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MISSING

. THE CENTRAL . . Railway and Engineering . . . . Club . . . . OF CANADA

OFFICIAL PROCEEDINGS

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C. L. WORTH, Sec.-Treas., Room 409 Union Station, Toronto.

PROCEEDINGS OF THE CENTRAL RAILWAY AND ENGINEERING CLUB OF CANADA MEETING.

Prince George Hotel, TORONTO, September 21st, 1909.

The President, Mr. Jefferis, occupied the chair.

Chairman,—

The first order of business is the reading of the minutes of the previous meeting. As all have been supplied with a copy of the minutes, it will be in order for some one to move their adoption.

Moved by Mr. Duguid, seconded by Mr. Fletcher that the minutes of the previous meeting be adopted as read. Carried.

Chairman,—

The second order of business is the remarks of the President. As this is the first meeting after the holidays it is a pleasure to see so many members present and as we have some good papers in store I would like to see the attendance kept up, in fact increased.

In regard to the picnic held at Jackson's Point in June, I am sure all those who went with us spent one of the happiest days of their life. The sports, especially the Old Man's race, and the Marathon, where the World's Records were made, will not soon be forgotten especially by the contestants and it was the universal opinion of one and all that the Amusement Committee excelled themselves and on behalf of the Club I would like to thank the Amusement Committee, the donators of prizes and all those who assisted in making the picnic such a success. A list of the donators of prizes will be found in the Book of Proceedings of this meeting.

The next order of business is the announcement of new members. I will now call on the Secretary to read the names of the new members.

Secretary,—

I am glad to state that we have twenty-five new members which is a good commencement for the season.

As some good papers will be given during the winter I would ask those who have not brought in any new members to bestir themselves and keep up the good work. I think there should be no difficulty for each member of the Club to secure at least one new member.

NEW MEMBERS.

Mr. J. Mitchell, Engineer, Consumers' Gas Co., Toronto.
Mr. G. Little, Engineer, Consumers' Gas Co., Toronto.
Mr. G. Kyle, Steamfitter, Consumers' Gas Co., Toronto.
Mr. J. Wright, Machinist, Consumers' Gas Co., Toronto.
Mr. W. Smith, Boilermaker, Consumers' Gas Co., Toronto.
Mr. A. Stewart, Patternmaker, Consumers' Gas Co., Toronto.
Mr. G. H. Boyd, Foundry Cost Clerk, Canada Foundry Co., Toronto.
Mr. B. Clarke, Foundry Superintendent, Canada Foundry Co., Toronto.
Mr. J. A. Catchpole, Foreman Patternmaker, Canada Foundry Co., Toronto.
Mr. J. Sharp, Mechanical Draughtsman, Canada Foundry Co., Toronto.
Mr. E. B. Price, Chief Clerk, Construction Dept., Canada Foundry Co., Toronto.
Mr. E. B. Gilmour, Superintendent of Moulding Dept., Canada Foundry Co., Toronto.
Mr. A. Tory, Storekeeper, Grand Trunk Railway, London.
Mr. P. J. Harley, Machinist, Grand Trunk Railway, Stratford.
Mr. T. F. Minera, Electric Motor Engineer, Sarnia Tunnel.
Mr. C. A. Saylor, Locomotive Foreman, Grand Trunk Railway, Hamilton.
Mr. M. A. Humber, Apprentice Instructor, Grand Trunk Railway, Stratford.
Mr. R. M. Carmichael, Engineer, Canadian Pacific Railway, Shrieber, Ont.
Mr. H. W. McMillan, Bridge Inspector, Canadian Pacific Railway, Toronto.
Mr. F. H. White, Representative Gas Light & Power Co., Toronto.
Mr. H. T. Whaley, Wholesale Lumber Merchant, Toronto.
Mr. M. C. J. Hocken, Representative Chapman Double Ball Bearing Co., Toronto.
Mr. F. D. Dewar, Philip Carey Manufacturing Co., Toronto.
Mr. J. J. Main, Manager, Polson Iron Works, Toronto.
Mr. A. M. McGarry, Salesman and Engineer, H. W. Johns-Manville Co., Toronto.

Chairman,—

I do not know how many of these new members are the results of the picnic, but it is certainly gratifying to see such a fine lot of new members, and it looks to me as though we are going to have an enjoyable time here this winter.

MEMBERS PRESENT.

A. Taylor.
G. A. Young.
J. McWater.
A. E. Till.
J. M. Downer.
J. Duguid.
Acton Burrows.
W. H. Bowie.
R. H. Brown.
A. W. Durnan.
W. S. Cowan.
G. H. Boyd.
G. Cook.
H. E. Rowell.
S. Turner, Jr.
G. D. Bly.
M. Marsh.
C. A. Jefferis.
L. S. Hyde.
R. H. Fish.
O. Burt.
B. Clarke.
J. Cave.
G. C. Keith.
J. Barker.
J. V. Jackson.
W. E. Cane.
C. H. Bull.
J. Wright.
G. Shand.
H. Cross.
S. Woods.
I. Jefferis.
H. G. Fletcher.
A. Hallamore.
R. Woodward.
J. Jacques.
F. Burrows.
H. Eddrup.
G. Black.
W. E. David.
W. J. Bird.
E. F. Friend.
J. M. Clements.
F. R. Wickson.
W. Price.
E. Armitage.
J. R. Armer.
J. C. Blanchflower.
A. G. McLellan.
E. Logan.
J. Herriot.
C. G. Herring.
W. E. Archer.
A. J. Lewkowiez.
A. M. Wickens.
T. F. Chapelle.
J. Kyle.
C. L. Worth.

The thanks of the Club are due to the following who so kindly donated prizes which were competed for at the Annual Picnic to Jackson's Point, June 19th, 1909.

The Philip Carey Mfg. Co., Toronto.
The Garlock Packing Co., Toronto.
Mr. G. A. Bronder, Consulting Engineer, New York.
Messrs. Rice Lewis & Son, Toronto.
Messrs. Baines & Peckover, Toronto.
Polson Iron Works Co., Limited, Toronto.
Dominion Bridge Co., Toronto.
Messrs. H. W. Petrie & Co., Toronto.
The Lukenheimer Co., Toronto.
Watson Pattern Works, Toronto.
Messrs. Reid & Brown, Toronto.
Treloar, Blashford & Co., Toronto.
Messrs. Bennett & Wright Co., Toronto.
The John Inglis & Co., Toronto.
Canadian Fairbanks Co., Toronto.
Gutta Percha Rubber Co., Toronto.
Elaterite Paint Co., Toronto.
Dodge Manufacturing Co., Toronto.
Downer Pattern Works, Toronto.
J. E. Morrison Brass Mfg. Co., Toronto.
Messrs. Sanderson, Pearcy Co., Toronto.
Messrs. Douglass Bros., Toronto.

The Canadian Rubber Co., Toronto.
The Queen City Oil Co., Toronto.
The Canadian Oil Co., Toronto.
The E. Harris Co., Toronto.
Messrs. Reid & Co., Toronto.
Messrs. Warden King Co., Toronto.
British American Oil Co., Toronto.
Central Electric & School Supply Co., Toronto.
Dunlop Tire & Rubber Goods Co., Toronto.
Murray Printing Co., Limited, Toronto.
Mr. C. L. Wilson, Assistant Manager, T. Y. & R. Ry., Toronto.

Chairman,—

We will pass over the other orders of business and come to the reading of papers and discussion thereof.

We have with us to-night Mr. Jackson, of the Grand Trunk Railway. I understand he has come here from Montreal to give us this paper, and as he has to leave on the 10.15 train, I think we had better ask him to read his paper at once in order that we may have a little time to discuss it in his presence I now take pleasure in calling upon Mr. Jackson.

CARE AND WASHING OUT OF LOCOMOTIVE BOILERS.

BY MR. J. V. JACKSON, BOILER INSPECTOR, GRAND TRUNK RAILWAY, MONTREAL.

Upon consideration of the subject of washing out boilers, t must be admitted that this is a very important part in the uccessful operation of any plant depending on boilers and steam power, and should, therefore, be given every possible attention by all concerned, to see that this work is done in a proper manner, and at the correct periods of time, or mileage run, this, however, is to be decided by some persons in authority, and governed by the conditions of water in the districts through which the different engines work. But, before proceeding with the washing out of boilers we will first consider the reasons for requiring to have the boilers washed out. It is well known that all waters contain impurities of some kind, more or less. Some of these impurities, we find, will settle as soon as they enter the boilers, and will there strongly adhere to the tubes and barrel plates, in this manner causing the barrel and tubes to block up quickly, interfering with the proper circulation of water through the boiler. Also there are other impurities, which are held in suspension, and will float to the surface of the water, when the water is sufficiently heated,

and this becomes in the form of a scum. Considerable of this matter is kept continually in motion by the circulation of the water inside the boiler, and, in this manner is carried back and forth to all parts of the boiler, and the gradual accumulations of these foreign substances leads to the formation of a coating of scale on practically all parts of the tubes and plates with which the water comes in contact. A very thin scale is considered to be beneficial to a boiler, seeing that it has the effect of preventing the corrosive action of the water upon the plates, tubes, etc., but when it becomes at all thick, the heat-conducting power of the plates to the water is greatly diminished, and it is stated that one-sixteenth inch thickness of scale calls for an increase of from 10% to 15% in fuel, whereas heavy scale forming on plates which are in direct contact with the flames from the furnace, may become a source of danger, since the heat from the fire is not carried to the water as fast as it should be and the plate does not get the necessary protection of the water, which should absorb this heat. In this manner the plates are liable to become overheated, and to corrugate between the stay bolts, also to start a large number of stays leaking. This result requires sending the boiler to the repair shops, for sheets to be straightened and all stays to be made tight, which is very expensive, when considered in comparison with the cost of preventing the cause, which is by proper attention to regular washing out; we also find in many cases that where scale is allowed to accumulate heavily against firebox sheets, that the sheet will crack out away from the staybolt holes, which sign, when found in the sheets of a firebox, is looked upon as strong evidence of the presence of heavy scale in the water space at this point. This scale should be at once removed, and sheets and bolts made clean, also if the cracks are bad, it will require the defective portion of plate to be cut out, and a patch to be put on in place. These patches are usually fastened to the firebox sheets with patch bolts, which protrude through the sheet, and in to the water space, from one-quarter to one-half inch, these small projections into the water space being close together, act as good collectors of sediment, and often become one solid line of scale around the inside edges of the patch, thus destroying the protection given to the edge of patch by the water, and in a large degree being the cause of patch bolts leaking at the heads, and edges of patches burning and cracking badly, thus showing the necessity of keeping firebox sheets and bolts clean at all times, and using the best means possible to accomplish this work, also, as a general rule, where to look for accumulations of sediment, scale, etc. In the first place, we have the crown sheet, which, being directly over the fire, and flames impinging at a direct angle against the plate, causes the water to evapor-

ate very rapidly at this point and to disintegrate itself from any suspended matter with which it may then be impregnated; this matter may be precipitated to the sheet or pass towards the front end of the boiler as scum, but in many cases it is found that the staybolts supporting the crown have become coated with this sediment, from the given line of the working level of water, down to and on the crown sheet, and, seeing that the crown sheet is the most important part of every locomotive boiler, too much care cannot be taken to seeing that the crown sheet and all the staybolts supporting the same, are kept clean from scale and sediment. We also find considerable sediment at the tubes and sides of barrel of boiler, at the point of entrance of feed water from top checks, also along the bottom and sides of barrel to throat sheet, and side water legs, to which it is carried and deposited, due to the circulation of the water, and will be found heavy at the bottom of barrel, also at lowest points in waterlegs, and near blow off cock, also in locomotives which are fitted with arch tubes, it will, in many cases, be found that the circulation, through these tubes, which is from throat sheet water leg to a high point of the door sheet, will carry and deposit scale and sediment on to the top of the firehole sleeve, there to be held by the staybolts, and to accumulate, until the firehole seam becomes overheated at the top, and sprung, due to what is rightly termed mud burn. This seam then leaks badly, and is often chipped and caulked by boilermakers, without having the cause of same removed, therefore great care should be taken by those in charge of washing out, to see that no sediment is allowed to remain on top of the firehole sleeve to cause trouble, also a large amount of scale and sediment is usually found at the bottom of door sheet water legs and at back ends of side water legs, where the water is more liable to be quiet, and favorable to the settlement of scale. We also find the tubes become heavily coated with scale close to the firebox tube sheet. This is undoubtedly due to the rapid evaporation of the water at this point, and the close formation of the nest of tubes being very favorable to receive the impurities deposited from the water. This adheres strongly to the tubes, generally, as hard scale. Also we must watch carefully along the side water spaces at the upper portion of the ogee, at at this point the staybolts are irregular, and the water space becomes decidedly narrower, and any large pieces of scale thrown over from the crown or broken off the high part of sides, may become lodged on these bolts and collect sediment quickly, until there is a solid blockage between the sheets which will cause serious trouble; however, in mentioning these several points to be carefully watched in locomotive boilers, it does not mean that other parts of the boiler do not become subject to the formation of scale and

sediment, but is to show that all available parts of a locomotive boiler should be thoroughly searched with a suitable light after having been washed out, to ascertain that the work has been properly done, and no scale or sediment is left in the boiler which can be removed. Also taking into consideration the disposition of washout holes and means of access to the interior of the boiler for the purpose of washing out, we find it advisable to have several holes on each side of saddle sheet, to wash down the sediment from off the crown sheet also to turn the water down onto the high part of side water legs, and to break up and remove any scale which may have become lodged amongst the bolts at these high parts, also several holes are required in back head to enable streams of water, and use of cleansing rods in various directions along crown sheet, also to wash down the back water space. Also several washout holes are required in side water legs, and at bottom of each corner. With simple engines there are holes wanted in bottom of front end tube sheet, to enable bottom of barrel being cleaned out, whereas, with the crossover or two cylinder compound locomotives, we find that washout holes in bottom of front end tube sheet cannot well be used to advantage, therefore it is necessary to have washout holes in the bottom of the barrel, there being usually two on each side of the boiler at points where they can be used to the best advantage, and do the best service. These holes are also finding favor, and are being put into boilers of simple engines. In washing a locomotive boiler it is advisable to first allow the steam pressure to blow off by blow-off lines from the engine, through car-heating steam hose to overhead pipes, which pipes are run from each pit in the engine house, to hot water well, where it acts as a heater to the water in the well at that time. This process is to be followed until the pressure in the boiler is reduced to about 10 lbs. gauge pressure, when hose connections from the blow-off cock of boiler to the blow-off pipes in pit can be made, and the hot water allowed to run from the boiler, and into the hot well or settling basin, until the boiler is quite empty, at which time all plugs may be removed from washout holes, and boiler be allowed to cool until a person can barely hold his hand upon the plates of same, or to about 160 degrees, at which time the boiler will be in a condition to be washed out with the water taken from the hot well for washout purposes, which well is kept at a lower temperature than the feed water well; but if this water is too hot for handling by men washing out the boilers, it may be tempered with cold water, by opening the cold water valve to pump, and combining the cold and hot water as required, directly before entering the pump, or the cold water may be turned on directly into the hot water well, until brought to the temperature required,

about 130 degrees, for washout purposes, and be pumped from there direct to those washing out the boilers.

In this matter of cooling and washing there is little possibility of the so-called baking process, of turning settling sediment from the water, into scale on sheets, when blowing off the water and preparing for washing out; also by washing out with hot water, the plates of the boiler are kept heated, and are thereby in a good condition to receive the hot feed water. This feed water is clean water which has overflowed from the washout hot well, which is, in turn, water that has passed through the settling basin, and over into the hot well for washout purposes, thus ensuring clean water for refilling boilers. But when washing the boilers it is necessary to start at the wash out holes on either side of the saddle sheet, and to clean everything possible in the form of scale and sediment from the crown sheet of firebox. by cleaning rods, and water from washout hose and nozzles, through these side holes, thereby throwing the loose sediment down into the water legs, from whence it can be easily removed, and from these holes the crooked nozzle should be turned down on to the bolts at top of side water spaces, to be sure of this being well cleaned of any loose sediment. Also the water can be thrown over on to the tubes to wash the same, from the front holes in saddle sheet. Next is to get into the cab, to wash and clean crown sheet from the holes in back head sheet, and to turn the water from the crooked nozzle down into the back water-leg, to clean the bolts and sheets of any loose sediment. Next is to go to the front end of barrel, and to barrel holes under the barrel, and by the proper use of long barrel cleaning rods, and short, and long and crooked nozzles, with a continued good pressure of water from same, say 100 to 150 lbs. pressure, to properly clean the barrel of all mud and scale, and sending same down into the water legs of boiler, Here at the water leg holes, the sediment should be broken up and cleaned out from the boiler as much as possible with long, short, and bent cleaning rods furnished for this purpose, and then the water to be turned on from the highest holes in water legs first, and bolts, etc., washed in all directions, and from these high holes to gradually work downward at each hole until the lowest point of the boiler has been washed clean, being sure to keep the low holes clear at all times when washing out, to allow the soft mud and sediment to freely escape with the water. At this point it is necessary that the leading boilermaker should examine the inside of the boiler, wherever accessible, with a long search-light to see that no sediment or scale is allowed to remain lodged inside, and to ensure the boiler being properly cleaned before refilling, because any neglect on the part of the washer-out is likely to cause more work for the boilermaker and more

expense for the company, therefore it would be expected that the boilermaker would see that the boilers are kept clean. After placing all plugs in washout holes in a proper manner, we will go back to the feed water hot well, and find the water, which is kept from 170 to 200 degrees in the well, is fed by gravity to a feed pump, and from here is forced through a superheater and through refilling lines to the boiler. This superheater is heated by exhaust steam from stationary engines, air compressors and pumps and in turn exhausts into the hot well, thereby delivering the water to the boiler at such a temperature as to enable steam to be got up from same in very short notice and the boiler is not allowed to get cold.

The process of washing out locomotive boilers as stated in this reading, will take about 90 minutes to blow off and take out plugs, and about four hours on an average from engine arriving on washout pit, to be washed out, refilled and made ready to be fired up for service.

Chairman,—

You have all heard the very able and interesting paper given by Mr. Jackson, and right at this point I would like to extend to Mr. Jackson a very hearty vote of thanks on behalf of the Club, as he may have to leave us right in the middle of a discussion.

Moved by Mr. Fletcher, and seconded by Mr. Burrows. Carried.

Chairman,—

On behalf of the Club, Mr. Jackson, I wish to thank you for coming from Montreal and giving us this very able paper. I am sure that you have given it a lot of thought and I hope we will have a good discussion on it.

Mr. Wickens,—

Mr. Chairman, you know that the washing out of locomotive boilers is not exactly in my line. I believe the paper is an excellent one and that the writer understands fully and thoroughly the principles of the case and the reasons boilers should be washed out. I know from the paper that Mr. Jackson knows how to wash out a boiler. I think if the average man washing out boilers would carry out the suggestions given in this paper, he will have no trouble. However, the paper, as it occurred to me, looks very much like a gilt edge wash. You understand the washing out of stationary boilers is not the same as the washing out of locomotive boilers. While no doubt the locomotive boiler can be washed out just like the paper shows, there is no doubt about it that if the stationary engineer proceeded to do it with his boilers, he would find considerable difficulty, due, in the first place, to

the fact that his boilers are covered up with brick work, and it is impossible to get them cooled off rapidly. It takes some time to get them cooled off properly. Then again when they are cooled off there is no good hot water and a splendid tank with all the sediment evaporated out of it as in locomotive work. In average practice when there are two boilers on the job, there is only an inch or an inch and a half hose to wash them out with. Of course there are not as many bad corners and not as much trouble to get at the different parts of a horizontal return tubular boiler as with a locomotive boiler. The washing out of a boiler under conditions of an average engineer not in railroad service, is a very different proposition from that experienced in railroad work.

There is one thing I notice lately in reading and studying this matter, that is, the railroads are taking more care now in looking after their boilers. They have learned that the locomotive boiler in order to evaporate water as it should do, must leave considerable sediment in the boiler after a long run. We all understand that scale is a bad conductor of heat, therefore it is necessary to get the scale out.

I may say right along that particular line, that a locomotive boiler at and about the fire box and over the first four feet of the tubes, evaporates seven and a half times as much water as the rest does, therefore we have to look for more scale there. Further, the scale is in the most dangerous place because it is where the most violent heat is.

A short time ago there were some experiments run in the Old Country on the line of forcing boilers. The gentlemen who ran the experiments used gas for fuel so that they could measure the heat units properly. They made a boiler specially for these experimental purposes. With the boiler clean they forced it to seventeen times its rated capacity. They did this for days and days. They took the temperature of the sheets on the fire side and on the water side, and they found that at the time when they were forcing the boiler at the greatest, there were only 69 degrees difference between the temperature on the water side and the fire side, showing that the water took up the heat from the metal as rapidly as the fire was forcing it, which therefore shows that the most rapid and incessant fire could not injure the sheet. They next painted the inner part of this boiler with a thin scum of oil and then ran a similar test. The difference between the temperature of the sheet on the fire side and on the water side was 296 degrees, showing that when they had this film of oil, the conductivity of the sheet was reduced 11%. They also went on and put heavier oil in this boiler, using paraffin, until the difference in temperature was 700 degrees when the paraffin was 1-32″ thick. So it goes to show, as far as oil is concerned,

that it is a detriment in a boiler. We meet with oil troubles all over this land, and meet with them bad. I might also add that these same gentlemen who conducted the experiments, also put in material which would form a scale rapidly, and they found it took 13% more heat to evaporate the water than when the sheet was clean.

These experiments were run under the management of the Manchester Steam Users Boiler Insurance Co., of England. They spent £7,000 on same. They further went on and exploded the boiler. I state these facts more to show you that these experiments were conducted by eminent engineers.

I think, in as far as the boilers are concerned, the paper is splendid, well got up and well thought out. I would like some gentleman who has a boiler away out in the backwoods where water is very hard and where they do not have many appliances for washing out boilers, to tell how he would wash out his boiler.

I think the paper is a very good one and will be very useful to this Club.

Mr. Taylor,—

I would like to hear all the remarks possible on this subject. Also, like Mr. Wickens, I would like to hear how you would wash out a boiler away back in the backwoods where there are no appliances for so doing. I think the trouble throughout the city is in the fact that they have not enough boilers. They just have one boiler throughout the week and it runs until Sunday, when they shut it down and try to clean it out with a 1½ inch hose. The first thing they know they have something wrong which they did not expect. Consequently they call upon a boiler maker to fix it up. That is the kind of business I am looking for. The man who is cleaning and handling boilers every week can tell us more than I can, and it is my desire to sit down and listen.

Chairman,—

While Mr. Burrows does not take care of boilers, yet I know he is a man who is posted on almost any subject, and I therefore would like to hear from him.

Mr. Acton Burrows,—

I think I will take the Chairman at his word, and make it only a word. He must be Irish as he always starts out with blarney when he wants anything. Perhaps I may take a little credit for this paper given us to-night. I suggested to Mr. Worth last spring to ask Mr. Jackson to give us such a paper. I was sure that you would all consider it a valuable paper to have and we are deeply indebted to Mr. Jackson for

giving it to us. I am sure I would only get into deep water if I said anything further.

Mr. Duguid,—

One must not imagine because I am connected with locomotive work that I know everything about the washing out of boilers. However, Mr. Wickens has said that he would like to know how they washed out boilers in the backwoods or in isolated places. From my experience with boilers I consider it is harder to clean a locomotive boiler with all appliances than a stationary boiler with no appliances. In the first place while the stationary boiler is covered in, you have a man hole on top and the hand holes in the bottom of the boiler and you can clean the tubes with scrapers. You have no staybolts to interfere with the cleaning out either as in locomotive boilers. In my opinion the cleaning out of a stationary boiler is an easy matter because you have every opportunity to thoroughly clean it, therefore in stationary boilers you have no reason to have scale, etc. Further in stationary boilers the tubes are set one above the other. Sometimes it is a little difficult to get the scale out from between the rows, but in my estimation it is a much easier matter to clean such boilers than a locomotive boiler. I have had considerable experience in the cleaning out of stationary boilers too.

Mr. Wickens states that he finds a good many dirty stationary boilers, but as my friend over here stated, the engineer goes down on a Sunday morning to wash out and he really does not get a chance to give his boiler sufficient care in way of keeping it clean.

There is really no such thing as washing out a boiler after it has become scaled. It is simply a matter of scaling the boiler, and if the boiler becomes scaled on account of the water, 300 pounds pressure will not clean it out. It is nearly impossible to wash it out in that case. It is also impossible to clean it out with rods. You can do a certain amount of cleaning over the crown sheet with a bar since they have done away with the old crown bars. Mr. Jackson is quite aware that very little can be done in regard to knocking the scale loose. However, the matter of keeping the boiler free from scale is an important question, and what washing out is intended to prevent as a boiler of 100 horse power will use about 33,000 pounds of water in ten hours or about 930 tons in one month, and with the purest kind of water they will find about 98 pounds of sediment in that water, or about 2,000 pounds in bad water, therefore you will realize the amount of material which will accumulate in a boiler. At the last meeting of the Master Mechanics' Association, it was reck-

oned that the loss of efficiency in locomotive boilers was $750.00 per boiler per year. 1-16 inch scale reduces the efficiency of a boiler 15%, ⅛ inch, 30%. There is no doubt that what causes the low efficiency of a dirty boiler, is that the fire box scale will not conduct the heat to the water and in my opinion there is no doubt that that has a great deal to do with the breaking of staybolts on account of the enormous expansion which takes place in the fire box on account of the scale on the water side. They say that the greatest deposit of scale is found in the barrel of the boiler near the top checks and that a large amount of sediment leaves the water as soon as it enters the boiler. As you know the water on entering the boiler circulates along the bottom of barrel and then along the side water legs across the crown sheet and then to the front of the boiler. Now there is no doubt the first deposit is after it makes the first circulation. Just as long as the circulation keeps up, the deposits will be in the barrel of the boiler and not where the greatest evaporation is. There will be no deposits from water unless it is very bad until it is some time in use or until the water becomes thoroughly saturated with sediment and is unable to carry it along. We have no deposits of scale in our inspirator pipes. What causes them to clog up is the leaky top checks. The reason we find deposits around the mud ring is because the sediment in the water after making the circulation, is washed back around the barrel of the boiler and on to the mud ring.

Regarding boiler cleaners, every little while some person comes around with some boiler cleanser. I know an agent who was working down in the Eastern province with a boiler cleanser. He had occasion to go to a boiler user. He said he had a cleanser which would keep his boiler clean. They said they had no occasion to use such a cleanser as the water was so good, and their trouble was the tubes were too clean. The agent could do nothing there and he went away, but next morning he came back and said he had forgotten to tell them about an article which would put just the right amount of scale on the boiler tubes, and therefore they would get the desired results from their boilers.

The mechanical skimmer gives very good results. While the ingredients are held in suspension on top of the water, there is no question in my mind but that a great amount of impurities can be removed then. However this method is not considered a success. It seems to me that a good class of skimmers for locomotive boilers would save 20% in boiler efficiency. After this sediment is liberated from the water by the heat there is a great amount of it which could be removed. My locomotive experience has not been connected directly with the washing out of boilers.

Mr. Woodward,—

I am surprised that they should call upon me. In taking out a set of flues, in my experience, I have always found a great amount of mud in the barrel of the boiler near front flue sheet where the top check feeds the boiler. I think as the water goes through the discharge pipe, as Mr. Duguid said, the mud and dirt dries and drops on the top of the tubes.

Chairman,—

I am sure that many of those who have been in the business for a number of years, when they read about a boiler explosion, wonder, like myself, how it is that there are not a great many more. In the first place I would like any gentleman here to tell me how you are going to get scale off the centre nest of tubes whether in stationary or any other kind of boilers. The only way to get the scale from these tubes, in my opinion, is to take the tubes out. After all, the question is, does it not pay to do that in preference to using this and that stuff, after you have taken a reasonable amount of care of your boilers? I think it has been estimated that you can take the tubes out, clean and repair them and put them back again for $1.00 apiece. Just as Mr. Wickens says, the boilers have to be cooled off and the engineer goes down Sunday and washes out. He can only do a make-shift job of it. The question often comes to me, does it not pay to periodically take the tubes out and clean them. This paper is a good one and the gentleman who gave it knows what he is talking about. I would like to ask, does not the Grand Trunk Railway, as many others do, at some seasons of the year when crowded for power, run their locomotives longer than the mileage allowance between washings?

Mr. Jackson,—

The rule is that boilers must be washed out every 1,000 miles, and that at a crowded time you are only allowed to run one more trip over the 1,000 miles before washing out.

Chairman,—

In my time they did not leave freight standing in the yard if there was anything to pull it.

In cleaning the legs down in the fire box can you always get the mud out. Can you always keep the boilers clean? After they have been running a certain amount of time they have got to have the stay bolts removed and it is only a question of time when you have to come back to them anyway. The whole question is, do we do the best we can under the circumstances? For instance if we have a first class, up-to-date plant in the city, where we can buy modern appliances. Mr.

Wickens or some other Boiler Inspector comes and examines the boilers and says we are doing all right and the plant is in good shape. To-morrow the inspector goes to a plant 150 miles from nowhere, the man in charge there has not got any appliances; how can we help him? That engineer goes to his employer and says he wants certain things in order to run his boilers properly, but the employer says he must do with what he has. Now how are we going to help that man? I read some years ago in a paper, that in Detroit at a steam boiler specialty works, where they made nothing but boiler safety and feed appliances and they had their boilers regularly inspected, etc., that a boiler blew up there, killing fourteen people. The ordinary citizen picks up his paper and on reading of a boiler explosion, thinks the boiler or the engineer is no good. In my mind I am only surprised that there are not more boiler explosions.

Mr. Taylor,—

From the mechanical standpoint I would like to say a few words. Mr. Duguid states that the mud collecting around the staybolts causes some of them to break. In my opinion there are a number of broken staybolts due to improper manufacture. Then again a man will drive one staybolt longer than another. The upsetting of the staybolt is twice as much as the other, the result is that the one hammered the most breaks first and probably takes others with it. Further, if they are hammered too much they become crystallized on the end and they are half broken before leaving the works. I think a great deal of the trouble with broken staybolts is due to excessive driving. I would like to ask Mr. Jackson what percentage of broken staybolts he can detect upon examination.

Mr. Jackson,—

In the boilers that are running to-day there is not so much of the hammer test used. Every staybolt that is put in the boiler nowadays has a tell-tale hole in it which runs into the centre of the bolt 1¼ inch or more. When the bolt breaks a fine jet of water comes out through that hole. In fact if any water whatever shows through any of these holes we must take the bolt out and renew same.

Chairman,—

Then according to that the staybolts may be partially broken around the firebox without knowing it.

Mr. Jackson,—

You could not tell by the hammer test as you could not be sure of it.

Chairman,—

I remember years ago when I was railroading and when they were using the radial stayed boilers a great deal, the Pennsylvania Railroad, which is considered one of the best roads in America for keeping up the standard of efficiency in all departments, had some boiler explosions, and they came to the conclusion after many tests, that the average boiler inspector could not tell whether the staybolts were broken or not. They prepared one or more boilers and invited a number of foreman boilermakers and boiler experts from the different railroads to attend a test they were running. Each man had the privilege of going over that boiler and picking out the staybolts he considered broken. After each man went over the boiler he would seal up his report and send it to a committee appointed to decide on the results of the test. Of all the men that attended that test, and there were some twenty or more, not one of them was right, as on tearing the boiler to pieces they discovered many more bolts broken than any had reported. I think that was one cause for the general introduction of the hollow staybolts. This all goes to show you how hard it is to tell such things with certainty.

Mr. Duguid says it is an easy matter to get into stationary boilers. It is a pretty hard matter to thoroughly examine them in many of the cases I have found. It is also a hard matter to examine a locomotive boiler thoroughly. In the plant I am connected with we have boilers that run twenty-four hours a day, and make three weeks run between washings. I do not have the boiler washers inspect them, but have a boiler maker inspector do so, but supposing there was a boiler explosion to-night, perhaps, they would say it is due to carelessness. It is a pretty hard proposition to tell with absolute certainty whether everything in that boiler is all right.

Mr. Jackson,—

While on this bolt question I wish to state that the bolts in the fire box would not have to be renewed to be sure that they were clean. When these boilers come to the shop and I may say here that they come about every 75,000 miles of service the tubes are taken out to make sure that they are cleaned. When the tubes are out of the boiler you can get access to all parts of it. Some of the staybolts would take a man an hour to clean properly, and we find by taking a large holding on hammer on the outside with a hook attachment, and a long stroke pneumatic hammer and flat snap on the inside, the jarring of that snap on the bolts will loosen any scale on them and leave you a clean thread on the bolts inside the water space. It also has a tendency of tightening up all the bolts and making sure that they are clean before sending the boiler out again.

The man who is working that holding on hammer can tell whether a staybolt is broken or not by the rebound. Besides that, after all the staybolts are hammered up, the assistant foreman goes through the boiler with a search light and takes out any that look defective. As a rule we take out some bolts around those which are broken, therefore this accounts oftentimes for so many bolts being taken out as broken.

Mr. Wickens spoke about the action of oil in boilers. We find, as in stationary boilers, when oil gets into the boiler and gets mixed up with the scale, it will hold on to the sheets and bolts and nothing will take it off except the use of chisel rods.

In connection with Mr. Duguid's idea about the scale not forming in the proximity of the top check of the boiler. Right here in Toronto I had occasion to retube a boiler, and had a couple of tube holes tapped out for wash out plugs so that men could have access to the boiler. At this point about three months later I had occasion to go into that same plant and saw these plugs taken out while washing out the boilers. While it was only three months from the time the boiler was retubed, yet it was here heavily scaled with dirt and mud.

Concerning boiler compounds, I was asked one time by our Superintendent if we had a boiler on which a certain boiler compound could be tested out carefully. I recommended a certain place where this test could be made and the compound gentleman was sent there and allowed to run his own test. At the end of ten days they took out eight flues at the bottom of the boiler and with the rod and washing out process they took out considerable sediment. They put new tubes back again and gave the compound a further test, and at the end of about three weeks we took out twenty-three tubes and still found heavy scale. The only difference in the scale was that it appeared to be a little softer. We had to retube the boiler just the same to clean it.

Mr. Wickens,—

This cleaning of boilers and keeping them clean gets pretty near to where I live. During the last year I made pretty nearly 6,000 reports on boilers I have inspected. Of course these 6,000 were not all different boilers, but probably 2,000 were. There is not much new in the way of boiler compounds and appliances for fighting scale that we do not have to get up against. In some localities it is an easy matter to remove scale in the boilers, but in other places it is nearly impossible to remove. In all cases where scale is hard to remove you have to take drastic measures to remove it, and in that case the man who buys a boiler compound that succeeds in removing the scale, says it makes the tubes leak. That is because the

tube ends were damaged by the fire and the scale made them tight. Concerning Mr. Duguid's idea about the skimmer, I think that is a most excellent idea. While magnesia is floating around, it is carrying some of the carbonates with it, and there is no reason why you cannot get rid of 20% of the scale which will form in the boiler by the use of the skimming process.

Chairman,—

We have gone into this matter pretty full and believe some other gentleman may have some other ideas along these lines which we shall be glad to hear.

Mr. Duguid,—

I think Mr. Wickens and Mr. Jackson got mixed up on what I said. Perhaps it was due to my inability to make a speech and I got mixed. I claim that scale is not formed at the time the feed water enters the boiler, but not until after it makes a circulation of the boiler. The scale is not deposited until after all the water makes that circulation. There is not heat enough in the water until after it has crossed the crown sheet and made a complete circulation. After it has has made that circulation it goes to the lowest part of the boiler near the front and drops the scale. I am of the opinion that the water must be almost the same temperature as steam before it will deposit scale.

Mr. Woodward,—

I noticed a remark made about staybolts. I do not think there is anything more important about a boiler than the staybolts. Years ago I have seen from two to three hundred bolts broken in an engine and have seen the plates bulged out three and four inches. However, that does not exist to-day, but in those days the man who had a good ear for music was the best inspector. In those days it was hard to tell whether a bolt was broken, and I might say that that difficulty is now overcome by the tell-tale holes in the bolts.

Chairman,—

That carries me back a number of years. My father is present to-night and will remember. He had a man who stood two or three feet away and he always told broken staybolts by the sound, or thought he could.

I was at an investigation to-day where a man was being held responsible for a thing which happened, in my judgment, he had no control over. The thought occurred to me that I am responsible for the boilers in the plant I am connected with. Although we have them washed out regularly and have

the boiler inspectors examine them regularly, and we do all we can do with the appliances we have, yet I have no absolute certainty that the boilers are all right and will not explode.

Mr. Duguid,—

I do not agree with you, Mr. Chairman. If the boilers are regularly washed out and a boiler inspector goes over them, I think you are safe from a boiler explosion.

Chairman,—

There is no guarantee, however, that there will be no explosion.

Mr. Duguid,—

I think where every boiler explosion has occurred you can trace it to some cause. With proper cleaning and proper looking after I think you have every assurance that your boiler will not explode.

Chairman,—

What I meant to say is that you have no certainty or guarantee that the material in that boiler is what it should be. I think Mr. Taylor can tell us about a brand new boiler built right here in Toronto and which stood the test and received the government inspector's certificate, and then let go right in the boiler shop under moderate hydrostatic pressure.

Mr. Taylor,—

The boiler burst in the strongest part. It did not burst at a joint but on a plate which was tested to 60,000 pounds and it burst right through that solid plate. It had been tested and stamped by the Canadian Steam Boat Boiler Inspector. There are a lot of petty explosions occurring continually, due to poor workmanship. As Mr. Jefferis says, I do not think there is any assurance that a boiler will not explode.

Chairman,—

A number of years ago Mr. Main, now manager of the Polson Iron Works, was delivering an address at an Engineers' Club here in Toronto, and he said in his remarks, "How did we know whether we were safe at that time as we did not know the condition of the boilers in that hotel." Not two weeks from that day one of the biggest concerns in Toronto had their boiler sent down to Polson's Iron Works with a wooden plug in it.

Mr. Taylor,—

Often times we are called upon to repair a boiler. We advise a new one but the proprietor will not stand for it as he says he will be satisfied if we will fix it up so that it will last

out the winter. We patch it up the best we can, yet there is surely an uncertainty in that case.

Mr. Bly,—

I have listened to the discussion very attentively, although I did not get here in time to hear the paper. Sometime ago I was operating a plant. I was only there a short time and after looking around I went to the proprietor and told him the boiler was leaking and we had better get it retubed. He said it must run until the holidays were over. I said it was taking a great chance, but he replied that there was no use in telling him about chances as it had to run two or three months longer until the rush was over. After the holidays we took the tubes out of that boiler. Some were broken and some were so thin that they would not stand the touch of a hammer. I think that is one reason why stationary engineers should require a government certificate. The proprietor of that establishment said as much to me that if I did not wish to run the boilers in their defective condition he would get someone who would. The consequence was I had to take the chances of running those boilers or losing my position. In this same plant the proprietor came to me and said that the factory inspector was around and wanted a boiler inspection report made out. He asked me to make it out, but finally said, "By the way I will have my stenographer make it out and you can sign it." I think there are a great many reports made out in that way.

Last year there was an explosion at Earlscourt, and I understand the pressure of that boiler was 15 pounds. One piece was found about 600 or 700 yards from where it was originally located and another piece about 200 yards. The tubes in that boiler looked as though some one had been splitting rails. I found that it had been torn right across the stop valve hole and through the plate. We found the steam guage. The end of the spring had apparently gone up against the side of the gauge and the other end was broken off. I believe the stop valve was never found.

I have found in stationary boiler work that the blowing down of the boiler in the morning is a great factor in keeping it clean. During the night the sediment has dropped down to the bottom of the boiler, and when in this position you can blow considerable sediment off. I have found this method very effective.

Mr. Jackson,—

Gentlemen, as I must leave you now, I take this opportunity to thank you for the hearty vote of thanks tendered me.

I would like to say in reference to what Mr. Bly was speaking

about, that the Grand Trunk Railway in Toronto do not leave it to their stationary engineers to make an inspection of their boilers. I examine the boilers and make out the reports, and the engineer as well as myself signs them.

Mr. Bird,—

I would like to ask Mr. Wickens whether he has any faith in boiler compounds.

Mr. Wickens,—

The base of all compounds is soda. Some people make compounds by adding maganese or using a coloring with it. A man will do just as well with a very strong soda or go a little further and get soda ash, or if you wish, get tri-sodium phosphate, which is the strongest solution. I know of cases where a few pounds of concentrated lye will break up scale in a boiler. No man can say that any one compound will suit all waters. All waters carry a certain amount of solid matter with them and in some cases often make scale which is nearly impossible to remove. As Mr. Duguid says, if you wash the boilers out often enough you will get very little scale.

While I am talking I would like to say one word about that explosion of which Mr. Bly spoke. I found the safety valve myself and it could not be moved at 7,000 pounds' pressure. The pin in it was stuck so fast that it took five blows of a chipping hammer to move it. I have visited many explosions and can always find a good reason why the boiler really exploded; however, I do not think any explosion is an accident. I have further to say that it is possible to miss something in a boiler inspection, but it is a rare case. There are many cases where boiler inspections have prevented explosions, by having the boiler repaired before it got dangerous.

Mr. Lewkowiez,—

I would like to throw a little light on the matter of feed water in boilers. I was connected with a feed water concern at one time. They used to run the feed water into a settling drum in the boiler and it proved a very efficient way of extracting a lot of soft mud or solid matter that might be in the water. Apparently the water does not need to travel very far before it will deposit the mud or scale in the boiler.

I think the engineers in Toronto should take up the matter of having proper boiler inspection. I do not mean inspection by a casualty company, but municipal inspection. I think such an inspection would be beneficial both to themselves and to the public at large.

Mr. Duguid,—

I would like to know if it is possible to take the impurities

out of the water so easily why they are not taken out before letting them into the boiler?

Chairman,—

You simply cannot do it. You can theorize and read about it but you simply cannot do it in actual practice. If you could do this, companies would not be spending hundreds of dollars in repairs and Mr. Taylor would not have a position. My theory is that the people who want to get the scale out of their boilers by compounds will have trouble with their stay-bolts, piston rods and packings. It is really cheaper to regularly wash out and periodically take the tubes out and clean them.

We are going to have a paper for October meeting by Mr. Shales of the Elevator Specialty Co., on the "Care and Maintenance of Elevators." I would like to have as many present at that meeting as possible.

Proposed by Mr. Herriot, seconded by Mr. Logan, that the meeting adjourn. Carried.