERIS, General Superintendent, Consumers' Gas Co., Toronto
1910 J. DUGUID, Master Mechanic, G.T.Ry.
1911 G. BALDWIN, Toronto.
1912 J. BANNAN, Chief Engineer, City Hall, Toronto.
1913 A. M. WICKENS, Executive Special, Canadian Casualty and Boiler Insurance Co., Toronto.
1914 T. J. WALSH, Chief Engineer, High Level Pumping Station, Toronto.

Published every month, except June, and July, August, by the Central Railway and Engineering Club of Canada.
C. L. WORTH, Sec-treas, Room 409, Union Station, Toronto.
Phones: Day, Main 4860.
Night, Hill. 5809.

MEETING OF THE CENTRAL RAILWAY AND ENGINEERING CLUB OF CANADA

COMMITTEE ROOM, HOTEL CARLS-RITE,
TORONTO, Wednesday, May 26th, 1915.

The President, Mr. Jas. Wright, occupied the chair.

Chairman,—

Gentlemen: It is time to open our meeting. The first order of business is the reading of the minutes of the previous meeting. You have all had a copy of these minutes, and it will be in order for some one to move that they be adopted as read.

Moved by Mr. C. Russell, seconded by Mr. G. H. Boyd, that the minutes of the previous meeting be adopted. Carried.

Chairman,—

I have to announce that the Executive held a somewhat informal meeting, and decided that in view of the existing business conditions, it would not be advisable to run a picnic this year. It is with regret that I make this announcement, as in other years we have always had a picnic second to none, and it has always been an event that the members looked forward to. However, there can be no doubt but that the decision which the Executive has arrived at is a wise one, when you take into consideration the prevailing financial conditions.

MEMBERS PRESENT

Geo. H. Boyd	Jas. Wright	Jas. Kelly.
Jno. Egan	A. R. Taylor	F. Smith
Chas. Russell	J. Douglas	J. W. Walker
Jas. Reid	L. H. Rummage	G. D. Bly
T. B. Cole	C. H. DeGrouchy	T. J. Walsh
J. Dodds	W. R. McRae	W. Evans
E. Logan	C. D. Scott	J. W. McLintock
A. M. Wickens	J. Barker	W. C. Robb
G. Baldwin	J. Herriott	G. Smith
J. Grassick	N. Davis	

Chairman,—

I shall now call upon Mr. Bly to read his paper.

SMOKE AND ITS PREVENTION

BY G. D. BLY

Manager, Monarch Supply Company.

The subject of smoke prevention admits of more complete treatment than is usually accorded it. The whole question of the combustion of coal is one of national importance, and is inevitably linked with that of smoke prevention. Not that it must be supposed for a moment that a smokeless fire is necessarily an economical fire; in many cases a fire may be perfectly smokeless and yet may be the cause of a very great waste of heat. Still, on the other hand, a fire may easily be smokeless and efficient; in fact some of the causes of smokeless firing are also the causes of perfect combustion, if not carried beyond their proper limits. Perfect combustion is smokeless combustion. There is only a certain quantity of coal in the world. What that quantity is no one knows precisely, but geologists are alike to form very reasonable estimates as to this amount in given districts; that, assuming the output of the coal to go on increasing at the same rate as heretofore, the supply will be exhausted in a little over a century. It therefore behoves all users of coal to limit the amount consumed as far as possible by making use of every possible unit of heat which is given out by the combustion of the coal, and to indulge in no waste that can be possibly avoided.

In reviewing the causes which contribute to the presence of smoke in the atmosphere of our towns, it is very easy to divide these into three classes as follows:

1. Domestic fires.
2. Boiler fires used for making steam.
3. Other furnaces used for industrial purposes.

With very few exceptions the house fires burn anthracite coal which gives off little or no smoke.

Of the two classes of industrial furnaces, those of steam boilers very much exceed the other in number, and it will be best to confine the discussion to these. The fuel consumed in boilers furnaces is, in almost all cases, obtained from coal. The question, therefore, becomes narrowed down to the combustion of coal in furnaces of boilers, and, in this connection, it is necessary to bear in mind that economy must not be lost sight of when considering the question from the point of view of the smoke.

All fuels, whether liquid or gaseous as petroleum or solid, are, chemically speaking, compound substances, made up of certain proportions of the simpler substances or elements. Coal for instance, consisting of the elements, hydrogen and oxygen, which exist separately under ordinary conditions as gases, carbon which is a solid, sulphur, nitrogen and ash. These exist in the coal in various quantities, according to its age and origin.

But in a complex substance such as coal the elementary substances first combine to form what are called compounds, in which the elements always exist in the same unvarying proportions.

The smallest particle of a compound substance which can have separate existence is called a molecule, this molecule being made up of atoms of the various substances forming the compound. This will be best made clear by the consideration of a concrete example. Take the case of the formation of water, by the combination of hydrogen and oxygen. If there are eighteen pounds of water, there will be sixteen pounds of oxygen and two pounds of hydrogen and the gases always combine in exactly the same ratio, which is fixed and invariable. The atomic weight of hydrogen is said to be one, and that of oxygen sixteen. Each element has its own atomic weight, is a relative quantity, and denotes the proportion in which the element exists in a compound, or the multiple of such proportions. Thus, in the case of water two molecules, that is, two volumes of hydrogen combine with one volume of oxygen to form two volumes of water in the form of steam.

The molecular weight of hydrogen is said to be two, the molecule of hydrogen being the smallest particle which can exist as hydrogen. Similarly the molecular weight of oxygen is thirty-two, or the weight of two atoms. One molecule of water is made up of two atoms of hydrogen and one atom of oxygen, and the symbolic expression for water is H_2O.

The same reasoning applies to the other combinations occurring in the combustion of fuel. In coal the principal are those of the combination of the hydrogen in the coal with the oxygen of the air to form water; the formation of carbon dioxide or carbonic acid by the combination of the carbon with the oxygen, and the incomplete combustion of the carbon, forming carbonic oxide or carbon monoxide, and lastly the burning of this carbon monoxide by taking up another atom so as to form carbon dioxide.

There is also the combustion of the sulphur in the coal so as to form sulphur dioxide (SO), but this is generally neglected.

Coke, which is sometimes used for raising steam, is almost entirely composed of carbon and contains very little gaseous matter.

The reactions which take place in the case of the combustion of oils producing coke-oven gases are more complex. A molecule of the carbon dioxide formed by the complete combustion of carbon in the air is made up of one atom of carbon and two atoms of oxygen (CO_2), so that in forty-four pounds of the gas there are twelve of the carbon and 2×16, which is thirty-two pounds of oxygen, or, in other words, one pound of carbon requires for its combustion 2.66 pounds of oxygen.

In one hundred volumes of atmospheric air there are seventy-nine volumes of nitrogen and twenty-one volumes of oxygen. And as the weights of equal volumes of nitrogen and oxygen are as fourteen is to sixteen, the proportions by weight are approximately twenty-three to seventy-seven.

That is to say, in the air there is a percentage by weight of oxygen of twenty-three, and, as one pound of carbon requires for its complete combustion 2.66 pounds of oxygen, this will be equivalent to saying that one pound of carbon requires for its complete combustion $2.66 \times \frac{100}{23} = 11.56$ pounds of air. Similarly one pound of hydrogen requires 36.3 pounds of air.

Now the air of the atmosphere is simply a mechanical mixture of oxygen, which combines with other substances during the process of combustion, and nitrogen gas, which is inert and simply serves to dilute the oxygen. It is in this way useful in checking a too rapid combustion of both combustibles and animal tissues, but, unfortunately, it takes up heat and carries it away to waste.

The different kinds of coal used vary much, in their smoke producing capacity. For instance, anthracite coal used in domestic furnaces is nearly smokeless. On the other hand, steam or soft coal and soft coal screenings used for steam contain a large amount of volatile matter which is very smoky in combustion. The coke which is left after the distillation of the gaseous matter from the coal is practically all carbon, and burns with a total absence of smoke.

The precise analysis of the several kinds of coal used are given in the following table. Only the constituents with which we are particularly concerned, that is, the hydrogen, oxygen and carbon, being mentioned, the quantity of sulphur being small and unimportant as a heat giving combustible. The actual percentage of sulphur varies from .75 to 1.50 per cent.

In this table are not included the liquid and gaseous fuels, nor such occasional fuels as wood and peat. C., H. and O. represent the fractions of a pound of the combustible

Kinds of Fuel	C.	H.	O.	A.	Smoke-giving Qualities
Coke, good	0.94	——	——	11.28	No smoke.
Coal, anthracite	0.915	0.035	0.026	12.13	Practically no smoke.
Coal, dry bituminous	0.87	0.05	0.04	12.06	Hardly any smoke.
Coal, caking	0.85	0.05	0.06	11.73	Very little smoke.
Coal, cannel	0.84	0.06	0.08	11.88	Considerable quantity.
Coal, dry long flaming	0.77	0.05	0.15	10.32	Very smoky.
Coal, lignite	0.70	0.05	0.20	9.3	Very smoky.

referred to in one pound of fuel. The letter A refers to the number of pounds of air required for perfect combustion of one pound of fuel. The quantity of each coal as regards its smoke-producing properties is given in the last column. Of course it must be understood that these are only average values, and must not be taken as absolute, especially as regards the coke, of which there are many varieties.

It will be noticed that the liability to give off black smoke increases as the hydrogen and oxygen increases and diminishes as the proportion of carbon in the fuel increases. From charcoal and coke, and to a lesser extent anthracite coal, which consists almost entirely of carbon, there is practically no smoke produced under any circumstances.

The liquid hydrocarbons are very smoky unless the air supply is carefully attended to. The same is true to a smaller extent in the case of wood and peat, although such smoke as is produced is not so objectionable as that given off from coal. The more gaseous a coal is, that is the more hydrogen and oxygen it contains, the more liable it is to smoke, and, therefore, all the more care is required in the adjustment of the air supply. The gaseous fuels, that is to say, the gases containing high percentages of carbon oxide and low percentages of hydrogen, are smokeless.

The chief constituents of coal, so far as heat-giving properties are concerned, are, as we have seen, hydrogen, carbon and sulphur. Of these the sulphur already appears in small quantities, and has a low heat-giving value, so that it is neglected in comparison with the other constituents. During the process of combustion the hydrogen of the coal combines with the oxygen of the air to form steam, and heat is given out in the process; the carbon also combines with the oxygen to form carbon dioxide or carbonic acid gas (CO_2), and if the air supply is plentiful complete combustion takes place, but with an insufficient air supply only a partial combustion takes place, and carbonic oxide or monoxide gas (CO) is formed, with the generation of a smaller quantity of heat.

It is therefore important irrespective of other considerations that the carbon in the fuel should be burned so as to produce CO_2 and not CO, the production of the latter being necessarily accompanied by a distinct loss of heat that would otherwise have been avoided.

What actually takes place when the coal is burnt on a boiler furnace is not easy to define in a few words. The process of the combustion of coal is a very complex one and depends to a great extent on the external circumstances accompanying the combustion. When firing takes place, that is, when a fresh supply of coal is thrown on the fire, the fire generally consists of a layer of fuel more or less completely incandescent, this being the carbon of the coal in the form of coke. On the new supply of coal being placed upon this glowing mass of fuel, the heat of the latter causes the release of the gaseous constituents of the coal, the hydrocarbons are driven off and burned above the fire with luminous flames.

These gases consist of combinations of the carbon which goes to make up those hydrocarbons which form a large part of the illuminating coal gas. Just as heat is absorbed during the process of the generation of steam from water, so when the gases are driven off from the coal, we have simply a process of evaporation, and heat is consequently absorbed during the process and a cooling of the furnace is the result. A high temperature is necessary, as otherwise the carbon and hydrogen will not combine with the oxygen of the air.

If the temperature of the furnace is sufficiently high and the air supply ample the hydrocarbon gases will be burned above the furnace with a heat-giving flame, steam and carbon dioxide being formed. If these two conditions are lacking the result will be the formation of smoke. This is a most important point to be noticed in connection with smoke production.

The combustion can then be divided into two stages—the volatilization and combustion of the hydrocarbons; and secondly, the combustion of the remaining carbon. The carbon may be completely burnt to CO_2 or only partially to CO. Most of the air which is used for the combustion of the carbon in this second stage is that which is allowed to pass upward between the furnace bars. If the air supply is ample, the carbon will be completely burned to CO_2 which will pass away from the fire to the flues and thence to the chimney. If the air supply from below is insufficient, the carbon will only combine to form CO which will appear at the top of the fire, and if there is a sufficient supply of air, the CO will burn. The flame of CO is readily distinguished by its violet-blue tint. If the conditions necessary for the proper combustion of the CO are absent then the gas will pass off as CO and will result in a corresponding loss of heat.

The actual interchanges which take place between the carbon and the oxygen are not very clearly understood, and it is held by some authorities that CO is formed first and takes up a further quantity of carbon as it passes over or through the incandescent fuel, and in this way the CO_2 is formed. This, however, does not greatly matter so far as the present argument is concerned, the main point being that with a sufficient air supply CO_2 is formed, which means that the carbon is perfectly consumed, and that with an insufficient air supply CO will be produced with a corresponding loss of heat and boiler inefficiency.

FORMATION OF SMOKE

The formation or non-formation of smoke is a matter of air supply and temperature. This much may be taken as certain, although the details of the various processes are not clearly determined. The formation of smoke occurs during the volatilization of the hydrocarbon gases. As these come off the coal, if the air supply is sufficient and at the same time the surrounding temperature is high enough to allow combustion to take place, the gases will be burnt with a bright flame, steam and carbon dioxide being formed in the process. If, however, the air supply is deficient or the air not being plentiful the flames penetrate to portions of the flues, which are below the necessary temperature, a recondensation takes place and the carbon becomes separated in a finely divided condition and smoke is formed.

Another reason given for the formation of smoke in some cases is that the high temperature of the furnace causes a dissociation of the constituents of the hydrocarbons, which, if the supply of oxygen is deficient, results in unburnt hydrogen and unconsumed carbon in the form of smoke. If, however, the air supply is ample, when this takes place the hydrogen and carbon will be burnt and no smoke will result.

The formation of smoke caused by an insufficient air supply is seen in the coal of an oil lamp without a chimney. If the wick is turned up a little too high, the natural air supply is not sufficient to maintain perfect combustion, but if a glass chimney be placed on the lamp an induced draught will be produced, more oxygen will reach the flame, and clear and smokeless combustion will result.

Some of the finely divided carbon forming the soot comes off from the coal direct without being first combined with the oxygen. In order that the combustion of fuel in a boiler furnace may be perfectly satisfactory from the point of view of the owner, and that of the outside public, the combustion must be both economical and smokeless. These two conditions are not necessarily co-existent. A furnace may be highly economical, regarding economy from all points of view, and at the same time may be periodically sending forth a quantity of unburnt carbon in the form of smoke; or a chimney may be almost smokeless and at the same time may be working in a very wasteful manner. It must not be supposed that these two conditions are necessarily opposed to one another, but in some cases they may be, and it is necessary to be careful in discriminating between smokelessness and economy.

The principal conditions which affect us are as follows: The presence of smoke in the gases escaping from a boiler flue is in most cases due to an insufficient air supply either in the neighbourhood of the fire doors and above the fuel, or at the back of the furnace near the bridge, or to partially burnt gases coming in contact with the cooling surfaces provided by the boiler plates next the water. Second, economical combustion may be interfered with to a small extent only by the amount of carbon carried away as smoke and by a deposit of carbon on the tubes and plates which interferes with the proper transmission of heat through them.

The chief source of loss of economy in the combustion of coal is due to a too liberal air supply which, besides the excess of oxygen present, contains much inert nitrogen, which takes up heat and carries it away up the chimney to waste. A too small air supply results in the formation of a quantity of CO and the carbon burnt in producing it is only partially consumed, and yields less than one-third the heat that it ought to evolve in complete combustion. Great care is therefore necessary in arranging the air supply so as to give the maximum economy in the combustion, combined with a smokeless chimney besides serving as a carrier of heat to waste the excess of air has a cooling effect on the tubes.

If it is important that the air supply should be carefully regulated as to quantity, so also the time of admission should be attended to. After firing, the maximum quantity of oxygen is required for several minutes, until the whole of the hydrocarbons have been driven off and consumed; after this time the supply should be much reduced. An excessive supply of air after the hydrocarbons have been driven off is not needed and is a source of waste. During the gasification period or that immediately after firing, air should be supplied not only underneath and over the bars, but also at or near the bridge so as to completely consume the hydrocarbon gases.

It has been said that the presence of or freedom of smoke in a boiler depends more than anything else on the quantity of air supplied to the furnace, the time at which this supply is admitted and the place of admission, that is, whether the air is allowed to pass into the furnace above the fire bars, below them, or both above and below at the same time. Not only is the smoke affected by the air supply but the economical working of the boiler depends to a great extent on this also.

The number of pounds of air required per pound of coal is somewhere in the neighbourhood of twelve, and does not vary greatly from this figure. An average value for the maximum weight of air per pound of coal may be taken as 11.5 pounds. This quantity is only that required under the most favourable circumstances, that is, when every particle of oxygen of the air supplied is completely consumed, and there is no waste oxygen carrying the heat away. These conditions are not possible of attainment in ordinary boiler furnaces, as it is not practicable to bring all the oxygen intimately in contact with the burning fuel so that it may be used.

If the air supply is deficient, either in the general supply or the quantity admitted to some important point of the furnace, the carbon does not take up its proper amount of oxygen, and carbon monoxide is formed instead of carbon dioxide. One pound of carbon completely burned to CO_2 gives out by its combustion about 14,500 heat units, where if partially burned to CO the heat yielded is only 4,500 heat units. It is therefore obvious that for every pound of carbon burnt to CO instead of CO_2 there is a loss of heat equal to about 10,000 heat units. For this reason alone it is absolutely necessary for economy that the carbon be fully burnt. This carbon may be free carbon in the incandescent fuel left after the hydrocarbons have been driven off, or it may be a combine carbon in the gases, and if the latter, the imperfect combustion may be accompanied by the evolution of smoke. In either case the remedy is more air, and consequently more oxygen.

The problem with which the engineers are confronted is not altogether a simple one, for if the air supply is deficient CO is formed in place of CO_2 and a consequent waste of heat takes place, and this may be accompanied by the formation of smoke, whereas if too much air is admitted to the furnace there is again a loss resulting from the excess of oxygen and nitrogen taking up heat and carrying it away from the boiler. There is a point where one loss ends and another begins, as the air supply is increased and in order to obtain the most economical results with freedom of smoke this point must be found. There is the farther question as to how far it is allowable to permit a large excess of air in order to force the boiler and so get a greater total evaporation from a given boiler but that point need not be considered at present.

The best indication of the quantity of air being used per pound of coal is that given by an analysis of the gases coming from the furnace. This is not difficult to obtain, samples of the gases being collected at suitable places in the flues and the analysis made by means of one of the many forms of rough apparatus used for that purpose.

On analyzing the products of combustion they will be found to consist of the following constituent gases:

Carbon dioxide or carbonic acid gas (CO_2) from the carbon of the coal and the oxygen of the atmosphere. There is found to be 17 per cent. to 5 per cent. of this gas present. These are extreme figures, the more usual ones being from 12 per cent. to 7 per cent.

Free oxygen (O). There is usually from 12 per cent. to 4 per cent. of this gas.

Carbon monoxide or carbonic oxide (CO). From 2.5 per cent. to none. In very many boilers working fairly economically, the quantity of this gas which can be detected by the usual means is none.

Unburnt hydrocarbons. These are in small quantities and not found by the ordinary analysis, but they often exist and must be a source of loss.

The last gas in the flue gases is nitrogen (N), which is found by difference, and the sum total of these subtracted from 100 and the remainder assumed to be wholly of nitrogen, usually there is 80 per cent. of this gas present.

It is clear, then, any excess of air in the flue gases results in heat being carried away to the chimney and so wasted; and, on the other hand, a deficiency in the air supply is a cause of a loss on account of the fuel being incompletely burnt and the escape of the carbon monoxide without being burnt.

Chairman,—

The paper is now open for discussion, and if any of the gentlemen present would like to ask any questions, Mr. Bly, I am satisfied, will be pleased to answer them.

Mr. Jas. Kelly,—

What do you consider is a reasonable temperature in the chimney over the top of the boiler?

Mr. G. D. Bly,—

About 500° to 550°; if you have 600°, you are getting a loss, and your draft should be checked.

Mr. Jas. Kelly,—

We have a pair of feeders on and the temperature in the stack is 690°.

Mr. G. D. Bly,—

Then there certainly is a loss. Have you got a stack damper or stack regulator?

Mr. Jas. Kelly,—

No, we have not.

Mr. G. D. Bly,—

The trouble seems to be, that you are taking too much air into the furnace, and you are heating the air and carrying it away.

Is it a return-tubular boiler?

Mr. Jas. Kelly,—

Yes. We made a test the other day, and found there is usually about six to six and one half pounds evaporation to the pound of coal.

Mr. G. D. Bly,—

An unusual thing occurred when I was having some Murphy Furnaces installed. The Murphy people ran an evaporation test. The most economical point in connection with these Murphy Furnaces, or what the Murphy people claim is their most economical point, is about 500° to 550° F. of flue gas. We ran a test on the hand-fired boiler; in this boiler the stack temperature dropped down to, I think it was, 425°, or perhaps lower. They never could find out the cause of this. A pyrometer was taken off another boiler and tried on this one, but with the same result. We were burning a mixture of hard coal and soft screenings with a forced draft. We thought perhaps an air leak had occurred above the boiler some place, and was cooling it down, but we were unable to find any.

Mr. Jas. Kelly,—

With good coal, and proper conditions, you should be able to evaporate about 8½ to 9 pounds, should you not?

Mr. G. D. Bly,—

A furnace with a brick arch in, you should get, say, about 8 to 8½ pounds at least.

Mr. Jas. Kelly,—

Before we used the feeders we were not experiencing any trouble, and I think before long we will be back again to the hand-fire system.

Mr. A. R. Taylor,—

I have listened with a great deal of interest to the paper to-night. There are one or two questions I would like to ask. I see you are trying to frighten us when you say that the coal supply is going to give out in about a century. You say that geologists have come to the conclusion that this is what will happen. Does this include new discoveries of coal fields? As you know, they are continually discovering new fields.

You spoke of anthracite coal, which you say is smokeless. From what I can make out, anthracite has lost most of its hydrocarbons. What causes this change; is it pressure? Or is it temperature, and is this the cause of its being smokeless?

There is a product largely advertised in England at the present time for sprinkling coal, and which it is claimed will do away with the smoke. I have heard that you can buy sufficient to cover a ton for 60 cents. If anything can be done to do away with the smoke, I think it certainly should be done in Toronto. When you go out on the lake, on a nice clear day, and look back at Toronto, it looks like anything but a smokeless city—very smoky, in fact. It would almost lead one to believe that the smoke inspectors are somewhat lax.

Mr. G. D. Bly,—

I never went into the formation of coal, and am not geologist enough to know just why anthracite was made smokeless.

The question of sprinkling something on the coal to make it smokeless—this is an old scheme, although what you refer to may be a new product for the purpose.

If you will remember, about three or four years ago, a shoe maker discovered that if you would sprinkle a little salt and water over your coal, good results would be obtained. (If you will notice, the man who discovers these things is always working a little out of his line, and men like ourselves who use thousands of tons of coal a year never think of them, because long association with coal has led the most of us to believe that although these things may come and go, there is very little in them.) This salt business created quite a sensation—had the people all worked up for a time, but gradually died out and now you never hear of it.

Mr. A. R. Taylor,—

Yes, I remember that. I also remember the time of the coal strike when someone started the people burning zinc with their coal, and the people were all worked up over this for a time.

Mr. G. D. Bly,—

About smoke prevention; you will remember when the new smoke ordinance came into force a few years ago, there were numberless designs of smoke prevention devices put on the market. I had occasion to try one of these devices. It was in the form of a jet over the top of the furnace. Like all the others, in time it became a source of trouble. The ends of the pipe would burn off and fill up.

If you go into the matter, you will find that all these things have been tried over and over again and have been discarded, but after a time they turn up again.

One smoke consumer in particular that I have in mind was used by the Robert Simspon Co. In this case they were using a motor-driven fan which was taking the gases from the stack and re-circulating them. They claimed they were obtaining good results, but I have not heard of it now for some time

To my mind, the good results obtained are usually the result of awakened interest on the part of the engineer. He will take a fresh interest in his plant while one of these things is being tried out, and will keep checking his fireman up. A good fireman who takes an interest in the plant is a boon, and I think worth almost anything you can pay him.

In so many cases, the manufacturer, instead of paying the men in the engine room good wages, will start to cut down expenses there, where, if he but knew, it is possible to waste more money than in any other part of the plant.

Chairman,—

I think I had the distinction of installing the first smoke burner ever used in the city of Toronto. About forty years ago a man named Gray designed a smoke consumer, and Doig's Machine Shop, where I was employed, undertook to manufacture them for him.

The first trial was at the Consumers' Gas Company, where the device was used for about two years and then, I presume, consigned to the place where they all go eventually, the scrap heap.

I agree with Mr. Bly that the biggest part of smoke prevention is done by the fireman. It is the man with the shovel that must do away with or permit smoke.

Mr. F. Smith,—

I would like to ask Mr. Bly about the furnace question. Take any furnace, or, as they are commonly called, steam boiler. Put on enough anthracite coal to last four or five hours. At the end of that time, when you go to fill up again, should the small air-vent in the door be left open, or should it be closed? The air that comes in there, I understand, is to burn up the gas. Is the heat you get from the gas sufficient to counterbalance the amount of cold air that is drawn in there?

Mr. G. D. Bly,—

I think a company has been formed, and is located on Bay Street just south of Adelaide, to handle a device for this purpose. They put a ring in the top of an ordinary house furnace, take the pipe out from the back of the furnace, carry it down to near the floor some place, take the air up through a perforated ring over the coal.

I think it is wise in all cases to have a little air passing over the coal until the gases are burnt off; it prevents their escaping into the house.

If you will notice, when you are putting fresh coal on your furnace; after shutting the door, you look through the opening in the front of it, and you will not see anything burning above the coal. Open the door and there will be a sudden explosion and immediately a flame will appear above the top of the coal you have put on. If you leave a little crack in the door open, you would find that this will burn for quite a long time.

I would just like to say that with the Murphy Furnace, I have found that it does not make any difference how hard you drive them, as long as you do not put coal in through the door you will not get any smoke whatever.

I have driven the Murphy Furnace to about 150 per cent.

overload. Under test we got 280 horse-power out of a 115-h.p. boiler.

A year ago last winter when the temperature was down to 18° or 20° below zero, you could see a white steam going up above the stack, but never a bit of smoke, and we were getting 250 to 300 horsepower out of the 115-h.p. boilers.

We were heating about 60,000 square feet of radiation with three 115-h.p. boilers at a temperature of 18° to 21° below zero. You can figure that out and see what we were getting out of these boilers, and there was never a sign of smoke.

I do not know of any furnace that you can crowd in this manner without causing smoke, other than an automatically side-fed or front-fed furnace.

Mr. F. Smith,—

I have much pleasure in moving that a hearty vote of thanks be extended to Mr. Bly for the splendid paper he has read this evening. I think it has been one of the best papers we have had this session and it has been on a subject interesting to us all, as it touches upon something with which we have all had more or less experience.

Mr. A. R. Taylor,—

I second that motion. Carried.

Mr. G. D. Bly,—

I thank you. I did not give the paper for any vote of thanks. I have the interests of the Club at heart, and am pleased to do anything I can to benefit it. I think it is not so much what we get out of these papers, but it is the points that are brought out in the discussion thereof; for that reason, I think that more of the members should take part in the discussion and take more active part in the Club.

At some time in the future, I may be able to take up the question of furnaces. I think it is a subject that would be of great interest to everyone.

Moved by Mr. G. H. Boyd, seconded by Mr. Jno. Egan, that the meeting adjourn.

To Parties Manufacturing, or Intending to Manufacture, in Canada

WE are prepared to produce, upon a large scale, articles of metal and wood.

Our facilities are those necessary for the extensive and economical manufacture of the heaviest freight cars and the highest class of passenger cars. These facilities include plants for the manufacture of steel, malleable and grey iron castings—rolled steel and iron products—frogs, switches and track work for electric and steam railways—coil and elliptic springs—forgings—cabinet and other wood work—and all preparatory and finishing adjuncts.

The various plants are distributed from Amherst, N.S., to Fort William, Ont.

Correspondence invited.

Please address Sales Department,
P.O. Box 180, Montreal

Canadian Car & Foundry Company, Limited
Canadian Steel Foundries, Limited
Pratt & Letchworth Company, Limited
Rhodes, Curry Company, Limited