CANADA
DEPARTMENT OF MINES
MINES BRANCH
HON. W. TEMPLEMAN, MINISTER; A. P. LOW, LL.D., DEPUTY MINISTER;
EUGENE HAANEL, PH.D., DIRECTOR.

AN

INVESTIGATION

OF THE

COALS OF CANADA

WITH REFERENCE TO THEIR ECONOMIC QUALITIES:

AS CONDUCTED AT McGILL UNIVERSITY, MONTREAL, UNDER THE AUTHORITY OF THE DOMINION GOVERNMENT

IN SIX VOLUMES

BY
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VOL. IV

OTTAWA
GOVERNMENT PRINTING BUREAU
1912

No. 83

THE
COALS OF CANADA:
AN ECONOMIC INVESTIGATION

VOL. IV

APPENDIX II

DETAILED RESULTS

OF THE

BOILER TRIALS

BY

R. J. DURLEY

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[1] This list contains only the samples which were included in the boiler trials. A complete list of all samples taken is given in Vol. I, p. 8, and Vol. II, p. 181.

DETAILED RESULTS
OF
BOILER TRIALS
BY
R. J. DURLEY.

INTRODUCTORY.

In the autumn of 1906, the Canadian Government, through Dr. A. P. Low, Director of the Geological Survey, decided to undertake a study of the fuels of the Dominion, somewhat on the lines of the fuel tests which had already been commenced by the United States Geological Survey. But inasmuch as the Government had not, at Ottawa, any suitable mechanical laboratories, and as research work had already been done by the Mining Department of McGill University on a number of western coals, Dr. Low invited Dr. Porter, the head of that department, to undertake the larger investigation. This proposal was approved by the University governors, and Dr. Porter was authorized to carry out the tests in the University laboratories, without charge; on the understanding that the Government would pay for such apparatus as might be required to supplement the existing equipment, and to make good all additions to the salaries, wages, and supplies accounts, rendered necessary by the investigation. At the request of Dr. Low, also, the Intercolonial, and Canadian Pacific railways, very generously agreed to haul the material—amounting to many hundreds of tons—free of charge.

Shortly after the commencement of the investigation the Dominion Department of Mines was created, under the Hon. William Templeman, as Minister of Mines, and Dr. A. P. Low, as Deputy Minister; and the investigation, together with all matters relating to economic minerals, was transferred from the Geological Survey to the Mines Branch, under the Directorship of Dr. Eugene Haanel. The original arrangement was, however, in all other respects, continued without change.

From the beginning it was intended to confine the investigation to the coals and lignites of the Dominion; and the following points were covered by the scheme:—

Sec. I.—General organization and administration.
II.—Preparation of a general summary report on Canada's coal fields and coal mines.
III.—Sampling in the field.
IV.—Crushing the samples and preparing them for treatment.
V.—Washing, and mechanical purification.
VI.—Coking trials.
VII.—Steam boiler trials.
VIII.—Producer, and gas engine trials.
IX.—Chemical laboratory work, and miscellaneous investigations.

TECHNICAL STAFF.

The technical staff engaged in the investigation comprised:—

(1). J. B. Porter, E.M., Ph. D.,D.Sc., Professor of Mining Engineering, McGill University—Responsible for the organization and general direction of the investigation, and directly in charge of Sections I, IV, and V, and VI (in part).

(2). R. J. Durley, B.Sc., Ma.E., Professor of Mechanical Engineering, McGill University—In charge of Sections VII and VIII.

(3). Théo. C. Denis, B.Sc., Mines Branch, Department of Mines, Ottawa—In charge of Sections II and III (in part).

(4). Edgar Stansfield, M.Sc., Chief Chemist—In charge of Section IX, and Sections III and VI (in part).

(5). H. F. Strangways, M.Sc., Dawson Fellow in Mining, McGill University—Assistant in Sections IV and V, 1907.

(6). H. G. Carmichael, M.Sc., Dawson Fellow in Mining, McGill University—Assistant in Sections IV and V, 1908.

(7). E. B. Rider, B.Sc., Demonstrator in Mining, McGill University —Assistant in Sections IV and V, 1909–10.

(8). Chas. Landry, Chief Mechanic of Mining Department, McGill University—Foreman in Sections IV and V.

(9). J. W. Hayward, M.Sc., Assistant Professor of Mechanical Engineering, McGill University—Assistant in charge of Section VII, 1907, and preliminary work in Section VIII.

(10). J. Blizard, B.Sc., Lecturer on Mechanical Engineering, McGill University—Assistant in charge of Section VII, 1908, and Assistant in Section VIII.

(11). D. W. Munn, M.A., B.Sc., Demonstrator in Mechanical Engineering, McGill University—Assistant in Sections VII and VIII.

(12). G. L. Guillet, M.Sc., Demonstrator in Mechanical Engineering, McGill University—Assistant in Section VII.

(13). G. Killam, M.A., B.Sc., Demonstrator in Mechanical Engineering, McGill University—Assistant in Section VIII.

(14). J. S. Cameron, B.Sc., Demonstrator in Mechanical Engineering, McGill University—Assistant in Section VIII.

(15). A. Balmfirth, Superintendent of McGill University Power House—Foreman in Section VII.

(16). J. Gardner, Foreman in Section VIII.

(17). J. Hoult, Fireman in all tests of Section VII.

(18). J. H. H. Nicolls, B.Sc., Assistant Chemist—Assistant in Section IX, 1908, 1909.

(19). R. T. Mohan, B.Sc., Assistant Chemist—Assistant in Section IX, 1908.

(20). P. H. Elliott, M.Sc., Assistant Chemist—Assistant in Section IX, 1908.

(21). E. J. Conway, B.Sc., Assistant Chemist—Assistant in Section IX, 1908.

(22). W. B. Campbell, Assistant Chemist—Assistant in Section IX, 1909.

(23). R. S. Boehner, M.Sc., Demonstrator in Chemistry, McGill University—Assistant in Section IX, 1908, 1909.

(24). H. Hartley, B.Sc., Assistant Chemist—Assistant in Section IX, 1909.

(25). W. B. Meldrum, B.Sc., of the Department of Chemistry, McGill University—Assistant in Section VI, 1909.

(26). H. H. Gray, B.Sc., Demonstrator in Metallurgy, McGill University—Assistant in Section VI, 1909.

(27). H. G. Morrison, B.Sc., Assistant Chemist—Assistant in Section IX, 1909, 1910.

There were also a number of machinists, mechanics, and labourers engaged more or less continuously in the several sections.

In addition to the persons above named, the following members of the University Staff very materially aided in the progress of the work by giving occasional assistance and advice:—

Alfred Stansfield, D.Sc., Professor of Metallurgy.

H. T. Barnes, D.Sc., Professor of Physics.

Acknowledgment is also due to the Governors of McGill University, and to W. Peterson, C.M.G., Principal; F. D. Adams, F.R.S., Dean; W. Vaughan, Esq., Secretary; S. R. Burrell, Esq., Chief Accountant, and many others.

LABORATORIES.

The laboratories of the Mining and Mechanical Departments of McGill University, in which the tests were made, were built and equipped some few years ago on a scale unequalled at the time in North America, the buildings and apparatus for the Ore Dressing Department alone costing over $150,000, and the Steam Laboratory an almost equal sum. This equipment needed very little augmentation in respect of sampling, crushing, coal washing, steam boiler tests, and chemical analysis; although a number of minor pieces of apparatus had to be purchased, such as extra calorimeters, pyrometers, thermometers, etc., etc.

In the matter of producer and gas engine tests, larger expenditure was necessary, as the University equipment was on too small a scale for the extensive tests contemplated. An addition 25×70 was, therefore, built to the Ore Dressing Laboratory, and equipped with a complete plant of the most modern type, the cost for building and plant being approximately $12,000. A detailed description of this plant, with cuts of the apparatus, etc., will be found in Vol. II, in Part VIII of the report, and similar descriptions of the apparatus used in the other parts of the investigation will be found in the other parts.

THE INVESTIGATION

Sampling in the Field.

Sixty-three separate mines or seams were specially sampled for the investigation. The work of sampling was always done by a responsible member of the technical staff, and every precaution was taken to ensure reliability. The general rules governing this sampling and the detailed descriptions of the work of sampling at the several mines are fully stated in Vol. I, Part III.

A list of the samples arranged in geographical order is given in the table of contents of each volume of the appendices III, IV, V, and VI, and is also printed in the text of the Report proper, Vol. I, pp. 8 to 11, and Vol. II, pp. 181 to 184.

Crushing and Sampling in the Laboratory.

The main samples on their arrival at the testing plant at McGill University were all crushed to go through a 2″ screen, mixed thoroughly on a large granolithic sampling floor, sampled for the chemist, etc., and finally resacked, sealed, and sent to a dry room for storage while awaiting test.

The methods of sampling are stated in detail in Vol. I, Part IV.

The smaller subsidiary samples were sent directly to the chemical laboratory, where they were stored in sealed vessels until required.

Mechanical Purification.

Each main sample was experimentally treated in the laboratory with heavy solutions, and the fractions analysed with a view to determining the probable results of washing. In all cases where these preliminary tests gave favourable results, a large lot was treated in the coal washing plant of the University, and this work was checked by a further series of tests with heavy solutions.

It would, of course, be possible in a laboratory to do extremely thorough washing at an expense disproportionate to the value of the coal; but this was not attempted, the aim being to reproduce commercial conditions. From comparative tests made between the laboratory work and coal washing in standard plants, it is evident that this end has been attained, and the tests as carried on may be taken in a broad way to represent average commercial work.

The whole subject of coal washing, as well as testing, is dealt with in a general way in Vol. I, Part V, and the results of all of the trials are presented in a series of summary tables. The detailed results of each test are given in Vol. III, Appendix I.

Coking Trials.

Coke, as ordinarily manufactured in beehive ovens, can only be produced from bituminous coals possessing particular qualities, but when

retort ovens are employed a larger range of coals are available, although even at best there are many coals from which good coke cannot be produced.

A series of trials were made to test the coking qualities of the various coals in both types of ovens, and also to determine upon a reliable method of producing coke from small quantities of coal and a method of comparing different cokes in respect of their strength, porosity, etc.

These experiments are described in detail and their results summarized in Vol. I, Part VI, but additional matter relating to special methods of testing, etc., will be found in Vol. VI, Appendix IV.

Boiler Trials.

The boiler trials were conducted in the boiler testing room of the Mechanical Engineering Department of McGill University, and the method used was as far as possible in accordance with standard testing practice. The equipment employed in these tests included a Babcock and Wilcox boiler, having 639 square feet of heating surface, and 16·79 square feet of grate area; an independent feed pump; weighing tanks, and standard scales for water and coal; together with the necessary apparatus for determining moisture in steam, analysing flue gases, and observing pressures and temperatures. Provision was made for supplying steam under the grate, also for working under forced draft, if required. Except in one or two cases where the character of the coal necessitated a change, the same pattern of fixed grate bars was used throughout the tests. These bars have air spaces, the area of which is 30 per cent of the total grate area. If different grate bars had been used for different grades of fuel, better economy in some instances would probably have been obtained; but it was felt that by using the same grate throughout, the tests would be more completely comparable with one another.

Before commencing the tests, the boiler was thoroughly scaled, cleaned, and tested, and all brick-work around the furnace was rebuilt. Preliminary trials were then made with a standard coal (Georges Creek), to make certain that the whole equipment was in good order. The series of regular tests was then begun, the same fireman being employed throughout. It was not found possible to make more than one boiler trial with most of the samples of coal, and it was decided that in every case the same evaporation of 2,000 pounds of water per hour should be aimed at; this being a rate at which the boiler was known to give nearly its best efficiency. The results of the tests show, therefore, the rate at which each sample of coal had to be burnt in order to furnish a certain supply of steam. As a check, the heat losses in every case were determined as far as possible. All the tests were at least of ten hours' duration, and the boiler tubes were, of course, cleaned before each run.

Since the practical working of a coal in the fire has a great bearing on its industrial value as a fuel, continuous notes were made of such points as the condition and thickness of the fire; the nature and amount of ash

and clinker formed; the frequency of slicing and cleaning the fire, and the method of firing found most suitable for each particular fuel.

The methods employed in conducting the trials are fully detailed in Vol. II, Part VII, and this part also contains a general discussion of the use of coal for steam raising, and a tabular summary of the whole series of trials.

Full notes of each of these trials are published in the present volume, followed by the summary record above referred to reprinted from Vol. II.

Producer Trials.

The producer trials were made in a special laboratory erected and equipped for the purpose at McGill University. Several producers were tested, but the standard trials were carried out in a special down-draught producer rated at 40 H.P.

The trials lasted at least 24 hours, and were checked by longer runs—one of 10 days.

The methods employed in conducting the trials are fully set forth in Vol. II, Part VIII, and the results of the trials are presented in tabular form. This Part also contains a discussion of general questions of the use of producers and gas engines for the generation of power. The detailed results of the trials are contained in Vol. V, Appendix III.

Chemical Work.

The chemical laboratory of the Mining Department at McGill University was given over exclusively to the work of the tests for more than three years. Standard methods of analysis were used as far as possible, and these, together with a number of important special methods, are fully described in Vol. II, Part IX. A summary statement of the analyses of all of the regular samples appears at the end of the same Part. Details of the less important analytic work, and accounts and records of a large amount of secondary work, are given in Vol. VI, Appendix V.

The Report.

It will be seen from the above description of the investigation, that an attempt has been made to cover a large field, and yet to do the work in great detail. As a result of this, a very large amount of information has been gathered; but much of it is so highly technical as to be only of interest to specialists, hence it has been thought best to divide the Report—which comprises six volumes—into two main sections of two and four volumes respectively.

In the first section there are separate chapters, or parts, dealing with each of the seven divisions of the investigation outlined in the last few pages. Each of these parts begins with an introduction in which the subject of the division is dealt with in a general way, followed by a more

or less extended description and discussion of the experimental work attempted; and concluding with a carefully tabulated summary of all of the tests in that division.

Preceding the technical reports referred to above, there are two important chapters, the first being an introduction dealing with the investigation as a whole, and the second being a very full descriptive paper on the history, geology, and present commercial development of the coal fields and coal mines of Canada, from the pen of Mr. Théo. C. Denis—a member of the permanent staff of the Mines Branch of the Department of Mines. This part of the Report, which is profusely illustrated with maps and photographs, differs from the remainder in that its matter is largely drawn from previous publications of the Geological Survey and other sources, but it possesses great value as an introduction to the somewhat technical reports which follow, and is of importance, on its own account, as the most complete work yet written on the coal fields of the Dominion.

The first two volumes of the Report, comprising Parts I to IX inclusive, may, therefore, be considered as complete in themselves, and it is hoped that they will prove of value, not only as contributions to the technological literature on coal, but also as a source of useful and timely information to the general public, on the coal resources of the Dominion and on the best methods of utilizing these resources.

The remaining four volumes, III, IV, V, and VI, are given up exclusively to tabulated records and details of the tests summarized in Volumes I and II, to which they thus become highly technical appendices.

SYDNEY COAL FIELD.

CAPE BRETON CO., NOVA SCOTIA.

TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 36.

Date—July 31, 1908. Trial Number—G.C.T. 58.

OBSERVATIONS OF GENERAL CONDITIONS

Notes.

No. 1 B. and W. working. Weather close and warm. Coal of medium size, not much small stuff. Fair amount of slate-like substance.

Time.	
7.30	Fire cleaned; and made up with No. 36 coal. Pressure, 85 lbs. per sq. in.
7.50	Tubes blown.
8.40	Started trial. Fire 2″ well burnt through; flame at back. Keeping thin fire (3″). This coal burns with much flame and smoke.
9.30	Grill half open. Does not coke at all.
10.05	Grill wide open.
10.30	Grill full open.
12.10	Slicer put in, found some hard clinker on bars. Did not remove. So far rake has not been put into fire. Fire not coking at all.
2.27	Sliced fire.
3.27	Sliced fire. Removed 40 lbs. clinker. Clinker when hot seems to be in plastic cakes spread over grate.
5.30	Fire cleaned. Removed 70 lbs. clinker in large slabs and hardened on cooling. Bluish in colour. Not very difficult to remove; but coal could not be used on shaking grate.
6.40	Trial finished, fire as at start. 52 lbs. ash raked from ash-pit. Blow-off examined and found tight.

ASH AND CLINKER.

	Tare.	Gross.	Net.	
3.27	..	...	40	Fire sliced.
5.30	75	145	70	Fire cleaned.
			110	lbs. clinker.
6.00	75	127	52	lbs. ash—raked from beneath bars.
			162	lbs. ash and clinker.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 58

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.40 a.m.						
8.45	50	50	8.40	10·8	5·8	1·8
9.15	221	271	9.10	10·1	7·2	1·7
9.45	133	404	9.40	10·2	8·8	0·4
9.55	63	467	10.10	12·0	6·5	0·2
10.25	146	613	10.40	9·2	10·3	0·2
10.55	152	765	11.10	9·5	8·8	1·1
11.15	122	887	11.40	8·9	10·1	0·9
11.45	122	1009	12.10	11·2	5·4	2·7
12.15	155	1164	12.40	10·9	5·4	2·9
12.17	42	1206	1.10	11·6	5·5	1·5
12.45	163	1369	1.40	9·2	8·9	1·6
1.15	173	1542	2.10	9·0	6·0	4·5
1.30	64	1606	2.40	9·0	10·0	0·2
2.00	105	1711	3.10	7·8	12·1	0·0
2.30	150	1861	3.40	12·5	5·3	1·4
3.00	101	1962	4.10	8·6	10·1	0·6
3.10	53	2015	4.40	10·5	8·0	0·5
3.40	134	2149	5.10	8·1	11·4	0·2
4.15	195	2344	5.40	8·4	9·5	0·9
4.45	150	2494	6.10	9·0	8·8	1·2
5.15	104	2598				
5.30	22	2620		9·8	8·2	1·2
5.45	158	2778				
6.15	143	2921				
6.40	33	2954				

OBSERVATIONS MADE DURING BOILER TRIAL No. 58

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.40	116	89	570	72	—·02	—·24	.....
8.55	112	89	560	72	—·02	—·24	520
9.10	122	89	575	72·5	—·02	—·26	378
9.25	113	89	570	72·5	—·02	—·27	537
9.40	122	90	620	72·5	—·02	—·26	454
9.55	118	90	580	72·5	—·02	—·26	438
10.10	122	90	620	73	—·02	—·26	529·5
10.25	123	90	630	73	—·02	—·27	494
10.40	120	90	640	73	—·02	—·27	572·5
10.55	121	91	625	73	—·02	—·28	431·5
11.10	118	90	610	73	—·02	—·28	472·5
11.25	122	91	580	73	—·02	—·28	480·5
11.40	122	91	590	73	—·02	—·28	413
11.55	120	91	585	73	—·02	—·28	413
12.10	117	91	635	73	—·02	—·28	469·5
12.25	122	90	600	73	—·02	—·28	523
12.40	123	90	640	73	—·02	—·28	491·5
12.55	121	90	600	73	—·02	—·28	421
1.10	123	91	700	73·5	—·02	—·28	472
1.25	119	90	620	73	—·02	—·28	483
1.40	123	90	610	73	—·02	—·28	410·5
1.55	121	90	620	73	—·02	—·28	521
2.10	123	91	560	73	—·02	—·26	385
2.25	120	95	570	73·5	—·02	—·26	439·5
2.40	114	91	660	73·5	—·02	—·26	449
2.55	115	91	630	73·5	—·02	—·26	449·5
3.10	111	91	600	74	—·02	—·26	380
3.25	115	91	630	74	—·02	—·26	371
3.40	123	92	780	74·5	—·02	—·30	299
3.55	116	91	720	74·5	—·02	—·30	530
4.10	118	91	710	74·5	—·02	—·30	491·5
4.25	122	91	650	74·5	—·02	—·30	460
4.40	123	93	640	74·5	—·02	—·28	511
4.55	123	91	640	74·5	—·02	—·28	412
5.10	121	89	610	74·5	—·02	—·28	432·5
5.25	118	89	580	74·5	—·02	—·28	381
5.40	93	97	540	74·5	—·02	—·28	331
5.55	98	89	520	74·5	—·02	—·26	349·5
6.10	117	88	530	74·5	—·02	—·26	279
6.25	123	89	600	74·5	—·02	—·28	388
6.40	123	88	710	74·5	—·02	—·30	428
	118·4	90·5	616	73·5	—·02	—·28	17,691·5 net

SUMMARY OF OBSERVATIONS

Date—July 31, 1908.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.40 a.m.	Ended—6.40 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned May, 1908
4.	Tubes cleaned	7.50 a.m.
5.	Fire cleaned	7.30 a.m., 5.30 p.m.

Fuel.

6.	Kind of coal	No. 36—Dominion Coal Co., Sydney, No. 7 mine
7.	Analysis of dry coal by weight (%)	C = 76·7, H = 5, S = 2·4, N_2 = 1·6, O_2 = 8·4, Ash = 5·9
8.	Calorific value of dry coal B.T.U. per lb	13860
9.	Moisture in coal as fired (%)	2·7
10.	Weight of coal fired (lbs.)	2954
11.	Combustible matter in ash and clinker (%)	14·9
12.	Weight of clinker (lbs.)	110
13.	Weight of ash (lbs.)	52

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−·02
15.	Air " above fire " "	−·18
16.	Air " at damper " "	−·28
17.	Amount of damper opening	Full − ¼ open, 5.55 p.m. to 6.10 p.m.
18.	Temperature of air in boiler house (°F.)	90·5
19.	Flue temperature (°F.)	616
20.	Analysis of dry flue gas by volume (%)	CO_2 = 9·8, O_2 = 8·2, CO = 1·2, N = 80·8

Water and Steam.

21.	Temperature of feed water (°F)	73·5
22.	Total weight of feed water (lbs.), corrected for difference of level	17691
23.	Water level in gauge at start (inches)	3¾
24.	" " finish (inches)	3½
25.	Correction for difference of level included above (lbs.)	−20
26.	Steam pressure by gauge (lbs. per sq. in)	118·4
27.	Barometer reading (inches)	29·59
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	15·6
29.	Temperature in steam calorimeter (°F.)	292·3

Notes.

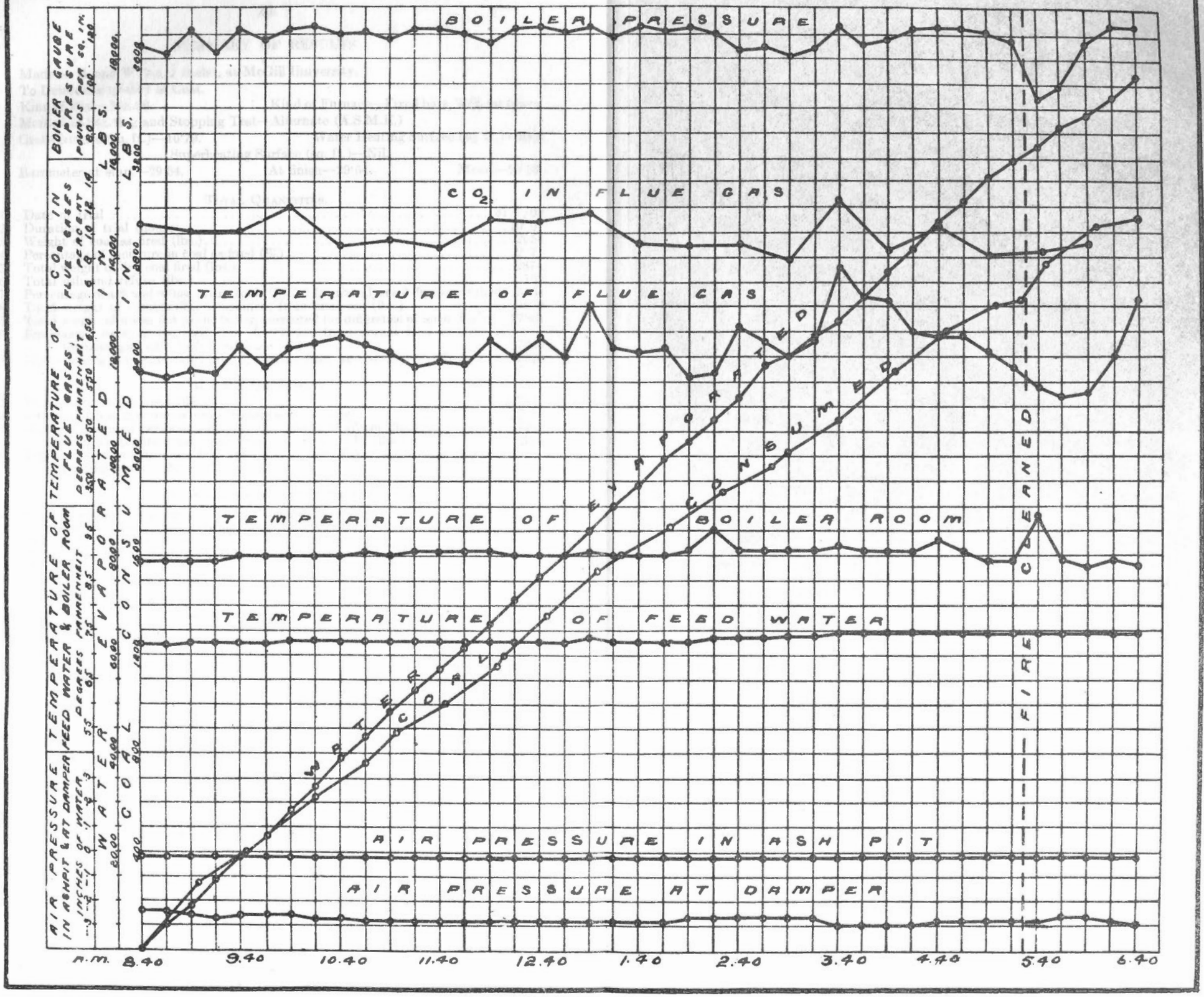
Coal burns with much flame and smoke. Grill open over fire. Not coking at all. Clinker bluish and plastic when hot; easily removed but could not be used on a shaking grate. Cleaned out once, sliced three times. Weather close and warm.

Proximate analysis: Fixed carbon..... 57·6; Volatile matter..... 36·5; Ash..... 5·9

GRAPHIC RECORD OF BOILER TRIAL.

G.C.T. 38.

COAL Nº 36



SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 36. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·64. At finish—29·54. Mean—29·59.

Total Quantities.

1.	Date of trial	31/7/08
2.	Duration of trial (hours)	10.0
3.	Weight of coal as fired (lbs.)	2954
4.	Percentage of moisture in coal as fired (%)	2·7
5.	Total weight of dry coal fired (lbs.)	2874
6.	Total ash and refuse (lbs.)	162
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 6·9; (*b*) weighed	5·64
8.	Total weight of combustible consumed, from analyses (lbs.)	2676
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	17691
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17620
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	20920

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	287·4
13.	Dry coal per square foot of grate surface per hour (lbs.)	17·1
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1762
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2092
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·27

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	118·4
18.	Temperature of feed water entering boiler (deg. F.)	73·5
19.	Temperature of escaping gases from boiler (deg. F.)	616
20.	Pressure of draft between damper and ash-pit (ins. of water)	·26
21.	Percentage of moisture in steam	·6

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	60·5
23.	Builders' rated horse-power	60·0
24.	Percentage of builders' rated horse-power developed	101

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	5·99
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	7·08
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	7·27
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	7·83

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	13860
30.	Calorific value of the combustible per lb. (B.T.U.)	14740
31.	Efficiency of boiler (based on combustible consumed) (%)	51·4
32.	Efficiency of boiler, including grate (based on dry coal) (%)	50·6

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	22·6
34.	" " of combustible consumed (from gas analyses) (lbs.)	18·6
35.	" " dry coal (from gas analyses) (lbs.)	17·3
36.	Proportion of heat of fuel in escaping dry flue gases (%)	15·7

TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 236.

Date—Aug. 3, 1908. Trial Number—G.C.T. 59.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Day bright and clear. No. 1 B. and W. working. Coal very small.

Time.	
7.50	Fire cleaned. Pressure, 105 lbs.
8.00	Cleaned tubes.
9.00	Trial started. Fire 2″ well burnt through. Cokes a little, probably due to moisture in coal.
9.30	Burning in a 2½″ fire. Much flame.
10.00	Coal coking badly. Grill opened.
11.00	Fire kept about 3″.
11.45	Still coking badly.
2.35	Steam on. A thin hard clinker on bar.
3.15	Sliced fire.
3.35	Sliced fire. Cannot get under clinker very well.
3.35	Grill closed.
4.15	Grill opened to half way.
5.50	Fire cleaned, thin layer of very hard clinker over bars; did not adhere so badly as at 3.35, due to steam having been put on.
7.03	Finished trial. Fire as at start. This coal is very bad in heating and pitting the bars.

CLINKER AND ASH.

	Tare.	Gross.	Net.	
5.50	75	116·5	41·5	lbs. clinker.
7.00	75	138	63·0	lbs ash.
			104·5	lbs. ash and clinker.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 59

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 9.00 a.m.						
9.30	185	185	9.00	8·3	9·8	0·5
10.00	156	341	9.30	7·2	11·4	0·8
10.03	38	379	10.00	9·9	9·2	0·1
10.30	156	535	10.30	12·4	6·6	0·6
11.00	137	672	11.00	9·2	9·4	0·9
11.15	93	765	11.30	10·1	8·8	0·6
11.45	139	904	12.00	11·2	7·3	1·0
12.15	175	1079	12.30	8·3	11·1	0·2
12.35	90	1169	1.00	9·6	7·4	2·9
1.05	137	1306	1.30	10.0	7·0	2·8
1.35	133	1439	2.00	10·2	8·9	0·7
2.05	158	1597	2.30	6·7	12·8	0·5
2.25	91	1688	3.00	10·1	8·4	0·8
3.05	137	1825	3.30	10·4	7·4	1·7
3.35	106	1931	4.00	14·2	3·1	1·3
3.40	55	1986	4.30	7·8	11·5	0·5
4.10	211	2197	5.00	11·0	5·4	3·2
4.40	114	2311	5.30	9·1	10·4	0·4
4.50	77	2388	6.00	7·7	11·6	0·6
5.20	124	2512	6.30	6·3	12·7	0·7
5.50	58	2570				
6.20	166	2736		9·5	9·0	1·0
6.25	40	2776				
7.03	131	2907				

OBSERVATIONS MADE DURING BOILER TRIAL No. 59

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
9.00	112	81	570	70·5	—·02	—·26	.....
9.15	107	83	550	71	—·02	—·30	490
9.30	110	83	560	71·5	—·02	—·30	325
9.45	119	84	560	72	—·02	—·30	323
10.00	113	84	610	72	—·02	—·32	486·5
10.15	121	84	625	72·5	—·02	—·32	481·5
10.30	114	84	660	72·5	—·02	—·36	503·5
10.45	123	84	650	72·5	—·02	—·32	513
11.00	123	85	640	72·5	—·02	—·32	392·5
11.15	110	85	580	72·5	—·02	—·32	550
11.30	113	85	600	72·5	—·02	—·32	519
11.45	113	85	640	72.5	—·02	—·36	404·5
12.00	118	87	650	72·5	—·02	—·34	529
12.15	110	87	605	72·5	—·02	—·32	562
12.30	113	85	590	72·5	—·02	—·32	415
12.45	121	84	590	72·5	—·02	—·32	363
1.00	122	84	570	72·5	—·02	—·32	391
1.15	121	83	590	72·5	—·02	—·32	502
1.30	115	82	575	72·5	—·02	—·32	501
1.45	118	83	550	72·5	—·02	—·30	370
2.00	118	84	550	72·5	—·02	—·30	427·5
2.15	123	84	550	72·5	—·02	—·30	433
2.30	120	86	560	72·5	—·02	—·30	360·5
2.45	113	84	580	72·5	—·02	—·32	440
3.00	102	84	600	73	—·02	—·32	472·5
3.15	108	84	580	73	—·02	—·34	380
3.30	112	83	650	73	—·02	—·34	342
3.45	118	83	860	72·5	—·02	—·34	469
4.00	123	84	760	72·5	—·02	—·34	582
4.15	102	84	610	72·5	—·02	—·32	591·5
4.30	123	84	620	72·5	—·02	—·32	383
4.45	110	84	730	72·5	—·02	—·34	471
5.00	102	84	700	72·5	—·02	—·32	632
5.15	113	84	660	72·5	—·02	—·32	462
5.30	119	84	650	72·5	—·02	—·30	485·5
5.45	121	83	640	72·5	—·02	—·30	472
6.00	98	83	570	72·5	—·02	—·30	419·5
6.15	108	82	620	72·5	—·02	—·30	381
6.30	111	82	585	72·5	—·02	—·30	328
6.45	118	82	580	72·5	—·02	—·30	401
7.00	123	82	660	72·5	—·02	—·32	464
	114.7	83·8	617	72·4	—·02	—·32	18,019 net

SUMMARY OF OBSERVATIONS.

Date—Aug. 1908. Boiler—B. and W. No. 2. At McGill University.
Commenced—9.00 a.m. Ended—7.03 p.m. Duration—603 mins.

General.

1. Method of stoking.....Hand-spreading on alternate sides
2. Kind of draft.....Natural
3. Condition of boiler and date of last cleaning.....Thoroughly cleaned May, 1908
4. Tubes cleaned.....8.00 a.m.
5. Fire cleaned.....7.50 a.m., 5.50 p.m.

Fuel.

6. Kind of coal.....No. 236—Dominion Coal Co., Sydney, No. 7 mine
7. Analysis of dry coal by weight (%). C=80, H=5·2, S_2=2·0, N_2=1·7, O_2=8·4, Ash=2·7.
8. Calorific value of dry coal B.T.U. per lb.....14310
9. Moisture in coal as fired (%).....4·5
10. Weight of coal fired (lbs.).....2907
11. Combustible matter in ash and clinker (%).....27·4
12. Weight of clinker (lbs.).....41·5
13. Weight of ash (lbs.).....63

Air and Flue Gas.

14. Air pressure under fire (inches of water).....−·02
15. " above fire " " .....−·21
16. " at damper " " .....−·32
17. Amount of damper opening, ...Full
18. Temperature of air in boiler house (°F.).....83·8
19. Flue temperature (°F.).....617
20. Analysis of dry flue gas by volume (%) CO_2=9·5, O_2=9·0, CO=1·0, N=80·5

Water and Steam.

21. Temperature of feed water (°F.).....72·4
22. Total weight of feed water, corrected for difference of level (lbs.).....18019
23. Water level in gauge at start (inches).....$3\frac{15}{16}$
24. Water level in gauge at finish (inches).....$3\frac{15}{16}$
25. Correction for difference of level (lbs.).....0
26. Steam pressure by gauge (lbs. per sq. in.).....114·7
27. Barometer reading (inches).....29·83
28. Pressure in steam calorimeter by gauge (lbs. per sq. in.).....14·9
29. Temperature in steam calorimeter (°F.).....290·2

Notes.

This clinker was very hard and stuck to bars until steam was put on. Forms in a hard, thin layer. Bars were found to be pitted afterwards.

Coal cokes badly. Could not be used on a shaking grate. Grill over fire open a little. Weather fine and clear.

Proximate analysis { Fixed carbon.....59·1 / Volatile matter.....38·2 / Ash.....2·7

SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 236. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·86. At finish—29·80. Mean—29·83.

Total Quantities.

1.	Date of trial	3/8/08
2.	Duration of trial (hours)	10·05
3.	Weight of coal as fired (lbs.)	2907
4.	Percentage of moisture in coal as fired (%)	4·5
5.	Total weight of dry coal fired (lbs.)	2776
6.	Total ash and refuse (lbs.)	104·5
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 3·72; (*b*) weighed	3·77
8.	Total weight of combustible consumed, from analyses (lbs.)	2672
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.),	18019
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17940
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	21320

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	276
13.	Dry coal per square foot of grate surface per hour (lbs.)	16·4
14.	Water evaporated per hour, corrected for quality of steam (lbs.)	1785
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2122
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·33

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	114·7
18.	Temperature of feed water entering boiler (deg. F.)	72·4
19.	Temperature of escaping gases from boiler (deg. F.)	617
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·30
21.	Percentage of moisture in steam	0·6

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	61·5
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	103

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	6·2
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	7·33
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	7·68
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	7·98

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	14310
30.	Calorific value of the combustible per lb. (B.T.U.)	14700
31.	Efficiency of boiler (based on combustible consumed) (%)	52·4
32.	Efficiency of boiler, including grate (based on dry coal) (%)	51·8

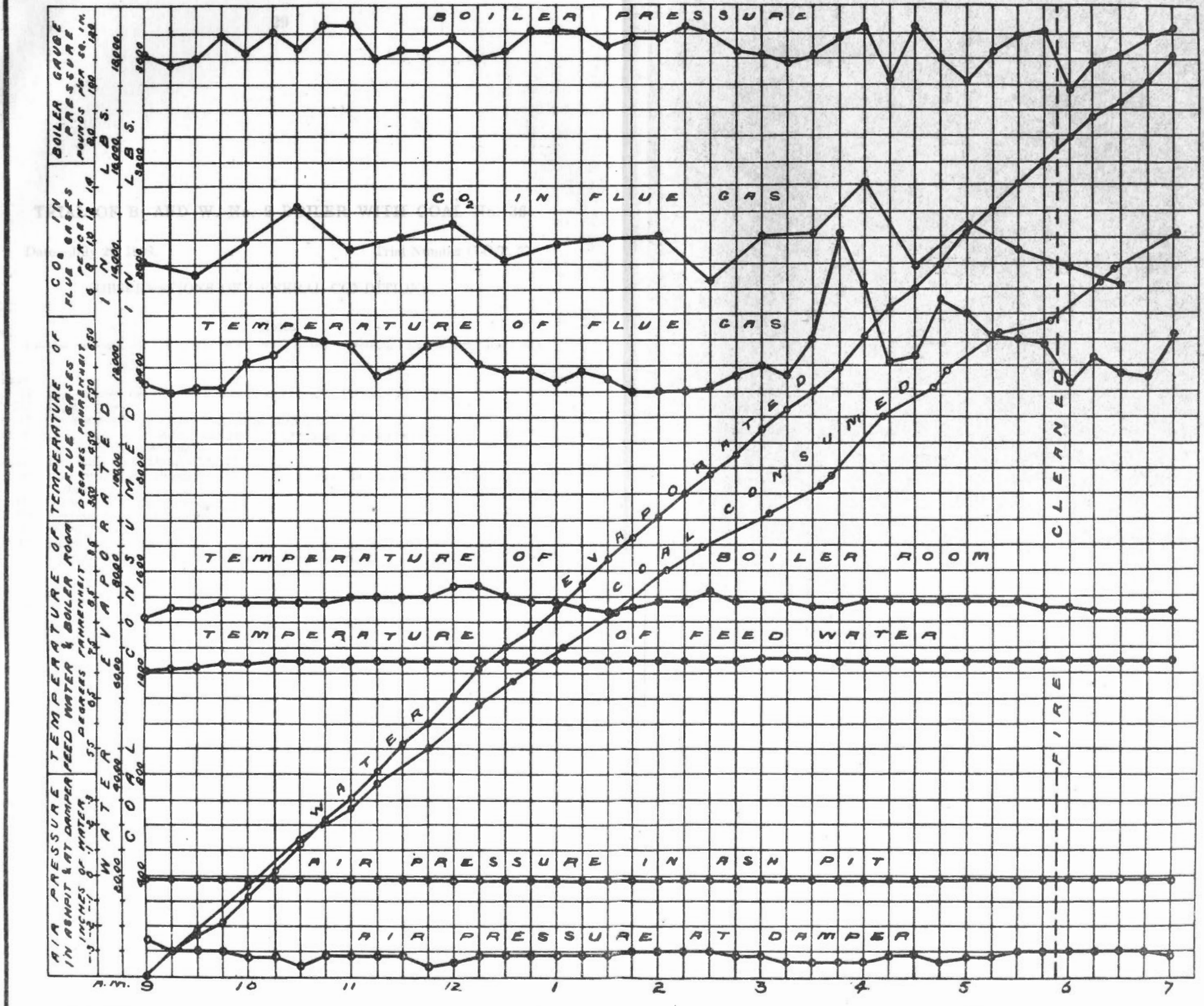
Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	23·7
34.	" " of combustible consumed (from gas analyses) (lbs.)	19·68
35.	" " dry coal (from gas analyses) (lbs.)	18·95
36.	Proportion of heat of fuel in escaping dry flue gases (%)	16·95

GRAPHIC RECORD OF BOILER TRIAL.

G.C.T. 59

COAL Nº 36/00



TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 35.

Date—July 29, 1908. Trial Number G.C.T. 57.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Day fine and clear, rain and thunder later. No. 2 B. and W. working. Coal in fairly large lumps.

Time.

7.34 Fire cleaned and made up with No. 35 coal. Pressure, 105 lbs.
7.45 Tubes blown.
8.45 Trial started. Fire 1½″ well burnt through.
9.00 Coal burns with much flame and large volumes of dense smoke.
9.15 Fire kept about 4″ thick.
10.00 Fire built up to about 6″ to 7″.
10.30 Ran slicing bar through. Thin clinker adhering to grate, put steam on under bars.
11.00 Opened grill. Much less smoke.
12.00 Keeping fire much thinner, 2″ to 3″.
1.30 Sliced fire, clinker came off easily; very hard.
2.45 Sliced fire. 32 lbs. clinker removed. This clinker was hard and in cakes covering bars. The steam had cooled bars considerably so that it was comparatively easy to remove. This coal would not do with a shaking grate. It is practically essential to use steam, otherwise clinker runs between the bars.
5.34 Cleaned out. Hard thin layer of clinker over fire, easily removed, however—83 lbs.
6.45 Finished trial; fire as at start. Not coking at all.

NOTE—*Essential*. To have air admitted above grate; and steam under.

CLINKER AND ASH.

	Tare.	Gross.	Net.	
2.45	75	107	32	
5.34	75	158	83	
			115	lbs. clinker.
6.45	75	150	75	lbs. ash.
			190	lbs. ash and refuse.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 57

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.45 a.m.						
8.46	56	56	8.45	10·1	6·9	1·0
9.15	253	309	9.15	7·5	10·1	0·0
9.30	52·5	361·5	9.45	11·8	6·2	0·0
10.00	190	551·5	10.15	8·3	7·6	4·0
10.30	173·5	725	10.45	12·3	1·9	6·2
11.00	190	915	11.15	13·1	3·4	1·6
11.30	82	997	11.45	14·0	4·0	0·9
12.00	103	1100	12.15	13·8	4·8	0·7
12.30	109	1209	12.45	9·1	10·2	0·6
1.00	82	1291	1.15	9·2	8·1	2·2
1.15	59	1350	1.45	11·5	6·7	1·0
1.45	153	1503	2.15	9·7	6·8	2·8
2.15	20	1703	2.45	9·5	9·6	0·7
2.45	134	1837	3.15	9·5	7·1	2·3
3.15	166	2003	3.45	10·7	5·8	2·6
3.40	134	2137	4.15	9·5	9·2	0·8
4.10	173	2310	4.45	11·5	7·6	0·5
4.35	106	2416	5.15	11·0	6·4	2·5
5.05	122	2538	5.45	10·5	6·4	3·1
5.30	87	2625	6.15	10·1	6·2	2·5
5.50	128	2753				
6.20	98	2851		10·6	6·8	1·8
6.45	91	2942				

OBSERVATIONS MADE DURING BOILER TRIAL No. 57

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.45	117	85	580	71	—·02	—·24	
9.00	110	85	520	71	—·02	—·25	500
9.15	111	87	500	71·5	—·02	—·25	351
9.30	114	87	480	71·5	—·02	—·26	394
9.45	122	87	580	71·5	—·02	—·26	390·5
10.00	120	88	660	71·5	—·02	—·26	527·5
10.15	113	89	520	71·5	—·02	—·30	430
10.30	113	89	590	72	—·02	—·30	297·5
10.45	116	89	810	72	—·02	—·28	420
11.00	109	88	560	72	—·02	—·26	479·5
11.15	117	89	625	72	—·02	—·23	341
11.30	118	89	830	72	—·02	—·26	470
11.45	111	88	730	72	—·02	—·24	505·5
12.00	110	89	715	72	—·02	—·24	448·5
12.15	119	88	710	72	—·02	—·24	461
12.30	120	91	690	72·5	—·02	—·22	429
12.45	120	88	670	72·5	—·02	—·24	475
1.00	119	88	600	72·5	—·02	—·24	400
1.15	118	89	600	72·5	—·02	—·24	491·5
1.30	116	89	590	72·5	—·02	—·24	377
1.45	123	89	700	72·5	—·02	—·25	380
2.00	123	89	700	72·5	—·02	—·25	510·5
2.15	117	89	655	72·5	—·02	—·25	486
2.30	113	89	660	72·5	—·02	—·25	448·5
2.45	112	89	655	73	—·02	—·25	501
3.00	118	89	670	73	—·02	—·25	381
3.15	118	89	650	73	—·02	—·25	485·5
3.30	120	88	725	73	—·02	—·26	479
3.45	120	88	725	73	—·02	—·28	484·5
4.00	118	88	680	73	—·02	—·28	544·5
4.15	118	88	700	73	—·02	—·28	458
4.30	120	88	870	73	—·02	—·28	478
4.45	123	87	810	73	—·02	—·28	502
5.00	123	87	730	73	—·02	—·28	490·5
5.15	123	87	710	73	—·02	—·28	502·5
5.30	123	86	640	72·5	—·02	—·28	421·5
5.45	120	87	600	72·5	—·02	—·26	329
6.00	113	87	650	73	—·02	—·20	565
6.15	123	88	650	73	—·02	—·20	346·5
6.30	123	86	660	73	—·02	—·22	473
6.45	123	86	660	73	—·02	—·20	476
	117·7	88·0	660	72·4	—·02	—·25	17,931 net

SUMMARY OF OBSERVATIONS.

Date—July 29, 1908.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.45 a.m.	Ended—6.45 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned May, 1908
4.	Tubes cleaned	7.45 a.m.
5.	Fire cleaned	7.34 a.m., 5.34 p.m.

Fuel.

6.	Kind of coal	No. 35—Dominion Coal Co., Sydney, No. 9 mine
7.	Analysis of dry coal by weight (%).	C = 77·0, H = 5·2, S = 3·7, N_2 = 1·5, O_2 = 6·7, Ash = 5·9
8.	Calorific value of dry coal B.T.U. per lb	14000
9.	Moisture in coal as fired (%)	1·8
10.	Weight of coal fired (lbs.)	2942
11.	Combustible matter in ash and clinker (%)	18·9
12.	Weight of clinker (lbs.)	115
13.	Weight of ash (lbs.)	75

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−·02
15.	" above fire " "	−·17
16.	" at damper " "	−·25
17.	Amount of damper opening	Various
18.	Temperature of air in boiler house (°F.)	88
19.	Flue temperature (°F.)	660
20.	Analysis of dry flue gas by volume (%)	CO_2 = 10·6, O_2 = 6·8, CO = 1·8, N = 80·8

Water and Steam.

21.	Temperature of feed water (°F.)	72·4
22.	Total weight of feed water, corrected for difference of level (lbs.)	17931
23.	Water level in gauge at start (inches)	$4\frac{7}{16}$
24.	Water level in gauge at finish (inches)	$4\frac{9}{16}$
25.	Correction for difference of level included above (lbs.)	−·20
26.	Steam pressure by gauge (lbs. per sq. in.)	117·7
27.	Barometer reading (inches)	29·88
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	15·7
29.	Temperature in steam calorimeter (°F.)	291·6

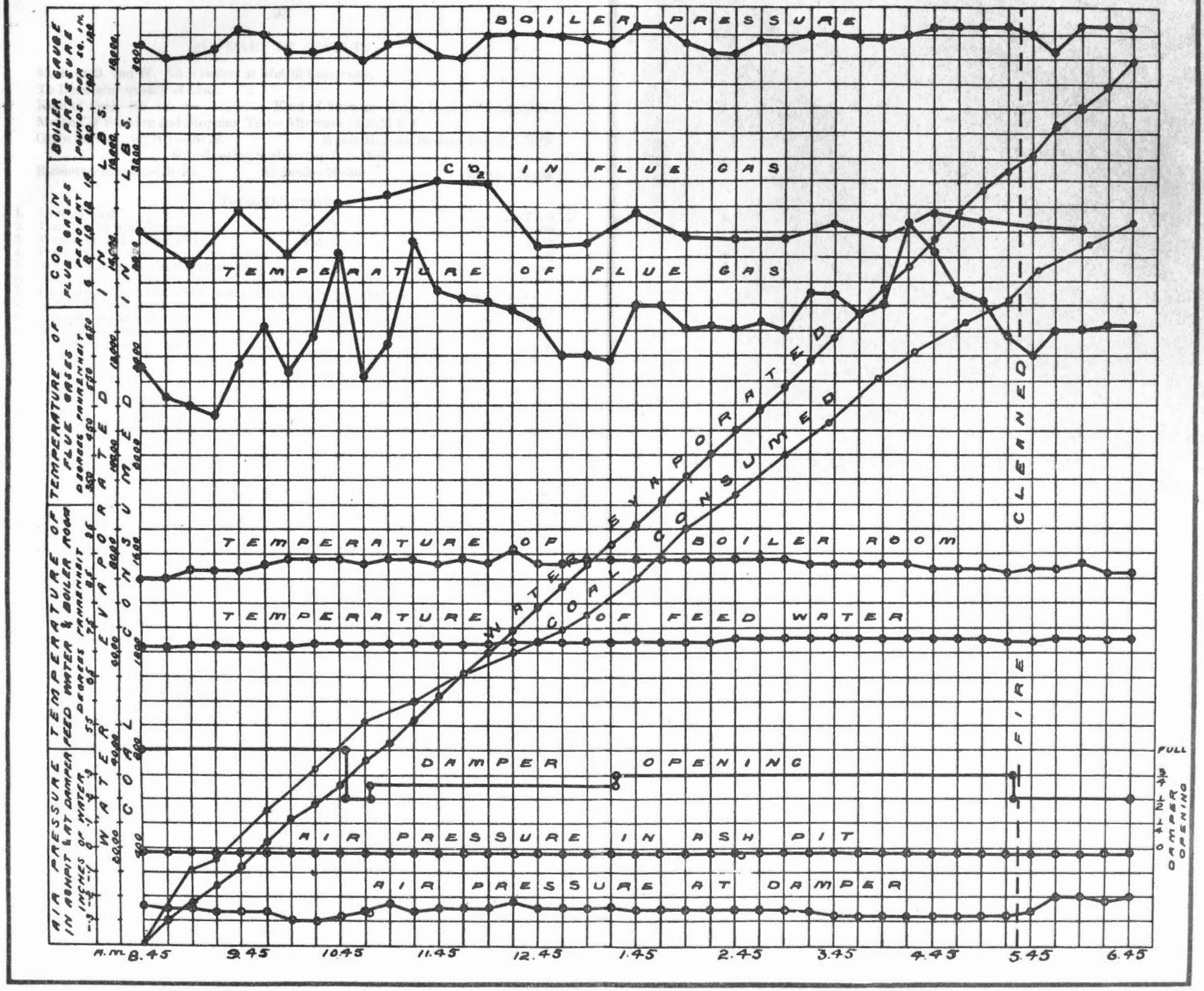
Notes.

This coal burnt with a great deal of flame and smoke. Air should be admitted above grate. To avoid clinker adhering to bars steam should be admitted underneath. Fire sliced—10.30, 1.30, 2.45. Best thickness seemed to be 3" to 4". Weather fine and clear, turning to rain and thunder.

Proximate analysis { Fixed carbon ..... 55·5; Volatile matter ..... 38·6; Ash ..... 5·9

G.C.T. 57

COAL Nº 35



SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 35. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·90. At finish—29·86. Mean—29·88.

Total Quantities.

1.	Date of trial	29/7/08
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	2942
4.	Percentage of moisture in coal as fired (%)	1·8
5.	Total weight of dry coal fired (lbs.)	2889
6.	Total ash and refuse (lbs.)	190
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 7·28; (*b*) weighed.	6·58
8.	Total weight of combustible consumed, from analyses (lbs.)	2678
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	17931
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17850
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	21220

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	289
13.	Dry coal per square foot of grate surface per hour (lbs.)	17·2
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1785
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2122
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·32

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	117·7
18.	Temperature of feed water entering boiler (deg. F.)	72·4
19.	Temperature of escaping gases from boiler (deg. F.)	660
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·23
21.	Percentage of moisture in steam	0·6

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	61·6
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	102

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	6·09
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	7·21
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	7·34
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	7·93

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	14,000
30.	Calorific value of the combustible per lb. (B.T.U.)	14,880
31.	Efficiency of boiler (based on combustible consumed) (%)	51·4
32.	Efficiency of boiler, including grate (based on dry coal) (%)	50·6

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	20·2
34.	" " of combustible consumed (from gas analyses) (lbs.)	16·77
35.	" " dry coal (from gas analyses) (lbs.)	15·55
36.	Proportion of heat of fuel in escaping dry flue gases (%)	15·24

TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 38.

Date—Aug. 5, 1908. Trial Number—60.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

No. 1 B. and W. and Robb, both working. Day dull and rainy. Coal in fairly large lumps with small stuff.

Time.

7.25 Cleaned out fire and made up with No. 38 coal—120 lbs.
7.35 Tubes blown.
8.45 Started trial. Fire 1½″ to 2″ thick well burnt through.
9.45 Fire 2½″ to 3″. Coal burns with medium amount of flame and much smoke. Coal cokes at first.
11.00 Coal does not coke so much.
1.00 Sliced fire. Thin hard clinker easily raised.
2.00 Opened grill ¾ full open.
2.15 Sliced fire. Removed some slabs of clinker (32 lbs.) about ½″ thick. Could not use this coal on a shaking grate.
3.50 Seems to coke rather worse since slicing.
4.15 Sliced fire and put on steam under bars.
5.25 Cleaned fire. Clinker in thin hard layer, difficult to remove. Steam shut off.
6.48 Finished trial. 49 lbs. ash raked from ash-pit.

CLINKER AND ASH.

	Tare.	Gross.	Net.	
2.15			32	lbs. clinker.
5.25	75	139	64	lbs. clinker.
		Total	96	lbs. clinker.
6.48	75	124	49	lbs. ash.
			145	lbs. ash and clinker.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 60

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.45 a.m.						
9.15	190	190	8.45	6·0	13·5	0·4
9.45	176	336	9.15	10·0	9·7	0·5
9.55	65	431	9.45	9·9	7·8	1·6
10.25	159	590	10.15	7·3	12·7	0·0
10.55	156	746	10·45	8·2	11·1	0·1
11.25	92	838	11.15	7·9	12·1	0·3
11.55	166	1004	11.45	10·3	7·1	2·6
12.25	192	1196	12.15	9·8	5·7	5·1
12.30	39	1235	12.45	9·1	6·6	4·6
1.00	169	1404	1.15	12·1	5·5	1·8
1.30	169	1573	1.45	9·5	7·3	3·2
2.00	120	1693	2.15	8·0	10·8	1·0
2.30	110	1803	2.45	9·1	9·8	0·8
3.00	130	1933	3.15	11·8	6·8	1·2
3.20	84	2017	3.45	8·5	9·2	1·7
3.50	99	2116	4.15	9·6	9·0	0·9
4.30	203	2319	4.45	8·0	10·8	0·8
5.00	121	2440	5.15	8·5	10·4	0·9
5.30	40	2480	5.45	9·3	6·8	2·9
6.00	215	2695	6.15	10·0	7·3	1·7
6.20	78	2773				
6.48	91	2864		9·1	9·0	1·6

OBSERVATIONS MADE DURING BOILER TRIAL No. 60

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.45	118	85	590	72·5	—·02	—·28	.....
9.00	121	86	580	72·5	—·02	—·28	321·5
9.15	106	85	610	72·5	—·02	—·28	604
9.30	110	87	580	72·5	—·02	—·28	453
9.45	121	86	600	72·5	—·02	—·28	432·5
10.00	116	86	575	73	—·02	—·28	511·5
10.15	120	86	590	73	—·02	—·28	472
10.30	113	85	590	72·5	—·02	—·28	504
10.45	122	86	575	72·5	—·02	—·28	446
11.00	119	86	580	72·5	—·02	—·28	462
11.15	119	86	580	73	—·02	—·28	511·5
11.30	122	86	560	73	—·02	—·28	385
11.45	118	86	560	72·5	—·02	—·28	490
12.00	123	88	540	72·5	—·02	—·28	385·5
12.15	123	87	590	73	—·02	—·28	479
12.30	121	86	580	73	—·02	—·30	443·5
12.45	123	85	580	73	—·02	—·30	441
1.00	122	85	570	73	—·02	—·30	400
1.15	123	85	600	73	—·02	—·30	527·5
1.30	113	85	560	73	—·02	—·30	570·5
1.45	123	85	580	73	—·02	—·30	410
2.00	123	85	530	73	—·02	—·28	421
2.15	116	86	540	73	—·02	—·30	368
2.30	121	88	675	73	—·02	—·30	288·5
2.45	118	85	640	72·5	—·02	—·30	523
3.00	122	85	670	72.5	—·02	—·30	411·5
3.15	117	85	680	72·5	—·02	—·30	451
3.30	108	83	570	72·5	—·02	—·28	433
3.45	110	84	590	72·5	—·02	—·28	429·5
4.00	110	84	660	72·5	—·02	—·28	452·5
4.15	119	85	590	72·5	—·02	—·28	420
4.30	118	85	620	72·5	—·02	—·30	389·5
4.45	113	85	565	72·5	—·02	—·28	452·5
5.00	119	85	660	72·5	—·02	—·30	462
5.15	113	83	610	72·5	—·02	—·28	432
5.30	98	86	490	72·5	—·02	—·24	379
5.45	123	84	610	72·5	—·02	—·30	280·5
6.00	121	83	660	72·5	—·02	—·30	491
6.15	121	84	680	72·5	—·02	—·30	549
6.30	123	84	650	72·5	—·02	—·30	494
6.48	123	84	740	72·5	—·02	—·30	642·5
	117·9	85·2	600	72·7	—·02	—·29	17,920 net

SUMMARY OF OBSERVATIONS.

Date—Aug. 5, 1908.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.45 a.m.	Ended—6.48 p.m.	Duration—603 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning	May 1908, thoroughly cleaned
4.	Tubes cleaned	7.35 a.m.
5.	Fire cleaned	7.25 a.m., 5.25 p.m.

Fuel.

6.	Kind of coal	No. 38—Dominion Coal Co., Sydney, No. 1 mine
7.	Analysis of dry coal by weight (%)	C = 78·6, H = 5·1, S = 1·9, N_2 = 1·5, O_2 = 7·0, Ash = 5·9
8.	Calorific value of dry coal B.T.U. per lb	14010
9.	Moisture in coal as fired (%)	2·8
10.	Weight of coal fired (lbs.)	2864
11.	Combustible matter in ash and clinker (%)	19·5
12.	Weight of clinker (lbs.)	96
13.	Weight of ash (lbs.)	49

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−·02
15.	" above fire " "	−·22
16.	" at damper " "	−·29
17.	Amount of damper opening	
18.	Temperature of air in boiler house (°F.)	85·2
19.	Flue temperature (°F.)	600
20.	Analysis of dry flue gas by volume (%)	CO_2 = 9·1, O_2 = 9·0, CO = 1·6, N = 80·3

Water and Steam.

21.	Temperature of feed water (°F.)	72·7
22.	Total weight of feed water, corrected for difference of level (lbs.)	17920
23.	Water level in gauge at start (inches)	$3\frac{3}{8}$" 310
24.	Water level in gauge at finish (inches)	$3\frac{7}{16}$" 320
25.	Correction for difference of level (lbs.)	−10
26.	Steam pressure by gauge (lbs. per sq. in.)	117·9
27.	Barometer reading (inches)	29·48
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	15·9
29.	Temperature in steam calorimeter (°F.)	291·8

Notes.

This coal forms a hard clinker which adheres to the bars; should have a steam jet underneath. It also tends to coke. It could not be used on a shaking grate. Much smoke is emitted. Sliced 1.00, 2.15, 4.15. Weather dull and rainy.

Proximate analysis	Fixed carbon	59·8
	Volatile matter	34·3
	Ash	5·9

SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 38. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·52. At finish—29·44. Mean—29·48.

Total Quantities.

1.	Date of trial	5/8/08
2.	Duration of trial (hours)	10·05
3.	Weight of coal as fired (lbs.)	2864
4.	Percentage of moisture in coal as fired (%)	2·8
5.	Total weight of dry coal fired (lbs.)	2784
6.	Total ash and refuse (lbs.)	145
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 7·3; (*b*) weighed	5·2
8.	Total weight of combustible consumed, from analyses (lbs.)	2580
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	17920
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17840
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	21200

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	277
13.	Dry coal per square foot of grate surface per hour (lbs.)	16·5
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1775
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2109
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·3

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	117·9
18.	Temperature of feed water entering boiler (deg. F.)	72·7
19.	Temperature of escaping gases from boiler (deg. F.)	600
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·27
21.	Percentage of moisture in steam	0·6

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	61·1
23.	Builders' rated horse-power	60·0
24.	Percentage of builders' rated horse-power developed	102

Economic Results.

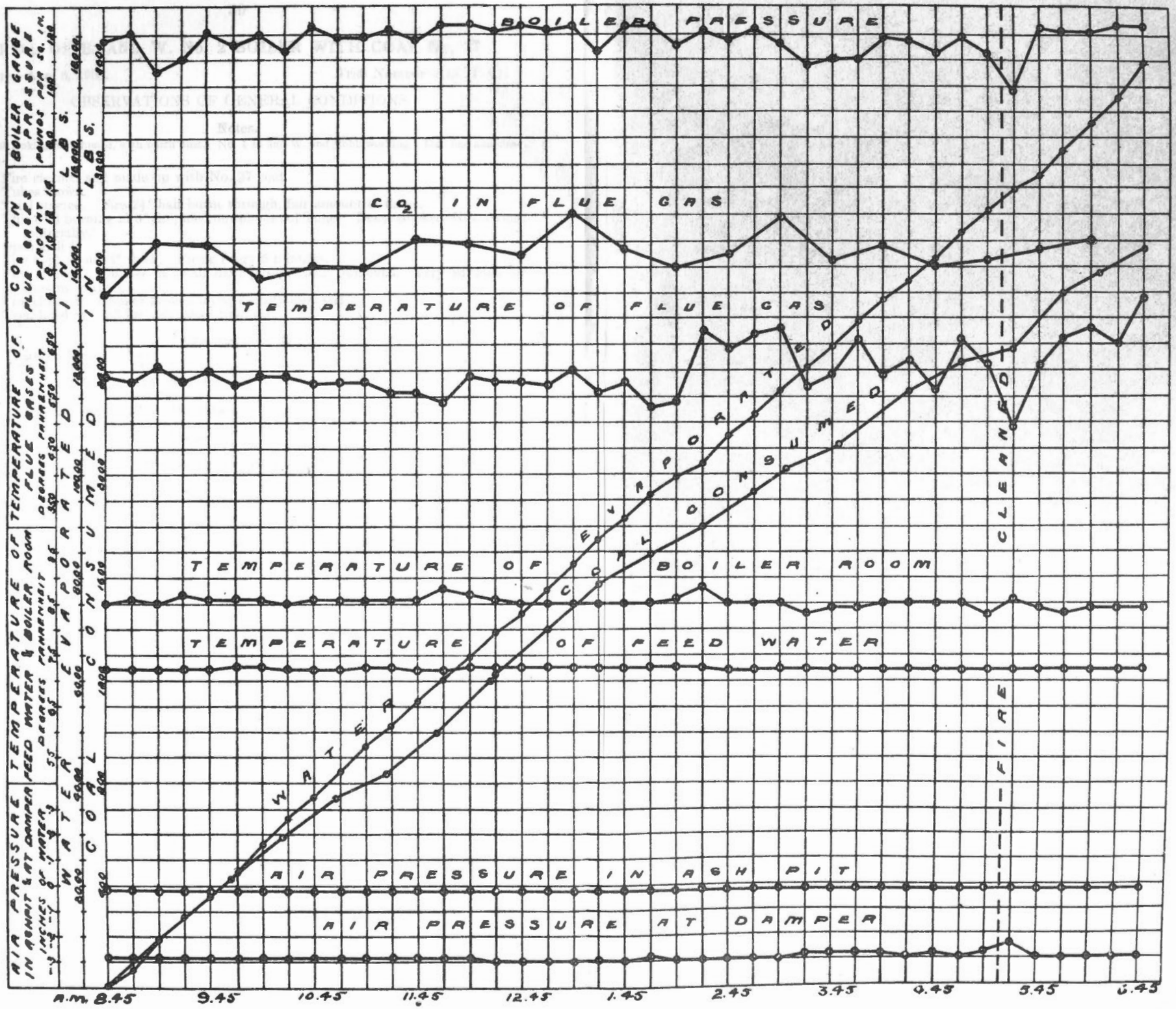
25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	6·26
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	7·40
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	7·61
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	8·22

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	14010
30.	Calorific value of the combustible per lb. (B.T.U.)	14900
31.	Efficiency of boiler (based on combustible consumed) (%)	53·3
32.	Efficiency of boiler, including grate (based on dry coal) (%)	52·4

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	23·2
34.	Dry flue gas per lb. of combustible consumed (from gas analyses) (lbs.)	19·7
35.	Dry flue gas per lb. dry coal (from gas analyses) (lbs.)	18·2
36.	Proportion of heat of fuel in escaping dry flue gases (%)	16·1


BOILER PRESSURE
CO2 IN FLUE GAS
TEMPERATURE OF FLUE GAS
TEMPERATURE OF BOILER ROOM
TEMPERATURE OF FEED WATER
AIR PRESSURE IN ASH PIT
AIR PRESSURE AT DAMPER
EVAPORATED
CONSUMED
COAL
WATER
AIR
CLEANED
FIRE
BOILER GAUGE PRESSURE POUNDS PER SQ. IN.
CO2 IN FLUE GASES PERCENT
TEMPERATURE OF FLUE GASES DEGREES FAHRENHEIT
TEMPERATURE OF BOILER ROOM DEGREES FAHRENHEIT
AIR PRESSURE IN ASH PIT & AT DAMPER INCHES OF WATER
A.M. 8.45
9.45
10.45
11.45
12.45
1.45
2.45
3.45
4.45
5.45
6.45

TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 37.

Date—Aug. 6, 1908. Trial Number—G.C.T. 61.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Coal in dull looking hard lumps, with much dust. No. 1 B. and W. and Robb working. Day fine and clear.

Time.

7.15 Fire cleaned and made up with No. 37 coal.
7.30 Tubes blown.
8.30 Trial started. Fire 2½" half burnt through, fair amount of flame.
8.45 This coal burning in 3" fire, medium amount of flame. Dense smoke. Not coking. materially.
10.15 Open grill ¼.
11.00 Fire kept about 4" thick. Firing every 5 minutes.
12.20 Fire cleaned. Clinker in small hard pieces, easily removed. Very suitable for shaking grate.
5.17 Fire cleaned. Clinker broken up and easily removed.
6.30 Trial finished. 85 lbs. ash raked from pit.

CLINKER AND ASH.

	Tare.	Gross.	Net.	
12.20	75	173	98	lbs. clinker.
5.20	75	189	114	lbs. clinker.
		Total	212	lbs. clinker.
6.30	75	160	85	lbs. ash.
			297	lbs. ash and clinker.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 61

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.30 a.m.						
8.35	72	72	8.30	8·6	9·4	1·0
9.10	189	261	9.00	9·6	7·5	2·1
9.40	178	439	9.30	8·4	11·2	0·2
10.10	212	651	10.00	10·3	6·4	2·1
10.35	137	788	10.30	8·1	11·4	0·4
11.05	145	933	11.00	9·5	8·6	1·4
11.45	210	1143	11.30	9·0	9·2	1·2
12.20	112	1255	12.00	8·4	9·4	1·7
12.26	47	1302	12.30	7·0	12·5	0·2
1.00	225	1527	1.00	9·8	7·5	1·6
1.30	137	1664	1.30	6·2	12·7	0·5
2.05	153	1817	2.00	7·7	12·1	0·1
2.30	143	1960	2.30	10·6	7·8	0·4
3.00	148	2108	3.00	9·6	9·4	0·4
3.15	74	2182	3.30	9·1	7·7	2·0
3.45	206	2388	4.00	8·7	10·2	1·0
4.15	151	2539	4.30	9·2	9·0	1·5
4.20	49	2588	5·00	10·8	7·0	1·9
4.50	118	2706	5.30	10·0	7·5	1·9
5.20	106	2812	6.00	7·0	11·7	0·4
5.50	119	2931				
6.30	194	3125		8·9	9·4	1·1

OBSERVATIONS MADE DURING BOILER TRIAL No. 61

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.30	123	85	570	72	—·02	—·26	.....
8.45	118	85	575	72	—·02	—·26	380
9.00	120	86	580	72	—·02	—·28	474·5
9.15	123	86	630	72·5	—·02	—·28	528·5
9.30	115	87	630	72·5	—·02	—·28	521·5
9.45	108	87	570	72·5	—·02	—·28	597
10.00	123	87	585	72·5	—·02	—·28	331
10.15	115	87	615	72·5	—·02	—·28	558·5
10.30	120	87	625	72·5	—·02	—·26	500
10.45	120	87	580	72·5	—·02	—·26	423
11.00	113	87	600	72·5	—·02	—·26	611
11.15	115	87	575	72·5	—·02	—·26	509·5
11.30	121	87	570	72·5	—·02	—·26	335·5
11.45	122	87	590	72·5	—·02	—·26	394
12.00	108	87	580	72·5	—·02	—·26	425
12.15	123	86	630	72·5	—·02	—·26	362
12.30	120	86	600	72·5	—·02	—·26	331
12.45	118	85	600	72·5	—·02	—·26	419
1.00	123	86	660	73	—·02	—·26	440·5
1.15	116	86	600	73	—·02	—·26	429·5
1.30	118	87	600	73	—·02	—·28	470·5
1.45	118	88	670	73	—·02	—·28	481·5
2.00	121	87	650	73	—·02	—·28	472·5
2.15	121	86	630	73	—·02	—·28	423
2.30	121	88	610	73	—·02	—·28	423
2.45	110	88	650	73	—·02	—·28	542
3.00	123	87	620	73	—·02	—·28	492
3.15	113	87	600	73	—·02	—·28	510·5
3.30	113	87	610	72·5	—·02	—·28	460
3.45	123	86	610	72·5	—·02	—·28	440
4.00	121	87	610	72·5	—·02	—·28	471
4.15	122	87	600	72·5	—·02	—·28	411
4.30	123	87	600	72·5	—·02	—·28	570
4.45	120	87	595	72·5	—·02	—·28	460
5.00	118	88	630	72·5	—·02	—·30	470·5
5.15	115	87	585	72·5	—·02	—·30	489
5.30	118	87	620	72·5	—·02	—·30	300
5.45	113	85	610	72·5	—·02	—·30	432
6.00	121	85	610	72·5	—·02	—·30	411
6.15	120	85	640	72·5	—·02	—·32	466
6.30	118	85	630	72·5	—·02	—·32	452
	118·4	86·6	608	72·6	—·02	—·28	18,218·5 net

SUMMARY OF OBSERVATIONS.

Date—Aug. 6, 1908.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.30 a.m.	Ended—6.30 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned May, 1908
4.	Tubes cleaned	7.30 a.m.
5.	Fire cleaned	7.15 a.m., 12.20 p.m., 5.17 p.m.

Fuel.

6.	Kind of coal	No. 37—Dominion, No. 10 Colliery, Dominion Coal Co., Glace Bay, N.S.—Emery seam.
7.	Analysis of dry coal by weight (%)	$C=73\cdot3$, $H=4\cdot9$, $S=2\cdot5$, $N_2=1\cdot2$, $O_2=7\cdot0$, Ash $=11\cdot1$
8.	Calorific value of dry coal B.T.U. per lb	13120
9.	Moisture in coal as fired (%)	2·8
10.	Weight of coal fired (lbs.)	3125
11.	Combustible matter in ash and clinker (%)	15·4
12.	Weight of clinker (lbs.)	212
13.	Weight of ash (lbs.)	85

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−·02
15.	" above fire " "	−·20
16.	" at damper " "	−·28
17.	Amount of damper opening	Various
18.	Temperature of air in boiler house (°F.)	86·6
19.	Flue temperature (°F.)	608
20.	Analysis of dry flue gas by volume (%)	$CO_2=8\cdot9$, $O_2=9\cdot4$, $CO=1\cdot1$, $N_2=80\cdot6$

Water and Steam.

21.	Temperature of feed water (°F.)	72·6
22.	Total weight of feed water, corrected for difference of level (lbs.)	18218
23.	Water level in gauge at start (inches)	$3\frac{15}{16}$"
24.	Water level in gauge at finish (inches)	4"
25.	Correction for difference of level (lbs.)	−10
26.	Steam pressure by gauge (lbs. per sq. in.)	118·4
27.	Barometer reading (inches)	29·57
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	15·8
29.	Temperature in steam calorimeter (°F.)	291·6

Notes.

This coal could be burnt to great advantage on a shaking grate. The clinker was in small, hard pieces and easily removed. It cokes but little. Dense smoke was emitted. The fire was kept about 4" thick. Weather fine and clear.

Proximate analysis		
	Fixed carbon	53·8
	Volatile matter	35·1
	Ash	11·1

SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 37. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·58. At finish—29·56. Mean—29·57.

Total Quantities.

1.	Date of trial	6/8/08
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	3125
4.	Percentage of moisture in coal as fired (%)	2·8
5.	Total weight of dry coal fired (lbs.)	3038
6.	Total ash and refuse (lbs.)	297
7.	Percentage of ash and refuse in dry coal (%) (*a*)from analyses 13·12; (*b*) weighed	9·8
8.	Total weight of combustible consumed, from analyses (lbs.)	2639
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	18218
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	18140
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	21560

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	304
13.	Dry coal per square foot of grate surface per hour (lbs.)	18·1
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1814
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2156
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·36

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs./sq. in.)	118·4
18.	Temperature of feed water entering boiler (deg. F.)	72·6
19.	Temperature of escaping gases from boiler (deg. F.)	608
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·26
21.	Percentage of moisture in steam	0·6

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	62·5
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	104

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	5·83
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	6·90
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	7·10
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	8·17

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	13120
30.	Calorific value of the combustible per lb. (B.T.U.)	14770
31.	Efficiency of boiler (based on combustible consumed) (%)	53·4
32.	Efficiency of boiler, including grate (based on dry coal) (%)	52·2

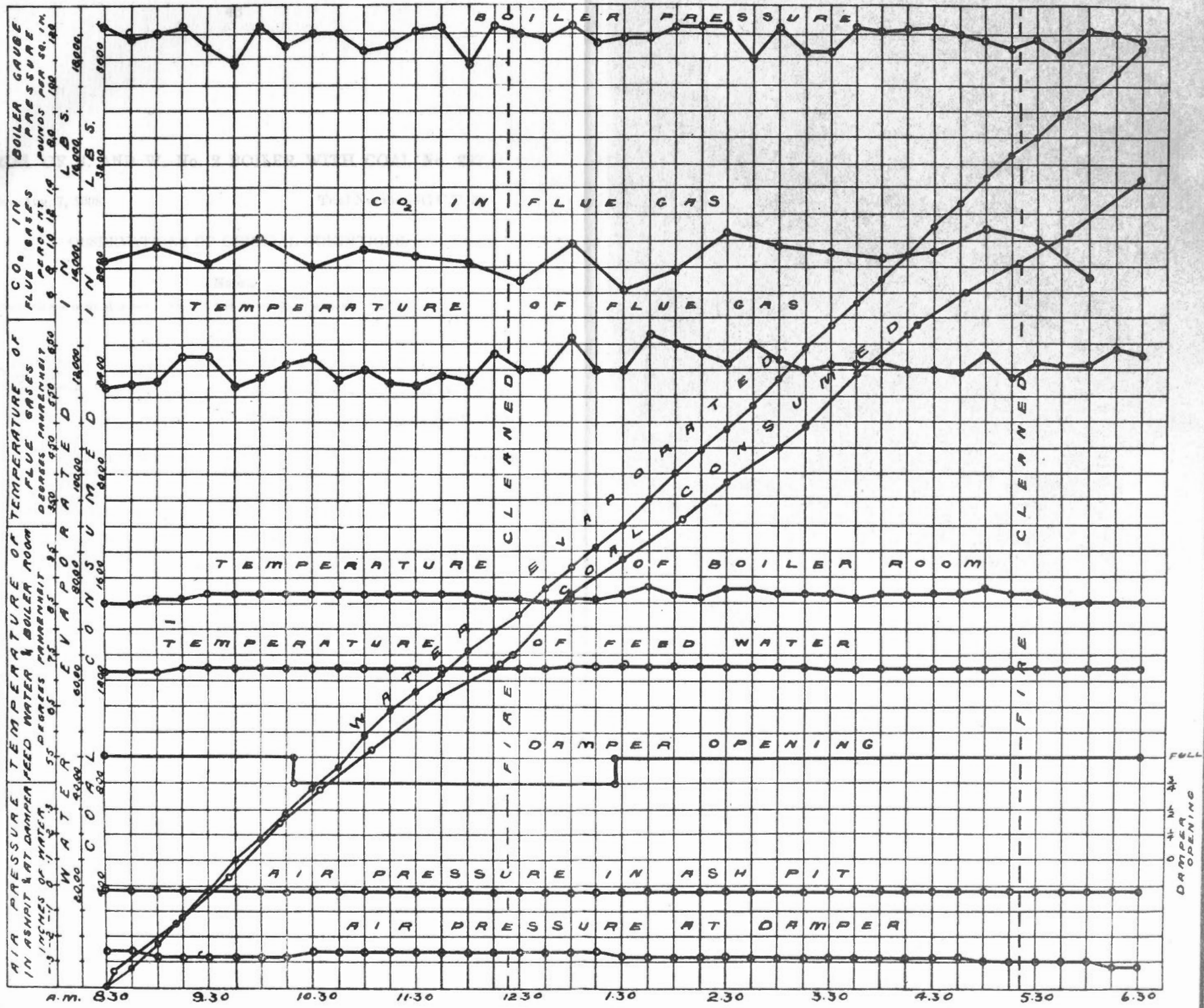
Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	24·8
34.	" " of combustible consumed (from gas analyses) (lbs.)	20·9
35.	" " dry coal (from gas analyses) (lbs.)	18·2
36.	Proportion of heat of fuel in escaping dry flue gases (%)	17·3

GRAPHIC RECORD OF BOILER TRIAL.

G.C.T. 61

COAL Nº 37



TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 237.

Date—Aug. 7, 1908. Trial Number—G.C.T. 62.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Weather dull and inclined to rain. No. 1 B. and W, and Robb working.

Time. a.m.	
7.20	Cleaned fire and made up with coal No. 237. Pressure, 115 lbs.
7.35	Tubes blown.
8.35	Trial started. Fire 1½″ thick half burnt through with flame along one side and the back.
9.05	Burning in a 3″ fire. Gives off much smoke. Burns with medium flame. Cokes but little.
9.23	Grill ¼ open.
9.35	Coal so small that fire is now only 2″ thick to enable draught to get through. Consequently firing very frequently.
9.50	Grill ½ open.
11.20	Sliced fire, large slabs of clinker removed. Not sticking to bars but in larger slabs than in unwashed. Could not be used on a shaking grate. 24 lbs. clinker removed.
12.00	Fire kept a bit thicker again; about 3″. Grill ¼ open.
12.30	Coal seems to burn best in 2½″ fire.
1.55	Sliced fire. Clinker in hard cakes, removed 16 lbs.
3.25	Sliced fire. Clinker in hard cakes, removed 9 lbs.
4.35	Sliced fire.
5.20	Cleaned fire; removed 44 lbs of clinker.
6.35	Finished trial. Fire as at start. 73 lbs. ashes raked from ash-pit.

Clinker and Ash.

11.20	Slicing.....		24	lbs.
1.55	Slicing.....		16	lbs.
3.25	Slicing.....		9	lbs.
5.20	Cleaned.....		44	lbs
			93	lbs. clinker.
6.35	75	148	73	lbs. ash.
			166	lbs. ash and clinker.

Note—The frequent slicing was due to the fusing together of the clinker which spread over the bars, impeding the supply of air from beneath.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 62

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.35 a.m.						
9.05	185	185	8.40	8·3	9·8	1·3
9.30	167	352	9.10	7·5	11·4	0·6
10.05	134	486	9.40	8·5	8·0	3·7
10.35	141	627	10.10	9·1	8·1	2·4
11.05	157	784	10.40	8·9	10·9	0·0
11.35	164	948	11.10	10·7	6·7	1·7
12.05	155	1103	11.40	6·5	13·2	0·3
12.30	160	1263	12.10	9·2	7·5	3·4
1.05	137	1400	12.40	9·5	9·2	0·8
1.40	167	1567	1.10	7·4	11·7	0·6
2.15	174	1741	1.40	8·6	8·4	2·6
2.45	133	1874	2.10	7·7	10·0	1·9
3.15	128	2002	2.40	8·5	11·5	0·0
3.25	86	2088	3.10	8·2	8·4	2·5
3.55	114	2202	3.40	7·4	12·7	0·1
4.25	160	2362	4.10	8·2	10·6	0·9
4.40	67	2429	4.40	10·5	8·1	0·6
5.20	202	2631	5.10	9·4	9·4	0·8
5.45	119	2750	5.40	10·5	7·3	2·1
6.15	114	2864	6.10	8·7	8·5	2·4
6.35	56	2920				
				8·7	9·6	1·4

OBSERVATIONS MADE DURING BOILER TRIAL No. 62.

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.35	115	83	600	73	—·02	—·30	.....
8.50	113	85	570	73	—·02	—·30	420
9.05	118	85	600	73	—·02	—·30	402
9.20	118	86	630	73	—·02	—·30	382
9.35	118	85	610	73	—·02	—·30	503
9.50	119	85	610	73	—·02	—·30	430
10.05	118	85	620	73	—·02	—·30	449
10.20	108	86	490	73·5	—·02	—·30	481
10.35	119	85	540	73·5	—·02	—·30	450
10.50	114	85	480	73·5	—·02	—·28	442·5
11.05	119	85	475	73·5	—·02	—·28	382
11.20	116	87	500	73·5	—·02	—·28	520
11.35	121	87	530	73·5	—·02	—·30	313
11.50	113	87	500	73·5	—·02	—·30	481·5
12.05	113	87	540	73·5	—·02	—·30	428
12.20	120	86	570	73·5	—·02	—·30	492·5
12.35	113	86	540	73	—·02	—·30	516
12.50	118	86	550	73	—·02	—·30	449
1.05	121	85	580	73	—·02	—·30	461
1.20	111	86	500	73	—·02	—·30	508·5
1.35	120	86	475	73	—·02	—·28	296
1.50	120	87	475	73	—·02	—·28	450
2.05	118	87	500	73	—·02	—·28	402
2.20	113	87	475	73	—·02	—·28	441
2.35	118	86	580	73·5	—·02	—·28	391·5
2.50	113	86	490	73	—·02	—·28	580·5
3.05	113	86	510	73	—·02	—·28	419·5
3.20	120	87	450	72·5	—·02	—·26	412
3.35	115	87	630	72·5	—·02	—·26	430
3.50	118	85	500	72·5	—·02	—·28	400
4.05	104	85	530	72·5	—·02	—·28	502·5
4.20	112	85	515	72·5	—·02	—·28	422
4.35	120	87	500	72·5	—·02	—·28	382·5
4.50	123	87	900	72·5	—·02	—·34	502
5.05	118	87	520	72·5	—·02	—·30	531
5.20	112	85	530	72·5	—·02	—·25	507·5
5.35	123	85	525	72·5	—·02	—·30	322·5
5.50	123	85	500	72·5	—·02	—·30	546·5
6.05	118	85	500	72·5	—·02	—·30	420
6.20	118	84	520	72·5	—·02	—·30	377
6.35	118	83	530	72·5	—·02	—·30	475
	116·6	85·7	541	73	—·02	—·29	17,722 net

SUMMARY OF OBSERVATIONS.

Date—Aug. 7, 1908.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.35 a.m.	Ended—6.35 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned May, 1908
4.	Tubes cleaned	7.35 a.m.
5.	Fire cleaned	7.20 a.m., 5.20 p.m.

Fuel.

6.	Kind of coal	No. 237—Dominion Coal Co., Sydney, No. 10 mine
7.	Analysis of dry coal by weight (%)	$C=78\cdot5$, $H=5\cdot2$, $S_2=2\cdot1$, $N_2=1\cdot3$, $O_2=7\cdot1$, Ash $=5\cdot8$
8.	Calorific value of dry coal B.T.U. per lb	13880
9.	Moisture in coal as fired (%)	4·5
10.	Weight of coal fired (lbs.)	2920
11.	Combustible matter in ash and clinker (%)	17·5
12.	Weight of clinker (lbs.)	93
13.	Weight of ash (lbs.)	73

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−·02
15.	" above fire " "	−·22
16.	" at damper " "	−·29
17.	Amount of damper opening	Full
18.	Temperature of air in boiler house (°F.)	85·7
19.	Flue temperature (°F.)	541
20.	Analysis of dry flue gas by volume (%)	$CO_2=8\cdot7$, $O_2=9\cdot6$, $CO=1\cdot4$, $N=80\cdot3$

Water and Steam.

21.	Temperature of feed water (°F.)	73
22.	Total weight of feed water, corrected for difference of level (lbs.)	17,722
23.	Water level in gauge at start (inches)	$3\frac{1}{2}$
24.	Water level in gauge at finish (inches)	$3\frac{5}{8}$
25.	Correction for difference of level, included above (lbs)	−·20
26.	Steam pressure by gauge (lbs. per sq. in.)	116·6
27.	Barometer reading (inches)	29·57
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	15·4
29.	Temperature in steam calorimeter (°F.)	290·5

Notes.

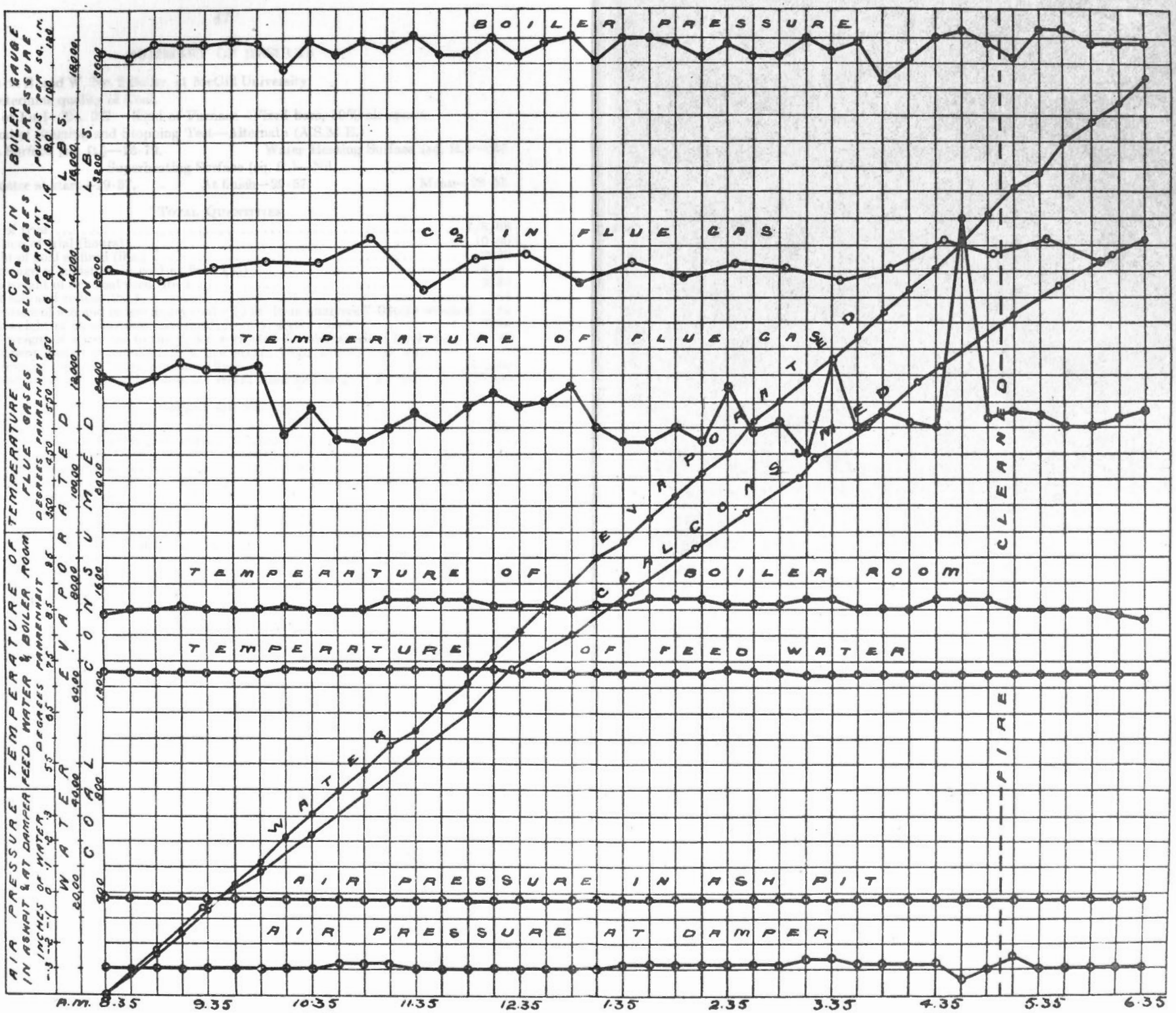
This coal was on the small side, necessitating a fire about 2½" thick only. Trouble was given by formation of clinker which formed over bars in a hard cake, necessitating frequent slicings to permit the air to get through. It could not be worked on a shaking grate. The coal did not coke. Much smoke was emitted. Air was admitted above the grate. Fire sliced 11.20, 1.55, 3.25, 4.35. Weather dull and inclined to rain.

Proximate analysis { Fixed carbon ..... 57·3; Volatile matter ..... 36·9; Ash ..... 5·8

GRAPHIC RECORD OF BOILER TRIAL.

G.C.T. 62.

COAL Nº 37/00



SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 237. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·57. At finish—29·57. Mean—29·57.

Total Quantities.

1.	Date of trial	7/8/08
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	2920
4.	Percentage of moisture in coal as fired (%)	4·5
5.	Total weight of dry coal fired (lbs.)	2789
6.	Total ash and refuse (lbs.)	166
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 7·03; (*b*) weighed	5·95
8.	Total weight of combustible consumed, from analyses (lbs.)	2593
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	17,722
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17,640
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	20,950

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	279
13.	Dry coal per square foot of grate surface per hour (lbs.)	16·54
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1764
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2095
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·2

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	116·6
18.	Temperature of feed water entering boiler (deg. F.)	73
19.	Temperature of escaping gases from boiler (deg. F.)	541
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·27
21.	Percentage of moisture in steam	0·6

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	60·7
23.	Builders' rated horse-power	60·0
24.	Percentage of builders' rated horse-power developed	101

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	6·07
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	7·17
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	7·51
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	8·08

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	13,880
30.	Calorific value of the combustible per lb. (B.T.U.)	14,735
31.	Efficiency of boiler (based on combustible consumed) (%)	52·9
32.	Efficiency of boiler, including grate (based on dry coal) (%)	52·2

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	24·6
34.	" " of combustible consumed (from gas analyses) (lbs.)	20·8
35.	" " dry coal (from gas analyses) (lbs.)	19·3
36.	Proportion of heat of fuel in escaping dry flue gases (%)	15·2

TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 13.

Date—Aug. 15, 1907. Trial Number—G.C.T. 24.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Weather fine still. No. 1 B. and W. boiler working, Robb boiler shut down.

Time.
7.25 Fire cleaned and made up with No. 13 coal. Pressure, 65 lbs.
7.45 Tubes cleaned.
8.50 Trial started. Fire 1½" thick, a little flame. Grill in fire door full open.
12.25 to 12.38. Fire cleaned. 60 lbs. of cinders and a thin hard clinker removed with some difficulty.
3.10 Fire sliced, clinker too thin to move.
3.20 Commenced to blow steam under bars.
3.30 Fire sliced, clinker still holding.
3.40 Fan started, grill closed.
4.39 Fan stopped. Fire sliced.
4.48 Grill opened.
5.25 to 5.37. Fire cleaned, 49 lbs. of clinker and cinders removed. Steam under bars stopped.
6.53 Trial stopped.
74 lbs. of ashes raked from pit.

CLINKER AND ASH.

Net.
109 lbs. clinker.
74 lbs. ash.

Blow-off examined and found tight. Front row of grate bars buckled sideways, leaving gap on L.H side: hence a quantity of cinders in ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 24

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.50						
8.57	145	145	9.15	9·2	9·0	0·0
9.20	177	322	9.55	10·9	6·5	0·3
9.41	165	487	10.25	10	7·4	1·0
10.10	166	653	11.00	8·5	10·7	0·3
10.41	164	817	11.30	9·0	9·0	0·4
11.08	160	977	12.03	6·8	10·4	0·8
11.39	159	1136	12.45	11·4	3·4	3·7
12.22	144	1280	1.15	10·2	5·8	2·0
12.49	152	1432	1.45	9·0	9·5	0·5
1.05	157	1589	2.15	9·0	10·2	0·4
1.36	163	1752	2.45	8·4	9·4	0·8
2.12	154	1906	3.17	6·1	14	0·3
2.45	179	2085	3.45	9·3	11·1	0·0
3.48	155	2240	4.17	8·5	9·9	0·7
4.06	168	2408	4.50	6·5	10	1·5
4.22	155	2563	5.15	17·4	1·2	0·1
5.00	175	2738	5.50	8·4	9·0	0·8
5.40	190	2928	6.15	9·7	8·6	0·7
6.15	176	3104				
6.53	58	3162		9·4	8·6	0·8

OBSERVATIONS MADE DURING BOILER TRIAL No. 24

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.50	119	77	550	70·5	0·0	−·30	.....
9.05	103	76	615	70·5	0·0	−·30	420
9.20	118	80	630	70·5	0·0	−·30	662
9.35	108	79	570	69	0·0	−·30	649
9.50	108	82	545	69·5	0·0	−·30	592
10.05	107	82	500	70	0·0	−·30	571
10.20	108	82	500	70·5	0·0	−·30	562
10.35	102	85	465	71	0·0	−·30	520
10.50	98	84	460	70·5	0·0	−·20	481
11.05	107	86	435	70·5	0·0	−·20	393·5
11.20	103	85	430	70·5	0·0	−·28	375
11.35	95	85	415	70·5	0·0	−·30	572
11.50	104	86	400	70·5	0·0	−·30	290·5
12.05	96	86	390	70·5	0·0	−·30	469
12.20	122	85	400	71	0·0	−·30	188
12.35	120	90	475	71	0·0	−·30	290·5
12.50	112	85	610	71	0·0	−·30	540·5
1.05	104	84	470	71	0·0	−·30	559·5
1.20	99	87	465	71	0·0	−·30	535·5
1.35	99	86	450	71·5	0·0	−·30	498
1.50	122	86	450	71·5	0·0	−·30	353·5
2.05	116	87	450	71·5	0·0	−·30	445·5
2.20	109	86	440	71·5	0·0	−·30	379·5
2.35	110	83	425	71·5	0·0	−·30	565
2.50	108	84	450	71·5	0·0	−·30	346
3.05	113	84	425	71·5	0·0	−·30	437·5
3.20	115	85	400	71·5	0·0	−·30	110
3.35	96	85	410	71·5	0·0	−·30	317
3.50	106	85	500	71·5	+·4	−·50	308·5
4.05	100	86	480	71·5	+·15	−·45	523
4.20	118	86	550	71·5	+·15	−·45	325
4.35	118	86	575	71·5	+·15	−·45	502·5
4.50	114	86	700	71·5	−·07	−·30	522·5
5.05	118	85	660	71·5	−·07	−·30	831·5
5.20	112	82	600	71·5	−·02	−·40	469
5.35	107	88	480	71·5	−·02	−·40	405
5.50	117	86	460	71·5	−·02	−·40	440·5
6.05	117	85	475	71·5	−·02	−·40	412
6.20	114	85	475	71·5	−·02	−·40	510
6.35	118	85	460	71·5	−·02	−·40	374
6.53	111	84	465	71·5	−·02	−·40	476
	109·5	84·4	490·0	71·0	+·01	−·32	18,134·5 net

SUMMARY OF OBSERVATIONS.

Date—Aug. 15, 1907.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.50 a.m.	Ended—6.53 p.m.	Duration—603 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural and forced
3.	Condition of boiler and date of last cleaning.	Thoroughly cleaned June, 1907. Fresh water, August 10.
4.	Tubes cleaned	7.45 a.m.
5.	Fire cleaned	7.25 a.m., 12.25 and 5.25 p.m.

Fuel.

6.	Kind of coal.	No. 13, No. 1 Colliery, Sydney Mines, Nova Scotia Steel & Coal Co. Over ⅞″ bars and picking belt.
7.	Analysis of dry coal by weight (%),	C=75·4, H=5·1, S=2·9, N=1·3, O=8·1, Ash=7·2.
8.	Calorific value of dry coal B.T.U. per lb	13770
9.	Moisture in coal as fired (%)	2·3
10.	Weight of coal fired (lbs.)	3162
11.	Combustible matter in ash and clinker (%)	30·4
12.	Weight of clinker (lbs)	109
13.	Weight of ash (lbs.)	74

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	+·01
15.	" above fire " "	−·19
16.	" at damper " "	−·32
17.	Amount of damper opening	Various
18.	Temperature of air in boiler house (°F.)	84·4
19.	Flue temperature (°F.)	490
20.	Analysis of dry flue gas by volume (%)	CO_2=9·4, O_2=8·6, CO=0·8, N_2=81·2

Water and Steam.

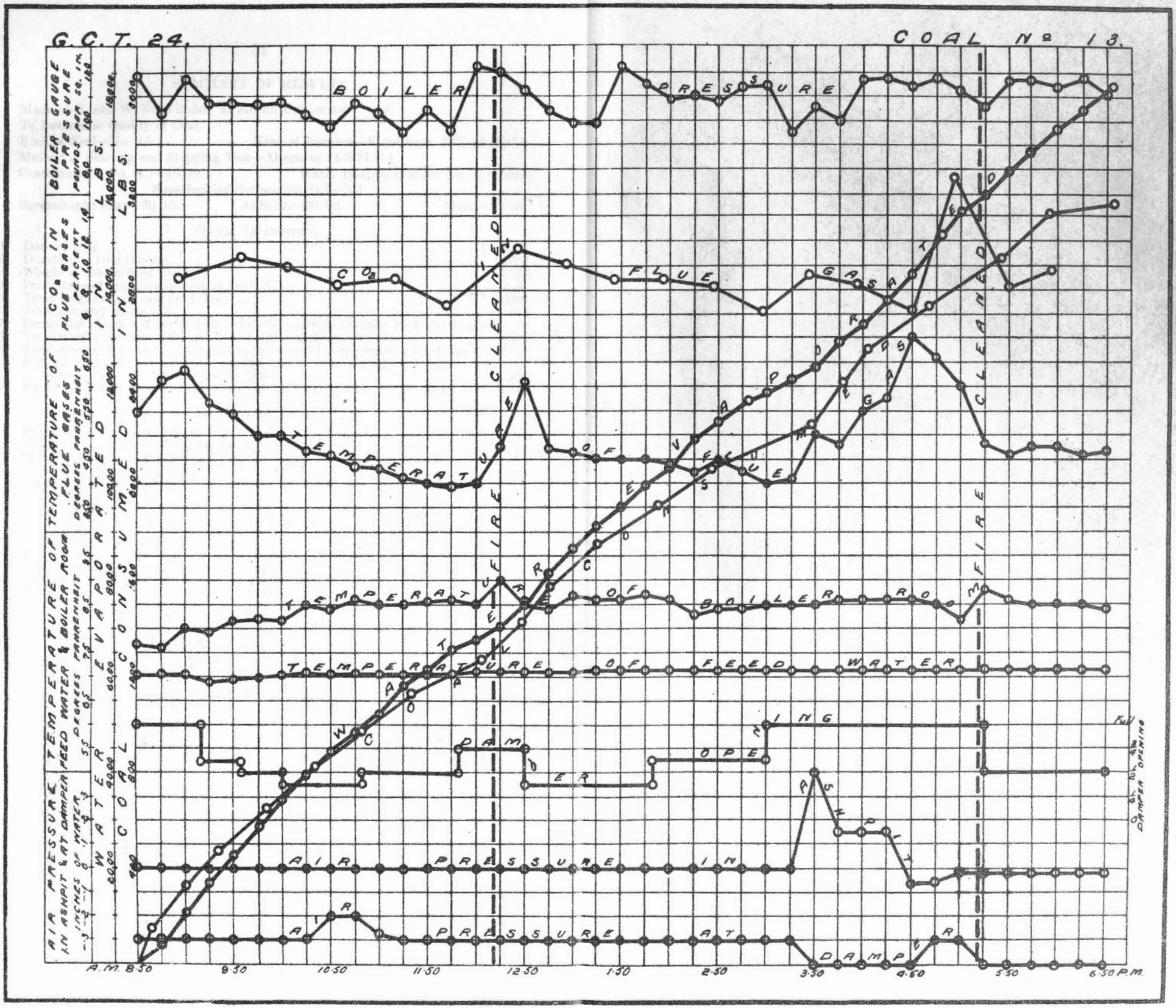
21.	Temperature of feed water (°F.)	71·0
22.	Total weight of feed water, corrected for difference of level (lbs.)	18134
23.	Water level in gauge at start (inches)	3½
24.	Water level in gauge at finish (inches)	3½
25.	Correction for difference of level (lbs.)	Nil
26.	Steam pressure by gauge (lbs. per sq. in.)	109·5
27.	Barometer reading (inches)	30·05
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	19·9
29.	Temperature in steam calorimeter (°F.)	284

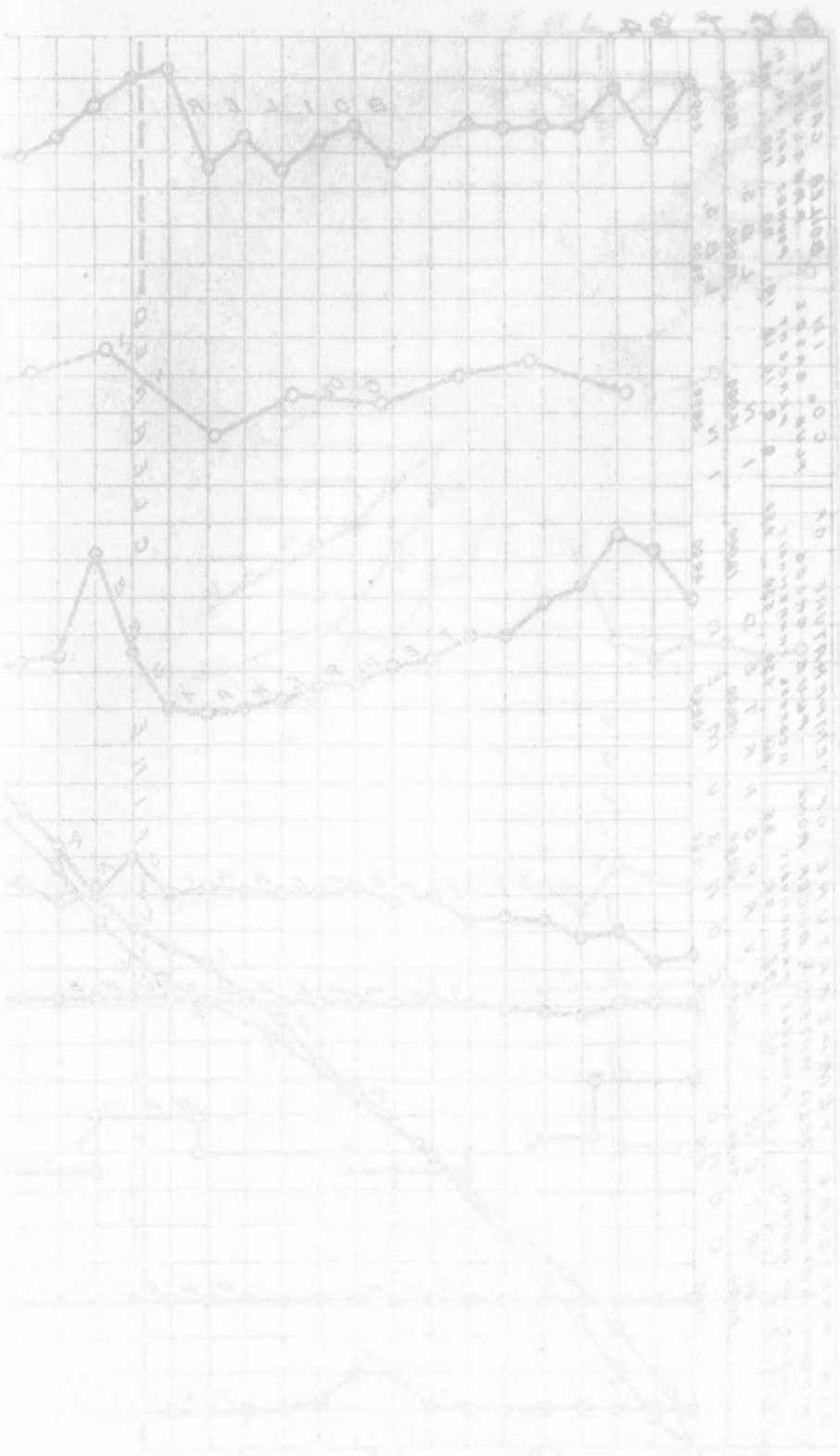
Notes.

Fire sliced 3.10 and 3.30 p.m. Air admitted over fire from start to 3.40 p.m. and from 4.48 to close. Steam blown under grate from 3.20 p.m. until 5.30 p.m. Draft forced from 3.40 to 4.39 p.m. Clinker thin and hard, removed with some difficulty. Front row of grate bars buckled during trial. Weather fine and still.

Proximate analysis of dry coal by weight (%)

Fixed carbon	55·4
Volatile matter	37·4
Ash	7·2


G.C.T. 24.
COAL No 13.
BOILER PRESSURE
CO2 IN FLUE GASES
TEMPERATURE OF FLUE GASES
TEMPERATURE OF BOILER ROOM
TEMPERATURE OF FEED WATER
AIR PRESSURE IN ASHPIT & AT DAMPER
BOILER GAUGE PRESSURE
CLEANED FIRE
UNCLEANED FIRE
A.M. 8.50 9.50 10.50 11.50 12.50 1.50 2.50 3.50 4.50 5.50 6.50 P.M.



SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 13. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—30·10. At finish—30·00. Mean—30·05.

Total Quantities.

1.	Date of trial	15/8/07
2.	Duration of trial (hours)	10·05
3.	Weight of coal as fired (lbs.)	3162
4.	Percentage of moisture in coal as fired (%)	2·3
5.	Total weight of dry coal fired (lbs.)	3089
6.	Total ash and refuse (lbs.)	183
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 10·3; (*b*) weighed	5·9
8.	Total weight of combustible consumed, from analyses (lbs.)	2769
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	18134
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17970
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	21345

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	308
13.	Dry coal per square foot of grate surface per hour (lbs.)	18·3
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1788
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2124
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·33

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs./sq. in.)	109·5
18.	Temperature of feed water entering boiler (deg. F.)	71·0
19.	Temperature of escaping gases from boiler (deg. F.)	490
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·33
21.	Percentage of moisture in steam	1·0

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	61·7
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	102·8

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	5·74
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	6·74
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	6·91
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	7·71

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	13770
30.	Calorific value of the combustible per lb. (B.T.U.)	14820
31.	Efficiency of boiler (based on combustible consumed) (%)	50·2
32.	Efficiency of boiler, including grate (based on dry coal) (%)	48·5

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	24·4
34.	" " of combustible consumed (from gas analyses) (lbs.)	20·5
35.	" " dry coal (from gas analyses) (lbs.)	18·4
36.	Proportion of heat of fuel in escaping dry flue gases (%)	13·0

TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 213.

Date—Aug. 16, 1907. Trial Number—G.C.T. 25.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

36 new grate bars in front. Weather fine.

Time.

8.45 Fire made up with some wood, a little 13 unwashed, and with 213 washed coal. Pressure, 0.
9.20 Tubes cleaned. Pressure, 120 lbs.
9.50 Trial started. Fire 2″ thick, a little flame. Grill in fire door open.
9.53 Commenced to blow steam into ash-pit.
5.37 Fire sliced.
6.43 to 6.49. Fire cleaned. 37 lbs. of thin clinker removed without difficulty. Steam under bars stopped.
7.50 Trial stopped. Fire very similar to start. 116 lbs. of ashes raked from pit.

CLINKER AND ASH

37 lbs. clinker.
116 lbs. ash

Blow-off examined and found tight.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 25

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 9.50 a.m.						
10.14	216	216	10.05	8·7	8·8	0·0
10.33	160	376	10.40	8·5	10·5	0·0
11.06	164	540	11.13	10·5	7·1	0·9
11.30	172	712	11.45	7·0	10·6	0·6
12.10	173	885	12.17	2·8	16·4	0·2
12.47	185	1070	12.58	8·3	10·9	0·4
1.23	188	1258	1.27	10·4	7·4	0·5
1.55	189	1447	2.03	12·4	4·4	1·2
2.18	141	1588	2.28	8·6	9·0	1·0
3.04	184	1772	3.02	9·6	8·3	0·6
3.35	158	1930	3.30	9·8	10·2	0·6
4.10	167	2097	4.00	6·5	12·0	0·5
4.36	162	2259	4.30	7·8	10·2	0·4
5.12	185	2444	5.11	9·4	8·4	0·5
5.51	159	2603	5.42	13·8	4·4	0·7
6.22	170	2773	6.05	14·6	4·8	0·2
6.56	169	2942	6.30	9·4	10·4	0·2
7.24	166	3108	7.00	8·0	10	0·2
7.50	85	3193	7.17	8·2	11	0·0
				9·2	9·2	0·5

OBSERVATIONS MADE DURING BOILER TRIAL No. 25

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
9.50	122	84	480	72	—·05	—·20	.....
10.05	117	87	590	72·5	—·05	—·30	467·5
10.20	115	86	590	72	—·05	—·30	429·5
10.35	113	87	620	72	—·05	—·30	451·5
10.50	122	88	635	72	—·05	—·35	607·5
11.05	122	88	580	72	—·05	—·25	460·5
11.20	120	91	580	72	—·05	—·20	632·5
11.35	122	90	570	72	—·05	—·20	673
11.50	104	89	560	72	—·05	—·20	416
12.05	120	92	555	72	—·02	—·20	419
12.20	104	92	610	72	—·05	—·20	503
12.35	120	90	575	72	—·05	—·20	415
12.50	122	91	540	72	—·05	—·20	498·5
1.05	117	92	585	72	—·05	—·20	389·5
1.20	121	92	550	72	—·05	—·20	523·5
1.35	117	93	570	72	—·05	—·25	545·5
1.50	122	92	550	72	—·05	—·20	422
2.05	122	92	540	72	—·05	—·20	346
2.20	107	93	590	72	—·05	—·20	654·5
2.35	114	94	500	72	—·05	—·20	346
2.50	110	94	500	72·5	—·02	—·20	571·5
3.05	112	96	505	72·5	—·02	—·25	308
3.20	99	92	620	72·5	—·02	—·20	579·5
3.35	116	91	560	73	—·05	—·20	412
3.50	115	92	540	73	—·05	—·20	426·5
4.05	114	92	560	73	—·05	—·20	464·5
4.20	117	92	580	72	—·05	—·30	488·5
4.35	115	93	550	72	—·05	—·25	451
4.50	116	92	560	72	—·05	—·30	475·5
5.05	105	92	540	72	—·05	—·30	483·5
5.20	106	93	540	72	—·05	—·30	393
5.35	120	91	490	72·5	—·05	—·30	381
5.50	117	92	580	72·5	—·05	—·25	399·5
6.05	120	92	720	73	—·05	—·35	562·5
6.20	120	92	670	73	—·05	—·35	563·5
6.35	119	91	735	72·5	—·05	—·35	434·5
6.50	107	95	525	72	—·05	—·30	562·5
7.05	107	90	590	72	—·02	—·30	435
7.20	122	91	520	72	—·05	—·25	356
7.35	102	91	590	72	—·05	—·25	529
7.50	104	91	625	72	—·05	—·30	503·5
	114·8	91·2	572	72·2	—·05	—·25	18931·5 net

SUMMARY OF OBSERVATIONS.

Date—Aug. 16, 1907.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—9.50 a.m.	Ended—7.50 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned June, 1907. Fresh water, August 10.
4.	Tubes cleaned	9.20 a.m.
5.	Fire cleaned	8.45 a.m., 6.45 p.m.

Fuel.

6.	Kind of coal	No. 213, No. 1 Colliery, Sydney Mines, Nova Scotia Steel & Coal Co., over $\frac{1}{2}$" bars and picking belt.
7.	Analysis of dry coal by weight (%)	C = 79·3, H = 5·4, S = 1·9, N = 0·9, O = 9·0, Ash = 3·5
8.	Calorific value of dry coal B.T.U. per lb	14,490
9.	Moisture in coal as fired (%)	3·3
10.	Weight of coal fired (lbs.)	3193
11.	Combustible matter in ash and clinker (%)	41·2
12.	Weight of clinker (lbs.)	37
13.	Weight of ash (lbs.)	116

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−0·05
15.	" above fire " "	−0·16
16.	" at damper " "	−0·25
17.	Amount of damper opening	Various
18.	Temperature of air in boiler house (°F.)	91·2
19.	Flue temperature (°F.)	572
20.	Analysis of dry flue gas by volume (%)	CO_2 = 9·2, O_2 = 9·2, CO = 0·5, N_2 = 81·1

Water and Steam.

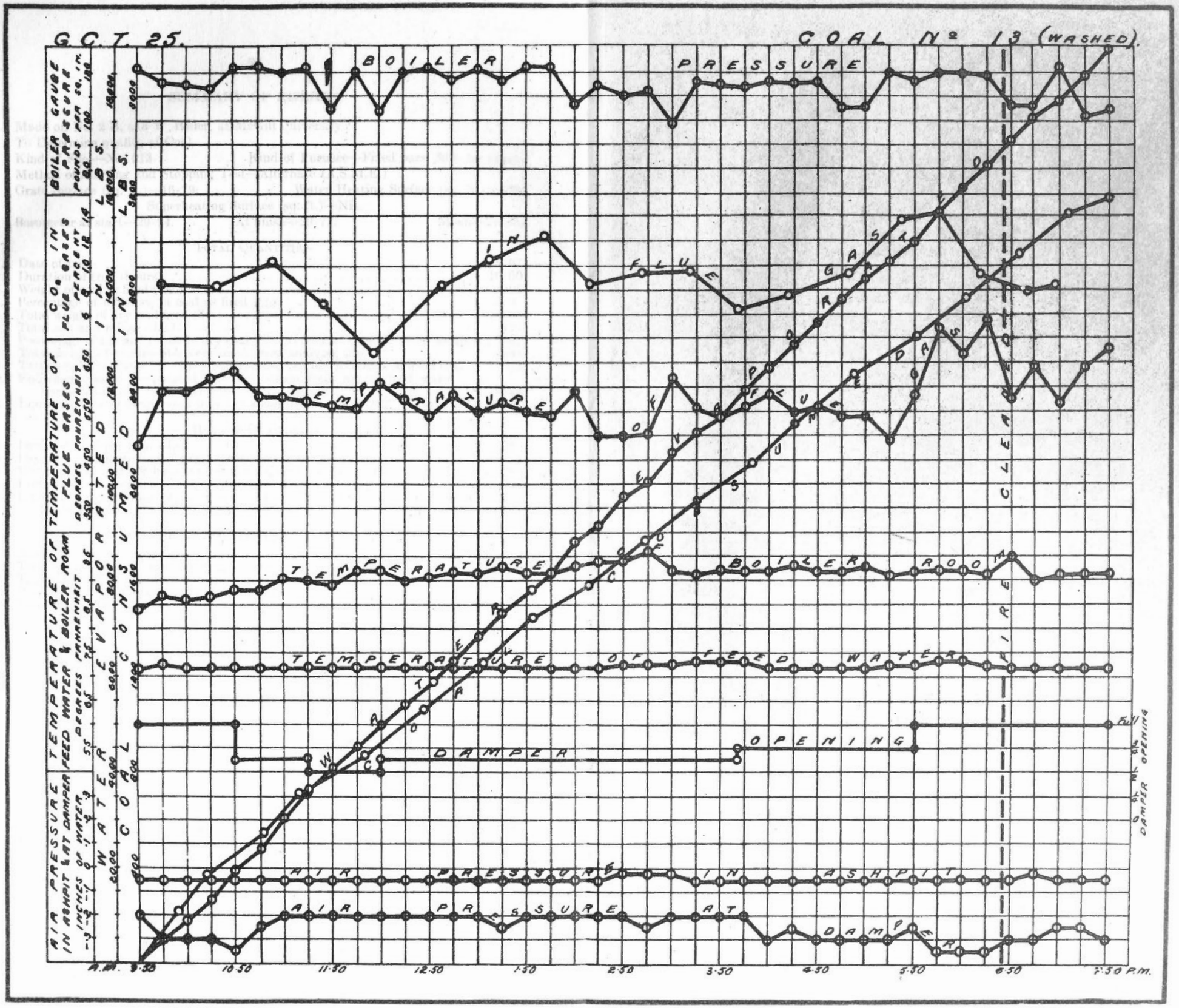
21.	Temperature of feed water (°F.)	72·2
22.	Total weight of feed water, corrected for difference of level (lbs.)	18,931
23.	Water level in gauge at start (inches)	3½
24.	Water level in gauge at finish (inches)	3⅜
25.	Correction for difference of level, included above (lbs.)	19
26.	Steam pressure by gauge (lbs. per sq. in.)	114·8
27.	Barometer reading (inches)	29·85
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	21·2
29.	Temperature in steam calorimeter (°F.)	294·6

Notes.

Fire sliced 5.37 p.m. Air admitted over fire throughout trial. Steam blown under grate throughout trial. Clinker thin and removed without difficulty. Grate bars in front row renewed. Weather fine.

Proximate analysis of dry coal by weight %

Fixed carbon	56·3
Volatile matter	40·2
Ash	3·5


G.C.T. 25.
COAL Nº 13 (WASHED).
BOILER PRESSURE
CO2 IN FLUE GASES
TEMPERATURE OF FLUE GASES
TEMPERATURE OF BOILER ROOM
TEMPERATURE OF FEED WATER
AIR PRESSURE IN ASHPIT
AIR PRESSURE AT DAMPER
FLUE GAS
CLEANED FIRE
DAMPER OPENING
Full
A.M. 9:30
10:30
11:30
12:30
1:30
2:30
3:30
4:30
5:30
6:30
7:30 P.M.

SUMMARY OF RESULTS

Made on No. 2 B. and W. Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 213. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·94. At finish—29·77. Mean—29·85.

Total Quantities.

1.	Date of trial	16/8/07
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	3193
4.	Percentage of moisture in coal as fired (%)	3·3
5.	Total weight of dry coal fired (lbs.)	3088
6.	Total ash and refuse (lbs.)	153
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 6·0; (*b*) weighed	5·0
8.	Total weight of combustible consumed, from analyses (lbs.)	2904
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	18931
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	18834
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	22376

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	309
13.	Dry coal per square foot of grate surface per hour (lbs.)	18·4
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1883
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2238
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·5

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	114·8
18.	Temperature of feed water entering boiler (deg. F.)	72·2
19.	Temperature of escaping gases from boiler (deg. F.)	572
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·20
21.	Percentage of moisture in steam	1·0

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	64·9
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	108·2

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	5·93
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	7·01
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	7·24
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	7·70

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	14490
30.	Calorific value of the combustible per lb. (B.T.U.)	15000
31.	Efficiency of boiler (based on combustible consumed) (%)	49·6
32.	Efficiency of boiler, including grate (based on dry coal) (%)	48·4

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	25·7
34.	" " of combustible consumed (from gas analyses) (lbs.)	21·7
35.	" " dry coal (from gas analyses) (lbs.)	20·4
36.	Proportion of heat of fuel in escaping dry flue gases (%)	16·3

TRIALS OF B. AND W. No. 2 BOILER WITH COAL No. 12.

Date—Aug. 9, 1907. Trial Number—G.C.T. 21.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Weather fine and warm. B. and W. boiler No. 1 working.

Time.
7.35 Tubes cleaned.
7.45 Fire cleaned and made up with No. 12 coal.
8.55 Trial started. Fire 1½″ thick, well burnt.
Grill in fire door half open.
10.20 Grill full open.
Fire about 4″ thick during morning.
12.44 to 12.51. Fire cleaned. 67 lbs. of cinders and thin clinker removed without difficulty.
4.27 Fire sliced.
5.43 to 5.54. Fire cleaned. 80 lbs. of thin clinker removed from bars with great difficulty.
6.55 Trial stopped. Fire very similar to start. 69 lbs. of ashes raked from pit.

CLINKER AND ASH.

147 lbs. clinker.
69 lbs. ash.

Blow-off examined and found to be tight. Fire about 4″ thick throughout.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 21

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval	Total.		CO_2	O_2	CO
Start 8.55 a.m.			9.00	5·8	11·6	0·6
9.11	189	189	9.40	9·6	8·4	0·6
9.35	144	333	10.10	9·8	7·8	0·8
10.00	171	504	10.35	8·4	9·1	1·1
10.25	167	671	11.05	8·0	10·6	0·8
10.49	145	816	11.35	11·4	7·2	0·4
11.18	170	986	12.07	8·4	10·3	0·1
11.51	156	1142	12.35	7·6	11·4	0·2
12.38	165	1307	1.05	14·3	3·3	1·0
1.04	159	1466	1.30	13·6	4·7	0·4
1.33	176	1642	2.05	11·4	7·2	0·4
1.48	156	1798	2.38	8·2	10·6	0·4
2.30	167	1965	3.00	10·3	8·4	0·3
2.55	142	2107	3.37	7·8	11·4	0·4
3.33	156	2263	4.15	8·0	11·8	0·1
4.07	151	2414	4.37	10·6	8·0	0·3
4.43	192	2606	5.07	9·8	9·0	0·3
5.12	147	2753	5.35	8·6	10·8	0·0
5.56	147	2900	6.00	7·2	12·2	0·2
6.25	183	3083	6.30	7·6	12·2	0·1
6.55	78	3161		9·3	9·3	0·4

OBSERVATIONS MADE DURING BOILER TRIAL No. 21

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.55	105	92	460	71	—·07	—·25	.....
9.10	111	90	520	71	—·07	—·25	105
9.25	105	89	610	71	—·07	—·25	393
9.40	107	91	610	71	—·07	—·25	541
9.55	103	92	610	71	—·07	—·25	557·5
10.10	101	92	550	71	—·07	—·25	513
10.25	112	92	520	71	—·07	—·25	466·5
10.40	110	94	550	71	—·07	—·25	453
10.55	108	93	510	71	—·07	—·25	536
11.10	103	93	515	71·5	—·07	—·25	399
11.25	108	93	555	71·5	—·07	—·25	402
11.40	99	93	580	71·5	—·07	—·25	498
11.55	95	93	525	71·5	—·07	—·25	376·5
12.10	108	96	500	71·5	—·07	—·25	398
12.25	117	97	515	71·5	—·07	—·28	374·5
12.40	113	97	485	71·5	—·07	—·28	400
12.55	108	103	520	71·5	—·07	—·28	276
1.10	118	99	800	71·5	—·07	—·28	420·5
1.25	104	97	720	71·5	—·07	—·28	675·5
1.40	118	97	725	72	—·07	—·28	382
1.55	98	96	700	72	—·07	—·28	709·5
2.10	102	99	590	71·5	—·07	—·28	451
2.25	102	102	550	72	—·07	—·28	491
2.40	103	97	575	72	—·07	—·25	497
2.55	102	98	610	71·5	—·07	—·25	424·5
3.10	108	97	580	71·5	—·07	—·25	564
3.25	105	97	525	71·5	—·07	—·25	388
3.40	100	97	510	72	—·07	—·25	426·5
3.55	107	96	515	72	—·07	—·25	387·5
4.10	98	95	515	71·5	—·07	—·25	413
4.25	96	96	555	71.5	—·07	—·25	419·5
4.40	99	96	720	71·5	—·07	—·25	391·5
4.55	103	96	645	71·5	—·07	—·25	561
5.10	121	95	565	72	—·05	—·35	482
5.25	114	94	525	71·5	—·05	—·35	445
5.40	112	93	480	71·5	—·05	—·35	387·5
5.55	104	102	500	71·5	—·05	—·35	229
6.10	118	95	700	71·5	—·05	—·35	505·5
6.25	115	94	715	71·5	—·05	—·35	574·5
6.40	117	93	615	71·5	—·05	—·35	547
6.55	104	93	610	72	—·05	—·35	479·5
	106·9	95·0	577	71·5	—·07	—·27	18,179 net

SUMMARY OF OBSERVATIONS

Date—Aug. 9, 1907.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.55 a.m.	Ended—6.55 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning.	Thoroughly cleaned June, 1907. Fresh water, August 2.
4.	Tubes cleaned	7.35 a.m.
5.	Fire cleaned	7.45 a.m., 12.45 and 5.45 p.m.

Fuel.

6.	Kind of coal, No. 12—No. 3 Colliery, Sydney Mines, Nova Scotia, Steel & Coal Co. Over $\frac{1}{2}''$ screen and picking belt.	
7.	Analysis of dry coal by weight (%)	C = 74·9, H = 5·1, S = 2·5, N = 1·4, O = 9·4, Ash = 6·7
8.	Calorific value of dry coal B.T.U. per lb	13680
9.	Moisture in coal as fired (%)	4·2
10.	Weight of coal fired (lbs.)	3161
11.	Combustible matter in ash and clinker (%)	24·0
12.	Weight of clinker (lbs.)	147
13.	Weight of ash (lbs.)	69

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−0·07
15.	" above fire " "	−0·20
16.	" at damper " "	−0·27
17.	Amount of damper opening	Various
18.	Temperature of air in boiler house (°F.)	95
19	Flue temperature (°F.)	577
20	Analysis of dry flue gas by volume (%)	$CO_2 = 9·3$, $O_2 = 9·3$, $CO = 0·4$, $N_2 = 81·0$

Water and Steam.

21.	Temperature of feed water (°F.)	71·5
22.	Total weight of feed water, corrected for difference of level (lbs.)	18179
23.	Water level in gauge at start (inches)	$4\frac{11}{16}$
24.	Water level in gauge at finish (inches)	$5\frac{1}{16}$
25.	Correction for difference of level included above (lbs.)	38
26.	Steam pressure by gauge (lbs. per sq. in.)	106·9
27.	Barometer reading (inches)	29·84
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	21·1
29.	Temperature in steam calorimeter (°F.)	286·1

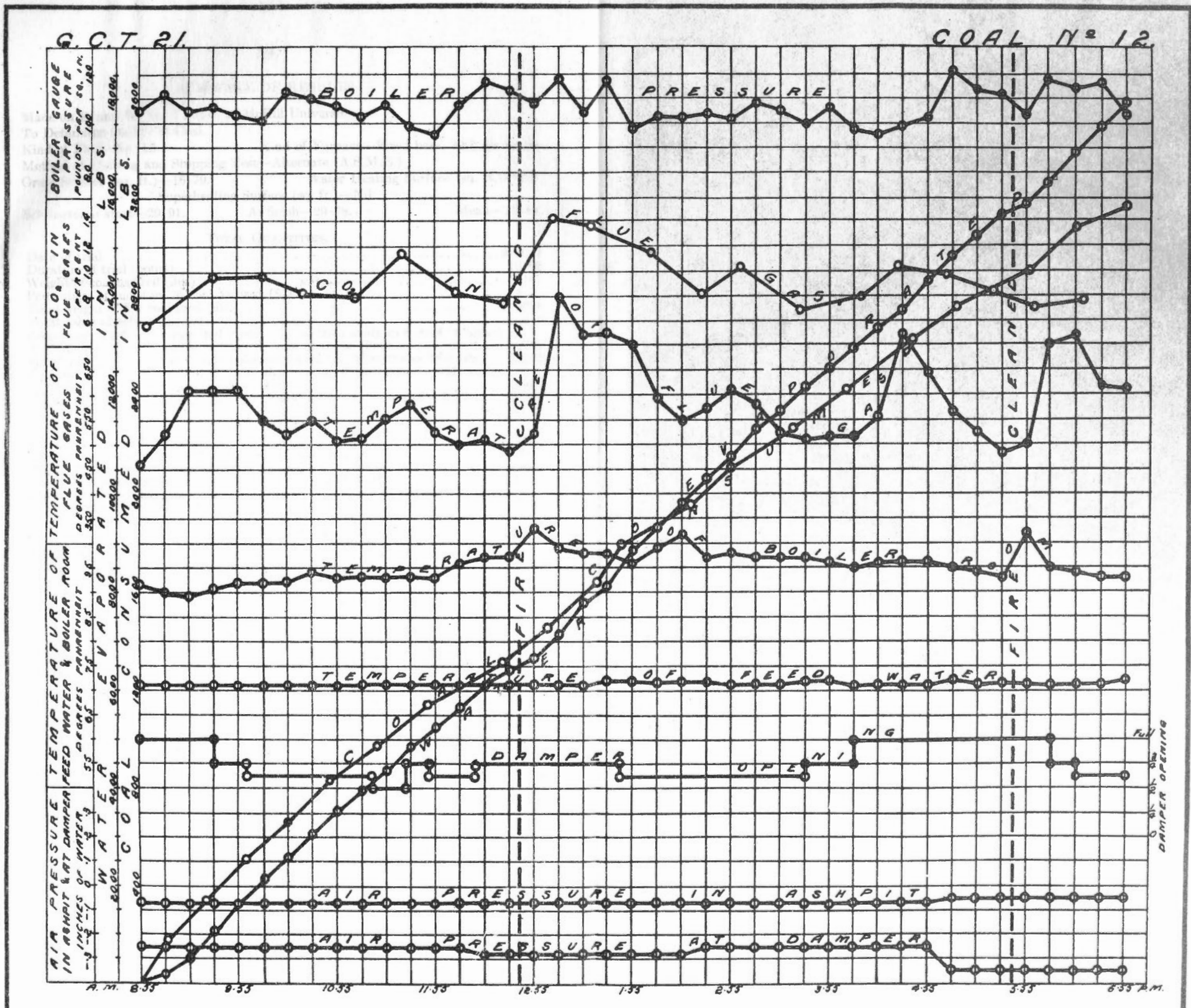
Notes.

Fire sliced 4.27 p.m. Air admitted over fire throughout trial. Clinker thin and hard. Weather fine and warm.

Proximate analysis of dry coal by weight %

Fixed carbon	54·3
Volatile matter	39·0
Ash	6·7

GRAPHIC RECORD OF BOILER TRIAL.



SUMMARY OF RESULTS

Made on B. and W. No. 2 boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 12. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·91. At finish—29·78. Mean—29·84.

Total Quantities.

1.	Date of trial	9/80/7
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	3161
4.	Percentage of moisture in coal as fired (%)	4·2
5.	Total weight of dry coal fired (lbs.)	3028
6.	Total ash and refuse (lbs.)	216
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 8·8; (*b*) weighed	7·1
8.	Total weight of combustible consumed, from analyses (lbs.)	2761
9.	Total weight of water fed to the boiler, corrected for difference in level (lbs)	18179
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	18010
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	21395

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	303
13.	Dry coal per square foot of grate surface per hour (lbs.)	18·1
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1801
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2139·5
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·35

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	106·9
18.	Temperature of feed water entering boiler (deg. F.)	71·5
19.	Temperature of escaping gases from boiler (deg. F.)	577
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·20
21.	Percentage of moisture in steam	1·0

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	62·1
23.	Builders' rated horse-power	60·0
24.	Percentage of builders' rated horse-power developed	103·5

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	5·74
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	6·77
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	7·06
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	7·75

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	13680
30.	Calorific value of the combustible per lb. (B.T.U.)	14670
31.	Efficiency of boiler (based on combustible consumed) (%)	51·0
32.	Efficiency of boiler, including grate (based on dry coal) (%)	50·0

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	25·6
34.	" " " of combustible consumed (from gas analyses) (lbs.)	21·0
35.	" " " dry coal (from gas analyses) (lbs.)	19·2
36.	Proportion of heat of fuel in escaping dry flue gases (%)	16·2

INVERNESS COAL FIELD.

INVERNESS CO., NOVA SCOTIA.

TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 14.

Date—Aug. 20, 1907. Trial Number G.C.T. 27.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Weather fine, still. No. 1 B. and W. boiler working. Robb boiler shut down.

Time.
7.15 Fire cleaned and made up with No. 14 coal. Pressure, 40 lbs.
7.39 Tubes cleaned.
8.45 Trial started. Fire 1½″ thick, considerable flame. Grill in fire door open. Pressure, 110 lbs.
10.27 Fire sliced.
11.08 Fire sliced.
11.48 Fire sliced.
11.55 Started to blow steam into ash-pit. 2″ of clinker hanging from bars.
12.13 to 12.22 Fire cleaned. 73 lbs. of cinder and thin hard clinker removed with difficulty.
5.13 to 5.18 Fire cleaned. 110 lbs. of clinker and cinders removed without difficulty.
6.45 Trial stopped. Fire very similar to start. 144 lbs. of ashes raked from pit. Blow-off cock examined and found tight.

CLINKER AND ASH.

183 lbs. clinker.
144 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL NO. 27

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.45 a.m.						
8.54	140	140	9.10	8·6	7·8	0·0
9.11	170	310	9.42	9·3	6·5	1·0
9.33	185	495	10.20	7·6	11·2	0·0
10.00	174	669	10.50	8·1	8·9	0·3
10.38	169	838	11.25	8·2	8·8	0·6
11.03	176	1014	11.55	10·6	9·0	0·0
11.31	186	1200	12.28	12·6	4·1	0·7
12.26	162	1362	12.50	9·6	7·7	0·1
12.42	177	1539	1.17	15·8	0·2	1·2
12.57	158	1697	1.46	12·0	4·4	1·2
1.16	167	1864	2.15	8·4	7·6	0·6
1.33	183	2047	2.45	10·1	6·7	0·7
1.55	176	2223	3.17	9·8	7·8	0·4
2.26	175	2398	3.45	10·8	7·4	0·2
2.56	179	2577	4.24	12·2	5·3	0·4
3.23	181	2758	4.46	10·6	7·0	0·4
3.58	174	2932	5.22	7·5	11·1	0·2
4.22	173	3105	5.45	10·6	6·2	0·6
4.40	161	3266	6.15	12·2	3·4	0·9
5.23	169	3435				
5.34	184	3619		10·2	6·9	0·5
5.50	156	3775				
6.11	182	3957				
6.30	156	4113				
6.45	12	4125				

OBSERVATIONS MADE DURING BOILER TRIAL No. 27

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.45	110	84	530	70	—·07	—·30	.....
9.00	121	86	535	70	—·07	—·30	341·5
9.15	102	86	525	70	—·07	—·30	576·5
9.30	118	86	535	70	—·07	—·30	418·5
9.45	116	89	490	70	—·07	—·30	482
10.00	104	89	450	70	—·07	—·30	425·5
10.15	108	90	425	71	—·07	—·30	376·5
10.30	105	89	460	71	—·07	—·30	323
10.45	102	89	500	71·5	—·07	—·35	563·5
11.00	118	91	450	71·5	—·07	—·35	272
11.15	122	92	525	71·5	—·07	—·35	470·5
11.30	99	92	465	71·5	—·07	—·35	511·5
11.45	98	92	410	72	—·07	—·35	343·5
12.00	118	92	450	72	—·07	—·35	278
12.15	99	92	425	72	—·07	—·35	404
12.30	121	90	700	72	—·07	—·35	357·5
12.45	112	90	735	71.5	—·07	—·35	537
1.00	118	88	700	71·5	—·07	—·30	680
1.15	122	88	750	71·5	—·07	—·30	547·5
1.30	118	88	615	72	—·07	—·30	655·5
1.45	108	87	575	72	—·07	—·30	574.5
2.00	118	86	600	72	—·07	—·30	524·5
2.15	102	85	550	71·5	—·07	—·30	618·5
2.30	120	85	535	71·5	—·07	—·30	334·5
2.45	116	85	525	71·5	—·07	—·30	611
3.00	118	84	500	71·5	—·07	—·30	420·5
3.15	116	85	485	71·5	—·07	—·30	415·5
3.30	118	85	525	71·5	—·07	—·30	424
3.45	119	85	510	71·5	—·07	—·30	461·5
4.00	113	85	500	71·5	—·07	—·30	554·5
4.15	119	86	525	71·5	—·07	—·35	365
4.30	120	85	635	71·5	—·07	—·35	480
4.45	113	85	540	71	—·07	—·35	548
5.00	104	85	515	71	—·07	—·35	426·5
5.15	105	85	475	71	—·07	—·35	499
5.30	123	85	725	71	—·07	—·35	221
5.45	118	85	725	71	—·07	—·35	709·5
6.00	123	84	600	71	—·07	—·35	565
6.15	123	85	625	71	—·07	—·35	600
6.30	114	85	615	71	—·07	—·35	694·5
6.45	117	84	600	71	—·07	—·35	541·5
	113·8	87·0	549	71·2	—·07	—·32	19,064 net

SUMMARY OF OBSERVATIONS

Date—Aug. 20, 1907.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.45 a.m.	Ended—6.45 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning.	Thoroughly cleaned June, 1907. Fresh water, August 17
4.	Tubes cleaned	7.39 a.m.
5.	Fire cleaned	7.15 a.m., 12.15 and 5.15 p.m.

Fuel.

6.	Kind of coal	No. 14, Inverness Coal & Ry. Co., Inverness Colliery. Over $\frac{1}{2}$" shaking screen and picking belt.
7.	Analysis of dry coal by weight (%).	C = 67·2, H = 4·8, S = 6·0, N = 0·9, O = 10·7, Ash = 10·4.
8.	Calorific value of dry coal B.T.U. per lb	12150
9.	Moisture in coal as fired (%)	7·3
10.	Weight of coal fired (lbs.)	4125
11.	Combustible matter in ash and clinker (%)	13·1
12.	Weight of clinker (lbs.)	183
13.	Weight of ash (lbs.)	144

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−0·07
15.	" above fire " "	−0·26
16.	" at damper " "	−0·32
17.	Amount of damper opening	Various
18.	Temperature of air in boiler house (°F.)	87·0
19.	Flue temperature (°F.)	549
20.	Analysis of dry flue gas by volume (%)	$CO_2 = 10·2$, $O_2 = 6·9$, $CO = 0·5$, $N_2 = 82·4$

Water and Steam.

21.	Temperature of feed water (°F.)	71·2
22.	Total weight of feed water, corrected for difference of level (lbs.)	19064
23.	Water level in gauge at start (inches)	3
24.	Water level in gauge at finish (inches)	$3\frac{1}{8}$
25.	Correction for difference of level included above (lbs.)	19
26.	Steam pressure by gauge (lbs. per sq. in.)	113·8
27.	Barometer reading (inches)	29·73
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	22·05
29.	Temperature in steam calorimeter (°F.)	293·7

Notes.

Fire sliced 10.27, 11.08, 11.48 a.m. Air admitted over fire throughout trial. Steam blown under grate from 11.55 a.m. Clinker thin, hard, and adherent. Weather fine and still.

Proximate analysis of dry coal by weight (%)

Fixed carbon	49·6
Volatile matter	40·0
Ash	10·4

SUMMARY OF RESULTS

Made on No. 2 B. and W. Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 14. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·73. At finish—29·73. Mean—29·73.

Total Quantities.

1.	Date of trial	20–8–07
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	4125
4.	Percentage of moisture in coal as fired (%)	7·3
5.	Total weight of dry coal fired (lbs.)	3820
6.	Total ash and refuse (lbs.)	327
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 12·0; (*b*) weighed	8·6
8.	Total weight of combustible consumed, from analyses (lbs)	3360
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	19064
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	18940
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	22514

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	382
13.	Dry coal per square foot of grate surface per hour (lbs.)	22·8
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1894
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2251
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	352

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs./sq. in.)	113·8
18.	Temperature of feed water entering boiler (deg. F.)	71·2
19.	Temperature of escaping gases from boiler (deg. F.)	549
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·25
21.	Percentage of moisture in steam	1·0

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	65·3
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	108·7

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	4·62
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	5·46
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	5·89
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	6·70

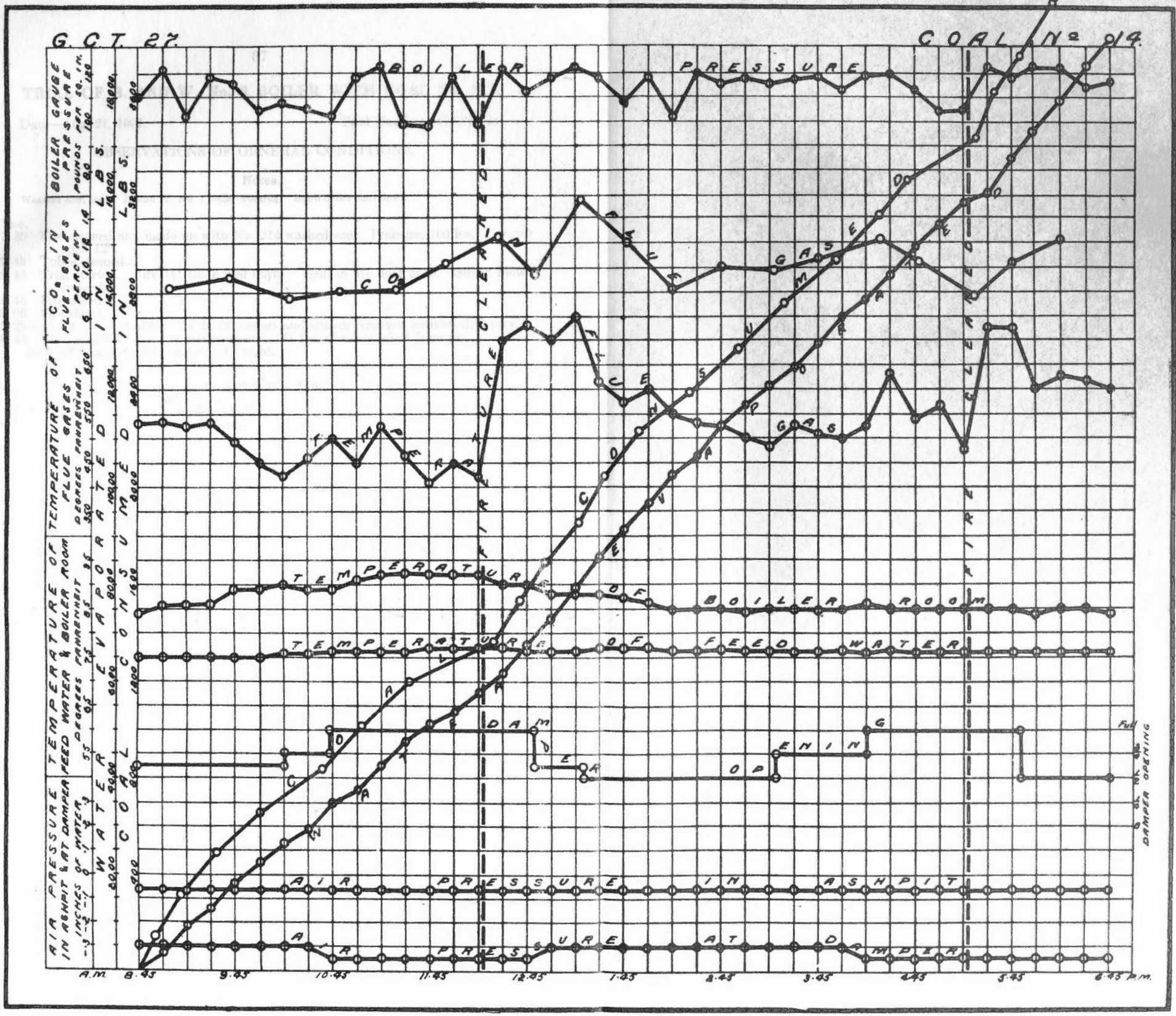
Efficiency.

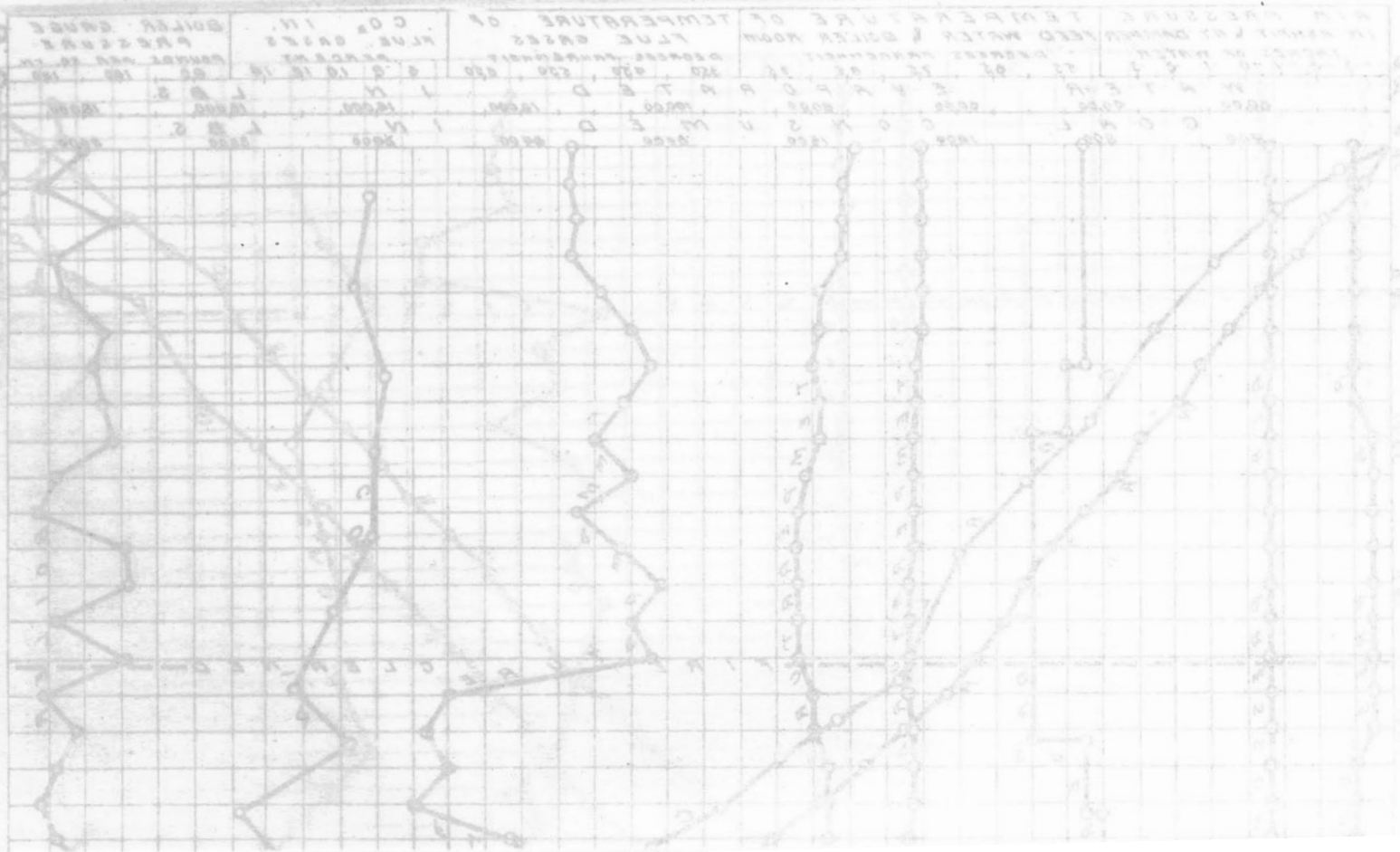
29.	Calorific value of dry coal per lb. (B.T.U.)	12150
30.	Calorific value of the combustible per lb. (B.T.U.)	13570
31.	Efficiency of boiler (based on combustible consumed) (%)	47·7
32.	Efficiency of boiler, including grate (based on dry coal) (%)	46·9

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	23·3
34.	" " " of combustible consumed (from gas analyses) (lbs.)	17·7
35.	" " " dry coal (from gas analyses) (lbs.)	15·6
36.	Proportion of heat of fuel in escaping dry flue gases (%)	14·2

GRAPHIC RECORD OF BOILER TRIAL.





TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 214.

Date—Aug. 21, 1907. Trial Number—G.C.T. 28.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Weather fine, cool. B. and W. No. 1 boiler working. Robb boiler shut down.

Time.
7.30 Fire cleaned and made up with No. 214 washed coal. Pressure, 100 lbs. Damper open 12″.
7.45 Tubes cleaned.
8.45 Trial started. Fire 1½″ thick well burnt. Grill in fire door open. Steam blown under fire.
12.45 Fire sliced.
3.05 Fire sliced.
5.29 to 5.33 Fire cleaned. 74 lbs of cinders and clinker removed without difficulty.
6.45 Trial stopped. Fire similar to start. 141 lbs. of ashes raked from pit.
Blow-off examined and found to be tight.

CLINKER AND ASH.

Net.
74 lbs. clinker.
141 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 28

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.45 a.m.						
8.51	77	77	8.53	10·2	5·1	0·5
9.10	195	272	9.30	10	7·7	0·3
9.24	200	472	10.02	10·9	4·4	1·5
9.50	184	656	10.30	10·6	6·0	0·7
10.10	162	818	11.00	9·0	9·1	0·0
10.38	166	984	11.30	7·9	11·3	0·0
11.10	174	1158	12.02	7·0	12·4	0·0
11.47	186	1344	12.32	6·8	11·4	0·0
12.20	176	1520	1.00	14·8	1·2	1·0
12.55	177	1697	1.35	11·7	5·3	0·2
1.16	181	1878	2.05	10·4	5·4	1·0
1.43	184	2062	2.30	10·4	9·9	0·0
2·02	160	2222	2.55	13·7	3·3	0·6
2.30	178	2400	3.24	11·0	7·0	0·4
3.06	165	2565	3.54	12·2	4·6	0·7
3.30	179	2744	4.24	13·0	2·4	1·4
3.53	178	2922	4.55	11·2	5·8	0·6
4.22	193	3115	5.25	11·4	8·1	0·0
4.55	181	3296	5.51	10·3	6·7	0·0
5.26	153	3449	6.20	11·7	3·8	0·3
5.43	167	3616				
6.05	189	3805		10·7	6·5	0·5
6.45	129	3934				

OBSERVATIONS MADE DURING BOILER TRIAL No. 28

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.45	121	77	530	70	—·05	—·25	.....
9.00	107	77	600	70	—·05	—·30	382
9.15	123	79	610	70	—·05	—·30	573
9.30	117	79	590	70	—·05	—·20	543·5
9.45	119	79	560	70	—·05	—·20	632·5
10.00	120	79	585	70	—·05	—·20	504
10.15	115	79	575	70	—·05	—·20	543
10.30	115	82	620	70	—·05	—·20	544
10.45	117	80	500	70	—·05	—·20	428·5
11.00	105	81	525	70	—·05	—·20	540
11.15	116	82	505	70	—·05	—·20	403·5
11.30	106	82	525	70	—·05	—·25	392·5
11.45	112	82	510	70	—·05	—·20	404
12.00	104	81	490	70	—·05	—·25	423·5
12.15	119	82	500	70	—·05	—·20	450
12.30	111	81	490	70	—·05	—·30	291
12.45	102	80	490	70	—·05	—·20	370
1.00	122	82	705	70	—·05	—·30	532·5
1.15	105	81	785	70	—·05	—·25	772·5
1.30	105	82	630	70	—·05	—·25	382
1.45	112	81	640	70	—·05	—·25	561
2.00	104	82	620	70	—·05	—·20	525·5
2.15	115	81	550	70	—·05	—·20	561·5
2.30	112	80	600	70	—·05	—·20	444
2.45	105	81	540	70	—·05	—·20	580·5
3.00	119	81	530	70	—·05	—·20	349·5
3.15	117	81	550	70	—·05	—·20	460 5
3.30	122	80	540	70	—·05	—·20	408·5
3.45	122	81	630	70	—·05	—·20	437·5
4.00	122	81	590	70·5	—·05	—·20	530·5
4.15	110	82	580	70	—·05	—·20	505·5
4.30	122	82	590	70	—·05	—·20	415·5
4.45	117	82	590	70	—·05	—·25	474
5.00	120	81	580	70	—·05	—·25	410·5
5.15	122	80	550	70·5	—·05	—·25	444·5
5.30	95	81	530	70·5	—·05	—·20	505·5
5.45	122	80	530	71	—·05	—·20	256
6.00	121	82	550	70·5	—·05	—·20	438·5
6.15	119	81	550	70·5	—·05	—·20	427·5
6.30	122	80	580	70·5	—·05	—·20	532
6.45	116	80	530	70·5	—·05	—·20	541·5
	114·8	80·7	565	70·1	—·05	—·22	18818 net

SUMMARY OF OBSERVATIONS

Date—Aug. 21, 1907. Boiler—B. and W. No. 2. At McGill University.
Commenced—8.45 a.m. Ended—6.45 p.m. Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned June, 1907, Fresh water, August 17.
4.	Tubes cleaned	7.45 a.m.
5.	Fire cleaned	7.30 a.m., 5.30 p.m.

Fuel.

6.	Kind of coal	No. 214, Inverness Colliery, Inverness Coal & Ry. Co. Over ½" shaking screen and picking belt.
7.	Analysis of dry coal by weight (%)	C = 70·3, H = 4·8, S = 5·0, N = 0·6, O = 12·8, Ash = 6·5
8.	Calorific value of dry coal B.T.U. per lb	12800
9.	Moisture in coal as fired (%)	9·2
10.	Weight of coal fired (lbs.)	3934
11.	Combustible matter in ash and clinker (%)	35·2
12.	Weight of clinker (lbs.)	74
13.	Weight of ash (lbs.)	141

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−0·05
15.	" above fire " "	−0·16
16.	" at damper " "	−0·22
17.	Amount of damper opening	Various.
18.	Temperature of air in boiler house (°F.)	80·7
19.	Flue temperature (°F.)	565
20.	Analysis of dry flue gas by volume (%)	$CO_2 = 10·7$, $O_2 = 6·5$, $CO = 0·5$, $N_2 = 82·3$

Water and Steam.

21.	Temperature of feed water (°F.)	70·1
22.	Total weight of feed water, corrected for difference of level (lbs.)	18818
23.	Water level in gauge at start (inches)	$2\frac{9}{16}$
24.	Water level in gauge at finish (inches)	$2\frac{5}{8}$
25.	Correction for difference of level included above (lbs.)	9·5
26.	Steam pressure by gauge (lbs. per sq. in.)	114·8
27.	Barometer reading (inches)	29·86
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	22·6
29.	Temperature in steam calorimeter (°F.)	294·2

Notes.

Fire sliced 12.45 and 3.05 p.m. Clinker removed without difficulty. Air admitted over fire throughout trial. Steam blown under grate throughout trial. Weather fine and cool.

Proximate analysis of dry coal by weight (%)

Fixed carbon	51·0
Volatile matter	42·5
Ash	6·5

SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 214. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·89. At finish—29·84. Mean—29·86.

Total Quantities.

1.	Date of trial	21/8/07
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	3934
4.	Percentage of moisture in coal as fired (%)	9·2
5.	Total weight of dry coal fired (lbs.)	3573
6.	Total ash and refuse (lbs.)	215
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 10·0; (*b*) weighed.	6·0
8.	Total weight of combustible consumed, from analyses (lbs.)	3216
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	18818
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	18710
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	22260

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	357
13.	Dry coal per square foot of grate surface per hour (lbs.)	21·3
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1871
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2226
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·48

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	114·8
18.	Temperature of feed water entering boiler (deg. F.)	70·1
19.	Temperature of escaping gases from boiler (deg. F.)	565
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·17
21.	Percentage of moisture in steam	1·0

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	64·5
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	108

Economic Results.

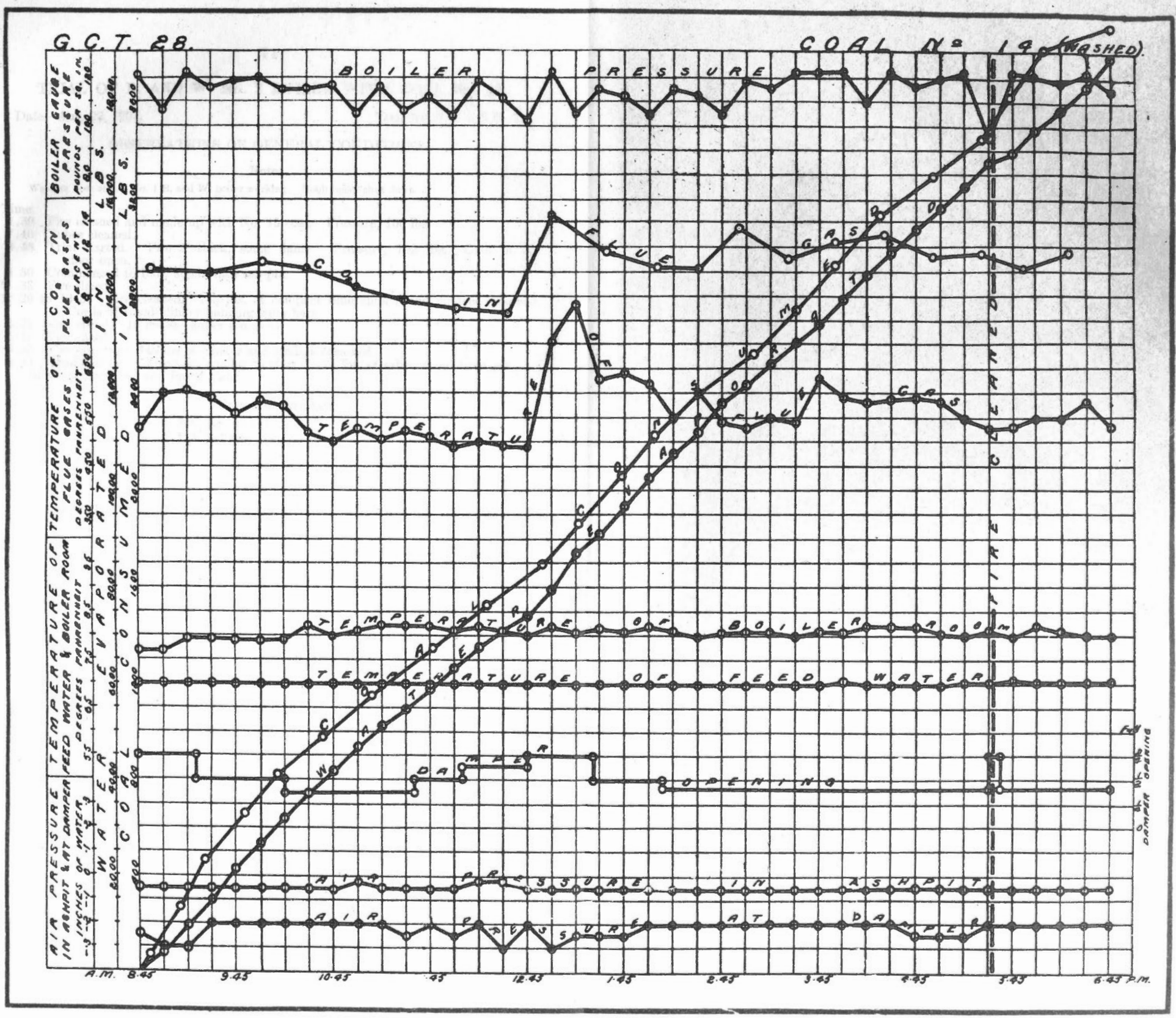
25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	4·79
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	5·67
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	6·24
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	6·93

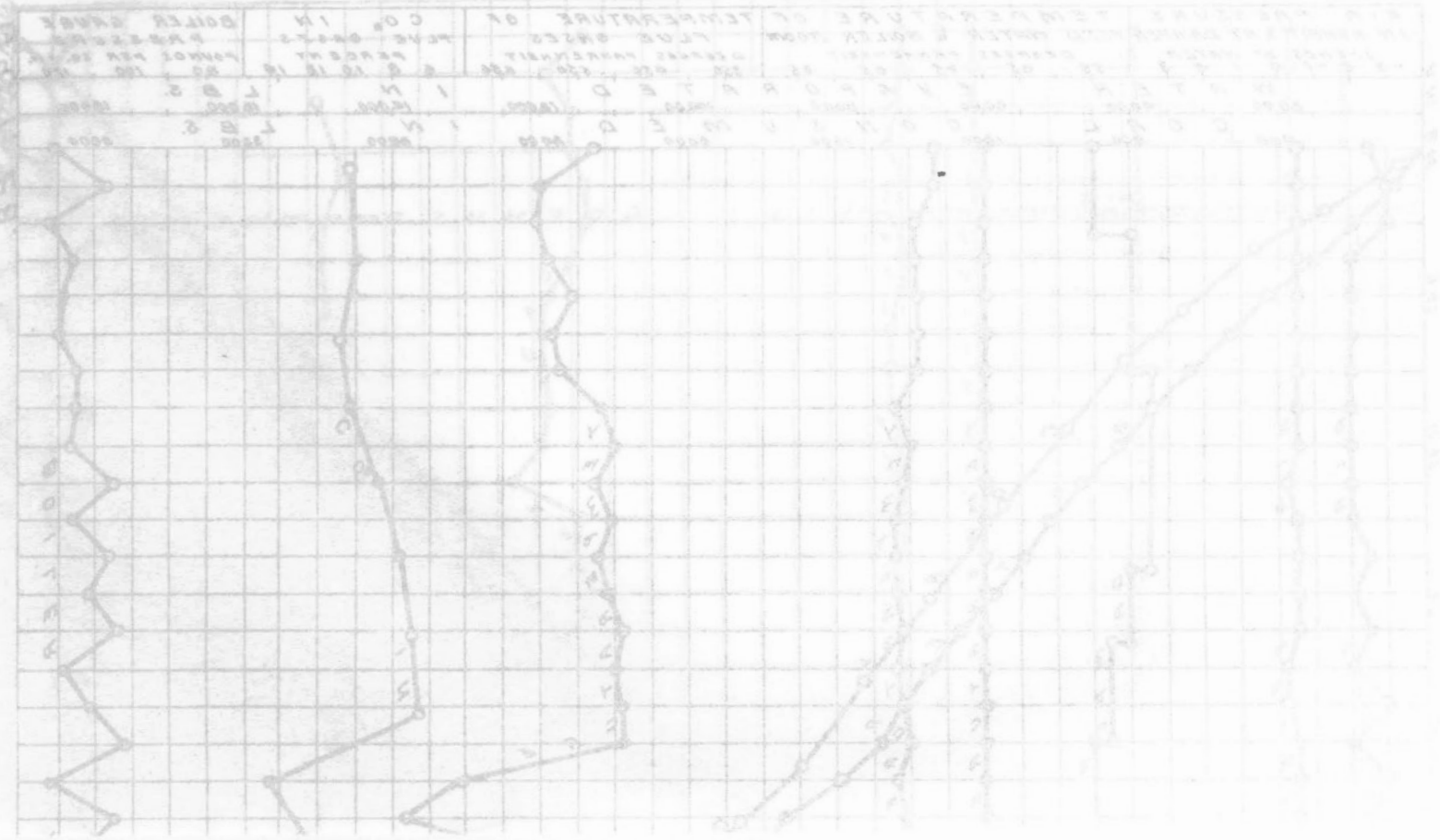
Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	12800
30.	Calorific value of the combustible per lb. (B.T.U.)	13700
31.	Efficiency of boiler (based on combustible consumed) (%)	48·9
32.	Efficiency of boiler, including grate (based on dry coal) (%)	47·0

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	22·3
34.	" " of combustible consumed (from gas analyses) (lbs.)	17·4
35.	" " dry coal (from gas analyses) (lbs.)	15·7
36.	Proportion of heat of fuel in escaping dry flue gases (%)	14·2


G.C.T. 28.
COAL No 19 (WASHED).
BOILER PRESSURE
CO2 IN FLUE GASES
TEMPERATURE OF FLUE GASES
TEMPERATURE OF BOILER ROOM
TEMPERATURE OF FEED WATER
AIR PRESSURE IN ASHPIT & AT DAMPER
BOILER GAUGE PRESSURE
CO2 IN FLUE GASES PERCENT
TEMPERATURE OF FLUE GASES DEGREES FAHRENHEIT
TEMPERATURE OF BOILER ROOM DEGREES FAHRENHEIT
AIR PRESSURE INCHES OF WATER
COAL
WATER
EVAPORATION
CONSUMED
FIRE CLEANED
DAMPER OPENING
A.M. 8.45 9.45 10.45 12.45 1.45 2.45 3.45 4.45 5.45 6.45 P.M.



TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 15.

Date—Aug. 22, 1907. Trial Number G.C.T. 29.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Weather fine, still. No. 1 B. and W. boiler working. Robb boiler shut down.

Time.
7.30 Fire cleaned and made up with No. 15 coal. Pressure, 100 lbs.
7.40 Tubes cleaned.
8.45 Trial started. Fire 2″ thick, some flame. Pressure, 102 lbs. Grill in fire door open.
8.50 Commenced to blow steam into ash-pit.
11.33 Fire sliced.
12.29 to 12.35 Fire cleaned. 145 lbs. of compact blue clinker and cinders removed. Cords of fused clinker hanging from bars.
3.21 Fire sliced. 18 lbs of clinker removed.
5.10 Fire sliced.
5.30 Fire cleaned. 145 lbs of clinker and cinders removed.
6.45 Trial stopped. Fire very similar to start. 124 lbs. of ashes raked from pit. Blow-off examined and found tight.

CLINKER AND ASH.

308 lbs. clinker.
124 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 29

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.45 a.m.						
8.48	165	165	8.53	8·8	7·2	1·1
9.04	183	348	9.26	10·4	6·4	1·0
9.21	188	536	9.52	10·8	4·5	1·1
9.40	175	711	10.24	7·0	12·7	0·3
10.21	183	894	10.55	8·9	8·9	0·4
11.10	189	1083	11.25	8·6	9·9	0·5
11.51	201	1284	11.55	10·3	7·6	0·0
12.38	192	1476	12.25	7·8	11·4	0·2
12.50	187	1663	12.55	9·5	7·0	1·0
1.08	205	1868	1.25	10·2	7·8	0·3
1.38	173	2041	1.56	12·2	6·4	0·2
2.19	171	2212	2.26	8·3	11·8	0·0
2.56	180	2392	2.55	10·1	8·1	0·1
3.32	183	2575	3.25	6·8	12·1	0·1
3.55	187	2762	3.55	8·5	8·6	0·2
4.33	193	2955	4.25	7·5	11·0	0·3
5.11	166	3121	4.55	6·7	12·9	0·2
5.45	183	3304	5.25	7·0	11·7	0·1
6.04	189	3493	5.55	9·4	8·4	0·2
6.45	182	3675	6.25	9·0	8·8	0·1
				8·9	9·2	0·4

OBSERVATIONS MADE DURING BOILER TRIAL No. 29

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.45	102	77	505	69·5	—·05	—·38	.....
9.00	122	78	490	69·5	—·05	—·35	195
9.15	109	80	530	69·5	—·05	—·30	624
9.30	121	81	480	69·5	—·05	—·30	614·5
9.45	104	81	480	70	—·05	—·25	572·5
10.00	117	82	470	70	—·05	—·25	437
10.15	107	82	450	69·5	—·05	—·25	498
10.30	107	82	425	70	—·05	—·25	630·5
10.45	123	83	415	70	—·05	—·25	197·5
11.00	122	82	400	70	—·05	—·25	287
11.15	123	82	425	70	—·05	—·30	429·5
11.30	112	83	440	70	—·05	—·25	344·5
11.45	109	84	480	70	—·05	—·30	437·5
12.00	115	83	490	70	—·05	—·30	409
12.15	116	85	460	70	—·05	—·35	479·5
12.30	96	85	460	70	—·05	—·20	504·5
12.45	115	85	500	70	—·05	—·30	131·5
1.00	110	85	480	70	—·05	—·35	554
1.15	110	85	450	70	—·05	—·25	366·5
1.30	112	83	510	70	—·05	—·25	433
1.45	112	84	580	70·5	—·05	—·30	635
2.00	116	85	540	70	—·05	—·25	493
2.15	98	85	500	70	—·05	—·20	585
2.30	115	85	450	70	—·05	—·20	420·5
2.45	113	85	420	70	—·05	—·20	373
3.00	104	84	470	70	—·05	—·20	426·5
3.15	110	85	445	70	—·05	—·30	360
3.30	110	85	510	70	—·05	—·30	345.5
3.45	115	85	515	70	—·05	—·35	553·5
4.00	109	85	510	70	—·05	—·35	478·5
4.15	114	85	505	70	—·05	—·35	418·5
4.30	106	85	485	70·5	—·05	—·35	517·5
4.45	112	85	485	70·5	—·05	—·35	368·5
5.00	97	85	450	70·5	—·05	—·35	412
5.15	110	85	540	70·5	—·05	—·35	328·5
5.30	96	85	530	70·5	—·05	—·30	471
5.45	110	85	580	70·5	—·05	—·30	371
6.00	115	83	545	70·5	—·05	—·30	464
6.15	112	83	510	70·5	—·05	—·30	529·5
6.30	109	82	530	70·5	—·05	—·30	488
6.45	100	82	510	70	—·05	—·25	523·5
	110·6	83·4	486·3	70·0	—·05	—·29	17604·5 net

SUMMARY OF OBSERVATIONS

Date—August 22, 1907.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.45 a.m.	Ended—6.45 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning.	Thoroughly cleaned June, 1907. Fresh water, August 17.
4.	Tubes cleaned	7.40 a.m.
5.	Fire cleaned	7.30 a.m., 12.30 and 5.30 p.m.

Fuel.

6.	Kind of coal—No. 15. Port Hood Colliery, Richmond Ry. Coal Co. (Over $\frac{1}{4}$" shaking screen and picking belt).	
7.	Analysis of dry coal by weight (%).	C=63·7, H=4·2, S=7·9, N=0·8, O=8·8, Ash=14·6.
8.	Calorific value of dry coal B.T.U. per lb	11770
9.	Moisture in coal as fired (%)	3·3
10.	Weight of coal fired (lbs.)	3675
11.	Combustible matter in ash and clinker (%)	8·9
12.	Weight of clinker (lbs.)	308
13.	Weight of ash (lbs.)	124

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−0·05
15.	" above fire " "	−0·22
16.	" at damper " "	−0·29
17.	Amount of damper opening	Various.
18.	Temperature of air in boiler house (°F.)	83·4
19.	Flue temperature (°F.)	486
20.	Analysis of dry flue gas by volume (%).	CO_2=8·9, O_2=9·2, CO=0·4, N_2=81·5

Water and Steam.

21.	Temperature of feed water (°F.)	70·0
22.	Total weight of feed water, corrected for difference of level (lbs.)	17604
23.	Water level in gauge at start (inches)	$3\frac{7}{16}$
24.	Water level in gauge at finish (inches)	$3\frac{3}{8}$
25.	Correction for difference of level included above (lbs.)	9·5
26.	Steam pressure by gauge (lbs. per sq. in.)	110·6
27.	Barometer reading (inches)	29·91
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	21·1
29.	Temperature in steam calorimeter (°F.)	291·5

Notes.

Fire sliced, 11.33 a.m., 3.21 and 5.10 p.m. Air admitted over fire throughout trial. Steam blown under grate throughout trial. Clinker compact and blue, hanging from bars. Weather fine and still.

Proximate analysis of dry coal by weight (%):

Fixed carbon	48·3
Volatile matter	37·1
Ash	14·6

SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 15. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·94. At finish—29·89. Mean—29·91.

Total Quantities.

1.	Date of trial	22/8/07
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	3675
4.	Percentage of moisture in coal as fired (%)	3·3
5.	Total weight of dry coal fired (lbs.)	3554
6.	Total ash and refuse (lbs.)	432
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 16·0; (*b*) weighed 12·2	
8.	Total weight of combustible consumed from analyses (lbs.),	2985
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	17604
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17500
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	20810

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	355
13.	Dry coal per square foot of grate surface per hour (lbs.)	21·2
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1750
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2081
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·26

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	110·6
18.	Temperature of feed water entering boiler (deg. F.)	70·0
19.	Temperature of escaping gases from boiler (deg. F.)	486
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·24
21.	Percentage of moisture in steam	1·0

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	60·4
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	101

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	4·80
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	5·67
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	5·86
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	6·98

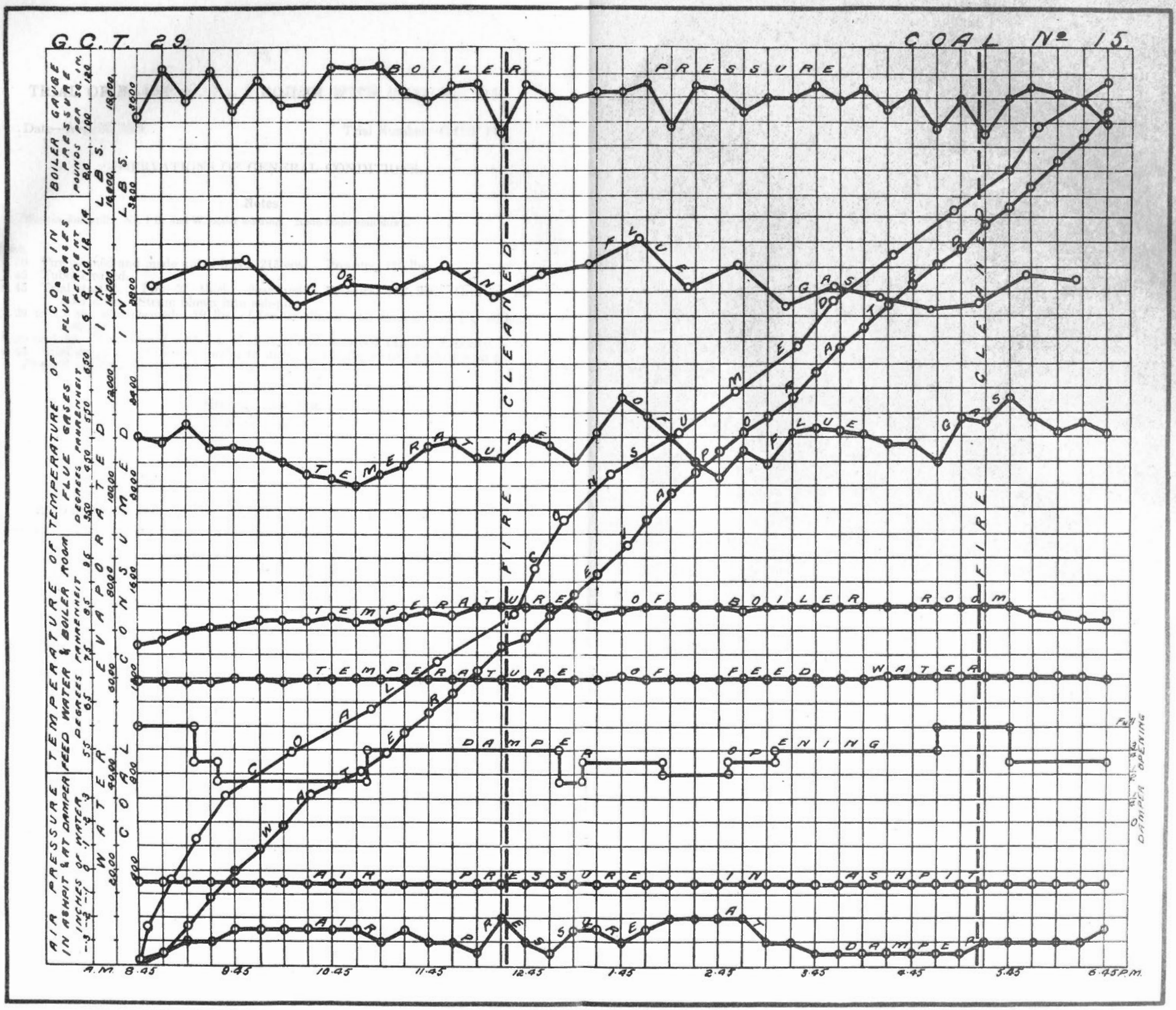
Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	11770
30.	Calorific value of the combustible per lb. (B.T.U.)	13790
31.	Efficiency of boiler (based on combustible consumed) (%)	48·9
32.	Efficiency of boiler, including grate (based on dry coal) (%)	48·2

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	26·7
34.	" " of combustible consumed (from gas analyses) (lbs.)	20·2
35.	" " dry coal (from gas analyses) (lbs.)	17·0
36.	Proportion of heat of fuel in escaping dry flue gases (%)	14·0

GRAPHIC RECORD OF BOILER TRIAL.



TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 215.

Date—Aug. 23, 1907. Trial Number—G.C.T. 30.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Weather fine, still. No. 1 B. and W. boiler working. Robb boiler shut down.

Time.
7.30 Fire cleaned and made up with No. 215 coal. Pressure, 110 lbs.
7.45 Tubes cleaned.
8.45 Trial started. Fire 2″ thick, clear red. Pressure, 102 lbs. Grill in fire door open. Steam blown into ash-pit.
12.29 to 12.36 Fire cleaned. 89 lbs. of friable clinker and cinders removed without difficulty.
5.29 to 5.36. Fire cleaned. 85 lbs. of clinker, etc., removed without difficulty.
6.45 Trial stopped. Fire very similar to start. 147 lbs. of ashes raked from pit. Blow-off examined and found to be tight.

CLINKER AND ASH.

174 lbs. clinker.
147 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 30

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.45 a.m.						
9.00	166	166	8.55	1·9	15·9	0·0
9.26	169	335	9.25	6·0	11·8	0·0
9.58	192	527	9.55	7·1	11·6	0·0
10.37	196	723	10.25	8·8	8·2	0·2
11.00	162	885	10.55	8·8	8·6	0·2
11.35	173	1058	11.25	12·9	7·1	0·4
12.15	183	1241	11.55	8·8	9·7	0·7
12.44	187	1428	12.25	5·6	13·8	0·2
1.16	174	1602	12.55	6·9	11·9	0·4
1.37	177	1779	1.28	6·2	13·4	0·0
2.07	154	1933	1.57	6·6	13·3	0·2
2.17	62	1995	2.25	14·6	5·2	0·2
2.45	153	2148	2.55	10·3	8·5	0·8
3.15	181	2329	3.25	10·2	7·5	1·1
3.48	180	2509	3.55	8·2	9·2	0·1
4.13	170	2679	4.30	11·2	6·6	0·0
4.42	164	2843	4.55	7·5	11·1	0·8
5.20	194	3037	5.25	11·0	8·2	0·0
5.43	167	3204	6.05	10·4	8·2	0·0
6.06	156	3360	6.25	10·3	.....	.....
6.45	148	3508		8·7	10·0	0·3

OBSERVATIONS MADE DURING BOILER TRIAL No. 30

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.45	102	80	490	69	—·05	—·35	.....
9.00	120	80	480	69	—·10	—·30	70·5
9.15	93	82	490	69·5	—·10	—·30	607
9.30	117	82	540	69·5	—·10	—·25	322
9.45	104	84	575	69·5	—·10	—·30	626
10.00	119	84	480	70	—·10	—·25	307·5
10.15	107	85	500	70	—·10	—·30	538
10.30	115	85	550	70	—·10	—·30	340·5
10.45	114	85	480	70	—·10	—·35	452
11.00	115	85	455	70·5	—·10	—·30	463
11.15	102	86	485	70·5	—·10	—·30	424
11.30	117	87	550	70·5	—·10	—·30	418
11.45	106	87	540	70·5	—·10	—·30	508·5
12.00	110	87	510	70·5	—·10	—·30	428·5
12.15	113	88	475	70·5	—·10	—·35	464
12.30	94	87	440	70·5	—·10	—·25	365
12.45	110	87	530	70·5	—·10	—·30	380·5
1.00	115	87	530	70·5	—·10	—·30	275·5
1.15	117	88	570	70·5	—·10	—·30	475
1.30	118	88	550	71	—·10	—·30	543
1.45	116	88	480	71	—·10	—·30	431·5
2.00	120	88	510	71	—·10	—·25	366
2.15	112	88	550	71	—·10	—·35	512
2.30	120	88	685	71	—·10	—·35	510
2.45	123	88	730	71	—·10	—·35	528
3.00	115	88	580	71	—·10	—·30	530·5
3.15	116	88	600	71	—·10	—·30	440·5
3.30	100	88	510	71	—·10	—·25	494·5
3.45	116	89	510	71	—·10	—·25	389
4.00	122	90	480	71	—·10	—·30	411
4.15	122	88	585	70·5	—·10	—·35	429·5
4.30	121	88	580	71	—·10	—·35	507
4.45	102	88	540	71	—·10	—·30	515·5
5.00	122	88	525	71	—·10	—·30	437·5
5.15	107	88	600	71·5	—·10	—·25	439·5
5.30	92	89	490	71	—·10	—·25	357·5
5.45	117	88	535	71·5	—·10	—·30	315
6.00	123	88	635	71·5	—·10	—·25	564·5
6.15	112	87	580	71	—·10	—·25	460·5
6.30	122	87	620	70·5	—·10	—·30	526·5
6.45	105	87	650	70	—·10	—·20	429
	112·5	86·7	541	70·6	—·10	—·30	17,405·5 net

SUMMARY OF OBSERVATIONS

Date—Aug. 23, 1907.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.45 a.m.	Ended—6.45 p.m.	Duration—600 mins.

General.

1. Method of stoking.....Hand-spreading on alternate sides
2. Kind of draft.....Natural
3. Condition of boiler and date of last cleaning.....Thoroughly cleaned June, 1907. Fresh water, August 17.
4. Tubes cleaned.....7.45 a.m.
5. Fire cleaned.....7.30 a.m., 12.30 and 5.30 p.m.

Fuel.

6. Kind of coal.....No. 215 Port Hood Colliery, Richmond Ry. Coal Co. Over $\frac{3}{4}$" shaking screen and picking belt
7. Analysis of dry coal by weight (%) C = 68·7, H = 4·4, S = 6·7, N = 0·6, O = 8·7, Ash = 10·9
8. Calorific value of dry coal B.T.U. per lb.....12550
9. Moisture in coal as fired (%).....5·5
10. Weight of coal fired (lbs.).....3508
11. Combustible matter in ash and clinker (%).....13·2
12. Weight of clinker (lbs.).....174
13. Weight of ash (lbs.).....147

Air and Flue Gas.

14. Air pressure under fire (inches of water).....−·01
15. " above fire " .....−·23
16. " at damper " .....−·30
17. Amount of damper opening.....Various
18. Temperature of air in boiler house (°F.).....86·7
19. Flue temperature (°F.).....541
20. Analysis of dry flue gas by volume (%)..CO_2 = 8·7, O_2 = 10·0, CO = 0·3, N_2 = 81·0

Water and Steam.

21. Temperature of feed water (°F.).....70·6
22. Total weight of feed water, corrected for difference of level (lbs.).....17405
23. Water level in gauge at start (inches).....3 $\frac{3}{16}$
24. Water level in gauge at finish (inches).....3 $\frac{11}{16}$
25. Correction for difference of level included above (lbs.).....76
26. Steam pressure by gauge (lbs. per sq. in.).....112·5
27. Barometer reading (inches).....29·87
28. Pressure in steam calorimeter by gauge (lbs. per sq. in.).....20·4
29. Temperature in steam calorimeter (°F.).....291·9

Notes.

Air admitted over fire throughout trial. Steam blown under grate throughout trial. Clinker friable removed without difficulty. Weather fine and still.

Proximate analysis of dry coal by weight %

Fixed carbon	51·2
Volatile matter	37·9
Ash	10·9

SUMMARY OF RESULTS

Made on No. 2 B. and W. Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 215. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·96. At finish—29·78. Mean—29·87.

Total Quantities.

1.	Date of trial	23/8/07
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	3508
4.	Percentage of moisture in coal as fired (%)	5·5
5.	Total weight of dry coal fired (lbs.)	3315
6.	Total ash and refuse (lbs.)	321
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 12·6; (*b*) weighed	9·7
8.	Total weight of combustible consumed, from analyses (lbs.)	2898
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	17405
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17215
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	20575

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	331
13.	Dry coal per square foot of grate surface per hour (lbs.)	19·7
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1721·5
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2057·5
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·22

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs./sq. in.)	112·5
18.	Temperature of feed water entering boiler (deg. F.)	70·6
19.	Temperature of escaping gases from boiler (deg. F.)	541
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·20
21.	Percentage of moisture in steam	1·0

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	59·5
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	99

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	4·97
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	5·85
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	6·20
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	7·10

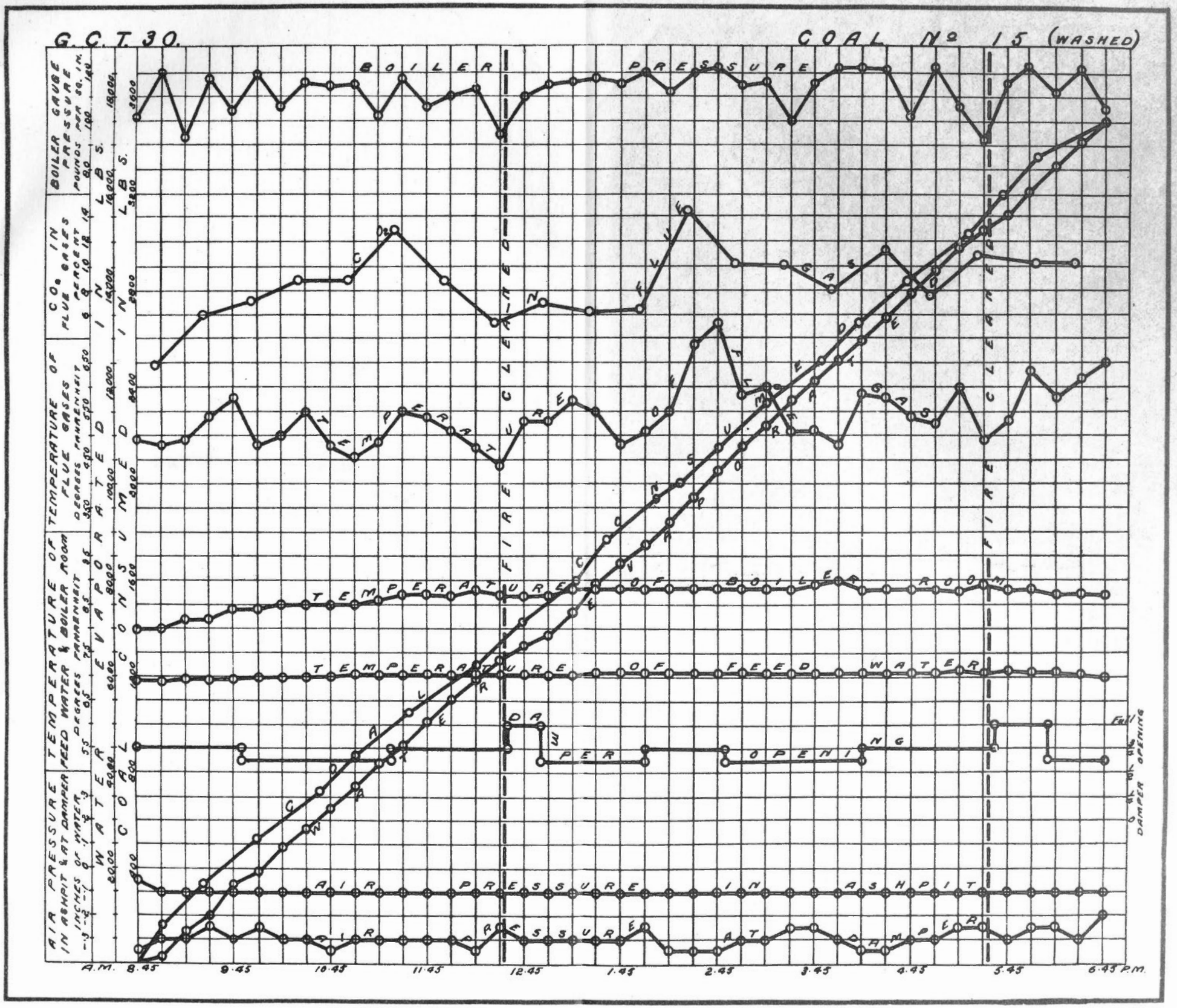
Efficiency.

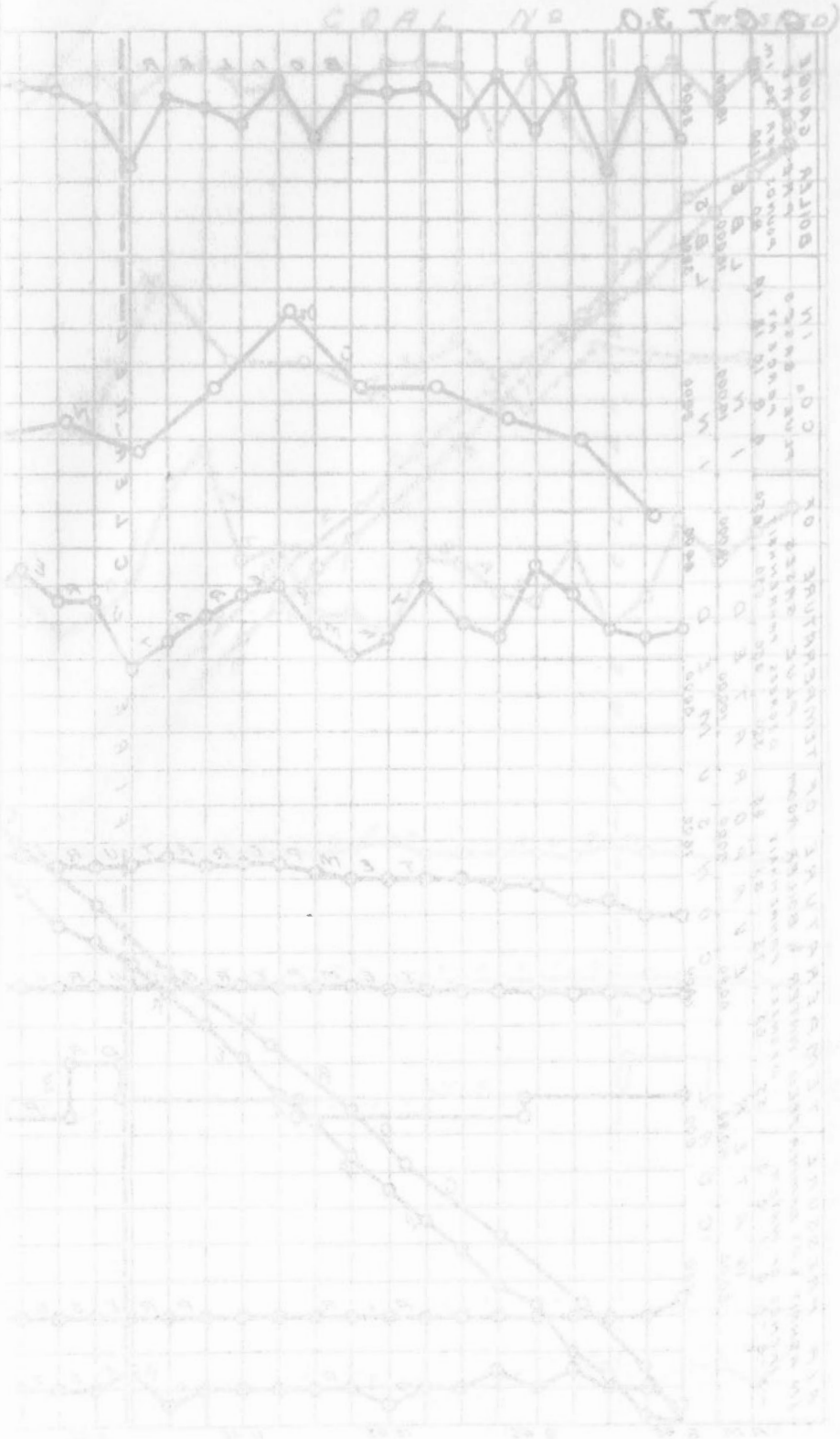
29.	Calorific value of dry coal per lb. (B.T.U.)	12550
30.	Calorific value of the combustible per lb. (B.T.U.)	14100
31.	Efficiency of boiler (based on combustible consumed) (%)	48·6
32.	Efficiency of boiler, including grate (based on dry coal) (%)	47·7

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	27·6
34.	" " of combustible consumed (from gas analyses) (lbs.)	21·7
35.	" " dry coal (from gas analyses) (lbs.)	19·0
36.	Proportion of heat of fuel in escaping dry flue gases (%)	16·5

GRAPHIC RECORD OF BOILER TRIAL.





PICTOU COAL FIELD.

PICTOU CO., NOVA SCOTIA.

TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 4.

Date—July 10, 1907. Trial Number—G.C.T. 10.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Weather fine and still. Grill in fire door full open. Coal in lumps from 6" downward.

Time.

a.m.

7.30 Fire cleaned and started firing with No. 4 coal. Pressure, 65 lbs.
8.15 Tubes cleaned.
8.35 Trial started. Fire 2" thick well burnt through.
9.50 Fire 8" thick.
12.25 Fire cleaned. 197 lbs. of clinker and cinders removed with many pieces of burnt stone. Clinker thick, viscous, porous, friable.
5.30 Fire cleaned. 220 lbs. of clinker, cinders removed.
6.38 Trial stopped. Fire very similar to start. 75 lbs. of ashes raked from pit. Blow-off cock examined and found tight.

CLINKER AND ASH.

417 lbs. clinker.
75 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 10.

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.35 a.m.						
8.38	95	95	8.45	8·2	5·8	3·5
9.04	176	271	9.15	9·0	10·7	0·0
9.27	172	443	9.45	9·2	10·2	0·0
10.04	188	631	10.15	8·2	11·6	0·0
10.35	212	843	10.45	8·6	11·3	0·0
11.10	157	1000	11.15	9·6	9·7	0·0
11.50	158	1158	11.45	9·4	10·4	0·0
12.12	160	1318	12.15	11·8	7·6	0·0
12.38	145	1463	12.45	10.3	5·9	2·7
12.50	174	1637	1.15	10·0	9·4	0·0
1.26	175	1812	1.45	8·7	9·5	0·9
1.53	173	1985	2.15	10·8	4·4	3·6
2.20	186	2171	2.45	11·4	7·9	0·0
2.50	180	2351	3.15	12·3	4·9	1·5
3.20	180	2531	3.45	11·2	7·0	0·5
3.47	177	2708	4.15	10·6	8·2	0·0
4.10	154	2862	4.45	10·4	8·9	0·0
4.36	174	3036	5.15	10·5	9·0	0·0
5.40	174	3210	5.45	9·1	8·5	0·7
5.50	165	3375	6.15	11.0	8·4	0·0
6.38	184	3559				
				10	8·5	0·7

OBSERVATIONS MADE DURING BOILER TRIAL No. 10.

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.35	110	83	440	67·5	—·02	—·30	.....
8.50	114	83	435	67·5	—·02	—·25	259
9.05	111	84	455	68	—·02	—·25	552
9.20	107	85	460	68	—·02	—·30	540·5
9.35	111	86	440	68	—·02	—·25	449
9.50	114	88	430	68.5	—·02	—·25	472
10.05	113	88	440	68·5	—·02	—·25	442
10.20	109	88	440	69	—·02	—·25	455·5
10.35	112	89	435	69	—·02	—·30	444·5
10.50	110	90	435	69	—·02	—·25	411
11.05	112	90	455	69	—·02	—·25	407
11.20	110	90	460	69	—·02	—·20	438
11.35	105	90	480	69	—·02	—·25	453
11.50	108	88	445	69	—·02	—·25	386
12.05	118	88	430	69	—·02	—·20	356·5
12.20	115	86	510	69·5	—·02	—·30	376·5
12.35	119	92	500	69·5	—·02	—·30	372·5
12.50	118	87	495	69·5	—·02	—·30	457
1.05	120	86	490	70	—·02	—·30	591
1.20	116	85	515	70	—·02	—·30	522
1.35	114	86	430	70	—·02	—·30	578
1.50	116	86	460	70·5	—·02	—·20	296·5
2.05	116	86	490	70	—·02	—·25	548
2.20	107	87	505	70	—·00	—·20	431·5
2.35	117	87	575	70·5	—·00	—·25	523
2.50	110	86	530	71	—·02	—·20	508
3.05	117	87	535	71	—·0	—·20	419
3.20	110	88	500	71	—·0	—·25	565·5
3.35	116	86	490	71	—·02	—·25	352·5
3.50	117	88	545	71	—·02	—·25	495·5
4.05	108	88	505	71	—·0	—·25	580
4.20	114	88	510	71	—·0	—·25	428
4.35	110	88	500	71	—·0	—·25	509·5
4.50	114	88	495	71	—·0	—·25	403
5.05	115	88	525	71	—·02	—·25	466·5
5.20	120	88	490	71	—·0	—·25	376
5.35	110	94	520	71	—·0	—·20	499
5.50	113	87	445	71·5	—·0	—·25	161·5
6.05	120	86	550	71·5	—·0	—·30	479·5
6.20	114	86	575	70·5	—·0	—·30	597
6.38	107	86	550	71	—·0	—·30	720
	113·1	87·3	486	69·9	—·01	—·25	18,271·5

SUMMARY OF OBSERVATIONS

Date—July 10, 1907.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.35 a.m.	Ended—6.38 p.m.	Duration—603 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning. Fresh water, July 4.	Thoroughly cleaned June, 1907.
4.	Tubes cleaned	8.15 a.m.
5.	Fire cleaned	7.30 a.m., 12.25 and 5.30 p.m.

Fuel.

6.	Kind of coal	No. 4, Six foot seam, Vale Colliery, Acadia Coal Co., Over $\frac{3}{4}$" screen and picking belt.
7.	Analysis of dry coal by weight (%)	C = 68·0, H = 4·2, S = 1·0, N = 1·8, O = 7·7, Ash = 17·3
8.	Calorific value of dry coal B.T.U. per lb	12020
9.	Moisture in coal as fired (%)	2·8
10.	Weight of coal fired (lbs.)	3559
11.	Combustible matter in ash and clinker (%)	16·4
12.	Weight of clinker (lbs.)	417
13.	Weight of ash (lbs.)	75

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−0·01
15.	" above fire " "	−0·19
16.	" at damper " "	−0·25
17.	Amount of damper opening	Various
18.	Temperature of air in boiler house (°F.)	87·3
19.	Flue temperature (°F.)	486
20.	Analysis of dry flue gas by volume (%)	$CO_2 = 10·0$, $O_2 = 8·5$, $CO = 0·7$, $N_2 = 80·8$

Water and Steam.

21.	Temperature of feed water (°F.)	69·9
22.	Total weight of feed water, corrected for difference in level (lbs.)	18271
23.	Water level in gauge at start (inches)	4 $\frac{1}{16}$
24.	Water level in gauge at finish (inches)	4
25.	Correction for difference of level included above (lbs.)	9·5
26.	Steam pressure by gauge (lbs. per sq. in.)	113·1
27.	Barometer reading (inches)	29·625
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	13·9
29.	Temperature in steam calorimeter (°F.)	276

Notes.

Air admitted over fire throughout trial. Clinker thick, viscous, porous, and friable, contained many pieces of burnt stone. Weather fine and still.

Proximate analysis of dry coal by weight (%): Fixed carbon 50·6; Volatile matter 32·1; Ash 17·3

SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 4. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·60. At finish—29·65. Mean—29·625.

Total Quantities.

1.	Date of trial	10/7/07
2.	Duration of trial (hours)	10·05
3.	Weight of coal as fired (lbs.)	3559
4.	Percentage of moisture in coal as fired (%)	2·8
5.	Total weight of dry coal fired (lbs.)	3,458
6.	Total ash and refuse (lbs.)	492
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 20·7; (*b*) weighed	14·3
8.	Total weight of combustible consumed, from analyses (lbs.)	2744
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	18271
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	18070
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	21500

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	296
13.	Dry coal per square foot of grate surface per hour (lbs.)	17·6
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1798
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2140
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·35

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	113·1
18.	Temperature of feed water entering boiler (deg. F.)	69·9
19.	Temperature of escaping gases from boiler (deg. F.)	486
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·24
21.	Percentage of moisture in steam	1·0

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	62·0
23.	Builders' rated horse-power	60·0
24.	Percentage of builders' rated horse-power developed	103

Economic Results.

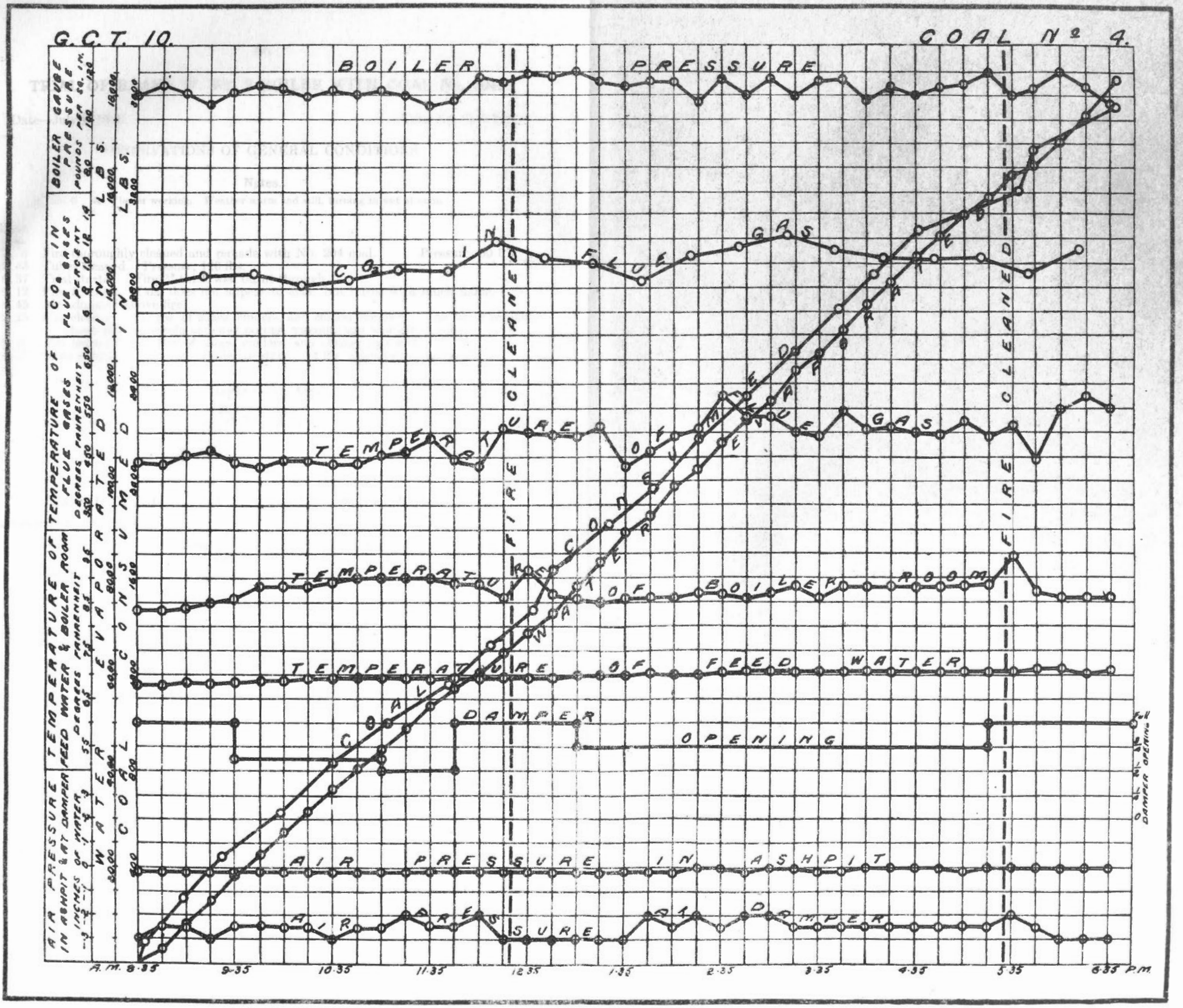
25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	5·13
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	6·04
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	6·23
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	7·84

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	12020
30.	Calorific value of the combustible per lb. (B.T.U.)	14550
31.	Efficiency of boiler (based on combustible consumed) (%)	52·0
32.	Efficiency of boiler, including grate (based on dry coal) (%)	50·0

Flue Gases.

33.	Dry flue gases per lb. carbon (from gas analyses) (lbs.)	23·4
34.	" " of combustible consumed (from gas analyses) (lbs.)	20·1
35.	" " dry coal (from gas analyses) (lbs.)	15·9
36.	Proportion of heat of fuel in escaping dry flue gases (%)	12·7


G.C.T. 10.
COAL Nº 4.
BOILER PRESSURE
CO₂ IN FLUE GASES
TEMPERATURE OF FLUE GASES
TEMPERATURE OF BOILER ROOM
TEMPERATURE OF FEED WATER
DAMPER OPENING
AIR PRESSURE IN ASHPIT
AIR PRESSURE
FIRE CLEANED
BOILER GAUGE PRESSURE
POUNDS PER SQ. IN.
WATER EVAPORATED
LBS.
COAL CONSUMED
LBS.
DEGREES FAHRENHEIT
PER CENT
INCHES OF WATER
A.M. 8·35
9·35
10·35
11·35
12·35
1·35
2·35
3·35
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5·35
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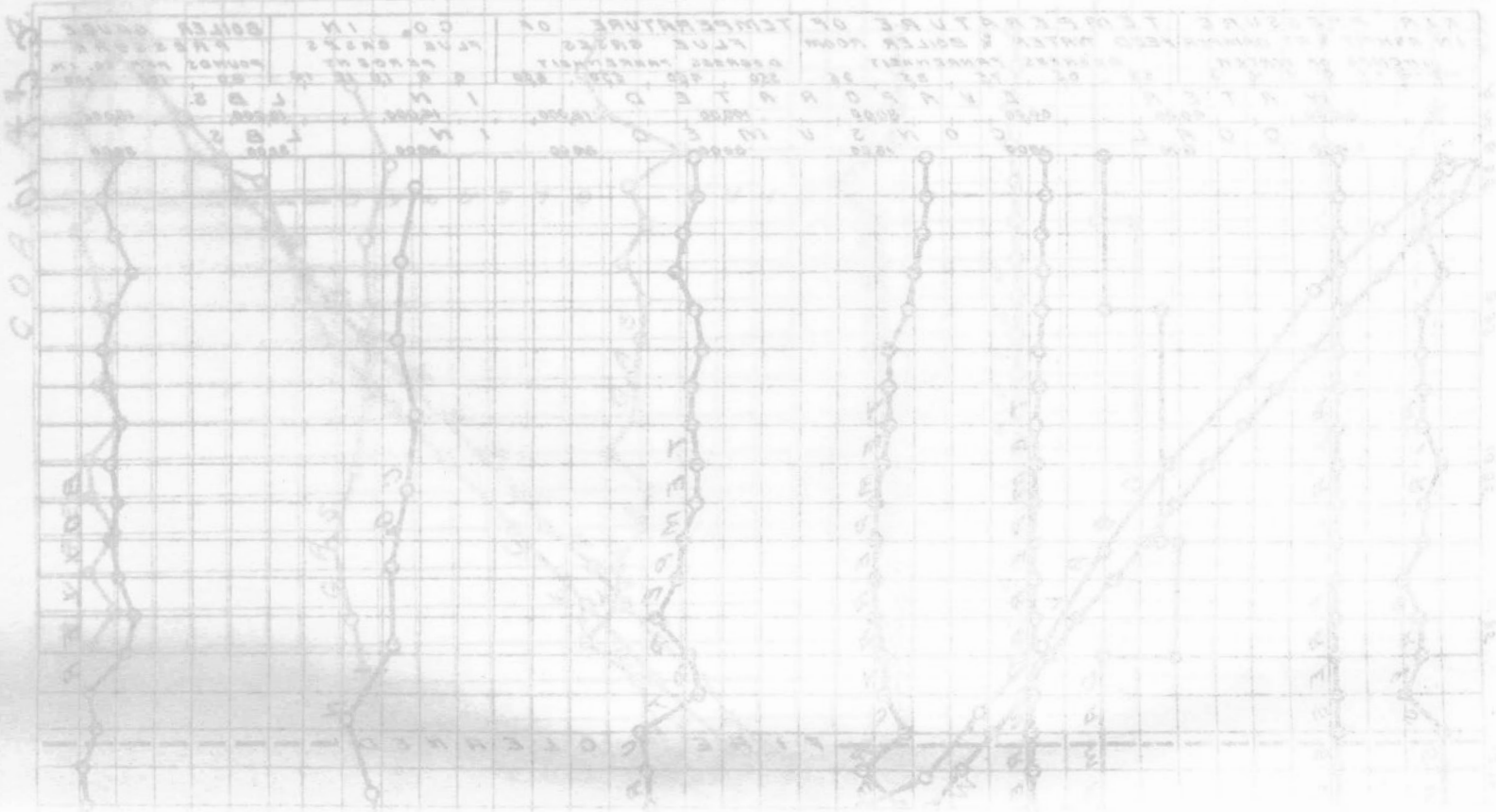


TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 204.

Date—July 8, 1907. Trial No. G.C.T. 9.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

B. and W. No. 1 boiler working. Weather warm and still, turning to wet at noon.

Time.
a.m.
7.30 Fire thoroughly cleaned and remade with No. 204 coal. Pressure, 50 lbs.
7.53 Tubes cleaned. Pressure, 120 lbs.
8.37 Trial started. Fire 2″ thick well burnt through.
9.12 Fire 5″ thick. Coal does not appear to cake, but burns with much flame.
9.45 Air admitted above fire.
12.25 Fire cleaned. 147 lbs. of ashes, cinders, and clinker removed. The latter formed about 50% of whole and was porous, viscous, and whitish in colour.
5.30 Fire cleaned. 115 lbs. of ashes, cinders, and clinker removed.
6.37 Trial stopped. Fire very similar to start. 74 lbs. ashes raked out of pit.

CLINKER AND ASH.

262 lbs. clinker.
74 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 9

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.37 a.m.						
8.53	177	177	8.45	10·8	5·6	1·7
9.12	173	350	9.15	8·6	6·4	3·6
9.37	192	542	9.45	10.6	7·7	0·2
10.25	202	744	10.15	12·3	7·2	0·0
11.03	184	928	10.45	12·4	5·8	1·0
11.25	141	1069	11.15	12·5	6·8	0·1
12.03	183	1252	11.45	12·6	6·6	0·0
12.40	195	1447	12·15	7·3	13·2	0·0
12.55	176	1623	12·45	8·6	9·3	0·2
1.29	160	1783	1.15	10·0	9·3	0·1
1.55	182	1965	1.45	11·4	8·4	0·0
2.40	171	2136	2.15	10·6	9·1	0·0
3.14	180	2316	2.45	11·0	8·7	0·0
3.38	152	2468	3.15	14·6	4·2	0·6
4.20	186	2654	3.45	11·9	4·1	3·0
4.55	165	2819	4.15	12·7	6·6	0·0
5.20	160	2979	4.45	11·2	8·4	0·0
5.43	155	3134	5.15	15·6	2·6	0·4
6.03	174	3308	5.45	10·9	8·1	0·0
6.37	83	3391	6.15	11·8	7·6	0·0
				11·4	7·3	0·5

OBSERVATIONS MADE DURING BOILER TRIAL No. 9

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	lbs.
8.37	103	88	480	67·5	—·02	—·30	.....
8.51	115	90	463	68	—·02	—·30	432
9.05	115	90	455	68	—·02	—·30	507·5
9.20	107	91	440	68·5	—·02	—·30	520
9.35	102	91	470	69	—·02	—·30	589
9.50	97	92	445	69	—·02	—·15	509
10.05	102	93	440	69	—·02	—·20	537
10.20	115	94	465	68·5	—·02	—·15	421
10.35	110	95	440	68·5	—·02	—·20	455
10.50	110	95	470	67·5	—·02	—·15	399
11.05	107	94	485	68·5	—·02	—·20	434·5
11.20	111	94	490	69	—·02	—·15	460
11.35	112	93	485	69	—·02	—·20	348
11.50	110	95	575	69	—·02	—·35	444
12.05	111	93	575	69	—·02	—·30	551·5
12.20	105	92	500	68·5	—·02	—·30	578
12.35	115	94	445	69	—·02	—·20	172
12.50	116	91	420	68·5	—·02	—·20	367
1.05	110	91	445	69	—·02	—·22	547
1.20	120	90	495	70	—·02	—·25	306·5
1.35	112	90	500	70	—·02	—·20	542·5
1.50	113	90	500	71·5	—·02	—·20	493·5
2.05	114	88	475	71·5	—·02	—·20	439·5
2.20	114	88	510	70	—·02	—·20	449·5
2.35	116	85	515	70·5	—·02	—·20	507
2.50	110	84	490	70·5	—·02	—·25	585·5
3.05	112	85	525	71·	—·02	—·20	425·5
3.20	116	86	540	71·5	—·02	—·20	622
3.35	112	86	530	71·5	—·02	—·20	517
3.50	116	85	545	71·5	—·00	—·20	401·5
4.05	107	84	520	71·5	—·00	—·20	550·5
4.20	116	84	505	71·	—·02	—·20	354·5
4.35	109	84	480	70·5	—·02	—·20	476·5
4.50	110	86	480	71	—·02	—·20	440·5
5.05	115	88	515	71	—·02	—·20	349
5.20	114	85	655	71·5	—·02	—·35	551
5.35	88	91	510	71·5	—·00	—·25	193·5
5.50	115	82	565	71·5	—·00	—·30	344
6.05	111	83	530	71	—·00	—·30	557
6.20	110	82	580	71	—·00	—·25	425·5
6.37	111	82	485	71·5	—·00	—·20	542·5
	110·6	89·	499	69·9	—·02	—·23	18,257 net

SUMMARY OF OBSERVATIONS

Date—July 8, 1907.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.37 a.m.	Ended—6.37 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning. Fresh water, July 4.	Thoroughly cleaned June, 1907.
4.	Tubes cleaned	7.53 a.m.
5.	Fire cleaned	7.30 a.m., 12.25 and 5.30 p.m.

Fuel.

6.	Kind of coal	No. 204. Six foot seam, Vale Colliery, Acadia Coal Co. (Over $\frac{3}{4}$" screen and picking belt).
7.	Analysis of dry coal by weight (%), C=71·7, H=4·2, S=1·0, N=1·7, O=8·8, Ash=12·6.	
8.	Calorific value of dry coal B.T.U. per lb	12760
9.	Moisture in coal as fired (%)	3·9
10.	Weight of coal fired (lbs.)	3391
11.	Combustible matter in ash and clinker (%)	14·3
12.	Weight of clinker (lbs.)	262
13.	Weight of ash (lbs.)	74

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−0·02
15.	" above fire " "	−0·17
16.	" at damper " "	−0·23
17.	Amount of damper opening	Various
18.	Temperature of air in boiler house (°F.)	89
19.	Flue temperature (°F.)	499
20.	Analysis of dry flue gas by volume (%), CO_2=11·4, O_2=7·3, CO=0·5, N_2=80·8	

Water and Steam.

21.	Temperature of feed water (°F.)	69·9
22.	Total weight of feed water, corrected for difference of level (lbs.)	18257
23.	Water level in gauge at start (inches)	$4\frac{5}{8}$
24.	Water level in gauge at finish (inches)	$5\frac{1}{16}$
25.	Correction for difference of level included above (lbs.)	66·5
26.	Steam pressure by gauge (lbs. per sq. in.)	110·6
27.	Barometer reading (inches)	29·58
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	8·3
29.	Temperature in steam calorimeter (°F.)	238

Notes.

Air admitted over fire from 9.45 a.m. to close. Clinker porous, viscous, and friable when cold, whitish in colour. Coal burned with much flame. Weather warm and still, turning to rain at noon.

Proximate analysis of dry coal by weight %

Fixed carbon	54·2
Volatile matter	33·2
Ash	12·6

SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 204. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·64. At finish—29·51. Mean—29·58.

Total Quantities.

1.	Date of trial	8/7/07
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	3391
4.	Percentage of moisture in coal as fired (%)	3·9
5.	Total weight of dry coal fired (lbs.)	3258
6.	Total ash and refuse (lbs.)	336
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 14·7; (*b*) weighed 10·3	
8.	Total weight of combustible consumed, from analyses (lbs.)	2780
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	18257
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17760
11.	Equivalent water evaporated into dry steam from and at 212°F. (lbs.)	21140

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	325·8
13.	Dry coal per square foot of grate surface per hour (lbs.)	19·4
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1776
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2114
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·31

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	110·6
18.	Temperature of feed water entering boiler (deg. F.)	69·9
19.	Temperature of escaping gases from boiler (deg. F.)	499
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·21
21.	Percentage of moisture in steam	4·0

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	61·3
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	102

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	5·38
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	6·24
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	6·49
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	7·60

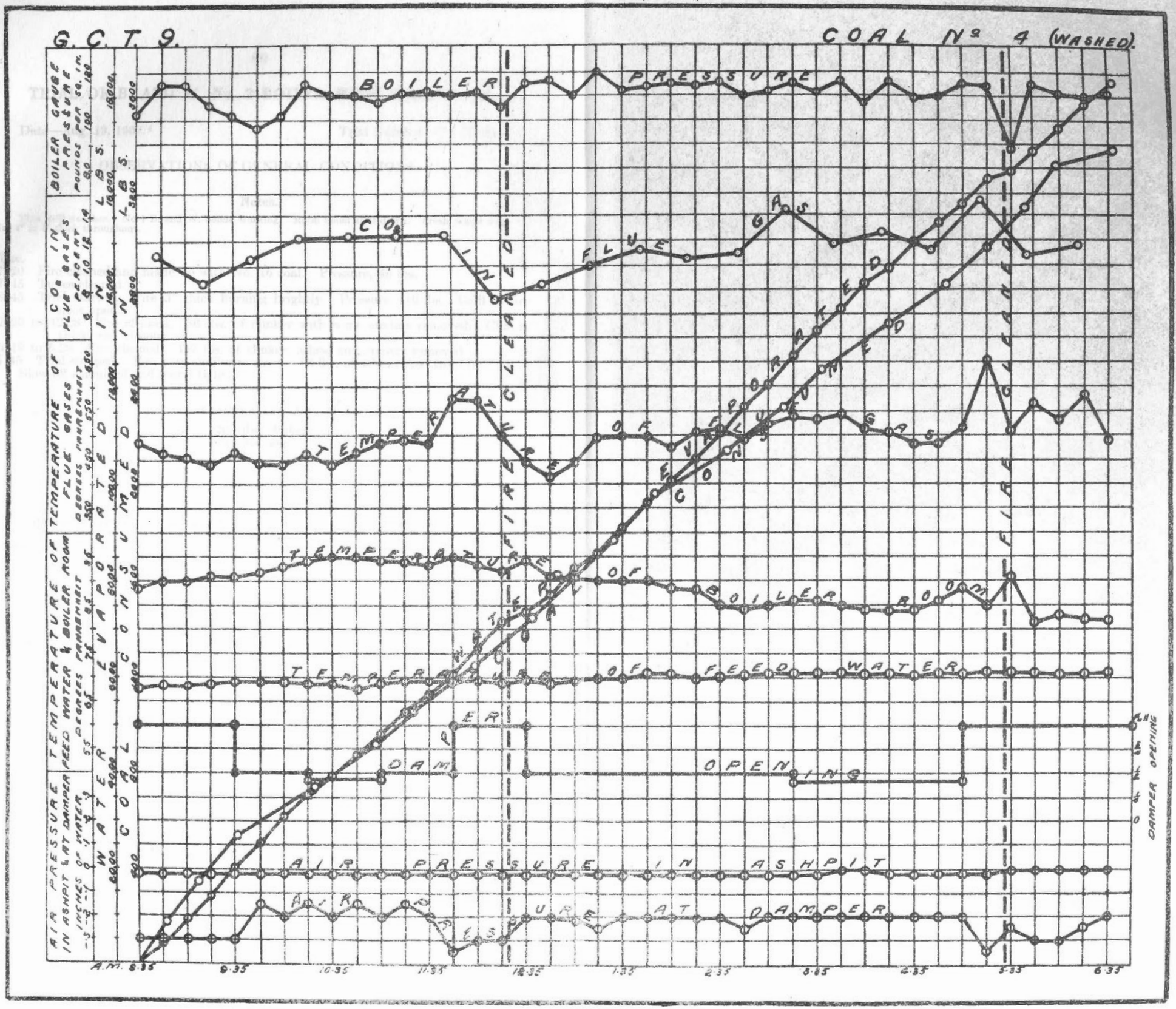
Efficiency.

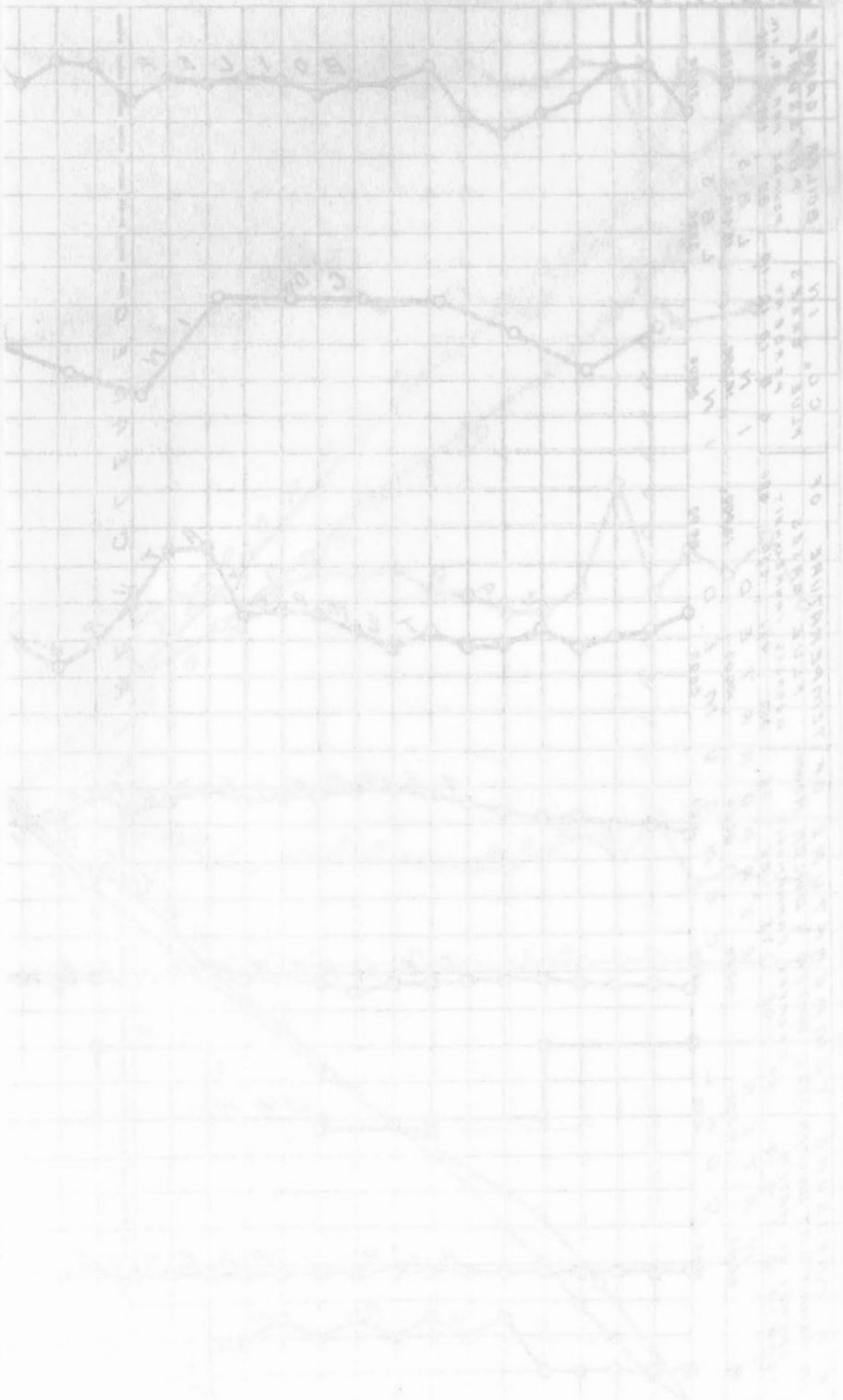
29.	Calorific value of dry coal per lb. (B.T.U.)	12760
30.	Calorific value of the combustible per lb. (B.T.U.)	14600
31.	Efficiency of boiler (based on combustible consumed) (%)	50·2
32.	Efficiency of boiler, including grate (based on dry coal) (%)	49·2

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	21·1
34.	" " of combustible consumed (from gas analyses) (lbs.)	17·7
35.	" " dry coal (from gas analyses) (lbs.)	15·2
36.	Proportion of heat of fuel in escaping dry flue gases (%)	11·7

GRAPHIC RECORD OF BOILER TRIAL.





TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 16.

Date—Aug. 19, 1907. Trial Number—G.C.T. 26.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Fine, still weather. No 1 B. and W. boiler working. Robb boiler shut down. Fresh water Aug. 17. Fire 4" to 6" thick throughout.

Time.
7.20 Fire cleaned and made up with No. 16 coal. Pressure, 40 lbs.
7.45 Tubes cleaned.
8.45 Trial started. Fire 3" thick burning brightly. Pressure, 110 lbs. Grill in fire door open.
12.20 to 12.28 Fire cleaned. 86 lbs. of clinker with some cinders removed. Clinker thick and viscous.
5.19 to 5.28 Fire cleaned. 117 lbs. of clinker, ashes, and cinders removed.
6.45 Trial stopped. Fire very similar to start. 83 lbs. of ashes raked from pit. Blow-off examined and found tight.

CLINKER AND ASH.

203 lbs. clinker.
83 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 26

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.45 a.m.						
9.15	263	263	9.10	11·1	7·7	0·0
9.35	178	441	9.43	11·8	7·0	0·1
10.01	183	624	10.10	10·0	8·5	0·0
10.45	183	807	10.36	9·3	8·9	0·0
11.35	205	1012	11.07	10·8	7·2	0·2
12.38	185	1197	11.40	9·5	8·3	0·2
1.00	178	1375	12.05	8·0	11·0	0·0
1.22	173	1548	12.37	10·9	6·9	0·2
2.05	158	1706	1.08	7·4	11·4	0·0
2.46	197	1903	1.40	9·6	8·3	0·1
3.28	206	2109	2.10	6·7	12·1	0·0
4.21	183	2292	2.40	11·1	7·6	0·0
5.17	171	2463	3.06	9·8	8·2	0·0
5.45	187	2650	3.36	9·7	8·8	0·0
6.14	184	2834	4.10	6·8	13·2	0·0
6.45	109	2943	4.36	9·0	10·4	0·0
			5.10	5·4	14·8	0·0
			5.40	10·9	6·9	0·0
			6.05	8·2	11·0	0·0
			6.30	6·8	11·4	0·0
				9·1	9·5	0·0.

OBSERVATIONS MADE DURING BOILER TRIAL No. 26

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.45	110	74	465	70·5	—·05	—·35	.....
9.00	113	74	510	70·5	—·05	—·35	429·5
9.15	110	76	610	70·5	—·05	—·35	434·5
9.30	107	77	585	70·5	—·05	—·35	609·5
9.45	112	79	560	70·5	—·05	—·35	531
10.00	119	81	520	70·5	—·05	—·35	446
10.15	114	79	517	70·5	—·05	—·35	577·5
10.30	119	79	500	70·5	—·05	—·35	451
10.45	120	80	500	70·5	—·05	—·35	490
11.00	114	82	500	70·5	—·05	—·35	566
11.15	118	82	460	70·5	—·05	—·35	402·5
11.30	117	83	490	70·5	—·05	—·35	531
11.45	105	84	465	70·5	—·05	—·35	390
12.00	103	83	465	70·5	—·05	—·35	438·5
12.15	98	83	435	70·5	—·05	—·35	450
12.30	89	87	425	70·5	—·05	—·35	241
12.45	118	83	475	70·5	—·05	—·35	673·5
1.00	111	83	460	70·5	—·05	—·35	
1.15	110	83	500	70·5	—·05	—·35	356·5
1.30	122	83	525	70·5	—·05	—·35	454
1.45	113	84	500	70·5	—·05	—·35	437
2.00	119	84	500	71	—·05	—·35	607·5
2.15	120	85	500	71	—·05	—·35	462·5
2.30	112	85	500	71	—·05	—·35	520·5
2.45	105	88	550	71	—·05	—·35	525·5
3.00	99	88	550	71	—·05	—·35	589·5
3.15	108	88	550	71	—·05	—·35	322·5
3.30	108	87	550	71	—·05	—·28	565
3.45	118	87	525	71	—·05	—·28	443
4.00	104	87	500	71	—·05	—·28	471·5
4.15	109	87	525	71	—·05	—·28	365
4.30	119	87	525	71	—·05	—·28	413·5
4.45	103	87	525	71	—·05	—·28	621
5.00	105	87	475	71	—·05	—·28	323·5
5.15	110	86	450	71	—·05	—·28	311·5
5.30	103	89	440	71	—·05	—·28	226·5
5.45	119	86	635	71	—·05	—·28	451
6.00	122	85	550	71	—·05	—·28	463·5
6.15	122	87	650	71	—·05	—·28	533·5
6.30	121	86	575	71	—·05	—·28	477·5
6.45	123	85	550	71	—·05	—·28	505·5
	111·9	83·7	514	70·7	—·05	—·33	18,091·5 net

SUMMARY OF OBSERVATIONS

Date—Aug. 19, 1907.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.45 a.m.	Ended—6.45 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning.	Thoroughly cleaned June, 1907. Fresh water, August 17.
4.	Tubes cleaned	7.45 a.m.
5.	Fire cleaned	7.20 a.m., 12.20 and 5.20 p.m.

Fuel.

6.	Kind of coal	No. 16—Foord seam, Allan Shaft Colliery, Acadia Coal Co. Over picking belt only.
7.	Analysis of dry coal by weight (%)	C = 74·1, H = 4·6, S = 0·6, N_2 = 1·9, O = 7·5, Ash = 11·3
8.	Calorific value of dry coal B.T.U. per lb	13230
9.	Moisture in coal as fired (%)	1·8
10.	Weight of coal fired (lbs.)	2943
11.	Combustible matter in ash and clinker (%)	12·4
12.	Weight of clinker (lbs.)	203
13.	Weight of ash (lbs.)	83

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−0·05
15.	" above fire " "	−0·26
16.	" at damper " "	−0·33
17.	Amount of damper opening	Various
18.	Temperature of air in boiler house (°F.)	83·7
19.	Flue temperature (°F.)	514
20.	Analysis of dry flue gas by volume (%)	CO_2 = 9·1, O_2 = 9·5, CO = 0·0, N_2 = 81·4

Water and Steam.

21.	Temperature of feed water (°F.)	70·7
22.	Total weight of feed water, corrected for difference of level (lbs.),	18091
23.	Water level in gauge at start (inches)	$3\frac{11}{16}$
24.	Water level in gauge at finish (inches)	$3\frac{7}{16}$
25.	Correction for difference of level, included above (lbs.)	0·38
26.	Steam pressure by gauge (lbs. per sq. in.)	111·9
27.	Barometer reading (inches)	30·0
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	20·5
29.	Temperature in steam calorimeter (°F.)	290·7

Notes.

Air admitted over fire throughout trial. Clinker thick and viscous. Weather fine and still.

Proximate analysis of dry coal by weight %: Fixed carbon ..... 55·4; Volatile matter ..... 33·3; Ash ..... 11·3

SUMMARY OF RESULTS

Made on No. 2 B. and W. Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 16. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—30·08. At finish—29·72. Mean—29·90.

Total Quantities.

1.	Date of trial	19/8/07
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	2943
4.	Percentage of moisture in coal as fired (%)	1·8
5.	Total weight of dry coal fired (lbs.)	2890
6.	Total ash and refuse (lbs.)	286
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 12·9; (*b*) weighed	9·9
8.	Total weight of combustible consumed, from analyses (lbs.)	2517
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	18091
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17978
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	21370

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	289
13.	Dry coal per square foot of grate surface per hour (lbs.)	17·2
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1797·8
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2137
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·34

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	111·9
18.	Temperature of feed water entering boiler (deg. F.)	70·7
19.	Temperature of escaping gases from boiler (deg. F.)	514
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·28
21.	Percentage of moisture in steam	1·0

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	61·9
23.	Builders' rated horse-power	60·0
24.	Percentage of builders' rated horse-power developed	103·2

Economic Results.

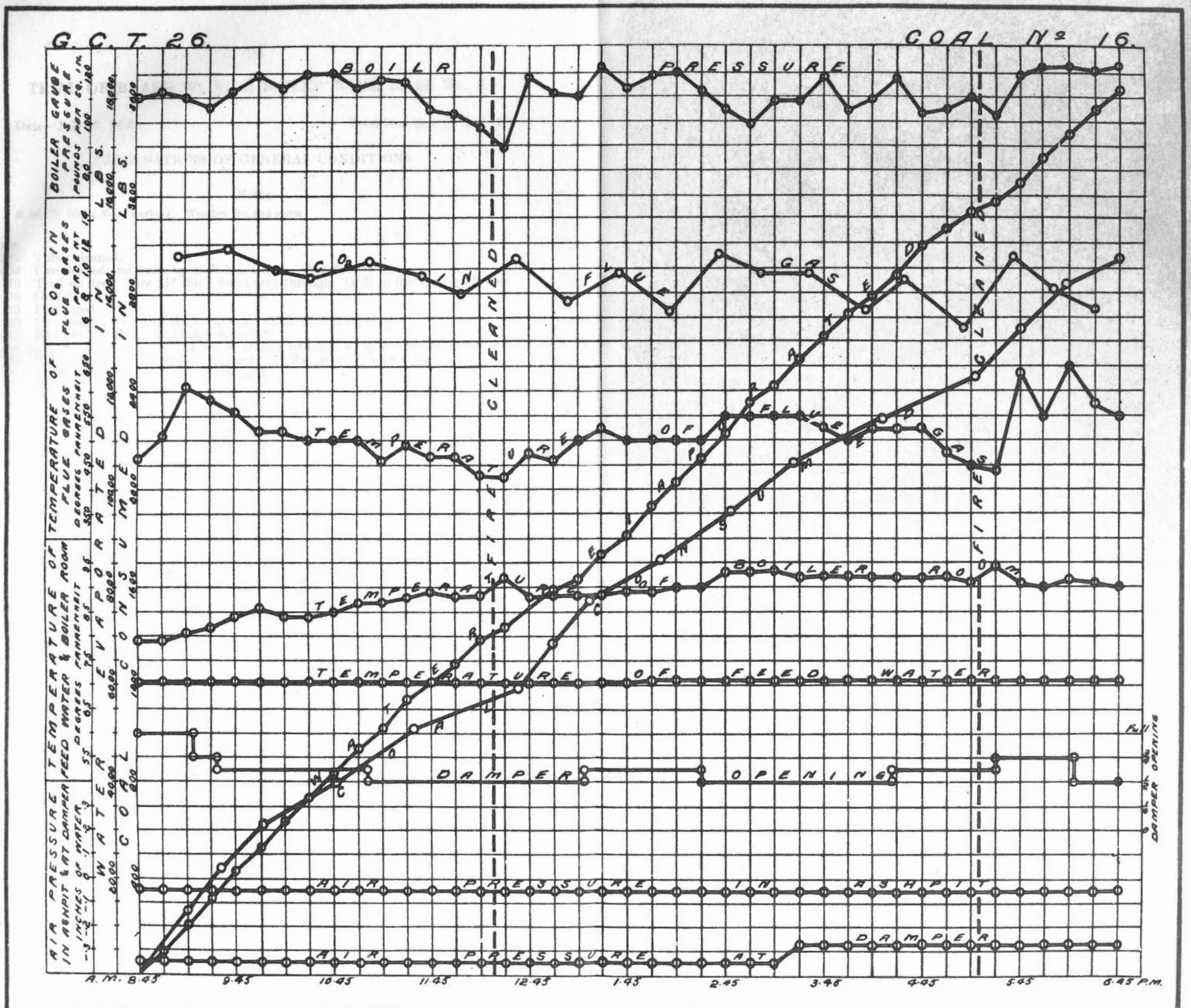
25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	6·14
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	7·24
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	7·39
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	8·49

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	13230
30.	Calorific value of the combustible per lb. (B.T.U.)	14920
31.	Efficiency of boiler (based on combustible consumed) (%)	55·0
32.	Efficiency of boiler, including grate (based on dry coal) (%)	53·9

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	27·3
34.	" " of combustible consumed (from gas analyses) (lbs.)	23·2
35.	" " dry coal (from gas analyses) (lbs.)	20·2
36.	Proportion of heat of fuel in escaping dry flue gases (%)	15·7


G. C. T. 26.
COAL No. 16.
BOILER PRESSURE
CO2 IN FLUE GASES
TEMPERATURE OF FLUE GASES
TEMPERATURE OF FEED WATER & BOILER ROOM
AIR PRESSURE IN ASHPIT & AT DAMPER
CLEANED FIRES
CLEANED FIRES
BOILER ROOM
FEED WATER
DAMPER OPENING
AIR PRESSURE IN ASHPIT
AIR PRESSURE AT DAMPER
A.M. 8.45
9.45
10.45
11.45
12.45
1.45
2.45
3.45
4.45
5.45
6.45 P.M.

TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 1

Date—July 29, 1907. Trial Number—G.C.T. 17

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

B. and W. boiler No. 1 working. Weather fine and warm.

Time.
7.45 Tubes cleaned.
8.00 Fire cleaned and made up with No. 1 coal. Pressure, 75 lbs.
9.10 Trial started. Fire 2½" thick well burnt through. Grill in fire door half open.
10.38 Grill closed.
2.25 Fire sliced.
4.00 Fire sliced. 18 lbs of thick, porous, friable clinker removed.
5.15 Fire sliced. 39 lbs. of clinker removed.
5.58 to 6.05 Fire cleaned. 153 lbs. of clinker removed without difficulty.
7.13 Trial stopped. Fire similar to start. 79 lbs. of ashes raked from pit.
Blow-off examined and found tight.

Clinker and Ash.

210 lbs. clinker.
79 lbs ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 17

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 9.10						
9.25	182	182				
9.47	170	352				
10.18	181	533				
10.47	162	695				
11.10	155	850				
12.05	152	1002				
1.00	163	1165				
1.25	159	1324				
2.09	185	1509		Sampling	doubtful	
2.45	154	1663				
3.18	169	1832				
4.07	158	1990				
4.35	176	2166				
5.33	159	2325				
6.07	186	2511				
6.50	157	2668				
7.13	53	2721				

OBSERVATIONS MADE DURING BOILER TRIAL No. 17

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
9.10	100	89	450	71·5	—·0	—·25	.....
9.25	114	90	415	71	—·01	—·25	148·5
9.40	118	91	435	70	—·01	—·25	448·5
9.55	110	91	435	70	—·01	—·25	468
10.10	103	93	450	70	—·01	—·25	494·5
10.25	116	93	475	70·5	—·01	—·25	487
10.40	115	93	475	71·5	—·01	—·25	513
10.55	113	94	465	70·5	—·01	—·25	532·5
11.10	109	94	450	70	—·01	—·25	352·5
11.25	113	95	435	71·5	—·01	—·25	449·5
11.40	113	96	430	71	—·01	—·25	662·5
11.55	103	95	425	70·5	—·01	—·25	531
12.10	99	95	410	70	—·01	—·25	506·5
12.25	108	97	425	71	—·01	—·25	290
12.40	108	98	415	70·5	—·01	—·25	382·5
12.55	109	97	425	71	—·01	—·25	496·5
1.10	104	97	410	70	—·01	—·25	426·5
1.25	104	98	415	71	—·01	—·25	481
1.40	104	99	425	71·5	—·01	—·25	353·5
1·55	104	98	410	72·5	—·01	—·25	445
2.10	98	98	410	72·5	—·01	—·25	443
2.25	118	97	425	71	—·01	—·25	380
2.40	122	96	400	71	—·01	—·25	354
2.55	114	97	435	71	—·01	—·25	423
3.10	122	97	450	70·5	—·01	—·25	421·5
3.25	114	97	440	70·5	—·01	—·25	480·5
3.40	108	95	454	70·5	—·01	—·25	407·5
3.55	118	94	415	70·5	—·01	—·25	403
4.10	109	95	435	70·5	—·01	—·25	413
4.25	108	95	435	70·5	—·01	—·25	524·5
4.40	112	92	440	70·5	—·01	—·25	267
4.55	108	92	420	71	—·01	—·25	515
5.10	112	93	410	71	—·01	—·25	221·5
5.25	104	94	425	70·5	—·01	—·25	343
5.40	113	91	410	71	—·01	—·25	325
5.55	108	92	400	71	—·01	—·25	333
6.10	100	98	420	71	—·01	—·25	226·5
6.25	107	93	480	71	—·01	—·25	411·5
6.40	117	92	516	71	—·01	—·25	570
6.55	117	91	560	71	—·01	—·25	516·5
7.13	100	91	595	71	—·01	—·25	616
	109·7	94·5	440	70·8	—·01	—·25	17,034 net

SUMMARY OF OBSERVATIONS

Date—July 29, 1907.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—9.10 a.m.	Ended—7.13 p.m.	Duration—603 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning.	Thoroughly cleaned June, 1907. Fresh water, July 18.
4.	Tubes cleaned	7.45 a.m.
5.	Fire cleaned	8.00 a.m. and 6 p.m.

Fuel.

6.	Kind of coal	No. 1—Third seam. Albion Colliery, Acadia Coal Co., Stellarton, Pictou Co., N.S.—R.O.M. Coal
7.	Analysis of dry coal by weight (%)	C=71·4, H=4·5, S=1·4, N=1·7, O=6·3, Ash=14·7
8.	Calorific value of dry coal B.T.U. per lb	12580
9.	Moisture in coal as fired (%)	2·0
10.	Weight of coal fired (lbs.)	2721
11.	Combustible matter in ash and clinker (%)	14·6
12.	Weight of clinker (lbs.)	210
13.	Weight of ash (lbs.)	79

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−0·01
15.	" above fire " "	−0·20
16.	" at damper " "	−0·25
17.	Amount of damper opening	Various
18.	Temperature of air in boiler house (°F.)	94·5
19.	Flue temperature (°F.)	440
20.	Analysis of dry flue gas by volume (%)—sampling doubtful.	

Water and Steam.

21.	Temperature of feed water (°F.)	70·8
22.	Total weight of feed water, corrected for difference of level (lbs.)	17034
23.	Water level in gauge at start (inches)	$4\frac{15}{16}$
24.	Water level in gauge at finish (inches)	$4\frac{7}{8}$
25.	Correction for difference of level, included above (lbs.)	9·5
26.	Steam pressure by gauge (lbs. per sq. in.)	109·7
27.	Barometer reading (inches)	29·50
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	19·45
29.	Temperature in steam calorimeter (°F.)	286

Notes.

Fire sliced 2.25, 4.00, and 5.15 p.m. Air admitted over fire from 9.10 to 10.38 a.m. Clinker thick, porous, friable, and removed without difficulty. Coal cokes and burns with much flame and smoke. Weather fine and warm.

Proximate analysis of dry coal by weight (%)

Fixed carbon	55·5
Volatile matter	29·8
Ash	14·7

SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 1. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·52. At finish—29·49. Mean—29·50.

Total Quantities.

1.	Date of trial	29/7/07
2.	Duration of trial (hours)	10·05
3.	Weight of coal as fired (lbs.)	2721
4.	Percentage of moisture in coal as fired (%)	2·0
5.	Total weight of dry coal fired (lbs.)	2667
6.	Total ash and refuse (lbs.)	289
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 17·2; (*b*) weighed	10·8
8.	Total weight of combustible consumed, from analyses (lbs.)	2208
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	17034
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	16900
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	20080

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	266
13.	Dry coal per square foot of grate surface per hour (lbs.)	15·8
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1682
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	1998
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·12

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	109·7
18.	Temperature of feed water entering boiler (deg. F.)	70·8
19.	Temperature of escaping gases from boiler (deg. F.)	440
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·24
21.	Percentage of moisture in steam	1·0

Horse-Power.

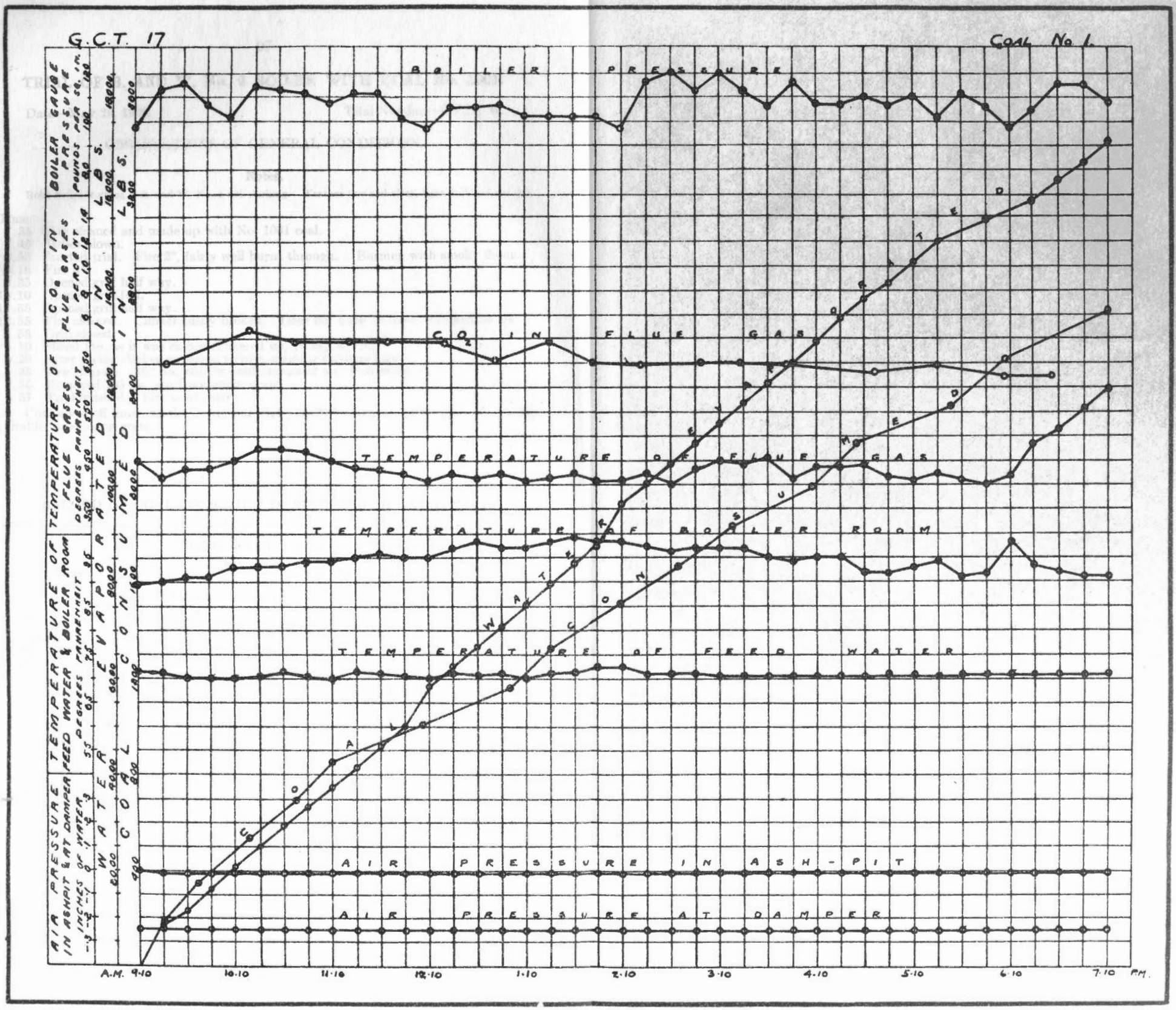
22.	Horse-power developed (Item 15 ÷ 34½)	57·9
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	96·5

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	6·26
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	7·38
27.	Equivalent evaporation from and at 212° F. per lb. dry coal (Item 11 ÷ Item 5)	7·54
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	9·10

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	12580
30.	Calorific value of the combustible per lb. (B.T.U.)	14750
31.	Efficiency of boiler (based on combustible consumed) (%)	59·5
32.	Efficiency of boiler, including grate (based on dry coal) (%)	57·9


G.C.T. 17
Coal No 1.
BOILER PRESSURE
CO2 IN FLUE GASES
TEMPERATURE OF FLUE GASES
TEMPERATURE OF BOILER ROOM
TEMPERATURE OF FEED WATER
AIR PRESSURE IN ASH-PIT
AIR PRESSURE AT DAMPER
BOILER GAUGE PRESSURE
CO2 IN FLUE GASES
TEMPERATURE OF FLUE GASES
TEMPERATURE OF BOILER ROOM
TEMPERATURE OF FEED WATER
AIR PRESSURE IN ASHPIT & AT DAMPER
WATER
COAL
EVAPORATION
CONSUMED
A.M. 9.10
10.10
11.10
12.10
1.10
2.10
3.10
4.10
5.10
6.10
7.10
P.M.

TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 1001.

Date—May 29, 1908. Trial Number—G.C.T. 31.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Robb boiler working. B. and W. No. 1 not working. Weather fine and clear, later dull and cloudy.

Time.
7.35 Fire cleaned and made up with No. 1001 coal.
7.45 Tubes blown.
8.55 Started trial. Fire 2″, fairly well burnt through. Burning with smoky flame.
9.16 Fire 4″.
9.35 Opened grill half way.
10.10 Opened grill full.
11.55 Opened grill half way.
12.35 Fire cleaned. Clinker easily broken. Does not cling to bars; removed 95 lbs.
1.55 Grill closed.
5.10 Sliced fire, as it was rather clinkered up, giving off CO.
5.20 After slicing clinker appeared to fuse, running through bars.
5.35 Fire cleaned. 152 lbs. clinker easily removed and broken up.
6.55 Removed 105 lbs. ash from under grate.
6.57 Trial finished. Fire as at start.

Coal gives off much smoke, cokes but little, easily broken up with rake. Would be suitable for shaking grate.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 31

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.55 a.m.						
9.16	147	147	9.10	5·5	10·2	2·9
9.53	198	345	9.33	7·7	9·2	2·3
10.34	208	553	10.00	7·8	9·3	1·9
11.15	187	740	10·30	7·8	10·3	1·3
11.55	190	930	10.53	8·8	9·2	1·8
12.35	194	1124	11.35	5·4	13·1	1·4
1.22	198	1322	12.01	8·6	11·4	0·2
1.57	204	1526	12.35	7·0	12·8	0·3
2.37	184	1710	12.52	8·3	10·9	0·0
3.20	180	1890	1.21	7·8	12·2	0·3
4.02	194	2084	1.52	9·8	9·0	0·1
4.45	203	2287	2.16	9·5	9·0	0·7
6.13	435	2722	2.41	7·5	12·5	0·0
6.57	110	2832	3.11	6·9	12·3	0·0
			3.35	7·1	12·7	0·3
			4.12	9·0	9·5	1·0
			4.39	8·1	9·7	1·7
			5.07	7·5	12·5	0·0
			6.00	8·9	10·0	0·7
			6.30	8·6	10·3	0·3
				8·0	10·4	1·0

OBSERVATIONS MADE DURING BOILER TRIAL No. 31

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.55	120	84	415	59	0·0	—·20	.....
9.10	120	84	465	58·5	—·05	—·20	207·5
9.25	121	86	480	58·3	—·025	—·20	449
9.40	122	87	470	58·3	—·025	—·20	443·5
9.55	121	87	510	58	—·025	—·20	474·5
10.10	121	87	505	57	—·025	—·20	439
10.25	123	87	460	56·5	0·0	—·20	501
10.40	123	87	475	56·5	—·25	—·20	424·5
10.55	122	87	505	56·5	0·0	—·20	503·5
11.10	121	87	490	57	0·0	—·20	496·5
11.25	123	87	475	56·5	0·0	—·20	438
11.40	122	87	465	57	0·0	—·20	365·5
11.55	122	89	465	57	—·01	—·20	390
12.10	118	90	470	56·5	—·01	—·20	439
12.25	110	90	455	56·5	—·01	—·20	448·5
12.40	98	93	440	56·5	0·0	—·20	381
12.55	115	89	515	56·5	—·02	—·20	397·5
1.10	120	89	525	56·5	—·01	—·20	409·5
1.25	123	89	525	56·5	—·01	—·20	513
1.40	123	89	545	56·5	—·01	—·20	555·5
1.55	106	89	530	57	—·01	—·20	564
2.10	118	91	485	56·5	—·01	—·20	461
2.25	121	92	495	57	—·01	—·20	468
2.40	120	93	495	57	—·01	—·20	544
2.55	118	93	475	58	—·01	—·20	335·5
3.10	123	93	470	58·5	0·0	—·20	368
3.25	122	93	480	58·5	0·0	—·20	408·5
3.40	123	92	480	59	0·0	—·20	385·5
3.55	120	92	510	59·5	—·01	—·20	422·5
4.10	118	92	495	59·5	—·01	—·20	417
4.25	118	93	500	59·5	—·01	—·22	440·5
4.40	121	93	510	59·5	—·01	—·22	489
4.55	120	89	500	60	—·01	—·22	437
5.10	122	92	490	60	—·01	—·22	403·5
5.25	123	89	495	60	—·01	—·22	489
5.40	73	94	435	60	—·01	—·22	415·5
5.55	116	89	495	60·5	—·01	—·22	171·5
6.10	103	89	550	60·5	—·01	—·24	478·5
6.25	93	89	545	60·5	—·01	—·23	563·5
6.40	118	89	550	60·5	—·01	—·22	362·5
6.57	120	89	570	60·5	—·01	—·23	554·5
	117	89·5	493	58·0	—·01	—·21	17,455·5 net

SUMMARY OF OBSERVATIONS

Date—May 29, 1908.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.55 a.m.	Ended—6.58 p.m.	Duration—603 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned May, 1908
4.	Tubes cleaned	7.45 a.m.
5.	Fire cleaned	7.35 a.m., 12.35 p.m. and 5.35 p.m.

Fuel.

6.	Kind of coal	No. 1001, Albion Colliery, Acadia Coal Co., Stellarton, N.S.
7.	Analysis of dry coal by weight (%)	$\begin{cases} C=72\cdot7,\ H=4\cdot4,\ S=1\cdot1, \\ N_2=1\cdot6, O_2=6\cdot4, Ash=13\cdot8 \end{cases}$
8.	Calorific value of dry coal B.T.U. per lb	12460
9.	Moisture in coal as fired (%)	2·0
10.	Weight of coal fired (lbs.)	2832
11.	Combustible matter in ash and clinker (%)	15·5
12.	Weight of clinker (lbs.)	247
13.	Weight of ash (lbs.)	105

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−0·01
15.	" above fire " "	−0·17
16.	" at damper " "	−0·21
17.	Amount of damper opening	Various
18.	Temperature of air in boiler house (°F.)	89·5
19.	Flue temperature (°F.)	493
20.	Analysis of dry flue gas by volume (%)	$CO_2=8\cdot0,\ O_2=10\cdot4,\ CO=1\cdot0,\ N=80\cdot6$

Water and Steam.

21.	Temperature of feed water (°F.)	58
22.	Total weight of feed water corrected for difference of level (lbs.)	17455
23.	Water level in gauge at start (inches)	$4\frac{13}{16}$
24.	Water level in gauge at finish (inches)	$4\frac{1}{16}$
25.	Correction for difference of level included above (lbs.)	114
26.	Steam pressure by gauge (lbs. per sq. in.)	117
27.	Barometer reading (inches)	29·63
28.	Pressure in calorimeter by gauge (lbs. per sq. in.)	15·2
29.	Temperature in calorimeter (°F.)	293

Notes.

This coal clinkers but is easily broken up. Would be suitable for a shaking grate. Gives off much smoke. Air admitted above bars 9.15 a.m. to 1.55 p.m.

Weather: fine at first, dull later.

Proximate analysis of dry coal by weight %: Fixed carbon..... 57·7; Volatile matter..... 28·5; Ash..... 13·8

SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—Coal No. 1001. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·63. At finish—29·64. Mean—29·63.

Total Quantities.

1.	Date of trial	29/5/08
2.	Duration of trial (hours)	10·05
3.	Weight of coal as fired (lbs.)	2832
4.	Percentage of moisture in coal as fired (%)	2·0
5.	Total weight of dry coal fired (lbs.)	2775
6.	Total ash and refuse (lbs.)	352
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 16·32; (*b*) weighed	12·7
8.	Total weight of combustible consumed from analyses (lbs.)	2320
9.	Total weight of water fed to the boiler corrected for difference of level (lbs.)	17455
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17380
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	20900

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	276
13.	Dry coal per square foot of grate surface per hour (lbs.)	16·5
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1730
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2080
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·25

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	117·0
18.	Temperature of feed water entering boiler (deg. F.)	58
19.	Temperature of escaping gases from boiler (deg. F.)	493
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·20
21.	Percentage of moisture in steam	0·5

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	60·3
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	100·5

Economic Results.

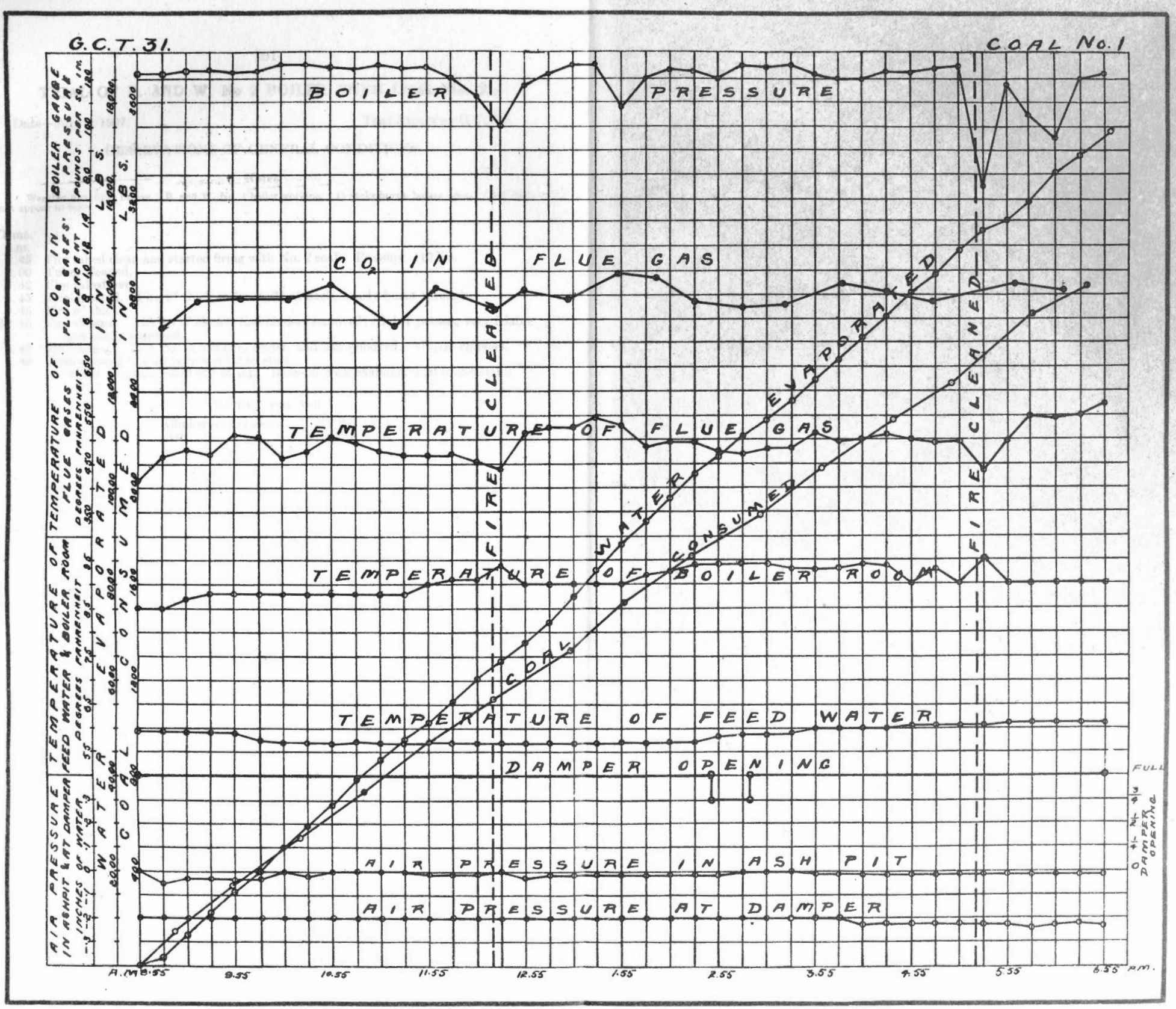
25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	6·18
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	7·38
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	7·53
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	9·00

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	12460
30.	Calorific value of the combustible per lb. (B.T.U.)	14460
31.	Efficiency of boiler (based on combustible consumed) (%)	60·1
32.	Efficiency of boiler, including grate (based on dry coal) (%)	58·4

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	27·5
34.	" " of combustible consumed (from gas analyses) (lbs.)	23·9
35.	" " dry coal (from gas analyses) (lbs.)	20·0
36.	Proportion of heat of fuel in escaping dry flue gases (%)	15·5


G.C.T. 31.
COAL No. 1
BOILER PRESSURE
CO₂ IN FLUE GAS
TEMPERATURE OF FLUE GAS
TEMPERATURE OF BOILER ROOM
TEMPERATURE OF FEED WATER
DAMPER OPENING
AIR PRESSURE IN ASH PIT
AIR PRESSURE AT DAMPER
WATER EVAPORATED
COAL CONSUMED
FIRE CLEANED
FIRE CLEANED
BOILER GAUGE PRESSURE POUNDS PER SQ. IN.
CO₂ IN FLUE GASES PER CENT
TEMPERATURE OF FLUE GASES DEGREES FAHRENHEIT
TEMPERATURE OF BOILER ROOM
TEMPERATURE FEED WATER & BOILER ROOM DEGREES FAHRENHEIT
AIR PRESSURE IN ASHPIT & AT DAMPER INCHES OF WATER
WATER EVAPORATED LBS.
COAL CONSUMED LBS.
FULL
DAMPER OPENING
A.M. 8.55 9.55 10.55 11.55 12.55 1.55 2.55 3.55 4.55 5.55 6.55 P.M.

TRIAL OF B. AND W. No 2 BOILER WITH COAL No. 2.

Date—July 5, 1907. Trial Number—G.C.T. 8.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Weather fine, light breeze. B. and W. No. 1 boiler working. 1¼ sacks burnt before trial. Coal does not appear to coke.

Time.
a.m.
7.45 Fire raked clean and started firing with No. 2 coal. Pressure, 110 lbs.
8.00 Tubes cleaned.
8.42 Fire raked over.
8.45 Trial started. Fire 2″ thick at front, 3″ at back, nearly burnt through.
9.45 Fire 8″ thick.
12.45 Fire cleaned. 115 lbs of clinker and cinders removed; clinker porous, very friable and easily removed.
5.46 Fire cleaned. 114 lbs. of clinker, cinder, and ash removed. (Little clinker).
6.45 Trial stopped. Fire very similar to start.
90 lbs. of ashes raked out of pit. Blow-off cock examined and found tight.

CLINKER AND ASH.

Clinker and cinders.....229 lbs.
Ash..... 90 lbs.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 8

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.45 a.m.						
8.48	80	80	9.00	6·4	13·4	0·0
9.13	153	233	9.30	10·4	7·4	0·2
9.36	170	403	10.00	15·1	3·5	0·0
9.48	124	527	10.30	14·7	4·3	0·0
10.24	173	700	11.00	15·4	4·8	0·0
11.05	191	891	11·30	11·0	8·0	0·0
11.52	192	1083	12.00	7·8	12·5	0·0
12.40	152	1235	12.30	7·3	12·8	0·0
1.10	178	1413	1.00	7·0	12·3	0·0
1.33	184	1597	1.30	8·2	12·4	0·0
2.16	162	1759	2.00	6·0	12·3	0·0
2.48	162	1921	2.30	9·2	10·7	0·0
3.22	179	2100	3.00	10·3	8·9	0·0
4.09	158	2258	3.30	12·4	7·3	0·0
4.50	165	2423	4.00	12·0	8·1	0·0
5.53	190	2613	4.30	13·3	5·9	0·0
6.17	174	2787	5.00	8·9	11·4	0·0
6.45	39	2826	5.30	8·8	11·4	0·0
			6.00	9·0	9·6	0·2
			6.30	13·4	5·8	0·0
				10·3	9·1	0·0

OBSERVATIONS MADE DURING BOILER TRIAL No. 8

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.45	123	84	450	67·5	0·0	0·25	.....
9.00	121	86	482	69·5	0·0	0·25	351·5
9.15	119	85	475	67·5	0·0	0·25	410
9·30	122	85·5	562	67·5	0·0	0·25	534·5
9.45	121	89	640	67·5	0·0	0·25	1080
10.00	110	88	560	68·5	0·0	0·25	
10.15	113	88	535	68·5	0·0	0·25	494·5
10.30	114	90	543	68	0·0	0·25	396
10.45	108	90	532	68	0·0	0·25	372·5
11.00	118	90	555	67·5	0·0	0·20	381
11·15	108	90	540	67	0·0	0·25	461
11.30	112	90	530	67	0·0	0·25	530
11.45	109	90	515	67·5	0·0	0·25	472
12.00	111	91	500	68	0·0	0·25	454·5
12.15	113	92	480	68	0·0	0·25	665·5
12.30	108	92	460	68·5	0·0	0·28	506.5
12.45	107	94	465	68·5	0·0	0·20	
1.00	114	92	490	70	0·0	0·25	333·5
1.15	112	91	570	69·5	0·0	0·25	468
1.30	106	91	575	70	0·0	0·25	463·5
1.45	108	91	540	70	0·0	0·25	578
2.00	107	89	525	70·5	0·0	0·20	469
2.15	100	90	520	70·5	0·0	0·20	405
2.30	118	92	570	70·5	0·0	0·25	436·5
2.45	106	92	570	70	0·0	0·20	474
3.00	108	92	580	70	0·0	0·20	523
3.15	107	92	610	70	0·0	0·20	486
3.30	117	91	560	70	0·0	0·20	443·5
3.45	109	92	580	70·5	0·0	0·25	507
4.00	114	88	568	70	0·0	0·20	385·5
4.15	113	88	570	70	0·0	0·20	559·5
4.30	108	89	585	70	0·0	0·20	368·5
4.45	111	90	560	70·5	0·0	0·20	495
5.00	117	88	545	70	0·0	0·25	821·5
5.15	106	88	540	70·5	0·0	0·20	
5.30	108	88	505	70·5	0·0	0·20	526·5
5.45	114	86	496	70·5	0·0	0·20	395·5
6.00	104	87	485	70·5	0·0	0·20	250
6.15	116	86	540	70·5	0·0	0·20	325
6.30	98	86	600	70·5	0·0	0·20	572
6.45	111	86	515	70·5	0·0	0·20	464
	111·4	89·3	537	69·3	0·0	0·23	18,290·5 net

SUMMARY OF OBSERVATIONS

Date—July 5, 1907.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.45 a.m.	Ended—6.45 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning. Fresh water July 4.	Thoroughly cleaned June, 1907.
4.	Tubes cleaned	8.00 a.m.
5.	Fire cleaned	7.45 a.m., 12.45 and 5.46 p.m.

Fuel.

6.	Kind of coal	No. 2 Cage-pit seam, Albion Colliery, Acadia Coal Co., Stellarton, Pictou Co., N.S.—R.O.M. Coal.
7.	Analysis of dry coal by weight (%).	C=74·2, H=4·5, S=0·9, N=2·1, O=7·9, Ash=10·5.
8.	Calorific value of dry coal B.T.U. per lb	13180
9.	Moisture in coal as fired (%)	2·3
10.	Weight of coal fired (lbs.)	2826
11.	Combustible matter in ash and clinker (%)	16·6
12.	Weight of clinker (lbs.)	229
13.	Weight of ash (lbs.)	90

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−0·0
15.	" above fire " "	−0·16
16.	" at damper " "	−0·23
17.	Amount of damper opening	Various.
18.	Temperature of air in boiler house (°F.)	89·3
19.	Flue temperature (°F.)	537
20.	Analysis of dry flue gas by volume (%)	CO_2=10·3, O_2=9·1, CO=0·0, N_2=80·5

Water and Steam.

21.	Temperature of feed water (°F.)	69·3
22.	Total weight of feed water, corrected for difference in level (lbs.)	18290
23.	Water level in gauge at start (inches)	3½
24.	Water level in gauge at finish (inches)	2½
25.	Correction for difference of level included above (lbs.)	76
26.	Steam pressure by gauge (lbs. per sq. in.)	111·4
27.	Barometer reading (inches)	29·70
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	8·1
29.	Temperature in steam calorimeter (°F.)	239·2

Notes.

Clinker porous, friable, and easily removed. Coal does not appear to coke. Weather fine, with light breeze.

Proximate analysis of dry coal by weight %

Fixed carbon	58·1
Volatile matter	31·4
Ash	10·5

SUMMARY OF RESULTS

Made—On B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 2. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·72. At finish—29·68. Mean—29·70.

Total Quantities.

1.	Date of trial	5/7/07
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	2826
4.	Percentage of moisture in coal as fired (%)	2·3
5.	Total weight of dry coal fired (lbs.)	2760
6.	Total ash and refuse (lbs.)	319
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 12·6; (*b*) weighed	11·6
8.	Total weight of combustible consumed, from analyses (lbs.)	2412
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	18290
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17800
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	21190

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	276
13.	Dry coal per square foot of grate surface per hour (lbs.)	16·4
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1780
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2119
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·31

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	111·4
18.	Temperature of feed water entering boiler (deg. F.)	69·3
19.	Temperature of escaping gases from boiler (deg. F.)	537
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·23
21.	Percentage of moisture in steam	3·0

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	61·4
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	102·4

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	6·47
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	7·49
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	7·67
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	8·80

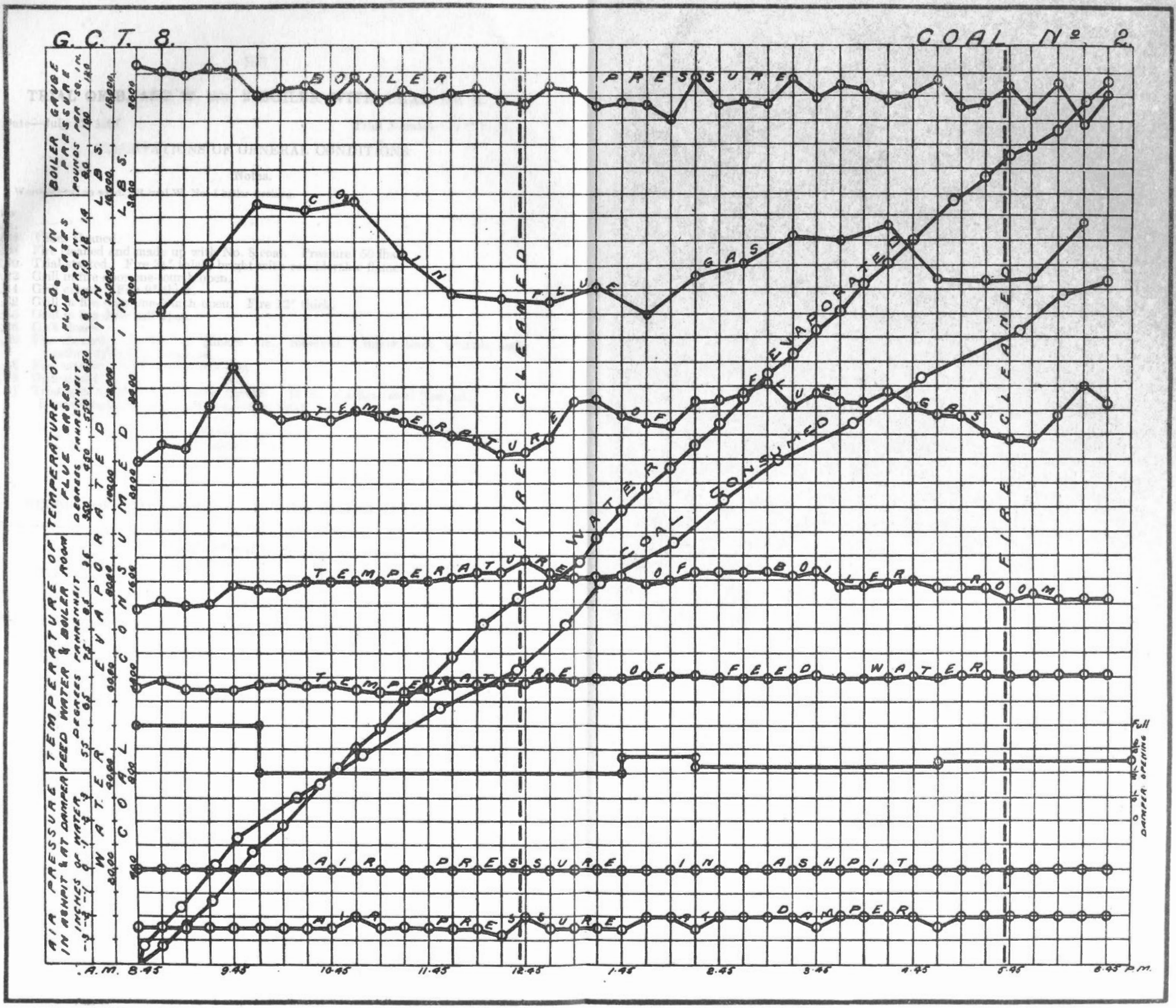
Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	13180
30.	Calorific value of the combustible per lb. (B.T.U.)	14710
31.	Efficiency of boiler (based on combustible consumed) (%)	57·7
32.	Efficiency of boiler, including grate (based on dry coal) (%)	56·3

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	24·2
34.	" " of combustible consumed (from gas analyses) (lbs.)	20·4
35.	" " dry coal (from gas analyses) (lbs.)	17·9
36.	Proportion of heat of fuel in escaping dry flue gases (%)	14·6

GRAPHIC RECORD OF BOILER TRIAL.



TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 8.

Date—July 12, 1907. Trial Number—G.C.T. 11

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Weather wet, no wind. B. and W. No. 1 boiler working.

Time.
a.m.
7.15 Tubes cleaned.
7.38 Fire cleaned and made up with No. 8 coal. Pressure, 50 lbs.
8.50 Trial started. Fire 3½″ thick, bright with considerable flame.
9.22 Grill in fire door one-fourth open.
9.44 Grill closed. Fire 9″ thick.
11.32 Grill in fire door one-fourth open. Fire 12″ thick.
12.55 Grill in fire door half open.
5.26 Grill closed.
5.35 Fire cleaned. 154 lbs. of clinker etc., removed. Clinker thick, whitish, and rather difficult to break up.
5.45 Fire remade. Grill opened half way.
6.18 Grill closed.
6.51 Trial ended. Fire very similar to start. 53 lbs. of ashes raked from pit. Blow-off cock examined and found to be tight.

CLINKER AND ASH
154 lbs. clinker.
53 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 11

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.50 a.m.						
9.09	183	183	9.00	10·2	6·3	1·1
9.38	169	352	9.30	8·8	10·8	0·0
10.08	140	492	10.00	10·1	9·1	0·0
10.36	178	670	10.30	12·3	6·2	0·0
11.13	171	841	11.00	11·6	6·2	0·9
12.07	161	1002	11.30	13·7	5·1	0·0
12.42	167	1169	12.00	13·5	5·9	0·2
1.15	177	1346	12.30	9·6	8·9	0·5
1.54	154	1500	1.00	11·4	7·4	0·2
2.24	126	1626	1.30	12·6	6·0	0·2
3.06	143	1769	2.00	12·2	7·0	0·0
3.48	159	1928	2.30	11·4	7·6	0·0
4.13	137	2065	3.00	10·8	9·0	0·0
5.01	167	2232	3.30	10·0	8·8	0·2
5.47	139	2371	4.00	10·4	8·8	0·0
6.23	140	2511	4.30	9·7	9·8	0·0
6.51	58	2569	5.00	9·4	10·5	0·0
			5.30	8·3	12·4	0·0
			6.00	7·0	12·0	0·0
			6.30	11·0	8·4	0·0
				10·7	8·3	0·2

OBSERVATIONS MADE DURING BOILER TRIAL No. 11

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.50	119	78	385	74	—·05	—·30	.....
9.05	114	78	425	72·5	—·05	—·30	444·5
9.20	122	81	420	71·5	—·02	—·30	436
9.35	120	80	435	71	—·05	—·25	571·5
9.50	115	81	435	70	—·02	—·30	475·5
10.05	115	84	435	69·5	—·02	—·30	432
10.20	118	83	420	70	—·02	—·30	551·5
10.35	123	83	480	69	—·02	—·30	625·5
10.50	113	82	425	69	—·02	—·25	604·5
11.05	116	84	415	69	—·0	—·25	442·5
11.20	120	81	420	69	—·02	—·20	444
11.35	119	83	420	69	—·02	—·20	570
11.50	114	82	445	69	—·02	—·20	487
12.05	109	81	450	69	—·02	—·20	440
12.20	106	80	445	69·5	—·02	—·20	512
12.35	120	80	450	69	—·02	—·25	352
12.50	112	80	485	69	—·02	—·30	651·5
1.05	118	80	425	70	—·02	—·30	362
1.20	107	78	480	70	—·0	—·30	527·5
1.35	122	78	470	70	—·02	—·20	389·5
1·50	120	77	495	70	—·05	—·25	504·5
2.05	120	78	485	70	—·0	—·25	441·5
2.20	114	78	485	69·5	—·02	—·25	494
2.35	113	79	480	70	—·02	—·20	448·5
2.50	120	80	480	70	—·02	—·20	461·5
3.05	117	79	480	70	—·0	—·20	472
3.20	108	78	460	70	—·0	—·20	410
3.35	111	78	455	70·5	—·02	—·20	370·5
3.50	112	78	525	70	—·0	—·30	401
4.05	109	80	550	70	—·0	—·35	523·5
4.20	122	78	535	70	—·0	—·35	421
4.35	121	80	515	70	—·02	—·35	573
4.50	111	78	490	70	—·0	—·30	527·5
5.05	111	78	460	70	—·0	—·30	466·5
5.20	114	78	480	69·5	—·0	—·30	325
5.35	108	79	420	69·5	—·0	—·20	547
5.50	92	80	425	69·5	—·02	—·25	241·5
6.05	101	78	440	69·5	—·0	—·25	250·5
6.20	120	80	520	70	—·0	—·20	440·5
6.35	100	78	520	69·5	—·0	—·25	673
6.51	121	78	490	69·5	—·02	—·20	398
	114·3	79·7	462	70·0	—·015	—·26	18,590·5 net

SUMMARY OF OBSERVATIONS.

Date—July 12, 1907. Boiler—B. and W. No. 2. At McGill University.
Commenced—8.50 a.m. Ended—6.51 p.m. Duration—601 mins.

General.

1. Method of stoking.....Hand-spreading on alternate sides
2. Kind of draft.....Natural
3. Condition of boiler and date of last cleaning.....Thoroughly cleaned June, 1907 Fresh water, July 4.
4. Tubes cleaned.....7.15 a.m.
5. Fire cleaned.....7.38 a.m., 5.35 p.m.

Fuel.

6. Kind of coal.....No. 8, Main seam, Acadia Colliery, Acadia Coal Co., Westville, Pictou Co., N.S. Over 1" screen and picking belt.
7. Analysis of dry coal by weight (%). C = 77·6, H = 4·7, S = 0·9, N = 1·6, O = 6·0, Ash = 9·2
8. Calorific value of dry coal B.T.U. per lb.....13,860
9. Moisture in coal as fired (%).....1·6
10. Weight of coal fired (lbs.).....2,569
11. Combustible matter in ash and clinker (%).....10·5
12. Weight of clinker (lbs.).....154
13. Weight of ash (lbs.).....53

Air and Flue Gas.

14. Air pressure under fire (inches of water).....−0·01
15. " above fire " " .....−0·20
16. " at damper " " .....−0·26
17. Amount of damper opening.....Various
18. Temperature of air in boiler house (°F.).....79·7
19. Flue temperature (°F.).....462
20. Analysis of dry flue gas by volume (%)..CO_2 = 10·7, O_2 = 8·3, CO = 0·2, N_2 = 80·8

Water and Steam.

21. Temperature of feed water (°F.).....70·0
22. Total weight of feed water, corrected for difference of level (lbs.).....18,590
23. Water level in gauge at start (inches).....$2\frac{15}{16}$
24. Water level in gauge at finish (inches).....$2\frac{13}{16}$
25. Correction for difference of level included above (lbs.).....19
26. Steam pressure by gauge (lbs. per sq. in.).....114·3
27. Barometer reading (inches).....29·49
28. Pressure in steam calorimeter by gauge (lbs. per sq. in.).....15·04
29. Temperature in steam calorimeter (°F.).....285

Notes.

Air admitted over fire from 9.22 to 9.44 and from 11.32 a.m. to 5.26 p.m. and from 5.45 to 6.18 p.m. Clinker thick, whitish, and difficult to break up. Weather wet, no wind.

Proximate analysis of dry coal by weight % { Fixed carbon..... 64·8 / Volatile matter..... 26·0 / Ash..... 9·2

SUMMARY OF RESULTS

Made on No. 2 B. and W. Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 8. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·48. At finish—29·51. Mean—29·49.

Total Quantities.

1.	Date of trial	12/7/07
2.	Duration of trial (hours)	10·02
3.	Weight of coal as fired (lbs.)	2569
4.	Percentage of moisture in coal as fired (%)	1·6
5.	Total weight of dry coal fired (lbs.)	2,527
6.	Total ash and refuse (lbs.)	207
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 10·3; (*b*) weighed	8·2
8.	Total weight of combustible consumed, from analyses (lbs.)	2,267
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	18,590
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	18,460
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	21,970

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	252
13.	Dry coal per square foot of grate surface per hour (lbs.)	14·8
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1,843
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2,193
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·43

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	114·3
18.	Temperature of feed water entering boiler (deg. F.)	70·0
19.	Temperature of escaping gases from boiler (deg. F.)	462
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·25
21.	Percentage of moisture in steam	1·0

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	63·5
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	106

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	7·68
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	8·55
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	8·69
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	9·68

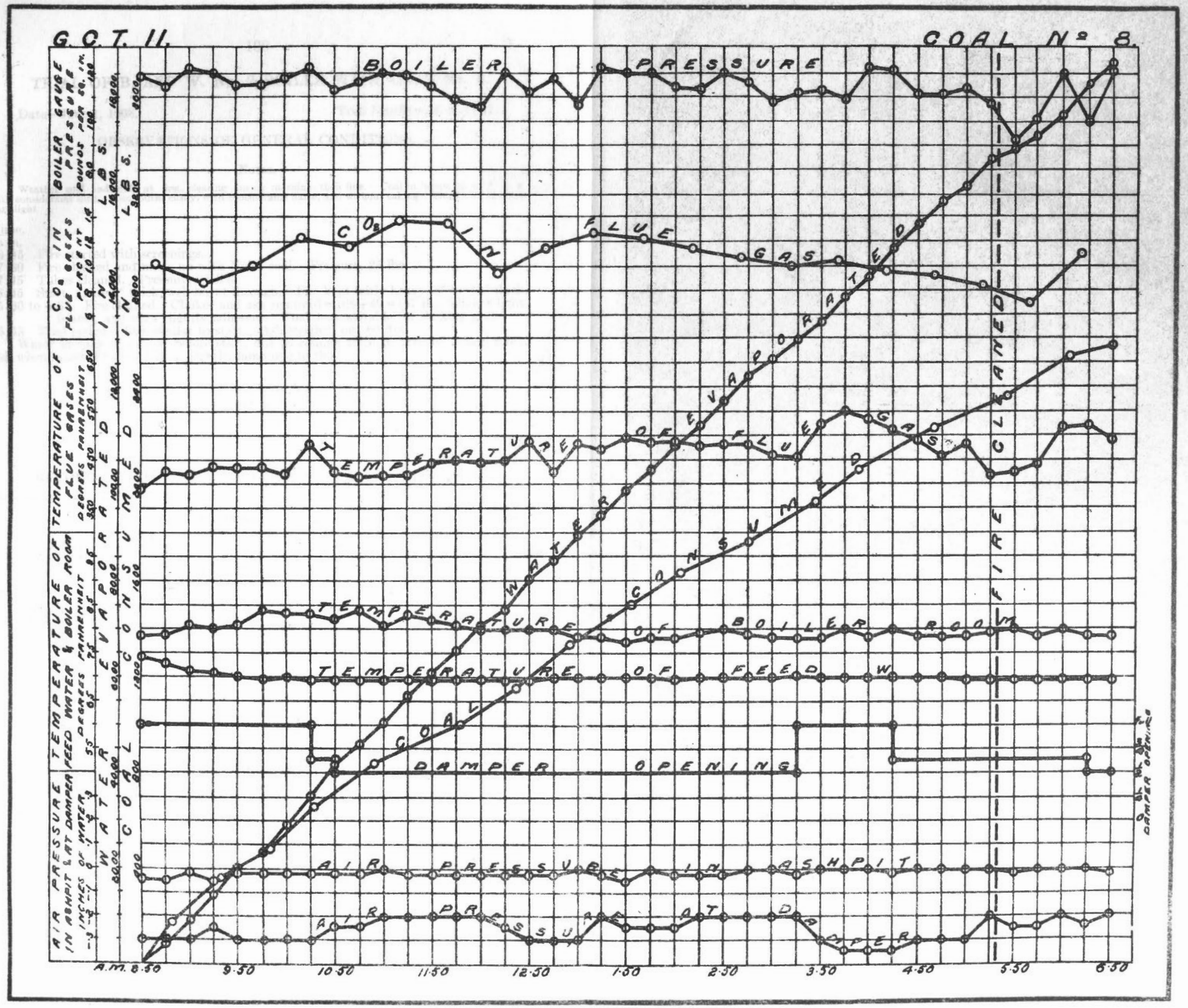
Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	13860
30.	Calorific value of the combustible per lb. (B.T.U.)	15280
31.	Efficiency of boiler (based on combustible consumed) (%)	61·3
32.	Efficiency of boiler, including grate (based on dry coal) (%)	60·6

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	23·0
34.	" " of combustible consumed (from gas analyses) (lbs.)	19·9
35.	" " dry coal (from gas analyses) (lbs.)	17·8
36.	Proportion of heat of fuel in escaping dry flue gases (%)	11·8

GRAPHIC RECORD OF BOILER TRIAL.



TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 8.

Date—June 1, 1908. Trial Number—G.C.T. 32.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Weather cold and dull at first, clearing during morning, then fine. Coal in lumps up to 4″ or 5″, with considerable dust. Coal burns easily, with considerable flame, and without caking. Smoke for the most part light.

Time.

a.m.

6.45 Fire started with screenings.

7.30 Fire cleaned and made up with No. 8 coal. Pressure, 25 lbs.

7.45 Tubes cleaned. Pressure, 75 lbs.

8.45 Start. Fire 2″ thick, well burnt through. Fire kept fairly heavy, 8″ to 12″ thick.

5.30 to 5.37 Fire cleaned. Clinker and ash removed = 108 + 49 = 157 lbs. Clinker light, friable, and very slightly adherent. Coal very suitable for shaking grate.

6.45 Trial ended. Fire similar to start. Ash weighed out 60 lbs.

Water at back of ash-pit before start, due to coming through floor of boiler room. Ash when raked out at end very slightly damp due to this.

CLINKER AND ASH.

217 lbs.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 32

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.45 a.m.						
9.15	251	251	8.50	6·9	10·1	2·3
9.28	72	323	9.17	7·6	10·8	1·4
9.45	111	434	9.40	9·0	10·3	0·2
10·15	215	649	10.20	7·9	10·7	0·6
10.45	133	782	10.47	7·6	10·7	0·8
11.15	106	888	11.16	7·3	12·0	0·0
11.30	88	976	11.46	9·9	9·5	0·4
11.45	47	1023	12.20	9·0	10·5	0·1
12.15	106	1129	12.50	9·4	8·5	0·7
12.45	184	1313	1.18	8·5	10·4	0·8
1.15	134	1447	1.49	8·4	10·6	0·3
1.45	106	1553	2.20	7·8	11·3	0·6
2.08	81	1634	2.48	9·2	9·6	0·7
2.15	39	1673	3.18	8·0	11·9	0·1
2.45	110	1783	3.49	7·4	12·0	0·9
3.15	92	1875	4.21	7·7	11·1	0·6
3.30	84	1959	4.48	8·9	10·8	0·0
3.45	34	1993	5.17	8·5	11·3	0·1
4.15	141	2134	5.57	7·9	10·9	0·1
4.45	92	2226	6.33	10·6	8·3	0·5
5.13	56	2282				
5.45	150	2432		8·4	10·6	0·5
6.15	141	2573				
6.45	56	2629				

OBSERVATIONS MADE DURING BOILER TRIAL No. 32

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.45	105	69	415	56	0·0	−·20	.....
9.00	120	67	470	56	0·0	−·20	390
9.15	105	69	515	55·5	0·0	−·22	374·5
9.30	116	69	530	56	0·0	−·22	656
9.45	120	71	535	55·5	−·01	−·22	497
10.00	112	72	550	55·5	−·01	−·25	610·5
10.15	112	70	490	55	−·01	−·23	534
10.30	111	73	525	55	−·01	−·23	580·5
10.45	118	77	485	55	−·01	−·20	510
11.00	110	72	445	55	−·01	−·20	515
11.15	101	71	445	55	−·01	−·20	535·5
11.30	111	74	450	55	−·01	−·20	314
11.45	123	73	485	55	−·01	−·20	455·5
12.00	103	73	465	55	−·01	−·20	544·5
12.15	113	73	455	55	−·01	−·20	525·5
12.30	113	71	460	55	−·01	−·20	367·5
12.45	113	72	500	55·5	−·01	−·20	466·5
1.00	120	73	485	55·5	−·01	−·20	385
1.15	118	73	485	55·5	−·01	−·20	427
1.30	121	73	480	55·5	−·01	−·20	469·5
1.45	118	72	490	56	−·01	−·20	372
2.00	111	73	525	56·5	−·01	−·23	401·5
2.15	116	71	515	56·5	−·01	−·23	488
2.30	121	71	500	56·5	−·01	−·23	474
2.45	104	73	480	56·5	−·01	−·23	550
3.00	119	74	505	57	−·01	−·22	404
3.15	120	73	490	57·5	−·01	−·22	374
3.30	118	73	500	57·5	−·01	−·23	439
3.45	114	73	485	57·5	−·01	−·23	463·5
4.00	119	73	500	57·5	−·01	−·23	352
4.15	113	73	585	57·5	−·01	−·23	462·5
4.30	120	77	495	58	−·01	−·23	411
4.45	122	77	500	58	−·01	−·23	464
5.00	108	77	490	58	−·01	−·23	430
5.15	122	75	495	58	−·01	−·23	363·5
5.30	108	75	470	58	−·01	−·22	413
5.45	112	75	505	58·5	−·01	−·22	264
6.00	122	75	565	58.5	−·01	−·23	336
6.15	112	75	580	58·5	−·01	−·23	520
6.30	108	75	585	58·5	−·01	−·23	495
6.45	116	74	600	58·5	−·01	−·23	505·5
	114·4	72·9	500·6	56·5	−·01	−·22	18,040·5 net

SUMMARY OF OBSERVATIONS

Date—June 1, 1908.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.45 a.m.	Ended—6.45 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned May, 1908
4.	Tubes cleaned	7.45 a.m.
5.	Fire cleaned	7.30 a.m., 5.30 p.m.

Fuel.

6.	Kind of coal	No. 8—Acadia Colliery, Acadia Coal Co., Westville, Pictou, N.S.
7.	Analysis of dry coal by weight (%), C=77·6, H=4·7, S=0·9, N=1·6, O=6·0, Ash=9·2.	
8.	Calorific value of dry coal B.T.U. per lb	13860
9.	Moisture in coal as fired (%)	1·5
10.	Weight of coal fired (lbs.)	2629
11.	Combustible matter in ash and clinker (%)	11·1
12.	Weight of clinker (lbs.)	157
13.	Weight of ash (lbs.)	60

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−0·01
15.	" above fire " "	−0·15
16.	" at damper " "	−0·22
17.	Amount of damper opening	Various
18.	Temperature of air in boiler house (°F.)	72·9
19.	Flue temperature (°F.)	501
20.	Analysis of dry flue gas by volume (%)	CO_2=8·4, O_2=10·6, CO=0·6, N=80·4

Water and Steam.

21.	Temperature of feed water (°F.)	56·5
22.	Total weight of feed water, corrected for difference of level (lbs.)	18040
23.	Water level in gauge at start (inches)	5
24.	Water level in gauge at finish (inches)	5
25.	Correction for difference of level included above (lbs.)	0
26.	Steam pressure by gauge (lbs. per sq. in.)	114·4
27.	Barometer reading (inches)	29·68
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	14·7
29.	Temperature in steam calorimeter (°F.)	290·7

Notes.

This coal while clinkering slightly gave but little trouble and would be very suitable for a shaking grate. Little smoke. Does not cake. Weather rather cold.

Proximate analysis of dry coal by weight %

Fixed carbon	64·8
Volatile matter	26·0
Ash	9·2

SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—Coal No. 8. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·73. At finish—29·63. Mean—29·68.

Total Quantities.

1.	Date of trial	1/6/08
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	2629
4.	Percentage of moisture in coal as fired (%)	1·5
5.	Total weight of dry coal fired (lbs.)	2590
6.	Total ash and refuse (lbs.)	217
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 10·35; (*b*) weighed 8·37	
8.	Total weight of combustible consumed, from analyses (lbs.)	2322
9.	Total weight of water fed to the boiler, corrected for difference in level (lbs.)	18040
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17900
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	21640

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	232
13.	Dry coal per square foot of grate surface per hour (lbs.)	13·82
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1790
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2164
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·38

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	114·4
18.	Temperature of feed water entering boiler (deg. F.)	56·5
19.	Temperature of escaping gases from boiler (deg. F.)	501
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·21
21.	Percentage of moisture in steam	0·7

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	62·7
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	104

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	6·86
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	8·25
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	8·36
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	9·32

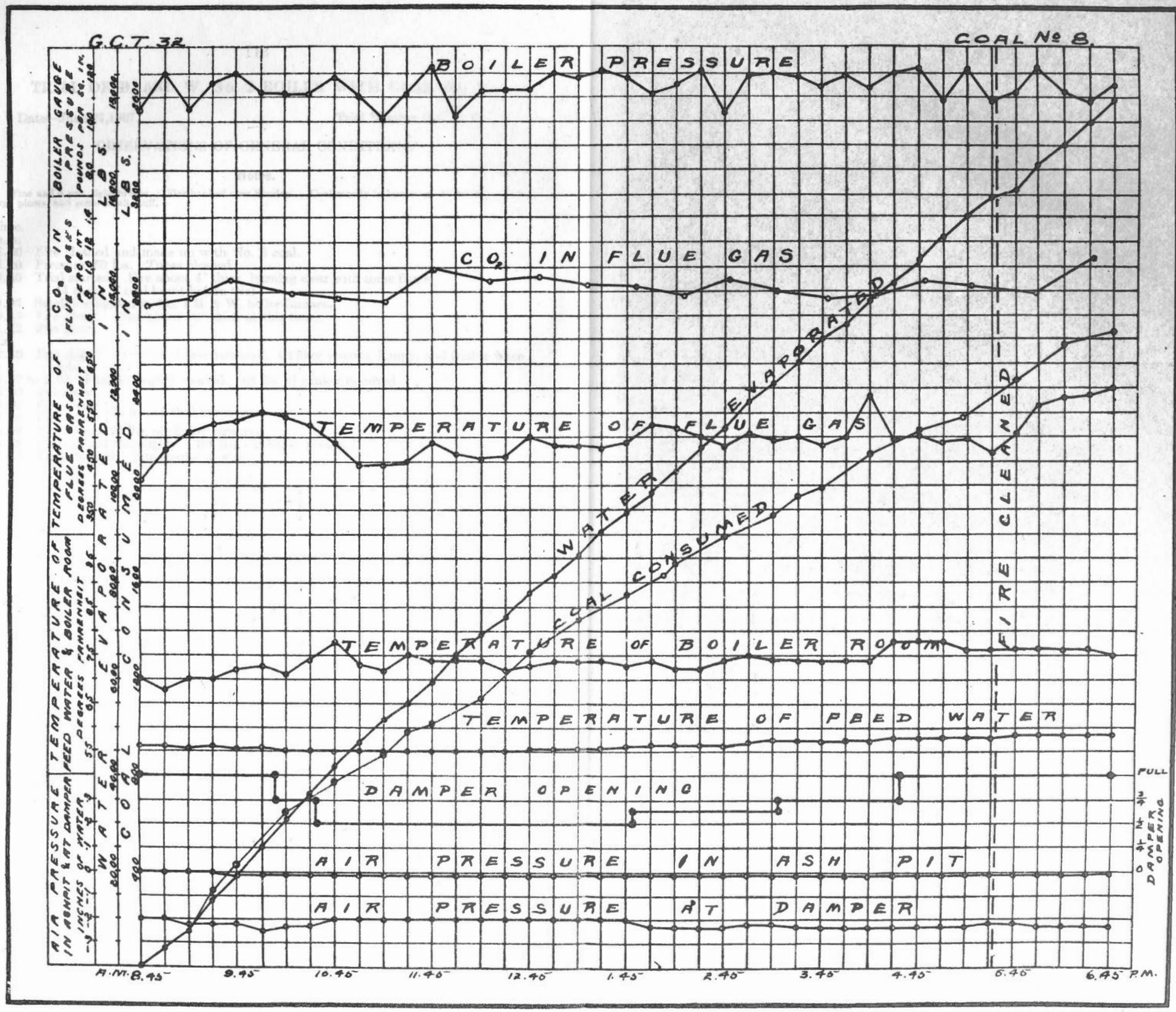
Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	13860
30.	Calorific value of the combustible per lb. (B.T.U.)	15280
31.	Efficiency of boiler (based on combustible consumed) (%)	59·0
32.	Efficiency of boiler, including grate (based on dry coal) (%)	58·3

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	27·6
34.	" " of combustible consumed (from gas analyses) (lbs.)	23·9
35.	" " dry coal (from gas analyses) (lbs.)	21·4
36.	Proportion of heat of fuel in escaping dry flue gases (%)	16·57

GRAPHIC RECORD OF BOILER TRIAL.



TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 3.

Date—June 24,1907. Trial Number G.C.T. 3.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Fine and warm, light breese. Fire banked over Sunday. Coal mostly in lumps of 3″ to 4″, a few large pieces, and some small stuff.

Time.

a.m.

8.00 Fire cleaned and made up with No. 3 coal.
8.20 Pressure, 50 lbs. Tubes cleaned.
9.30 Trial started. Fire about 4″ thick, burning clear with some flame.
1½ sacks of coal burnt before trial
10.05 Small fire lighted in No. 1 B. & W. boiler furnace.
10.43 Fire sliced. (Fire about 12″ thick at this time).
11.43 Fire sliced.

p.m.

12.30 Fire sliced. 14 lbs of clinker removed. Clinker viscous, lumpy, and friable when cold.
1.57 to 2.03 Fire thoroughly cleaned. 68 lbs. of clinker removed.
3.30 Fire sliced.
4.00 Fire sliced
4.48 Fire sliced } 32 lbs. of clinker removed
6.00 Fire sliced. 21 lbs. of clinker removed.
6.28 Fire cleaned thoroughly. 101 lbs. of clinker removed.
7.35 Trial stopped. Fire similar to start.

CLINKER AND ASH.

236 lbs. clinker.
81 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 3

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start						
9.30	.....	.....				
9.40	89	89				
10.14	184	273				
10.57	187	460				
11.47	189	649				
12.41	187	836				
1.37	207	1043				
2.18	190	1233	Cancelled	Sampling	doubtful	
2.56	184	1417				
3.38	164	1581				
4.10	162	1743				
4.55	203	1946				
5.40	196	2142				
6.45	187	2329				
7.10	197	2526				
7.35	67	2593				

OBSERVATIONS MADE DURING BOILER TRIAL No. 3

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
9.30	119	90	380·0	65·0	—·09	0·25	.....
9.45	107	91	375	66·0	—·09	0·25	495
10.00	106	92	370	65·0	—·09	0·25	613
10.15	110·5	94	375	65·0	—·09	0·25	373
10.30	100	94	365	64·5	—·09	0·29	358
10.45	100	96	500	64·5	—·09	0·29	288
11.00	100	96	445	64·5	—·09	0·27	394·5
11.15	105·0	95	445	64·5	—·09	0·26	484
11.30	123	96	420	64·5	—·09	0·22	373·5
11.45	118	97	465	64·0	—·09	0·19	496·5
12.00	116	97	445	64·0	—·09	0·20	473
12.15	106	96	467	65·0	—·08	0·20	321
12.30	114	98	470	65·5	—·08	0·20	358·5
12.45	119	97	445	66·0	—·08	0·20	396
1.00	109	97	425	66·5	—·08	0·20	537·5
1.15	118	97	420	66·0	—·08	0·20	459·5
1.30	108	97	420	66·0	—·08	0·20	395·5
1.45	105	97	415	66·0	—·08	0·20	448
2.00	111	97	405	66·5	—·08	0·20	445·5
2.15	111	97	360	66·5	—·08	0·20	121·5
2.30	114	97	415	67·5	—·08	0·20	345
2.45	104	97	415	66·5	—·08	0·20	492
3.00	113	97	415	66·5	—·08	0·20	280
3.15	110	98	425	67·5	—·08	0·20	427·5
3.30	110	98	475	67·5	—·08	0·20	368
3.45	103	98	480	67·5	—·08	0·20	463
4.00	116	96	505	67·5	—·08	0·20	444
4.15	113	97	500	67·5	—·08	0·20	526
4.30	114	101	465	67·5	—·08	0·20	538·5
4.45	113	100	510	67·5	—·08	0·20	502·5
5.00	117	96	505	68·0	—·08	0·20	412·5
5.15	113	96	440	67·5	—·08	0·20	987·5
5.30	123	97	430	67·5	—·08	0·20	
5.45	110	97	420	67·5	—·08	0·20	472·5
6.00	119	96	465	67·5	—·08	0·20	422·5
6.15	110	98	475	67·5	—·08	0·20	410
6.30	99	96	465	67·5	—·08	0·20	483·5
6.45	93	98	440	67·5	—·08	0·21	336
7.00	118	94	415	67·5	—·08	0·21	332·5
7.15	119	94	430	68·0	—·08	0·21	509·5
7.35	119	94	425	68·0	—·08	0·21	484
	111·1	96·2	437	66·2	—·08	0·21	17,044·5 net

SUMMARY OF OBSERVATIONS

Date—June 24, 1907. Boiler—B. and W. No. 2. At McGill University.
Commenced—9.30 a.m. Ended—7.35 p.m. Duration—605 mins.

General.

1. Method of stoking.....Hand-spreading on alternate sides
2. Kind of draft.....Natural
3. Condition of boiler and date of last cleaning. Thoroughly cleaned June, 1907. Fresh water, June 20
4. Tubes cleaned.....8.20 a.m.
5. Fire cleaned.....8.00 a.m., 1.57 and 6.28 p.m.

Fuel.

6. Kind of coal.....No. 3—Main seam, Drummond Colliery, Intercolonial Coal Co., Westville, Pictou Co., N.S. Over 1″ screen and picking belt.
7. Analysis of dry coal by weight (%).....C=72·6, H=4·3, S=2·5, N=2·1, O=4·0, Ash=14·5
8. Calorific value of dry coal B.T.U. per lb.....12960
9. Moisture in coal as fired (%).....1·1
10. Weight of coal fired (lbs.).....2593
11. Combustible matter in ash and clinker (%).....9·6
12. Weight of clinker (lbs.).....236
13. Weight of ash (lbs.).....81

Air and Flue Gas.

14. Air pressure under fire (inches of water).....−0·08
15. " above fire " " .....−0·19
16. " at damper " " .....−0·21
17. Amount of damper opening.....Full
18. Temperature of air in boiler house (°F.).....96·2
19. Flue temperature (°F.).....437
20. Analysis of dry flue gas by volume (%)—sampling doubtful.

Water and Steam.

21. Temperature of feed water (°F.).....66·2
22. Total weight of feed water corrected for difference of level (lbs.).....17044
23. Water level in gauge at start (inches).....$3\frac{1}{2}$
24. Water level in gauge at finish (inches).....$3\frac{7}{8}$
25. Correction for difference of level included above (lbs.).....57
26. Steam pressure by gauge (lbs. per sq. in.).....111·1
27. Barometer reading (inches).....29·72
28. Pressure in steam calorimeter by gauge (lbs. per sq. in.).....2·25
29. Temperature in steam calorimeter (°F.).....243·4

Notes.

Fire sliced 10.43, 11.43 a.m., 12.30, 3,30, 4.00, 4.48, and 6.00 p.m. Clinker thick and viscous, friable when cold. Coal in lumps averaging 4″ without much small stuff.
Weather fine and warm. B. and W. No. 1 boiler cold.

Proximate analysis of dry coal by weight %

Fixed carbon	60·8
Volatile matter	24·7
Ash	14·5

SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 3. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·75. At finish—29·70. Mean—29·725.

Total Quantities.

1.	Date of trial	24/6/07
2.	Duration of trial (hours)	10·08
3.	Weight of coal as fired (lbs.)	2593
4.	Percentage of moisture in coal as fired (%)	1·1
5.	Total weight of dry coal fired (lbs.)	2564
6.	Total ash and refuse (lbs.)	317
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 16·0; (*b*) weighed.	12·4
8.	Total weight of combustible consumed, from analyses (lbs.)	2152
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	17044
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	16730
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	19950

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	254·4
13.	Dry coal per square foot of grate surface per hour (lbs.)	15·2
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1660
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	1980
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·1

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	111·1
18.	Temperature of feed water entering boiler (deg. F.)	66·2
19.	Temperature of escaping gases from boiler (deg. F.)	437
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·13
21.	Percentage of moisture in steam	3·0

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	57·4
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	95·6

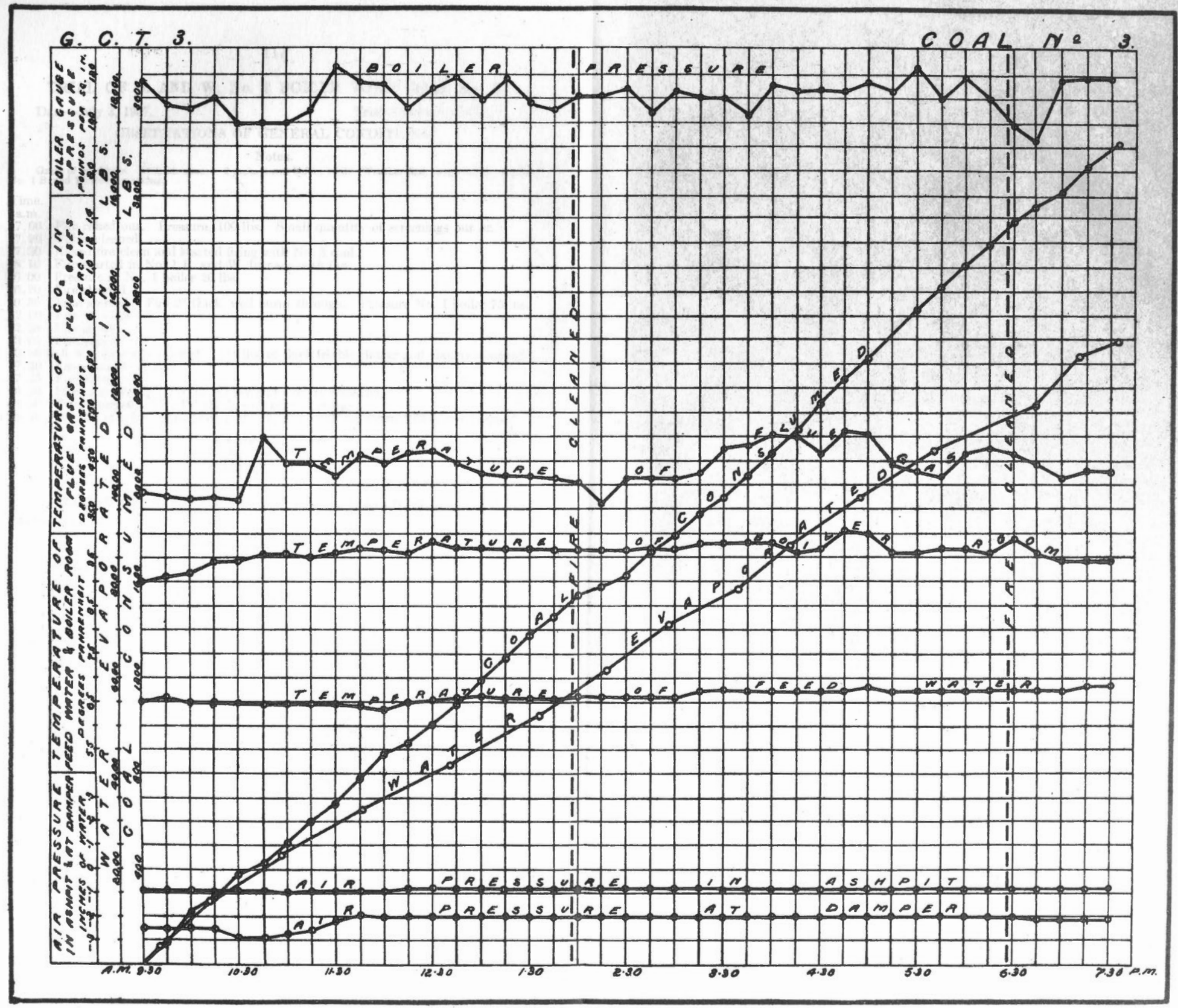
Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	6·57
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	7·69
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	7·78
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	9·28

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	12960
30.	Calorific value of the combustible per lb. (B.T.U.)	15150
31.	Efficiency of boiler (based on combustible consumed) (%)	59·2
32.	Efficiency of boiler, including grate (based on dry coal) (%)	58·0

GRAPHIC RECORD OF BOILER TRIAL.



TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 3.

Date—July 3, 1907. Trial Number—G.C.T. 7

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Grate of fixed bars. 30% air space. 2 sacks burnt before trial. Weather fine, temperature moderate. No. 1 B. and W. boiler working.

Time.

a.m.

7.00 Fire raked out. Pressure, 100 lbs. Small quantity of screenings put on.
7.20 Tubes cleaned.
7.30 Raked fire clean and started firing with No. 3 coal.
8.10 Fire started in No. 1 B. and W. furnace with fan.
10.00 Pressure in No. 1 boiler 20 lbs.
10.20 Fire cleaned.
10.30 Trial started. Fire 2″ thick, well burnt through. Pressure No. 1 boiler 75 lbs.
12.00 Fire 4″ thick.
2.28 Fire sliced.
3.05 Fire sliced.
3.26 to 3.35 Fire well cleaned. 144 lbs. of thick friable clinker and cinders removed.
7.30 Fire about 4″ thick.
7.35 Fire sliced.
8.20 Fire cleaned. 121 lbs. of clinker and cinders removed.
8.30 Trial stopped. Fire 1½″ thick, well burnt through.
8.30 100 lbs. of ashes raked from pit. Blow-off cock examined and found tight.

CLINKER AND ASH.

265 lbs. clinker.
100 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 7

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 10.30 a.m.						
10.45	213	213	10.45	10·1	7·9	0·2
11.15	181	394	11.15	6·7	13·2	0·0
11.54	158	552	11.45	10·7	7·9	0·2
11.35	199	751	12.15	8·5	9·6	0·8
1.22	172	923	12.45	5·5	15·3	0·0
2.00	171	1094	1·15	3·5	17·1	0·0
2.40	169	1263	1.45	6·0	14·5	0·0
3.30	199	1462	2.15	6·0	13·5	0·0
3.50	183	1645	2.45	5·9	13·8	0·0
4.25	183	1828	3.15	5·8	14·3	0·0
5.04	182	2010	3.45	3·9	16·0	0·0
5.29	186	2196	4.15	3·8	16·2	0·0
6.18	186	2382	4.45	3·6	16·4	0·0
6.53	188	2570	5.15	4·8	15·3	0·0
7.37	169	2739	5.45	6·1	14·2	0·0
8.30	102	2841	6.15	5·8	14·3	0·0
			6.45	4·6	15·7	0·0
			7.15	4·4	16·2	0·0
			7.45	5·0	15·3	0·0
			8.10	6·1	14·7	0·0
				5·8	14·1	0·1

OBSERVATIONS MADE DURING BOILER TRIAL No. 7

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	lbs.
10.30	102	94	540	65	—·02	—·25	.....
10.45	107	89	500	65	—·04	—·30	292
11.00	123	92	475	65	—·04	—·30	462
11.15	120	91	520	65·2	—·03	—·29	108·4
11.30	122	91	505	66	—·03	—·30	
11.45	122	91	540	66	—·03	—·31	477
12.00	108	91	470	66	—·03	—·25	466
12.15	123	92	480	66·5	—·03	—·25	472
12.30	123	94	465	67·5	—·03	—·25	523
12.45	115	94	445	67·5	—·03	—·20	526·5
1.00	122	92	485	68	—·03	—·23	342·5
1.15	117	92	445	68	—·02	—·25	414·5
1.30	123	90	445	68	—·02	—·25	395·5
1.45	123	90	455	68	—·02	—·25	403
2.00	123	89	455	68·5	—·01	—·27	487·5
2.15	122	90	460	68·5	—·02	—·25	396
2.30	123	91	465	69	—·02	—·22	413
2.45	120	92	475	69	—·01	—·25	471
3.00	114	96	490	68·5	—·01	—·25	446
3.15	110	91	505	68·5	—·02	—·25	641·5
3.30	119	96	470	69	—·02	—·25	422
3.45	113	92	510	69	—·02	—·23	313·5
4.00	117	94	505	69	—·01	—·23	387·5
4.15	109	88	550	69	—·01	—·25	473·5
4.30	117	89	520	69·2	—·03	—·26	512·5
4.45	119	89	560	69·2	—·03	—·30	590
5.00	107	89	530	69·2	—·04	—·28	546·5
5.15	123	89	505	69	—·02	—·26	550
5.30	117	86·5	495	69	—·01	—·30	445·5
5.45	119	86	510	69	—·03	—·29	529
6.00	117	87	505	68	—·01	—·30	533
6.15	117	87	520	66·5	—·03	—·30	481
6.30	98	86	480	66	—·01	—·30	576·5
6.45	118	86	480	66	—·01	—·29	335
7.00	117	86	500	66	—·02	—·28	471
7.15	102	85	470	67	—·02	—·28	509
7.30	123	82	465	66	—·02	—·30	363
7.45	123	82	515	67·5	—·02	—·30	418·5
8.00	115	82	460	67·5	—·03	—·29	464
8.15	112	81	510	67·5	—·02	—·28	417·5
8.30	102	83	480	67·5	—·0	—·20	429·5
	116·2	89·0	494	67·5	—·02	—·27	18,463 net

SUMMARY OF OBSERVATIONS

Date—July 3, 1907. Boiler—B. and W. No. 2. At McGill University.
Commenced—10.30 a.m. Ended—8.30 p.m. Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning. Fresh water, June 20.	Thoroughly cleaned June, 1907.
4.	Tubes cleaned	7.20 a.m.
5.	Fire cleaned	7.30 and 10.20 a.m., 3.26 and 8.20 p.m.

Fuel.

6.	Kind of coal	No. 3, Main seam, Drummond Colliery, Intercolonial Coal Co., Westville, Pictou Co., N.S. Over 1″ screen and picking belt.
7.	Analysis of dry coal by weight (%)	C = 72·6, H = 4·3, S = 2·5, N = 2·1, O = 4·0, Ash = 14·5
8.	Calorific value of dry coal B.T.U. per lb	12960
9.	Moisture in coal as fired (%)	1·2
10.	Weight of coal fired (lbs.)	2841
11.	Combustible matter in ash and clinker (%)	17·7
12.	Weight of clinker (lbs.)	265
13.	Weight of ash (lbs.)	100

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−0·02
15.	" above fire "	−0·24
16.	" at damper "	−0·27
17.	Amount of damper opening	Various
18.	Temperature of air in boiler house (°F.)	89
19.	Flue temperature (°F.)	494
20.	Analysis of dry flue gas by volume (%)	$CO_2 = 5·8$, $O_2 = 14·1$, CO = 0·1, N = 80·0

Water and Steam.

21.	Temperature of feed water (°F.)	67·5
22.	Total weight of feed water corrected for difference of level (lbs.)	18463
23.	Water level in gauge at start (inches)	$4\frac{15}{16}$
24.	Water level in gauge at finish (inches)	$4\frac{7}{8}$
25.	Correction for difference of level included above (lbs.)	9·5
26.	Steam pressure by gauge (lbs. per sq. in.)	116·2
27.	Barometer reading (inches)	29·825
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	7·5
29.	Temperature in steam calorimeter (°F.)	237

Notes.

Fire sliced 2.28, 3.05, and 7.35 p.m. Clinker thick and friable. Weather fine. B. and W. No. 1 boiler working.

Proximate analysis of dry coal by weight %: Fixed carbon 60·8; Volatile matter 24·7; Ash 14·5

SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal, and effect of working No.1 Boiler. C./f.trial G.C.T.3.
Kind of Fuel—No. 3 Coal. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·825. At finish—29·825. Mean—29·825.

Total Quantities.

1.	Date of trial	3/7/07
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	2,841
4.	Percentage of moisture in coal as fired (%)	1·2
5.	Total weight of dry coal fired (lbs.)	2807
6.	Total ash and refuse (lbs.)	365
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 17·6; (*b*) weighed.	13·0
8.	Total weight of combustible consumed from analyses (lbs.)	2313
9.	Total weight of water fed to the boiler corrected for difference of level (lbs.)	18463
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17910
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	21400

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	280·7
13.	Dry coal per square foot of grate surface per hour (lbs.)	16·7
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1791
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2140
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·35

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	116·2
18.	Temperature of feed water entering boiler (deg. F.)	67·5
19.	Temperature of escaping gases from boiler (deg. F.)	494
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·25
21.	Percentage of moisture in steam	4·0

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	62·0
23.	Builders' rated horse-power	60·0
24.	Percentage of builders' rated horse-power developed	103

Economic Results.

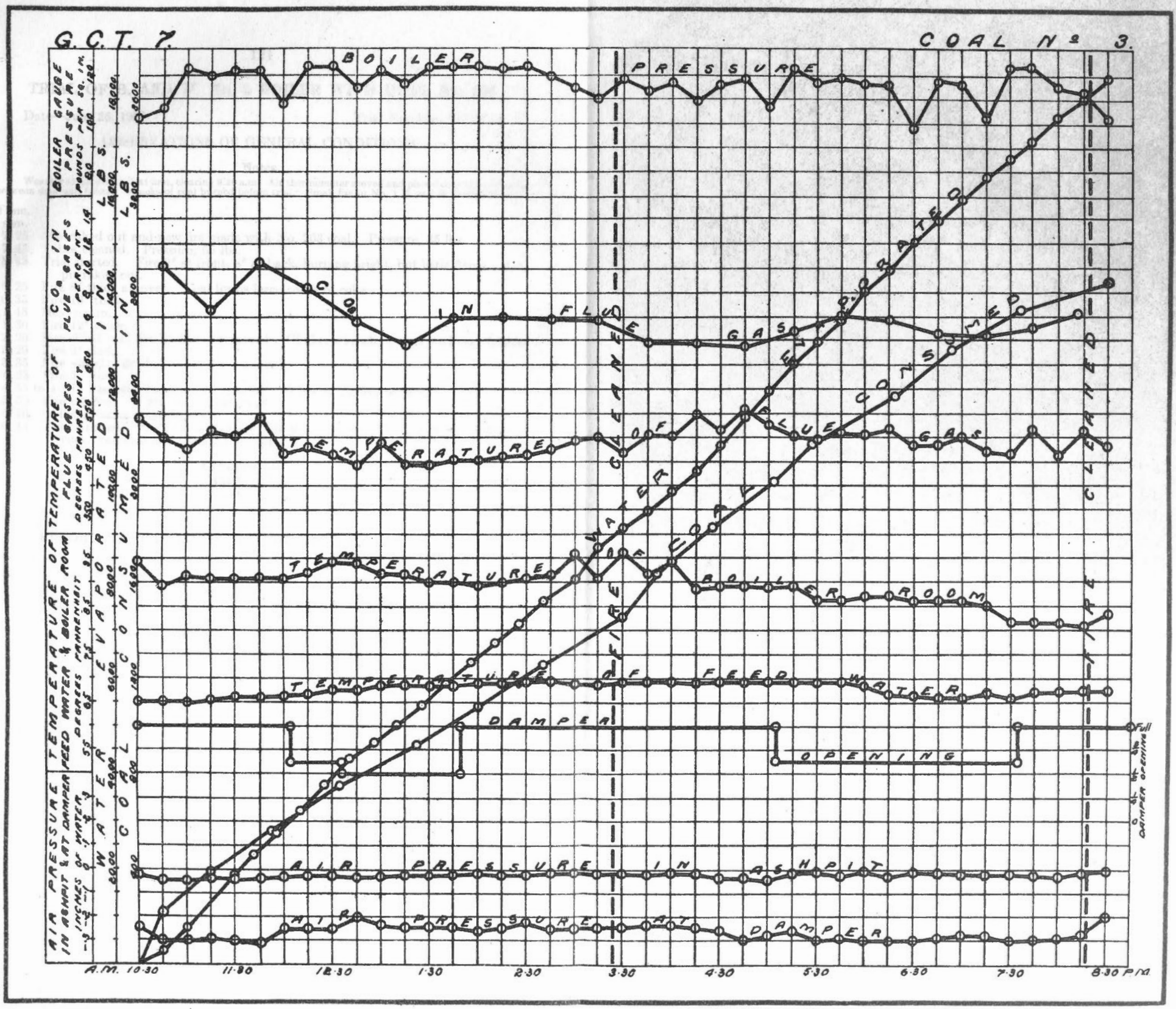
25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	6·5
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	7·53
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	7·63
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	9·26

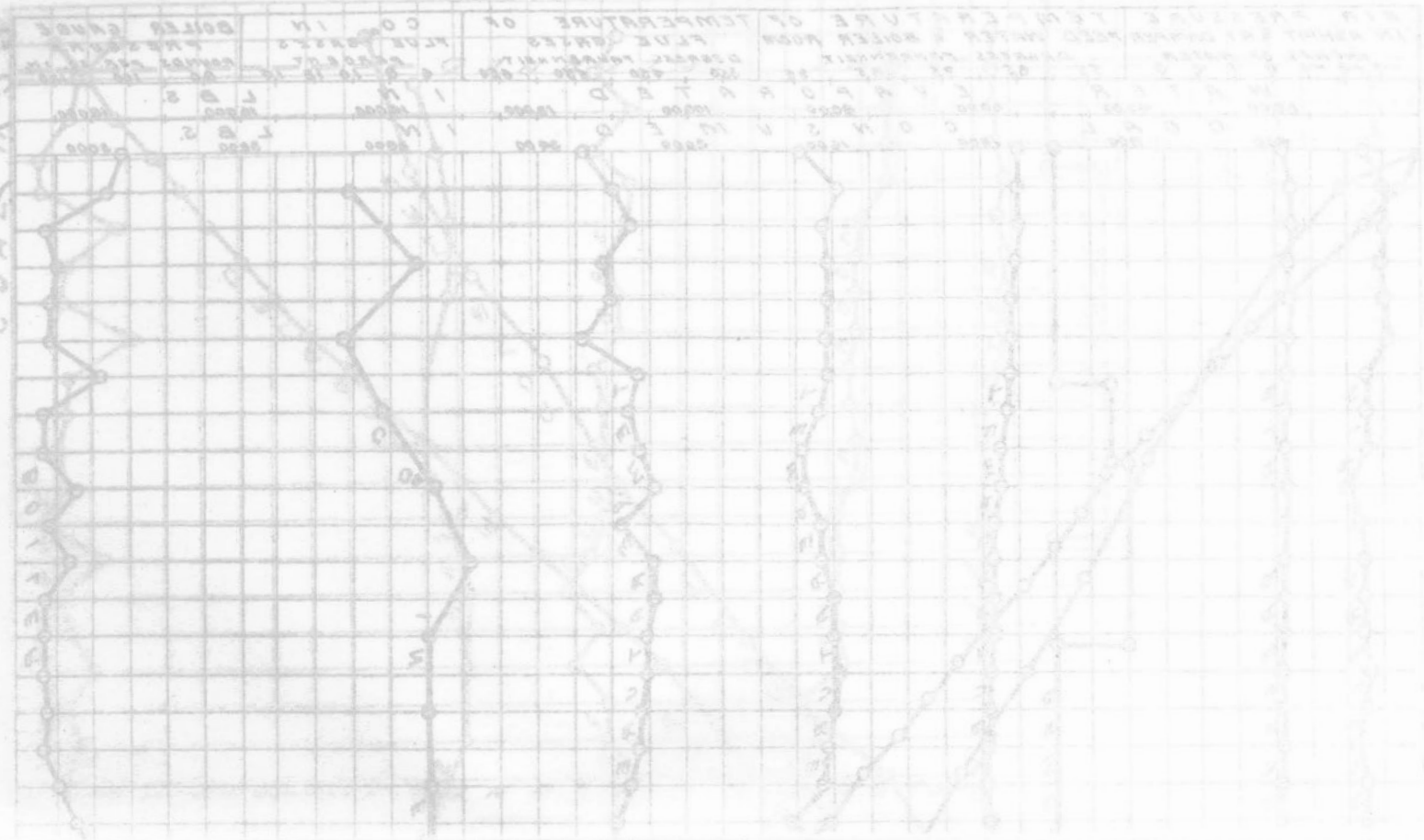
Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	12960
30.	Calorific value of the combustible per lb. (B.T.U.)	15150
31.	Efficiency of boiler (based on combustible consumed) (%)	59·0
32.	Efficiency of boiler, including grate (based on dry coal) (%)	56·8

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	41·6
34.	" of combustible consumed (from gas analyses) (lbs.)	35·6
35.	" dry coal (from gas analyses) (lbs.)	30·2
36.	Proportion of heat of fuel in escaping dry flue gases (%)	22·7


G.C.T. 7.
COAL Nº 3.
BOILER PRESSURE
CO2 IN FLUE GASES
TEMPERATURE OF FLUE GASES
TEMPERATURE OF BOILER ROOM
TEMPERATURE OF FEED WATER
AIR PRESSURE IN ASHPIT & AT DAMPER
BOILER GAUGE PRESSURE
CO2 IN FLUE GASES
TEMPERATURE OF FLUE GASES
TEMPERATURE OF BOILER ROOM
TEMPERATURE OF FEED WATER
AIR PRESSURE IN ASHPIT
AIR PRESSURE AT DAMPER
WATER EVAPORATED
COAL CONSUMED
WATER EVAPORATED PER LB. COAL
FIRE CLEANED
DAMPER OPENING
A.M. 10·30 11·30 12·30 1·30 2·30 3·30 4·30 5·30 6·30 7·30 8·30 P.M.



TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 203.

Date—June 26, 1907. Trial Number—G.C.T. 4.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Weather moist and dull at first, clearing 9.30 a.m. Air thermometer moved and placed directly in draught between door and boiler. 2 sacks of coal burned before trial. Small fire in No. 1 B. and W. boiler furnace.

Time.
a.m.
7.25 Fire raked out and new fire made with No. 203 coal. Pressure, 35 lbs.
7.45 Tubes cleaned. Pressure, 65 lbs.
8.45 Trial started. Fire 2″ at front, 8″ at back, burning bright, but little flame. Ash-pit raked out.
9.25 Fire 8″ thick all over. Coal forms large cakes of coke.
10.35 Fire 10″ thick.
11.45 Heavy rain.
1.30 Fire 12″ thick.
2.20 Fire sliced. 11 lbs. of clinker removed. Clinker whitish, spongy, and very friable.
3.20 Fire 8″ thick.
3.35 Fire sliced. 30 lbs. of clinker removed.
4.28 Fire 7″ thick.
4.55 to 4.58 Fire sliced and partly cleaned. 39 lbs. of clinker removed.
5.30 Fire cleaned. 71 lbs. clinker removed.
6.10 64 lbs. of ashes raked from pit.
6.45 Trial stopped. Fire similar to start. 15 lbs. of ashes raked out of pit. Blow-off cock examined and found to be tight.

CLINKER AND ASH.
151 lbs. clinker.
79 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 4

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start						
8.45	.....	.....	8.45	5·0	12·7	0·0
9.18	163	163	9.50	7·6		
9.39	154	317	10.20	5·0		
10.19	168	485	10.47	9·4		
11.00	164	649	11.14	6·4		
11.21	154	803	11.50	7·3		
11.49	187	990	12.22	6·2		
11.21	169	1159	12.44	5·2	14·7	0·1
1.18	172	1331	1.08	5·6	14·4	0·0
2.36	189	1520	1.35	5·3	14·9	0·0
3.18	165	1685	2.09	6·8	13·4	0·0
3.57	169	1854	2.37	5·1	13·3	0·2
4.33	150	2004	3.16	5·8	13·6	0·0
5.07	165	2169	3.40	6·8	12·8	0·1
5.48	165	2334	4.04	6·0	13·6	0·1
6.18	166	2500	4.31	6·2	14·0	0·0
6.40	91	2591	5.04	5·8	13·9	0·0
			5.42	5·0	14·4	0·1
			6.16	5·7	14·0	0·3

OBSERVATIONS MADE DURING BOILER TRIAL No. 4

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.45	103	87·0	425	69·5	—·08	—·20	.....
9.00	100	90	425	70·0	—·08	—·20	392
9.15	118	90	510	68·0	—·08	—·20	371
9.30	101	93·0	450	67·5	—·08	—·25	603·5
9.45	103	94·0	465	67·5	—·08	—·25	448
10.00	103	93·0	435	67·0	—·08	—·25	468
10.15	117	95·0	450	·67·0	—·08	—·25	487·5
10.30	119	95·0	435	66·0	—·08	—·25	399
10.45	118	98	465	65·5	—·08	—·25	334
11.00	117	97	495	65·0	—·08	—·25	594·5
11.15	108	96	485	65·0	—·08	—·25	524·5
11.30	118	96	485	65·0	—·08	—·25	513
11.45	103	92	450	64·5	—·08	—·25	591·5
12.00	121	89	450	64·5	—·08	—·25	325·5
12.15	104	84	445	64·5	—·08	—·25	391·5
12.30	119	91	460	64·5	—·08	—·25	455·5
12.45	114	90	435	64·5	—·08	—·25	461
1.00	114	90	450	65·5	—·08	—·25	324·5
1.15	115	92	475	66·0	—·08	—·25	378
1.30	120	90	475	66·0	—·08	—·25	409·5
1.45	114	92	485	66·0	—·08	—·25	427·5
2.00	119	91	490	67·0	—·08	—·25	380
2.15	121	90	490	68·0	—·08	—·25	397
2.30	114	93	445	67·5	—·08	—·25	417
2.45	112	94	455	67·5	—·08	—·25	362
3.00	119	92·5	500	67·5	—·08	—·25	373
3.15	108	94	503	68·5	—·08	—·25	469
3.30	115	95	510	68·5	—·08	—·25	395
3.45	117	96	510	68·5	—·08	—·25	396·5
4.00	114	94	510	68·5	—·08	—·25	410·5
4.15	118	93	510	69·0	—·08	—·25	451·5
4.30	116	95	550	69·0	—·08	—·25	445
4.45	119	93	550	69·0	—·08	—·25	418·5
5.00	121	98	535	69·0	—·08	—·25	442·5
5.15	108	93	460	69·0	—·08	—·25	493·5
5.30	121	91	470	69·0	—·08	—·25	513·5
5.45	106	94	540	69·0	—·08	—·25	359·5
6.00	122	89	525	68·5	—·08	—·25	524
6.15	89	89	485	68·0	—·08	—·25	471·5
6.30	113	87	475	68·0	—·08	—·25	359
6.45	88	86	490	68·5	—·08	—·25	483
	112·5	92·2	479	67·0	—·08	—·25	17,534

SUMMARY OF OBSERVATIONS

Date—June 26, 1907.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.45 a.m.	Ended—6.45 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning. Fresh water, June 20.	Thoroughly cleaned June, 1908.
4.	Tubes cleaned	7.45 a.m.
5.	Fire cleaned	7.25 a.m., 5.30 p.m.

Fuel.

6.	Kind of coal	No. 203, main seam, Drummond Colliery, Intercolonial Coal Co., Westville, Pictou Co., N.S.—Over 1″ screen and picking belt.
7.	Analysis of dry coal by weight (%)	C = 76·0, H = 4·5, S = 1·3 N = 2·0, O = 4·9, Ash = 11·3
8.	Calorific value of dry coal B.T.U. per lb	13550
9.	Moisture in coal as fired (%)	1·7
10.	Weight of coal fired (lbs.)	2591
11.	Combustible matter in ash and clinker (%)	13·0
12.	Weight of clinker (lbs.)	151
13.	Weight of ash (lbs.)	79

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−0·08
15.	" above fire " "	−0·22
16.	" at damper " "	−0·25
17.	Amount of damper opening	Various
18.	Temperature of air in boiler house (°F.)	92·2
19.	Flue temperature (°F.)	479
20.	Analysis of dry flue gas by volume (%). CO_2 = 6·1 (CO from 12.44 to 5.16 p.m. = 0·1)	

Water and Steam.

21.	Temperature of feed water (°F.)	67·0
22.	Total weight of feed water, corrected for difference of level (lbs.)	17534
23.	Water level in gauge at start (inches)	3⅜
24.	Water level in gauge at finish (inches)	4½
25.	Correction for difference of level included above (lbs.)	171
26.	Steam pressure by gauge (lbs. per sq. in.)	112·5
27.	Barometer reading (inches)	29·42
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	2·7
29.	Temperature in steam calorimeter (°F.)	249·8

Notes.

Fire sliced 2.20, 3.35, and 4.55 p.m. Clinker whitish, spongy, and very friable. Coal formed large cakes of coke. Coal crushed to maximum of 1″. Weather moist and dull at first, clearing at 9.30 a.m.

Proximate analysis of dry coal by weight %: Fixed carbon ..... 63·4; Volatile matter ..... 25·3; Ash ..... 11·3

SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 203. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·50. At finish—29·34. Mean—29·42.

Total Quantities.

1.	Date of trial	26/6/07
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	2591
4.	Percentage of moisture in coal as fired (%)	1·7
5.	Total weight of dry coal fired (lbs.)	2547
6.	Total ash and refuse (lbs.)	230
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses, 13·0; (*b*) weighed	9·03
8.	Total weight of combustible consumed from analyses (lbs.)	2216
9.	Total weight of water fed to the boiler corrected for difference of level (lbs.)	17534
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17230
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	20910

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	254·7
13.	Dry coal per square foot of grate surface per hour (lbs.)	15·2
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1723
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2091
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·27

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	112·5
18.	Temperature of feed water entering boiler (deg. F.)	67·0
19.	Temperature of escaping gases from boiler (deg. F.)	479
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·17
21.	Percentage of moisture in steam	2·0

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	60·6
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	101

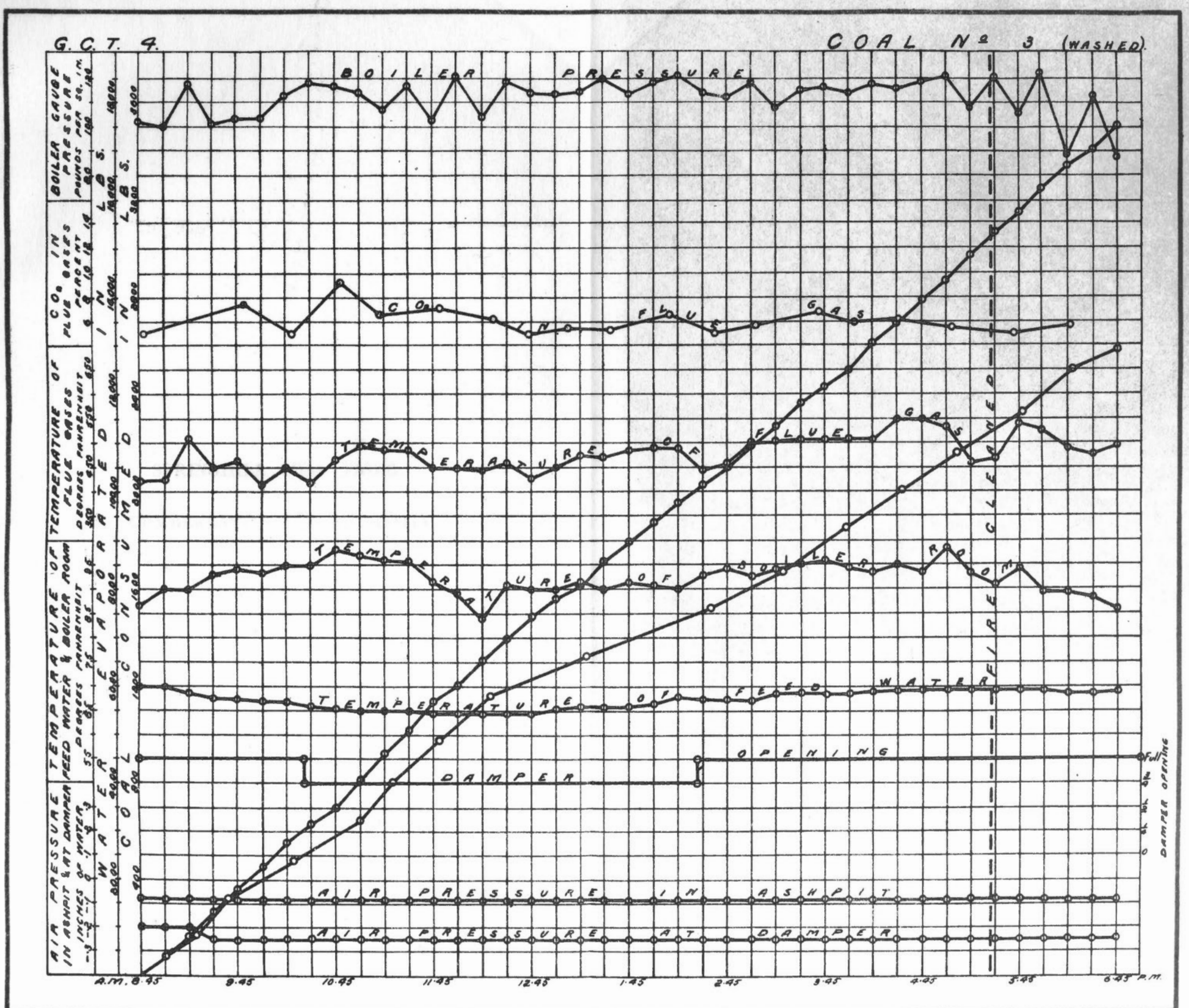
Economic Results.

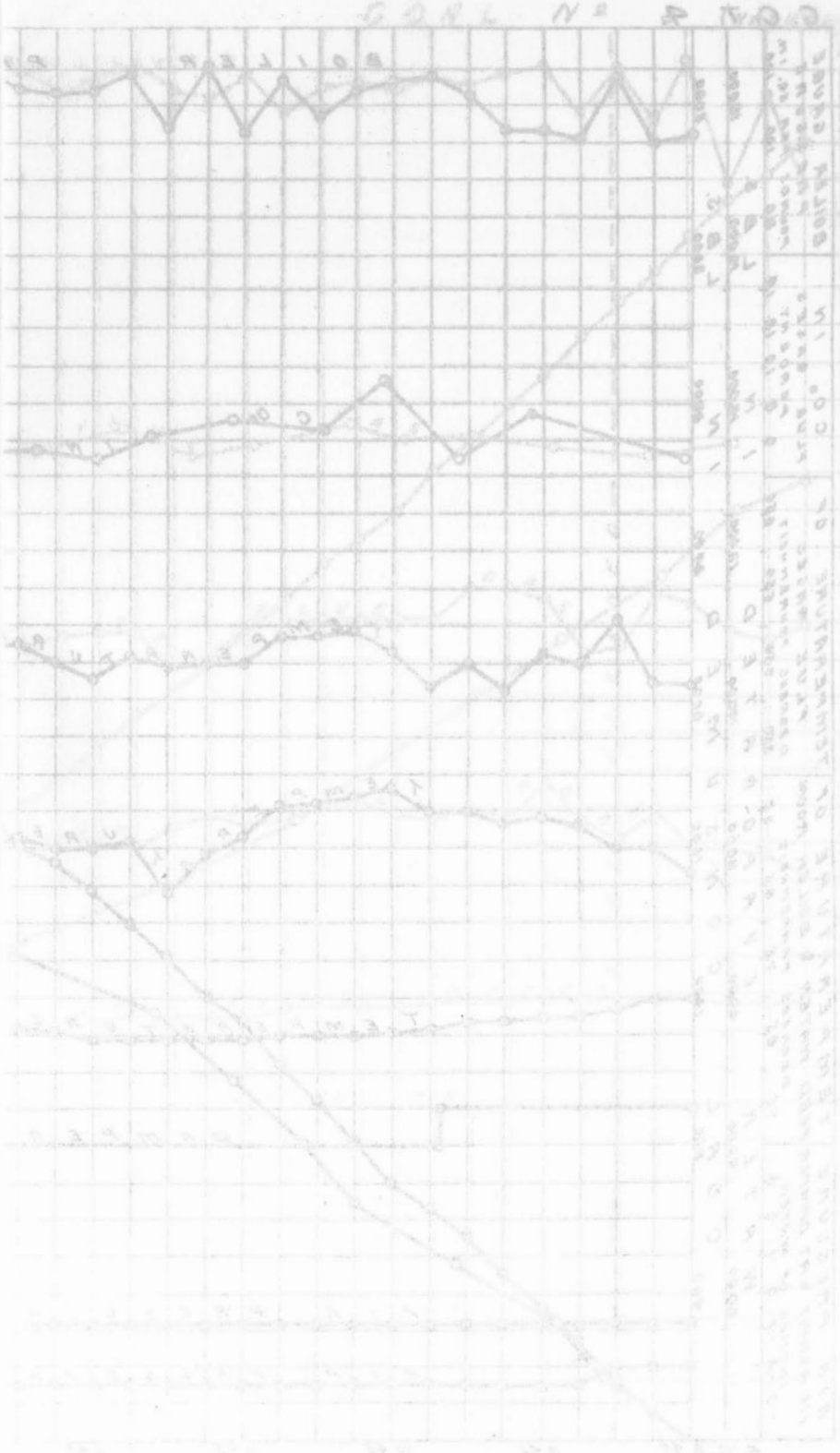
25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	6·77
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	8·07
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	8·20
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	9·45

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	13550
30.	Calorific value of the combustible per lb. (B.T.U.)	15300
31.	Efficiency of boiler (based on combustible consumed) (%)	59·7
32.	Efficiency of boiler, including grate (based on dry coal) (%)	58·6

GRAPHIC RECORD OF BOILER TRIAL.





SPRINGHILL COAL FIELD.

CUMBERLAND CO., NOVA SCOTIA.

TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 5.

Date—July 22, 1907. Trial Number—G.C.T. 14.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Weather warm. 1.00 p.m. rain. B. and W. No. 1 boiler working. Boiler blown down completely and refilled July 18.

NOTE—About 8.15 on July 19 mud drum door began to leak and no trial could be made. Joint was remade on July 20 and boiler tested under steam. No further leak was noticed and there was no loss of water between July 20 and 22.

a.m.
7.43 Fire thoroughly cleaned and remade with No. 5 coal. Pressure, 50 lbs.
7.50 Tubes cleaned.
8.55 Trial started. Fire 2″ thick, a little flame and smoke.
10.05 Grill in fire door half open.
11.05 Grill full open.
12.26 Fire sliced.
2.02 Fire sliced. 30 lbs. thick lumps of clinker removed.
3.15 Fire sliced. 37 lbs. of clinker removed.
4.30 Grill half open. Fire sliced.
5.11 Fire sliced.
5.34 Grill closed.
5.43 to 5.55 Fire well cleaned. 133 lbs. of viscous adhesive clinker removed.
6.55 Trial stopped. Fire similar to start. 50 lbs. of ashes raked from pit. Blow-off examined and found to be tight.

CLINKER AND ASH.

200 lbs. clinker.
50 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 14

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.55 a.m.						
9.08	172	172	9.10	10·4	7·4	0·0
9.26	144	316	9.40	10·3	4·7	2·0
9.55	164	480	10.08	10·6	6·9	0·5
10.19	131	611	10.42	10·5	4·5	3·6
10.43	149	760	11.10	13·0	4·8	0·4
11.03	158	918	11.40	10·9	5·7	1·8
11.20	135	1053	12.15	10	6·4	2·2
11.36	132	1185	12.48	11·8	6·2	0·9
12.03	150	1335	1.10	9·6	9·1	0·1
12.22	150	1485	1.40	9·0	10·6	0·0
12.52	131	1616	2.17	9·5	8·3	0·2
1.23	154	1770	2.40	9·0	11·0	0·0
2.08	163	1933	3.13	8·6	10·8	0·0
2.45	162	2095	3.41	6·2	13·2	0·0
3.26	163	2258	4.12	6·1	13·1	0·0
3.46	160	2418	4.40	7·2	12·5	0·9
4.24	166	2584	5.09	5·9	13·8	0·0
4.48	147	2731	5.39	7·6	12·2	0·0
5.18	150	2881	6.10	4·0	15·8	0·0
6.08	165	3046	6.35	5·0	15·4	0·0
6.55	173	3219				
				8·8	9·6	0·5

OBSERVATIONS MADE DURING BOILER TRIAL No. 14

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.55	107	96	425	76	−·02	−·20	.....
9.10	122	93	400	75·5	−·02	−·20	239·5
9.25	114	95	440	74·5	−·02	−·28	561
9.40	120	97	390	73·5	0·0	−·20	443
9.55	112	98	390	73	−·02	−·20	518
10.10	107	97	395	73	0·0	−·20	465·5
10.25	112	97	400	73	−·02	−·25	450
10.40	112	99	400	73	−·02	−·20	432
10.55	116	99	435	72	−·02	−·30	411
11.10	122	98	520	72	−·02	−·30	520·5
11.25	122	98	495	72·5	0·0	−·30	575
11.40	122	98	450	73	0·0	−·20	569
11.55	120	98	460	73·5	0·0	−·25	510·5
12.10	122	97	450	73	0·0	−·25	495·5
12.25	120	94	475	73·5	0·0	−·25	524·5
12.40	123	93	535	73·5	−·05	−·25	476·5
12.55	120	91	490	73	0·0	−·25	528
1.10	121	92	485	73	0·0	−·25	473
1.25	122	90	465	73	0·0	−·25	498
1.40	110	92	455	73·5	−·05	−·20	438
1.55	120	92	460	74	0·0	−·20	336·5
2.10	124	92	435	74	0·0	−·20	453
2.25	122	92	495	74	−·02	−·25	412
2.40	120	92	490	74	−·05	−·25	477
2.55	116	92	475	74	0·0	−·20	504
3.10	116	93	485	74	0·0	−·25	343·5
3.25	117	93	515	74	−·02	−·20	345·5
3.40	120	92	460	74	−·02	−·20	447·5
3.55	118	90	465	74	−·02	−·20	459
4.10	114	92	440	74	−·02	−·25	453·5
4.25	112	90	455	74	−·02	−·25	350
4.40	120	92	500	74	−·02	−·20	463·5
4.55	111	90	440	74	0·0	−·25	508
5.10	110	92	475	74	0·0	−·25	416·5
5.25	111	91	470	73·5	0·0	−·25	432·5
5.40	122	90	440	74	−·02	−·20	395
5.55	100	99	450	74	0·0	−·25	465
6.10	116	91	470	74	0·0	−·25	735
6.25	118	91	540	74	0·0	−·25	
6.40	120	91	535	75	0·0	−·25	566·5
6.55	110	90	490	74	0·0	−·20	556
	116·6	93·6	462	73·7	−·01	−·23	18,194·5 net

SUMMARY OF OBSERVATIONS

Date—July 22, 1907.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.55 a.m.	Ended—6.35 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning. Fresh water, July 18.	Thoroughly cleaned June, 1907
4.	Tubes cleaned	7.50 a.m.
5.	Fire cleaned	7.43 a.m., 5.43 p.m.

Fuel.

6.	Kind of coal	No. 5—Springhill No. 2 Colliery, Cumberland Railway & Coal Co., Cumberland Co., N.S. Over $\frac{3}{4}$" screen and picking belt.
7.	Analysis of dry coal by weight (%)	C = 75·1, H = 4·9, S = 1·6, N = 1·2, O = 8·0, Ash = 9·2
8.	Calorific value of dry coal B.T.U. per lb	13860
9.	Moisture in coal as fired (%)	1·9
10.	Weight of coal fired (lbs.)	3219
11.	Combustible matter in ash and clinker (%)	20·8
12.	Weight of clinker (lbs.)	200
13.	Weight of ash (lbs.)	50

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−0·01
15.	" above fire "	−0·18
16.	" at damper "	−0·23
17.	Amount of damper opening	Various
18.	Temperature of air in boiler house (°F.)	93·6
19.	Flue temperature (°F.)	462
20.	Analysis of dry flue gas by volume (%)	$CO_2 = 8·8$, $O_2 = 9·6$, $CO = 0·5$, $N_2 = 81·1$

Water and Steam.

21.	Temperature of feed water (°F.)	73·7
22.	Total weight of feed water, corrected for difference of level (lbs.)	18194
23.	Water level in gauge at start (inches)	$4\frac{7}{16}$
24.	Water level in gauge at finish (inches)	$4\frac{3}{16}$
25.	Correction for difference of level included above (lbs.)	38
26.	Steam pressure by gauge (lbs. per sq. in.)	116·6
27.	Barometer reading (inches)	29·58
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	13·1
29.	Temperature in steam calorimeter (°F.)	278

Notes.

Fire sliced 12.26, 2.02, 3.15, 4.30, and 5.11 p.m. Air admitted over fire from 10.05 a.m. to close. Clinker viscous and adherent. Weather warm, rain in afternoon.

Proximate analysis of dry coal by weight %

Fixed carbon	58·5
Volatile matter	32·3
Ash	9·2

SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 5. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·61. At finish—29·55. Mean—29·58.

Total Quantities.

1.	Date of trial	22/7/07
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	3219
4.	Percentage of moisture in coal as fired (%)	1·9
5.	Total weight of dry coal fired (lbs.)	3157
6.	Total ash and refuse (lbs.)	250
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 11·6; (*b*) weighed	7·9
8.	Total weight of combustible consumed from analyses (lbs.)	2791
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	18194
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure	18010
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	21370

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	315·7
13.	Dry coal per square foot of grate surface per hour (lbs.)	18·8
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1801
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2137
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·34

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	116·6
18.	Temperature of feed water entering boiler (° F.)	73·7
19.	Temperature of escaping gases from boiler (° F.)	462
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·22
21.	Percentage of moisture in steam	1·0

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	61·9
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	103

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	5·65
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	6·63
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	6·77
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	7·65

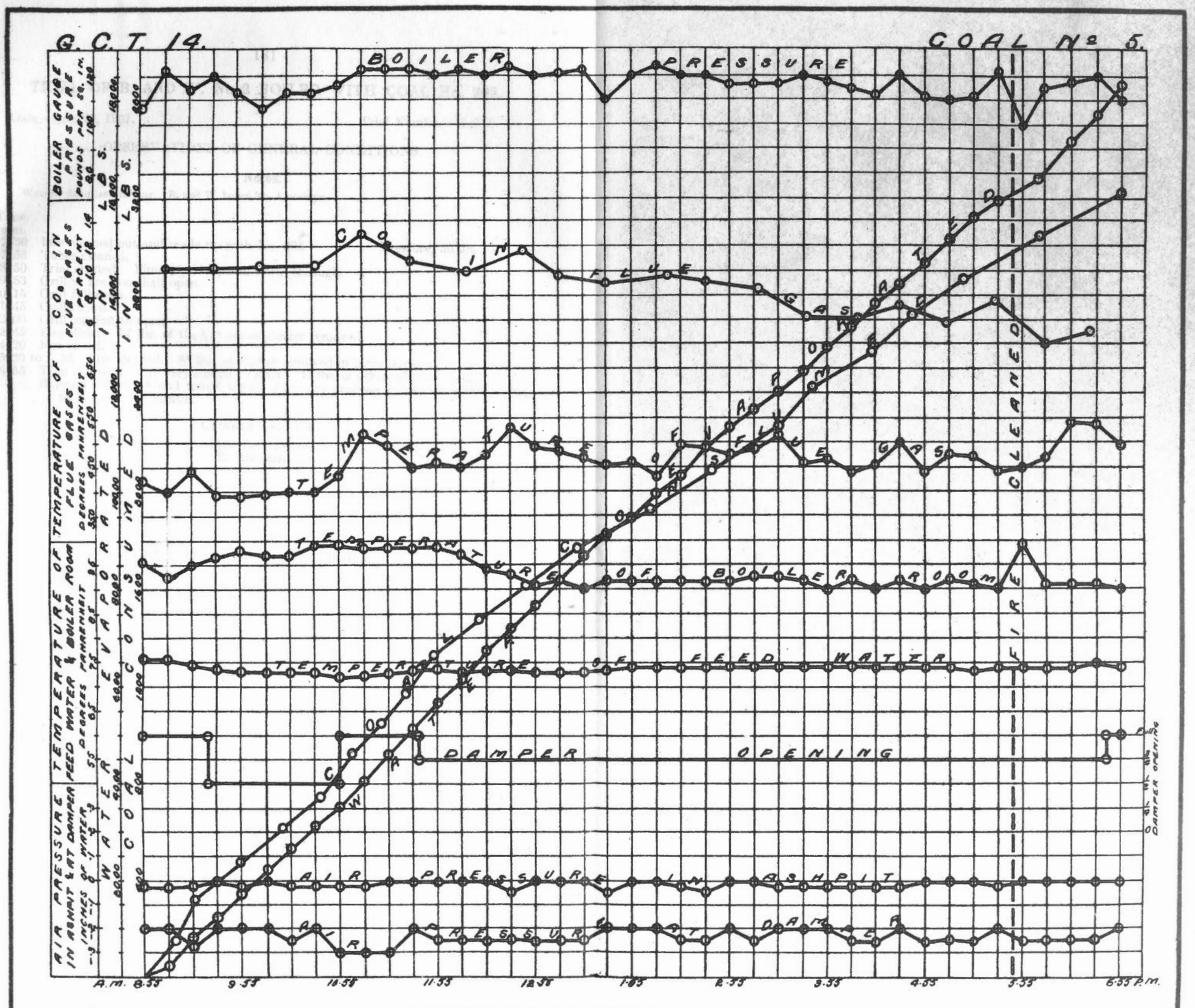
Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	13370
30.	Calorific value of the combustible per lb. (B.T.U.)	14720
31.	Efficiency of boiler (based on combustible consumed) (%)	50·1
32.	Efficiency of boiler, including grate (based on dry coal) (%)	49·0

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	26·7
34.	" of combustible consumed (from gas analyses) (lbs.)	22·7
35.	" dry coal (from gas analyses) (lbs.)	20·4
36.	Proportion of heat of fuel in escaping dry flue gases (%)	13·2

GRAPHIC RECORD OF BOILER TRIAL.



TRIAL OF B. AND W. No 2 BOILER WITH COAL No. 205.

Date—July 26, 1907. Trial Number—G.C.T. 16.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Weather damp and raining. B. and W. boiler No. 1 working.

Time.
a.m.
7.30 Fire cleaned out and made up with No. 205 Pressure, 30 lbs.
7.55 Tubes cleaned.
8.50 Trial started. Fire 1½" thick, well burnt through.
9.53 Grill in fire door half open.
10.15 Grill full open.
1.45 Grill closed.
2.00 Grill one-fourth open.
2.45 Fire sliced. 27 lbs. of thick, viscous clinker removed.
4.20 Fire sliced.
5.30 to 5.35 Fire cleaned. 85 lbs. of clinker removed in large slabs.
6.55 Trial stopped. Fire very similar to start. 47 lbs. of ashes raked from pit. Blow-off examined and found tight. Flue gas analysis results doubtful owing to defect in apparatus.

CLINKER AND ASH.

112 lbs. clinker.
47 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 16

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.50 a.m.						
9.04	166	166				
9.30	156	322				
9.48	168	490				
10.33	181	671				
11.02	158	829				
11.30	180	1009				
11.53	162	1171				
12.38	150	1321				
1.30	180	1501	Sampling	incorrect		
2.00	170	1671				
2.32	157	1828				
3.16	200	2028				
3.44	180	2208				
4.27	184	2392				
4.56	159	2551				
5.45	162	2713				
6.03	153	2866				
6.55	90	2956				

OBSERVATIONS MADE DURING BOILER TRIAL No. 16

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.50	99	85	440	72	0·0	—·25	.....
9.05	119	89	420	72·5	0·0	—·30	302
9.20	115	86	480	72·5	0·0	—·35	462
9.35	119	87	445	73	0·0	—·30	529
9.50	117	87	440	73	0·0	—·35	466·5
10.05	115	88	430	73	0·0	—·30	549·5
10.20	120	88	470	73·5	0·0	—·35	404
10.35	121	88	500	74	0·0	—·30	485·5
10.50	116	87	530	73·5	0·0	—·25	484·5
11.05	122	90	510	74	0·0	—·35	553
11.20	121	90	495	73	0·0	—·35	571·5
11.35	114	91	465	73	0·0	—·30	604
11.50	121	90	450	73·5	0·0	—·30	494·5
12.05	117	89	465	73·5	0·0	—·25	602·5
12.20	122	91	440	74	0·0	—·25	382
12.35	120	91	455	74	0·0	—·15	489·5
12.50	114	90	425	73·5	0·0	—·20	490
1.05	120	91	450	73·5	0·0	—·20	347
1.20	120	92	430	74	0·0	—·20	425·5
1.35	120	92	465	74	0·0	—·25	370
1.50	120	93	455	74	0·0	—·25	440·5
2.05	115	92	460	74	0·0	—·25	479
2.20	117	93	465	73·5	0·0	—·25	466·5
2.35	120	92	435	73·5	0·0	—·25	332
2.50	116	91	470	73·5	0·0	—·25	472·5
3.05	116	92	430	73·5	0·0	—·30	426·5
3.20	116	92	480	73	0·0	—·30	403
3.35	116	90	480	73	0·0	—·20	463·5
3.50	117	90	450	73	0·0	—·30	400·5
4.05	117	90	485	73	0·0	—·30	392·5
4.20	110	89	515	72·5	0·0	—·30	347
4.35	117	89	575	73	0·0	—·30	604
4.50	120	90	540	73	0·0	—·30	525·5
5.05	110	89	510	73	0·0	—·30	508
5.20	115	89	520	73	0·0	—·30	441
5.35	115	93	490	72·5	0·0	—·30	327·5
5.50	120	89	525	72·5	0·0	—·35	377
6.05	117	88	490	72·5	0·0	—·35	553·5
6.20	110	88	490	72·5	0·0	—·25	503
6.35	103	87	500	72	0·0	—·20	472
6.55	98	86	530	72	0·0	—·25	497
	116·0	89·6	476	73·2	0·0	—·28	18,447·5 net

SUMMARY OF OBSERVATIONS

Date—July 26, 1907.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.50 a.m.	Ended—6.50 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned June, 1907. Fresh water, July 18.
4.	Tubes cleaned	7.55 a.m.
5.	Fire cleaned	7.30 a.m., 5.30 p.m.

Fuel.

6.	Kind of coal....	No. 205 Springhill No. 2 Colliery, Cumberland Ry. & Coal Co., Cumberland Co., N.S.—Over $\frac{3}{4}$" screen and picking belt
7.	Analysis of dry coal by weight (%)	C=76·9, H=5·0, S=1·4 N=1·0, O=8·6, Ash=7·1
8.	Calorific value of dry coal B.T.U. per lb	13860
9.	Moisture in coal as fired (%)	3·8
10.	Weight of coal fired (lbs.)	2956
11.	Combustible matter in ash and clinker (%)	10·4
12.	Weight of clinker (lbs.)	112
13.	Weight of ash (lbs.)	47

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	0·0
15.	" above fire " "	−0·18
16.	" at damper " "	−0·28
17.	Amount of damper opening	Various
18.	Temperature of air in boiler house (°F.)	89·6
19.	Analysis of dry flue gas by volume (%)—Errors in sampling.	
20.	Flue temperature (°F.)	476

Water and Steam.

21.	Temperature of feed water (°F.)	73·2
22.	Total weight of feed water, corrected for difference of level (lbs.)	18447
23.	Water level in gauge at start (inches)	3 $\frac{3}{16}$
24.	Water level in gauge at finish (inches)	3 $\frac{1}{4}$
25.	Correction for difference of level included above (lbs.)	9·5
26.	Steam pressure by gauge per sq. in. (lbs.)	116·0
27.	Barometer reading (inches)	29·23
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	15·2
29.	Temperature in steam calorimeter (°F.)	280

Notes.

Fire sliced 2.45 and 4.20 p.m. Air admitted over fire from 9.53 to close. Clinker thick and viscous and removed in large slabs. Coal coked readily. Weather damp and raining.

Proximate analysis of dry coal by weight %

Fixed carbon	59·8
Volatile matter	33·1
Ash	7·1

SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 205. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·24. At finish—29·22. Mean—29·23.

Total Quantities.

1.	Date of trial	26/7/07
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	2956
4.	Percentage of moisture in coal as fired (%)	3·8
5.	Total weight of dry coal fired (lbs.)	2843
6.	Total ash and refuse (lbs.)	159
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 7·9; (*b*) weighed	5·6
8.	Total weight of combustible consumed (lbs.), from analyses	2617
9.	Total weight of water fed to the boiler (lbs.), corrected for difference of level	18447
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure	18260
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	21680

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	284·3
13.	Dry coal per square foot of grate surface per hour (lbs.)	17·0
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1826
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2168
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·4

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	116·0
18.	Temperature of feed water entering boiler (°F.)	73·2
19.	Temperature of escaping gases from boiler (°F.)	476
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·28
21.	Percentage of moisture in steam	1·0

Horse-Power.

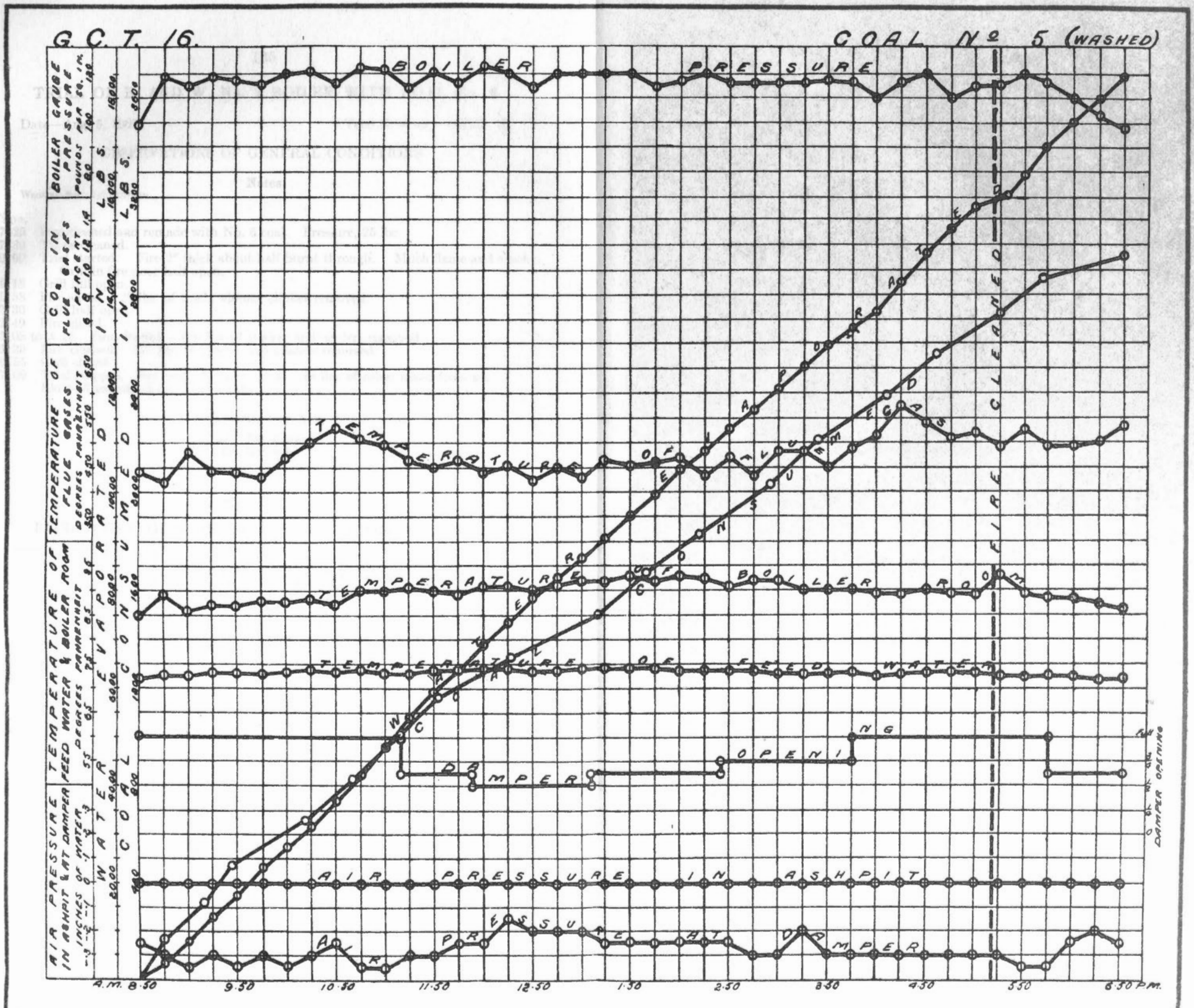
22.	Horse-power developed (Item 15 ÷ 34½)	62·9
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	105

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	6·26
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	7·36
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	7·63
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	8·30

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	13860
30.	Calorific value of the combustible per lb. (B.T.U.)	14910
31.	Efficiency of boiler (based on combustible consumed) (%)	53·7
32.	Efficiency of boiler, including grate (based on dry coal) (%)	53·1


G. C. T. 16.
COAL Nº 5 (WASHED)
BOILER PRESSURE
TEMPERATURE OF FLUE GASES
TEMPERATURE OF BOILER ROOM
TEMPERATURE OF FEED WATER
AIR PRESSURE IN ASHPIT
AIR PRESSURE AT DAMPER
DAMPER OPENING
FIRE CLEANED
BOILER GAUGE PRESSURE POUNDS PER SQ. IN.
CO2 IN FLUE GASES PER CENT
TEMPERATURE OF FLUE GASES DEGREES FAHRENHEIT
TEMPERATURE OF BOILER & BOILER ROOM DEGREES FAHRENHEIT
WATER EVAPORATED POUNDS
COAL LBS.
INCHES OF WATER
A.M. 8.30 9.30 10.30 11.30 12.30 1.30 2.30 3.30 4.30 5.30 6.30 P.M.

TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 6.

Date—Aug. 5, 1907. Trial Number —G.C.T. 19.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Weather fine; light breeze.

Time.
7.25 Fire cleaned and remade with No. 6 coal. Pressure, 25 lbs.
7.30 Tubes cleaned.
9.00 Trial started. Fire 2" thick about half burnt through. Much flame and smoke. Grill in fire door half open.
11.18 Grill full open.
1.58 Fire sliced. 28 lbs. of thick, viscous clinker removed.
2.30 Grill half open.
2.49 Fire sliced.
3.08 to 3.16 Fire cleaned. 106 lbs. of clinker and cinders removed.
5.25 Fire cleaned. 117 lbs. of clinker and cinders removed.
6.55 Grill closed.
7.09 Trial stopped. Fire very similar to start. 49 lbs. of ashes raked from pit. Blow-off examined and found tight.

CLINKER AND ASH.

251 lbs. clinker.
49 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 19

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 9.00 a.m.						
9.16	198	198	9.20	8·4	9·0	0·6
9.32	157	355	9.55	8·4	7·8	1·2
9.51	158	513	10.50	7·4	9·6	0·8
10.21	172	685	11.20	8·0	11·2	0·2
10.55	177	862	11.50	6·5	11·9	0·3
11.14	135	997	12.20	7·3	11·1	0·8
11.47	152	1149	12.50	5·2	13·5	0·7
12.14	170	1319	1.20	4·5	13·7	0·0
12.49	163	1482	2·20	6·0	13·6	0·4
1.25	175	1657	2.55	6·5	12·9	0·2
2.02	180	1837	2.36	6·1	12·2	0·2
2.35	181	2018	3.55	4·2	10·8	0·2
3.20	183	2201	4.22	5·0	14·0	0·5
3.40	152	2353	4.53	5·0	14·3	0·1
4.04	152	2505	5.25	4·7	15·5	0·0
4.30	156	2661	5.53	14·4	4·1	0·3
4.58	174	2835	6.15	12·5	5·3	0·2
5.46	164	2999	6.45	11·0	6·4	0·6
6.04	177	3176				
6.30	155	3331		7·3	10·9	0·4
7.09	69	3400				

OBSERVATIONS MADE DURING BOILER TRIAL No. 19

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
9.00	98	86	445	69·5	—·07	—·25	.....
9.15	117	86	475	69	—·07	—·25	250·5
9.30	108	84	540	69	—·07	—·25	626
9.45	114	86	500	69	—·07	—·25	489
10.00	117	87	475	69	—·07	—·25	545
10.15	110	89·5	455	70	—·07	—·25	533·5
10.30	113	90	475	70·5	—·07	—·25	464·5
10.45	111	91	485	69	—·07	—·25	474·5
11.00	110	90	450	69	—·07	—·25	546
11.15	115	88	435	69·5	—·07	—·25	353
11.30	113	85	460	69·5	—·07	—·25	453·5
11.45	115	89	475	69·5	—·07	—·25	501·5
12.00	110	89	475	69·5	—·07	—·25	315
12.15	104	89	460	70	—·07	—·25	524·5
12.30	113	86	490	70	—·07	—·25	423
12.45	106	88	510	70	—·07	—·25	411·5
1.00	108	88	485	70	—·07	—·25	472·5
1.15	118	88	460	70	—·07	—·25	398·5
1.30	113	89	475	70	—·07	—·25	455
1.45	104	90	510	70	—·07	—·25	415
2.00	108	93	540	70	—·07	—·25	419
2.15	111	91	525	70	—·07	—·25	425·5
2.30	114	89	480	70	—·07	—·25	395·5
2.45	114	90	460	70	—·07	—·25	311
3.00	116	88	480	70	—·07	—·25	342·5
3.15	109	94	515	71	—·07	—·25	444
3.30	119	93	595	70	—·07	—·25	294
3.45	115	93	530	70	—·07	—·25	511·5
4.00	111	89	515	70	—·07	—·25	436
4.15	108	91	450	70	—·07	—·25	429
4.30	113	89	516	70	—·07	—·25	362·5
4.45	105	90	540	70	—·07	—·25	525
5.00	108	89	520	70	—·07	—·25	462·5
5.15	118	90	515	70	—·07	—·25	409
5.30	108	90	515	70	—·07	—·25	418·5
5.45	123	90	805	70	—·07	—·25	399·5
6.00	123	91	610	71	—·07	—·25	616
6.15	115	90	595	71	—·07	—·25	663
6.30	117	90	525	71·5	—·07	—·25	464
6.45	118	89	500	71·5	—·07	—·25	572
7.09	107	89	470	71	—·07	—·25	491·5
	112	89·2	505	70	—·07	—·25	17,846·5 net

SUMMARY OF OBSERVATIONS

Date—Aug. 5, 1907.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—9.00 a.m.	Ended—7.09 p.m.	Duration—609 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned, June 1907. Fresh water, August 2.
4.	Tubes cleaned	7.30 a.m.
5.	Fire cleaned	7.25 a.m., 3.08 and 5.25 p.m.

Fuel.

6.	Kind of coal	No. 6—Springhill No. 3 Colliery, Cumberland Ry. & Coal Co., Cumberland Co., N.S.—Over ¼" screen and picking belt
7.	Analysis of dry coal by weight (%)	C=73·1, H=4·6, S=1·8, N=1·8, O=7·2, Ash=11·5
8.	Calorific value of dry coal B.T.U. per lb	13000
9.	Moisture in coal as fired (%)	2·2
10.	Weight of coal fired (lbs.)	3400
11.	Combustible matter in ash and clinker (%)	31·1
12.	Weight of clinker (lbs.)	251
13.	Weight of ash (lbs.)	49

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−0·07
15.	" above fire "	−0·18
16.	" at damper "	−0·25
17.	Amount of damper opening	Various
18.	Temperature of air in boiler house (°F.)	89·2
19.	Flue temperature (°F.)	505
20.	Analysis of dry flue gas by volume (%)	CO_2=7·3, O_2=10·9, CO=0·4, N_2=81·4

Water and Steam.

21.	Temperature of feed water (°F.)	70·0
22.	Total weight of feed water, corrected for difference of level (lbs.)	17846
23.	Water level in gauge at start (inches)	4⅜
24.	Water level in gauge at finish (inches)	4⅜
25.	Correction for difference of level, included above (lbs.)	38
26.	Steam pressure by gauge (lbs. per sq. in.)	112·0
27.	Barometer reading (inches)	29·85
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	19·15
29.	Temperature in steam calorimeter (°F.)	281·6

Notes.

Fire sliced 1.58 and 2.49 p.m. Air admitted over fire throughout trial. Clinker thick and viscous. Coal coked and burnt with much flame and smoke. Weather fine with light breeze.

Proximate analysis of dry coal by weight %: Fixed carbon 55·0; Volatile matter 33·5; Ash 11·5

SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 6. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·87. At finish—29·82. Mean—29·85.

Total Quantities.

1.	Date of trial	5/8/07
2.	Duration of trial (hours)	10·15
3.	Weight of coal as fired (lbs.)	3400
4.	Percentage of moisture in coal as fired (%)	2·2
5.	Total weight of dry coal fired (lbs.)	3325
6.	Total ash and refuse (lbs.)	300
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 16·7; (*b*) weighed	9·03
8.	Total weight of combustible consumed, from analyses (lbs.)	2770
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	17846
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17660
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	21005

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	328
13.	Dry coal per square foot of grate surface per hour (lbs.)	19·5
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1739
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2070
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·24

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	112·0
18.	Temperature of feed water entering boiler (deg. F.)	70·0
19.	Temperature of escaping gases from boiler (deg. F.)	505
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·18
21.	Percentage of moisture in steam	1·0

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	60
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	100

Economic Results.

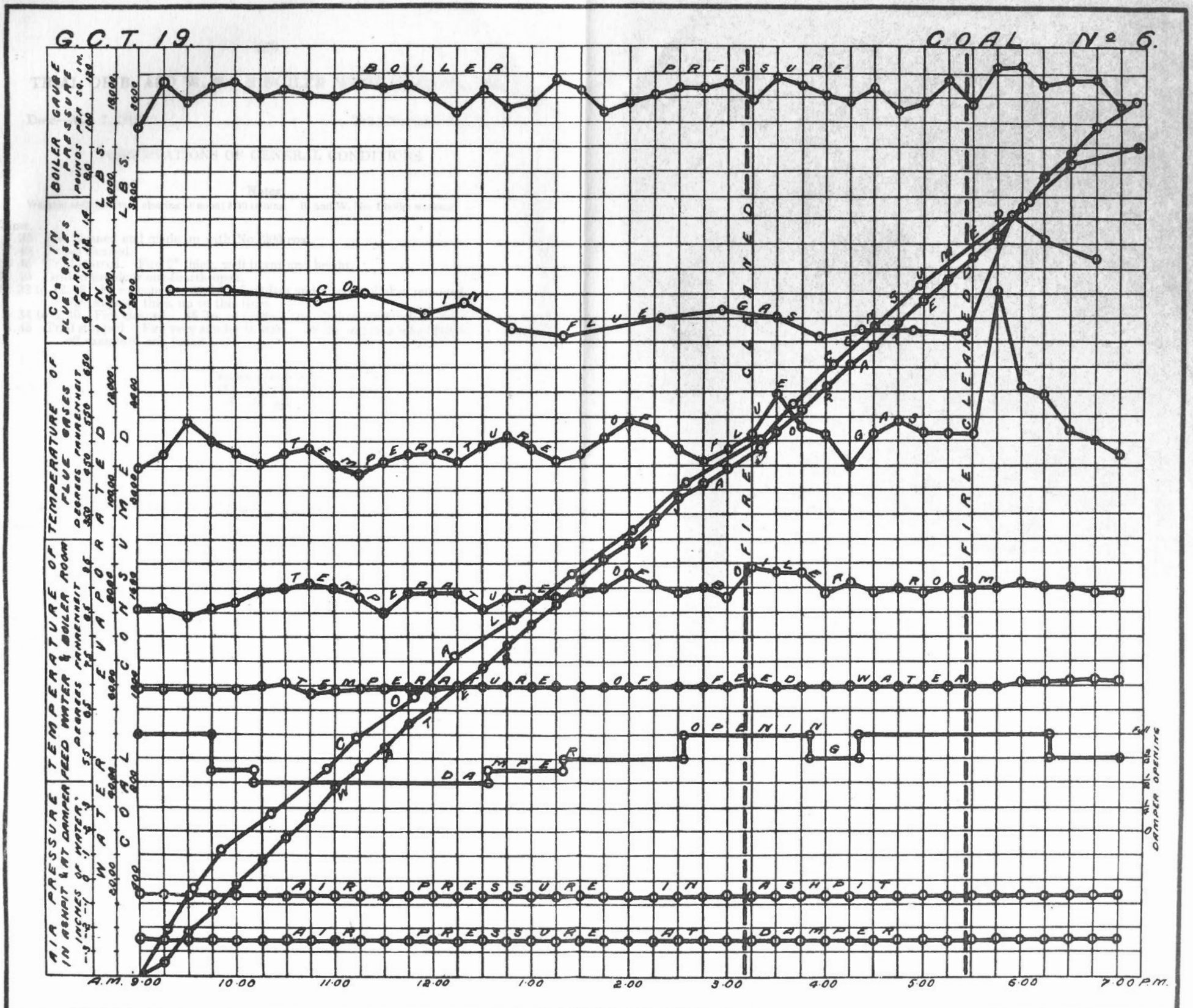
25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	5·25
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	6·18
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	6·31
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	7·59

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	13000
30.	Calorific value of the combustible per lb. (B.T.U.)	14700
31.	Efficiency of boiler (based on combustible consumed) (%)	49·9
32.	Efficiency of boiler, including grate (based on dry coal) (%)	46·9

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	32·1
34.	" of combustible consumed (from gas analyses) (lbs.)	28·2
35.	" dry coal (from gas analyses) (lbs.)	23·5
36.	Proportion of heat of fuel in escaping dry flue gases (%)	18·9


G.C.T. 19.
COAL No 6.
BOILER PRESSURE
BOILER GAUGE PRESSURE POUNDS PER SQ. IN.
CO2 IN FLUE GASES PERCENT
TEMPERATURE OF FLUE GASES DEGREES FAHRENHEIT
TEMPERATURE OF FEED WATER & BOILER ROOM DEGREES FAHRENHEIT
AIR PRESSURE IN ASHPIT & AT DAMPER INCHES OF WATER
WATER EVAPORATED LBS.
COAL CONSUMED LBS.
CO2 IN FLUE GASES
TEMPERATURE OF FLUE GASES
TEMPERATURE OF BOILER ROOM
TEMPERATURE OF FEED WATER
OPENING
DAMPER
AIR PRESSURE IN ASHPIT
AIR PRESSURE AT DAMPER
CLEANED FIRE
CLEANED FIRE
A.M. 9:00
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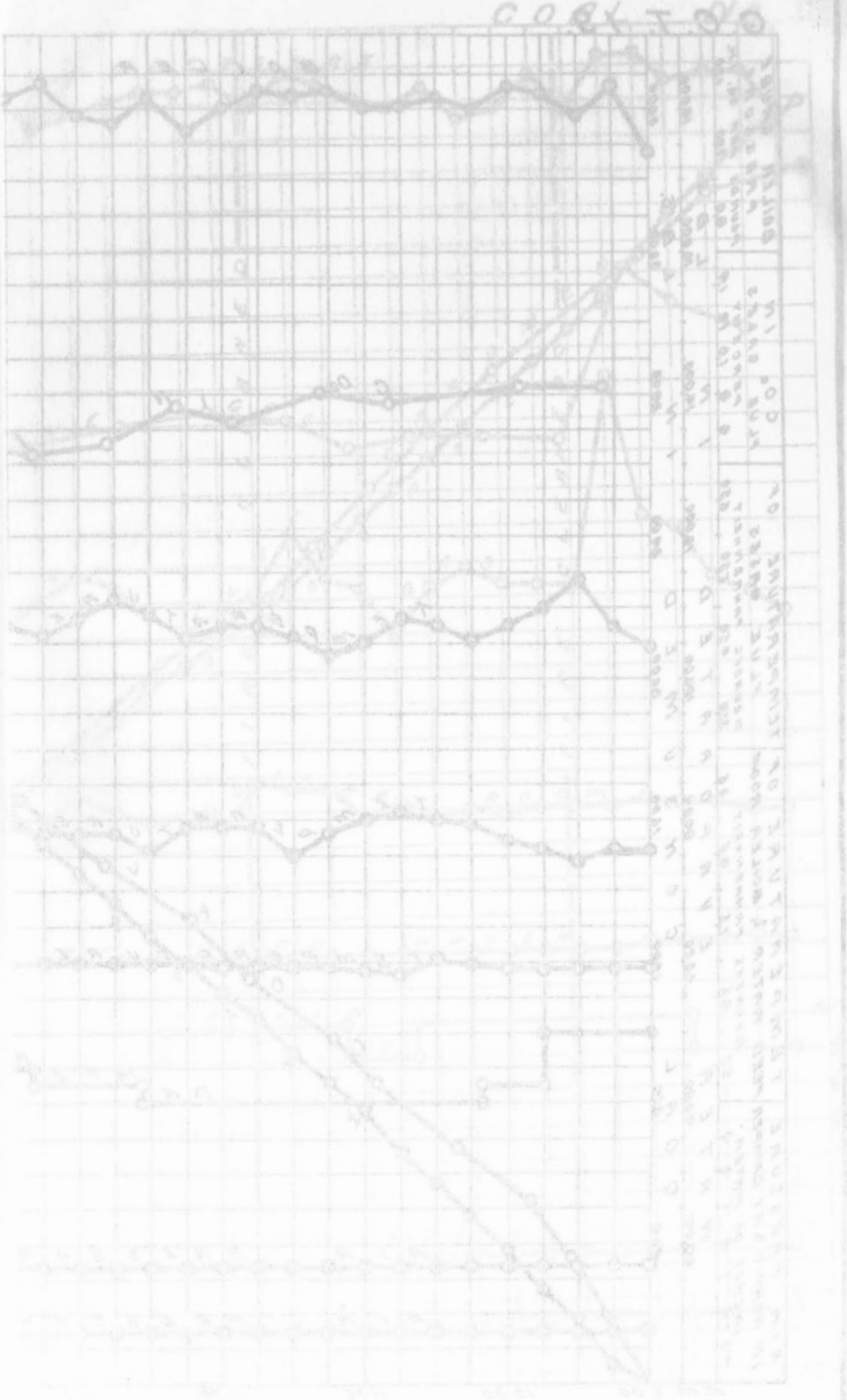


TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 206.

Date—Aug. 7, 1907. Trial Number—G.C.T. 20.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Weather cool, overcast, clearing at noon; 3.30 raining. B. and W. No. 1 boiler working.

Time.
7.35 Fire cleaned and made up with No. 206 coal.
7.40 Tubes cleaned.
8.45 Trial started. Fire 2″ thick, well burnt and bright.
10.50 Grill in fire door one-fourth open.
12.33 to 12.43 Fire cleaned. 69 lbs. of cinders and viscous clinker removed. Fire kept 4″ thick up to this time.
5.34 to 5.40 Fire cleaned. 65 lbs. of cinders and clinker removed.
6.45 Trial stopped. Fire very similar to start. 98 lbs. of ashes raked from pit. Blow-off examined and found tight.

CLINKER AND ASH.
134 lbs. clinker.
98 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 20

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.45 a.m.						
8.58	37	37	9.03	11·4	7·1	0·1
9.21	167	204	9.32	10.0	6·0	1·8
9.38	151	355	10.00	9·8	7·2	0·8
10.05	146	501	10.30	10·4	6·0	1·6
10.38	158	659	11.00	9·0	8·5	1·3
11.15	147	806	11.45	10·0	8·0	1·2
11.50	152	958	12.15	8·6	11·2	0·2
12.30	144	1102	12.45	9·3	8·2	1·3
12.58	146	1248	1.13	6·2	12·0	0·6
1.16	149	1397	1.45	7·0	12·2	0·5
1.48	142	1539	2.18	8·5	10·1	0·6
2.18	183	1722	2.47	7·0	11·1	0·7
2.45	151	1873	3.15	8·0	11·2	0·7
3.24	158	2031	3.45	9·0	10·9	0·1
3.57	173	2204	4.17	7·0	12·2	0·5
4.30	147	2351	4.45	7·5	11·8	0·2
4.58	157	2508	5.15	4·6	14·6	0·0
5.32	148	2656	5.50	7·0	11·8	0·4
6.06	164	2820	6.20	8·2	11·2	0·3
6.45	153	2973		8·3	10·2	0·6

OBSERVATIONS MADE DURING BOILER TRIAL No. 20

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.45	111	87	485	70·5	—·05	—·25	.....
9.00	110	88	440	70·5	—·05	—·25	380·5
9.15	109	86	440	70·5	—·05	—·25	449
9.30	108	87	440	70·5	—·05	—·25	488
9.45	108	89	420	70·5	—·05	—·25	494
10.00	109	91	415	71·0	—·05	—·25	376·5
10·15	119	91	475	71·0	—·05	—·25	460·5
10.30	117	92	475	71·0	—·05	—·25	557·5
10.45	117	92	490	71·0	—·05	—·25	529
11.00	108	92	470	71·0	—·05	—·25	478·5
11.15	103	92	470	71·0	—·05	—·25	434
11.30	107	93	470	71·0	—·05	—·25	402
11.45	117	92	540	71·0	—·05	—·25	376·5
12.00	113	93	525	71·0	—·05	—·25	514
12.15	114	92	460	71·0	—·05	—·25	408
12.30	114	92	480	71·0	—·05	—·25	388
12.45	120	96	500	71·0	—·05	—·25	229
1.00	113	92	580	71·5	—·05	—·25	640
1.15	119	92	550	71·5	—·05	—·25	394
1.30	119	92	510	71·5	—·05	—·25	470·5
1.45	117	93	530	71·5	—·05	—·25	451·5
2.00	119	92	530	71·5	—·05	—·25	503·5
2.15	123	92	510	71·5	—·05	—·25	556·5
2.30	102	93	520	71·5	—·05	—·25	577
2.45	122	93	515	71·5	—·05	—·25	423·5
3.00	119	92	520	71·0	—·05	—·25	529·5
3.15	113	92	525	71·0	—·05	—·25	474·5
3.30	120	91	510	71·0	—·05	—·25	394·5
3.45	111	90	570	71·0	—·05	—·25	474
4.00	118	89	525	71·0	—·05	—·25	431
4.15	122	89	560	71·0	—·05	—·25	419
4.30	117	89	580	71·5	—·05	—·3	515
4.45	121	88	525	71·5	—·05	—·3	458·5
5.00	120	88	515	71·0	—·05	—·3	495
5.15	117	88	510	71·0	—·07	—·35	456·5
5.30	119	88	500	71·0	—·07	—·35	415·5
5.45	119	92	515	71·0	—·07	—·35	286·5
6.00	112	88	540	71·0	—·07	—·35	445·5
6.15	119	87	625	71·0	—·07	—·35	564
6.30	119	88	575	71·0	—·07	—·35	475
6.45	119	87	610	71·0	—·07	—·35	489·5
	115.2	90·5	511	71	—·05	—·27	18,207 net

SUMMARY OF OBSERVATIONS

Date—Aug. 7, 1907. Boiler—B. and W. No. 2. At McGill University.
Commenced—8.45 a.m. Ended—6.45 p.m. Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned June, 1907. Fresh water, August 2.
4.	Tubes cleaned	7.40 a.m.
5.	Fire cleaned	7.35 a.m., 12.33 and 5.34 p.m.

Fuel.

6.	Kind of coal	No. 206—Springhill No. 3 Colliery, Cumberland Railway & Coal Co., Cumberland Co., N.S. Over $\frac{3}{4}$" screen and picking belt
7.	Analysis of dry coal by weight (%)	C = 75·4, H = 4·9, S = 1·5, N = 1·4, O = 8·5, Ash = 8·3
8.	Calorific value of dry coal B.T.U. per lb	13570
9.	Moisture in coal as fired (%)	3·4
10.	Weight of coal fired (lbs.)	2973
11.	Combustible matter in ash and clinker (%)	19·6
12.	Weight of clinker (lbs.)	134
13.	Weight of ash (lbs.)	98

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−0·05
15.	" above fire " "	−0·21
16.	" at damper " "	−0·27
17.	Amount of damper opening	Various
18.	Temperature of air in boiler house (°F.)	90·5
19.	Flue temperature (°F.)	511
20.	Analysis of dry flue gas by volume (%)	$CO = 8·3$, $O_2 = 10·2$, $CO = 0·6$, $N_2 = 80·9$

Water and Steam.

21.	Temperature of feed water (°F.)	71·0
22.	Total weight of feed water corrected for difference of level (lbs.)	18207
23.	Water level in gauge at start (inches)	$4\frac{3}{16}$
24.	Water level in gauge at finish (inches)	$4\frac{3}{16}$
25.	Correction for difference of level (included above) (lbs.)	nil
26.	Steam pressure by gauge (lbs. per sq. in.)	115·2
27.	Barometer reading (inches)	29·68
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	19·4
29.	Temperature in steam calorimeter (°F.)	283·8

Notes.

Air admitted over fire from 10.50 a.m. to close. Clinker viscous. Weather cool and showery.

Proximate analysis of dry coal by weight %

Fixed carbon	57·0
Volatile matter	34·7
Ash	8·3

SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 206. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·69. At finish—29·68. Mean—29·68.

Total Quantities.

1.	Date of trial	7/8/07
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	2973
4.	Percentage of moisture in coal as fired (%)	3·4
5.	Total weight of dry coal fired (lbs.)	2872
6.	Total ash and refuse (lbs.)	232
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 10·2; (*b*) weighed	8·1
8.	Total weight of combustible consumed from analyses (lbs.)	2567
9.	Total weight of water fed to the boiler corrected for difference of level (lbs.)	18207
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	18040
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	21450

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	287
13.	Dry coal per square foot of grate surface per hour (lbs.)	17·1
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1804
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2145
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·36

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	115·2
18.	Temperature of feed water entering boiler (deg. F.)	71
19.	Temperature of escaping gases from boiler (deg. F.)	511
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·22
21.	Percentage of moisture in steam	1·0

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	62·2
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	103

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	6·1
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	7·2
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	7·49
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	8·35

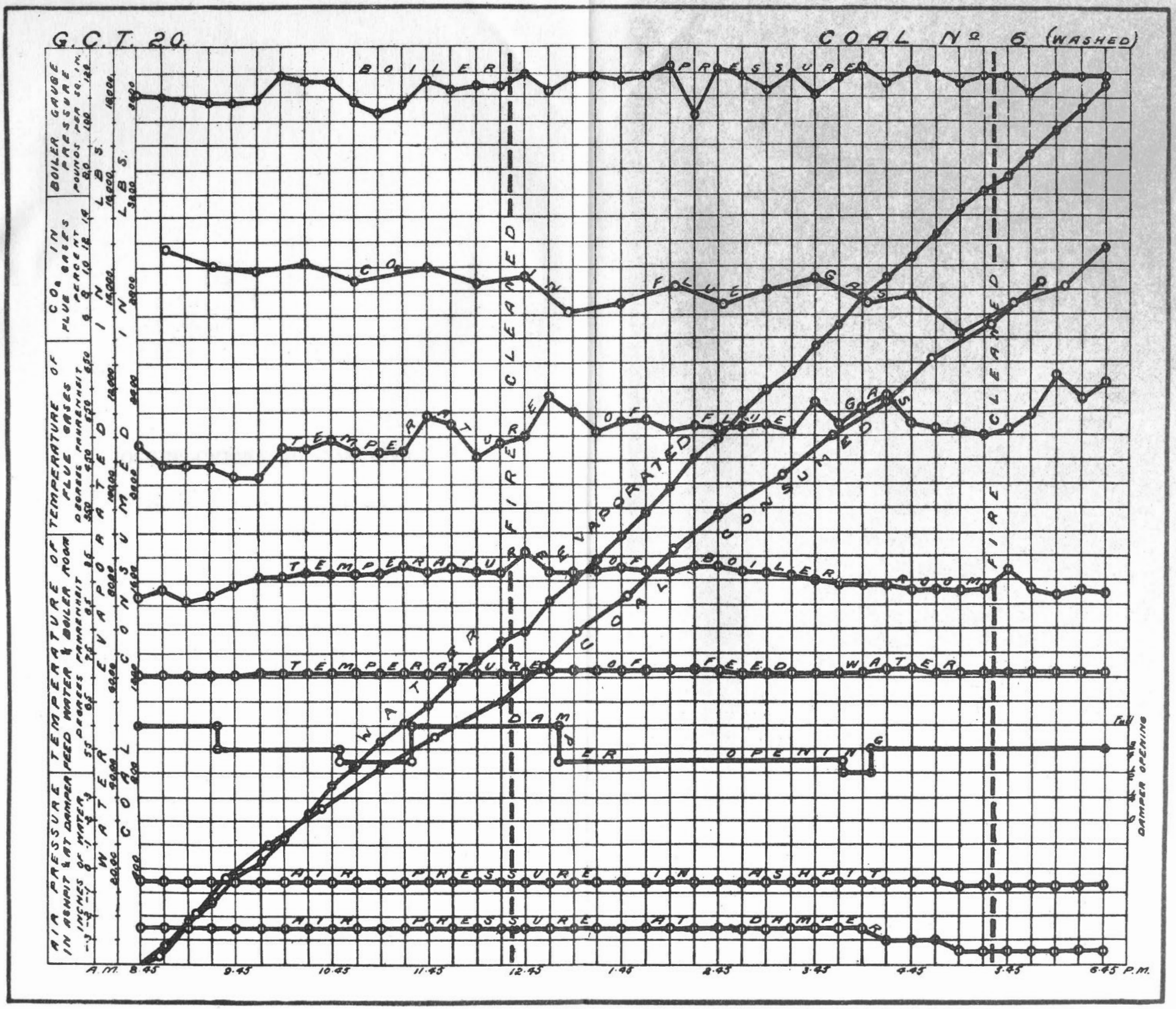
Efficiency.

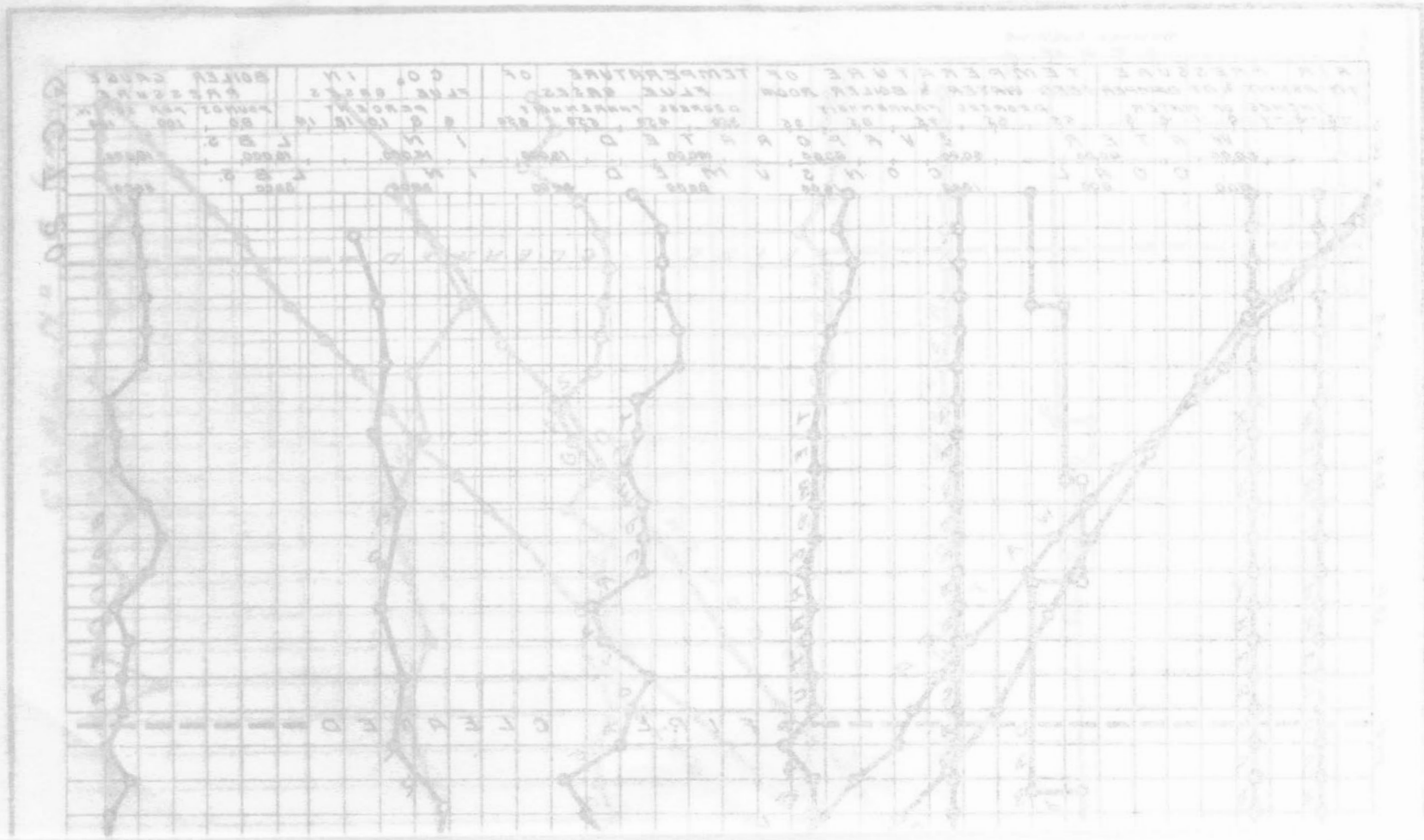
29.	Calorific value of dry coal per lb. (B.T.U.)	13570
30.	Calorific value of the combustible per lb. (B.T.U.)	14800
31.	Efficiency of boiler (based on combustible consumed) (%)	54·5
32.	Efficiency of boiler, including grate (based on dry coal) (%)	53·4

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	27·8
34.	" " of combustible consumed (from gas analyses) (lbs.)	23·4
35.	" " dry coal (from gas analyses) (lbs.)	21·0
36.	Proportion of heat of fuel in escaping dry flue gases (%)	15·6

GRAPHIC RECORD OF BOILER TRIAL.





JOGGINS-CHIGNECTO COAL FIELD.

CUMBERLAND CO., NOVA SCOTIA.

TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 7.

Date—June 21, 1907. Trial Number—G.C.T. 2.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Weather still and foggy, cleared about 10 a.m. Very small fire on No. 1 B. and W. boiler grate.

Time.
a.m.
8.00 Fire raked out and remade with No. 7 coal, 3 bags used.
9.20 Fire well cleaned.
9.25 Fire about 3″ thick all over.
10.50 Fire sliced.
Commenced to blow a little steam into ash-pit.
11.13 to 11.30 Fire cleaned. Clinker adhering closely to bars, difficult to remove. 20 lbs. clinker removed.
1.15 to 1.20 Fire cleaned. 48 lbs of clinker removed.
3.29 Fire sliced.
3.48 Fire sliced.
From 1.20 on fire was kept thin (4″ to 6″ thick); this gave better results than previous thick fire.
4.10 Fire sliced.
4.26 to 4.32 Fire cleaned. 54 lbs. of clinker removed.
7.05 to 7.12 Fire cleaned. 70 lbs. of clinker removed
7.25 Trial stopped. 205 lbs. of ash weighed.

CLINKER AND ASH.
192 lbs. clinker
205 lbs. ash

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 2

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 9.25 a.m.						
9.25	.....	.....	10.30	3·9	11.7	0·6
9.28	134	134	11.00	3·1	11·1	1·6
9.42	164	298	11.42	6·1	12·2	1·0
9.59	183	481	12.25	4·5	13·6	0·7
10.25	173	654	12.57	5·5	13·5	0·9
11.33	172	826	1.32	6·8	11·7	0·6
12.00	187	1013	1.55	5·5	13·9	0·1
12.20	157	1170	2.23	7·1	11·7	0·6
1.20	171	1341	2.57	6·1	12·7	0·6
1.24	172	1513	3.26	7·4	11·0	0·6
2.00	176	1689	3.55	7·1	11·7	0·5
2.33	166	1855	4.23	4·0	15·6	0·1
3.05	135	1990	5.00	8·0	10·4	0·6
3.29	186	2176	5.27	6·0	13·0	0·1
3.50	146	2322	6.00	5·2	12·9	0·2
4.10	151	2473	6.30	5·4	13·4	0·6
4.45	185	2658	6.55	6·2	11·8	1·0
4.58	134	2792				
5.25	174	2966		5·7	12·5	0·6
5.55	177	3143				
6.18	174	3317				
6.48	183	3500				
7.25	148	3648				

OBSERVATIONS MADE DURING BOILER TRIAL No. 2

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
9.25	93·8	80·4	352·5	64	—·1	—·20	.....
9.40	94·0	82·0	330	62·5	—·08	—·21	268·5
9.55	94·0	82	345	62·5	—·08	—·23	398·5
10.10	95	84	327·5	62·5	—·08	—·22	372
10.25	98	86	327·5	62·0	—·08	—·25	416·5
10.40	93	87	360	62·0	—·08	—·22	342·5
10.55	99	90	425	61·5	—·08	—·39	327
11.10	103·0	92	460	61·7	—·08	—·30	346
11.25	103	95	475	62·5	—·08	—·28	512
11.40	92	89	435	63·0	—·08	—·30	377
11.55	123	90	355	63·5	—·08	—·30	562
12.10	109	90	360	64·0	—·08	—·30	488·5
12.25	88	91	352	64·0	—·08	—·30	433·5
12.40	105	90	348	64·0	—·08	—·30	501
12.55	118	91	365	64·5	—·08	—·30	382
1.10	123	92	390	64·5	—·08	—·20	340
1.25	103	91	415	64·5	—·08	—·25	333·5
1.40	119	91	410	64·7	—·08	—·20	402·5
1.55	114	91·5	440	64·7	—·08	—·25	507·5
2.10	114	93	435	64·5	—·08	—·29	534
2.25	115·5	93	435	64·5	—·08	—·30	682
2.40	113	93	410	64·5	—·08	—·28	367
2.55	118	92	420	64·5	—·08	—·28	418·5
3.10	122	93	415	65·0	—·08	—·25	521·5
3.25	115·5	93	490	64·5	—·08	—·25	407
3.40	115·5	93	445	65·0	—·08	—·25	598
3.55	114	93	445	66·0	—·08	—·28	486
4.10	105	94	450	66·5	—·08	—·27	566·5
4.25	114·0	94	435	65·5	—·08	—·27	491
4.40	113	94	475	66·0	—·09	—·28	381
4.55	122	94	500	66·0	—·09	—·30	582
5.10	119	94	485	66·5	—·09	—·30	618
5.25	123	94	520	66·0	—·09	—·29	521
5.40	121·5	93	515	66·5	—·09	—·29	529
5.55	119·0	92	552	66·5	—·09	—·29	576
6.10	110·5	92	560	65·5	—·09	—·28	521
6.25	100	91	435	65·5	—·09	—·29	404·5
6.40	105·5	90	535	65·5	—·09	—·29	489·5
6.55	120	90	440	66·5	—·09	—·29	549·5
7.10	108	90	525	66·0	—·09	—·29	470·5
7.25	109	89	535	65·5	—·09	—·29	364
	109·5	90·7	429·7	64·52	—·08	—·27	18,260·5 net

SUMMARY OF OBSERVATIONS

Date—June 21, 1907.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—9.25 a.m.	Ended—7.25 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned June, 1907 Fresh water, June 20.
4.	Tubes cleaned	Before trial
5.	Fire cleaned	8.00, 9.20, and 11.13 a.m. 1.15, 4.26, and 7.5 p.m.

Fuel.

6.	Kind of coal	No. 7—Chignecto Colliery, Maritime Ry., Coal, and Power Co., Cumberland Co., N.S., Hand picked sample
7.	Analysis of dry coal by weight (%)	C = 66·2, H = 4·8, S = 6·4, N = 1·3, O = 8·0, Ash = 13·3
8.	Calorific value of dry coal B.T.U. per lb	12150
9.	Moisture in coal as fired (%)	3·0
10.	Weight of coal fired (lbs.)	3648
11.	Combustible matter in ash and clinker (%)	22·4
12.	Weight of clinker (lbs.)	192
13.	Weight of ash (lbs.)	205

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−0·08
15.	" above fire " "	−0·24
16.	" at damper " "	−0·27
17.	Amount of damper opening	Full
18.	Temperature of air in boiler house (°F.)	90·7
19.	Flue temperature (°F.)	429·7
20.	Analysis of dry flue gas by volume (%)	$CO_2 = 5·7$, $O_2 = 12·5$, $CO = 0·6$, $N_2 = 81·2$

Water and Steam.

21.	Temperature of feed water (°F.)	64·5
22.	Total weight of feed water, corrected for difference of level (lbs.)	18260·5
23.	Water level in gauge at start (inches)	$4\frac{3}{8}$
24.	Water level in gauge at finish (inches)	$4\frac{1}{8}$
25.	Correction for difference of level included above (lbs.)	0·38
26.	Steam pressure by gauge per sq. in. (lbs.)	109·5
27.	Barometer reading (inches)	29·85
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	6·7
29.	Temperature in steam calorimeter (°F.)	237

Notes.

Fire sliced 10.50 a.m., 3.29, 3.48, and 4.10 p.m. Steam blown under grate from 10.50 a.m. to close. Clinker thin, vitreous, and adherent. Weather still and foggy, clearing during morning.

Proximate analysis of dry coal by weight %

Fixed carbon	45·7
Volatile matter	41·0
Ash	13·3

SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 7. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·90. At finish—29·87. Mean—29·885.

Total Quantities.

1.	Date of trial	21/6/07
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	3648
4.	Percentage of moisture in coal as fired (%)	3·0
5.	Total weight of dry coal fired (lbs.)	3538
6.	Total ash and refuse (lbs.)	397
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 17·1; (*b*) weighed	11·2
8.	Total weight of combustible consumed, from analyses (lbs.)	2933
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	18260·5
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17710
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	21240

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	353·8
13.	Dry coal per square foot of grate surface per hour (lbs.)	21·1
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1771
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2124
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·33

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	109·5
18.	Temperature of feed water entering boiler (deg. F.)	64·5
19.	Temperature of escaping gases from boiler (deg. F.)	429·7
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·19
21.	Percentage of moisture in steam	4·0

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	61·7
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	103

Economic Results.

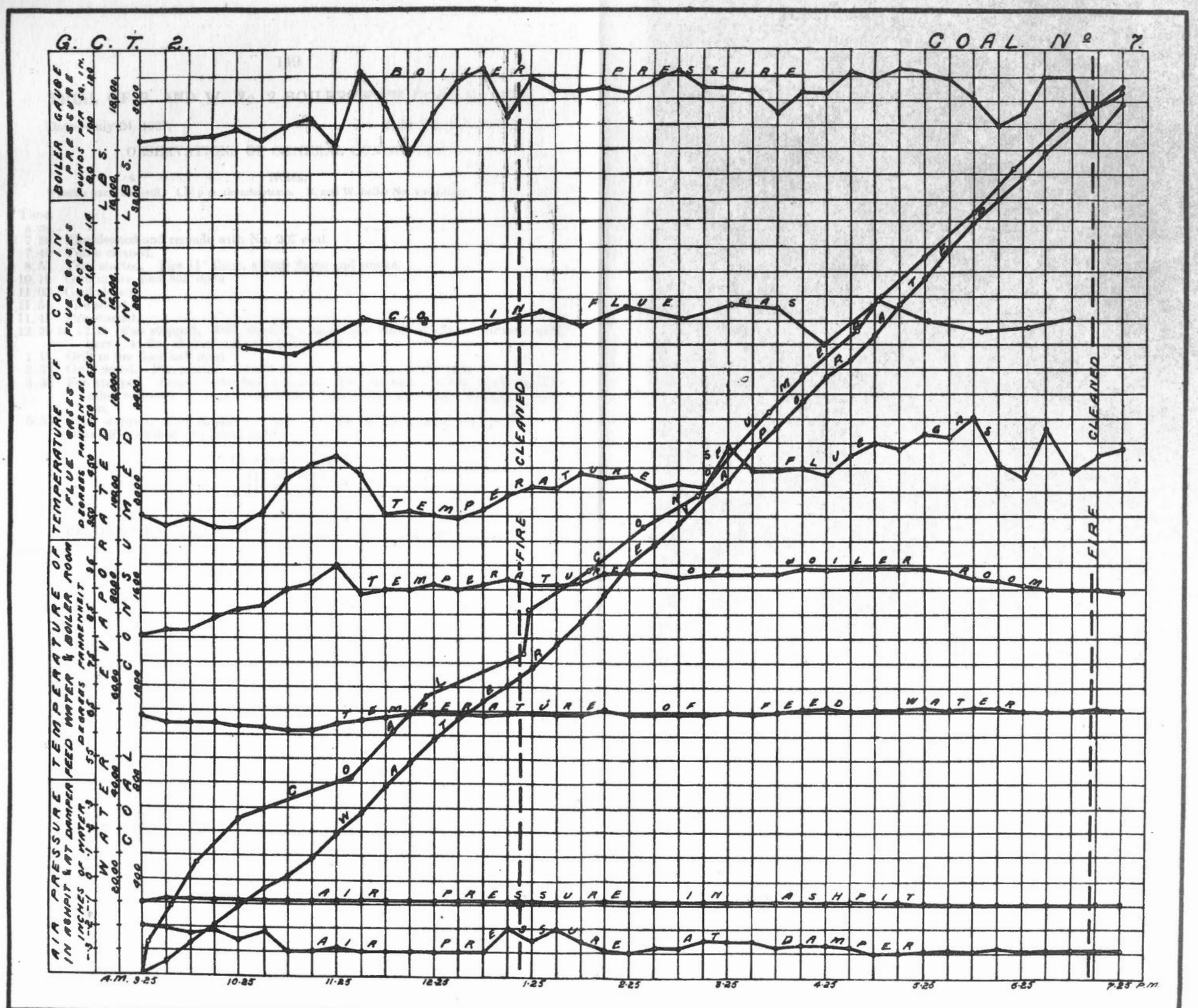
25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	5·01
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	5·82
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	6·00
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	7·26

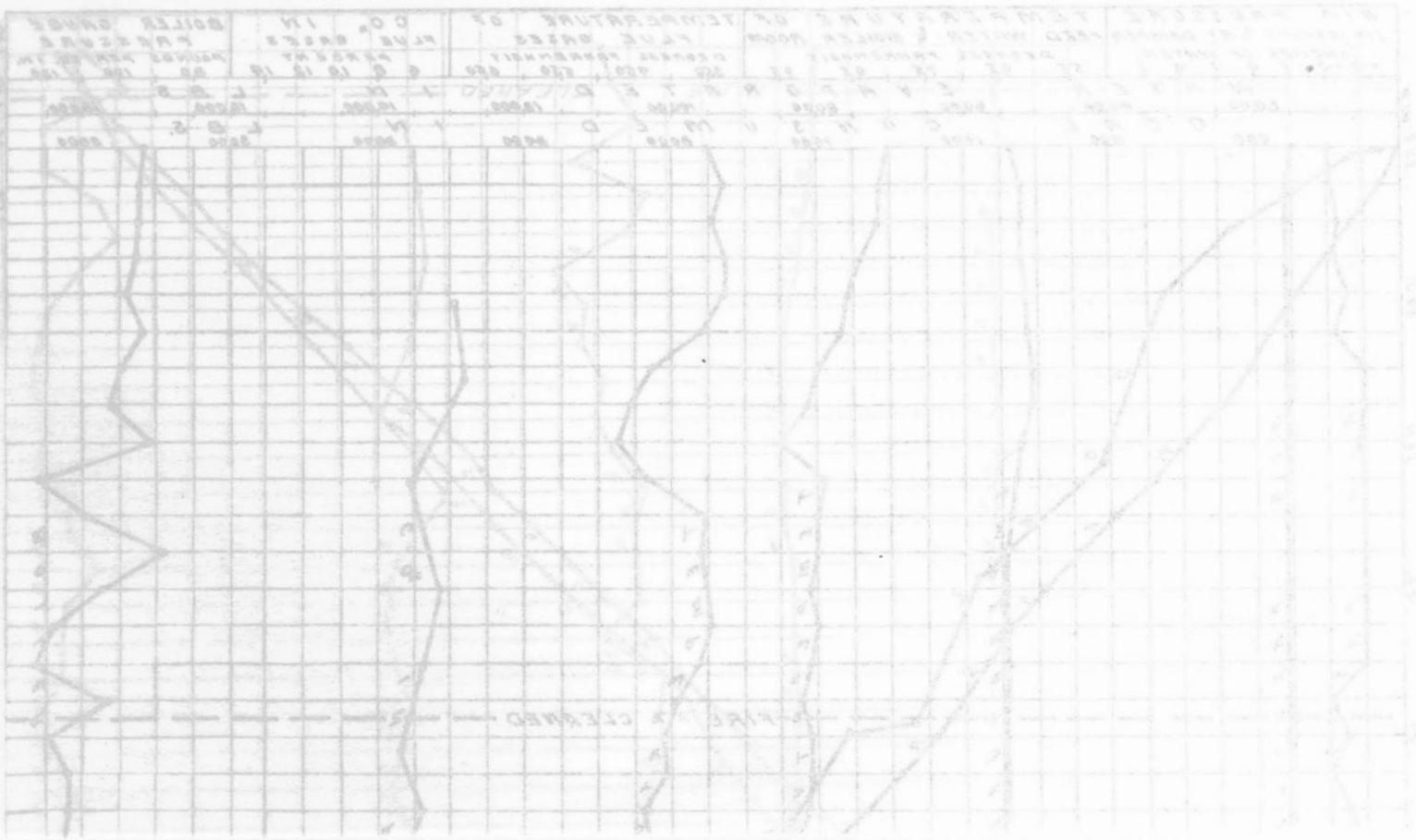
Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	12150
30.	Calorific value of the combustible per lb. (B.T.U.)	14000
31.	Efficiency of boiler (based on combustible consumed) (%)	50·1
32.	Efficiency of boiler, including grate (based on dry coal) (%)	47·9

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	38·9
34.	" " of combustible consumed (from gas analyses) (lbs.)	31·1
35.	" " dry coal (from gas analyses) (lbs.)	25·8
36.	Proportion of heat of fuel in escaping dry flue gases (%)	17·3


G. C. T. 2.
COAL Nº 7.
BOILER PRESSURE
CO2 IN FLUE GASES
TEMPERATURE OF FLUE GASES
TEMPERATURE OF BOILER ROOM
TEMPERATURE OF FEED WATER
AIR PRESSURE IN ASHPIT
AIR PRESSURE AT DAMPER
FIRE CLEANED
BOILER GAUGE PRESSURE POUNDS PER SQ. IN.
CO2 IN FLUE GASES PER CENT
DEGREES FAHRENHEIT
WATER EVAPORATED LBS.
COAL CONSUMED LBS.
AIR PRESSURE IN AIR DAMPER & WATER IN INCHES OF WATER
A.M. 9-25
10-25
11-25
12-25
1-25
2-25
3-25
4-25
5-25
6-25
7-25 P.M.



TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 207.

Date—July 24, 1907. Trial Number—G.C.T. 15.

OBSERVATIONS OF GENERAL CONDITIONS

Notes.

Weather warm and still. 1.00 p.m. thunderstorm. B. and W. boiler No. 1 working.

Time.

a.m.

7.30 Fire cleaned and remade with No. 207 coal.
7.40 Tubes cleaned.
8.55 Trial started. Fire 1½" thick, a little flame and smoke.
10.10 Grill in fire door half open.
11.03 Grill closed.
11.34 Fire sliced.
11.45 Fan started.
12.29 to 12.39 Fan stopped. Fire cleaned, a thin, hard sheet of clinker formed over bars. 44 lbs. clinker and cinders removed.
1.18 Grill in fire door half open.
2.33 Grill closed. Fan started. Commenced to blow steam under bars.
5.30 Fan stopped. Steam under bars stopped. Fire cleaned. 69 lbs. of clinker and ashes removed. Clinker more friable than previously. Back fire bar dropped out.
6.55 Trial stopped. Fire similar to start. 117 lbs. of ashes raked from pit. Blow-off examined and found tight.

CLINKER AND ASH.

113 lbs. clinker.
117 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 15

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.55 a.m.						
9.12	199	199	9.45	9·9	6·5	2·2
9.36	174	373	10.16	9·2	10·0	0·0
10.12	207	580	10.50	7·0	10·6	0·6
10.31	174	754	11.15	10·3	7·6	0·8
11.05	178	932	11.50	9·5	6·7	3·0
11.49	160	1092	12.15	6·6	12·7	0·0
12.43	165	1257	12.50	9·0	8·4	1·6
1.03	113	1370	1.18	7·4	12·0	0·0
1.33	189	1559	1·48	8·2	9·4	0·8
2.03	185	1744	2.20	8·0	10·2	0·3
2.36	203	1947	2.47	8·6	9·8	0·4
3.09	190	2137	3.15	9·6	7·7	1·1
3.40	193	2330	3.45	6.6	13·3	0·0
4.17	168	2498	4.17	11·1	3·9	3·8
4.36	179	2677	4.50	11·0	7·1	0·0
5.05	183	2860	5.17	6·0	14·0	0·0
5.58	182	3042	5.49	7·2	12·6	0·0
6.25	201	3243	6.17	7·5	10·9	0·2
6.55	101	3344	6.52	6·1	14·3	0·0
				8·4	9·9	0·8

OBSERVATIONS MADE DURING BOILER TRIAL No. 15

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.55	104	89	455	75·5	0·0	−·25	.....
9.10	120	90	450	75	−·05	−·30	389
9.25	115	92	440	74·5	−·05	−·30	454
9.40	117	91	475	74	−·05	−·25	425
9.55	116	93	425	74	−·05	−·30	505
10.10	122	91	470	73·5	−·05	−·30	577
10.25	106	94	465	73·5	−·05	−·25	501
10.40	118	94	430	73·5	−·05	−·30	440
10.55	116	95	445	73·5	−·05	−·30	369·5
11.10	117	95	425	74·5	−·05	−·30	417·5
11.25	110	95	410	74·5	−·02	−·30	494
11.40	116	95	430	74·5	−·02	−·30	329
11.55	116	95	510	74·5	+·40	−·30	414
12.10	110	95	380	74·5	+·30	−·30	521·5
12.25	120	94	380	75	+·10	−·30	167
12.40	120	94	420	75	0·0	−·30	211
12.55	118	96	465	74·5	0·0	−·30	365
1.10	120	92	465	74·5	0·0	−·30	425·5
1.25	120	93	470	75	0·0	−·30	462
1.40	114	91	470	74	0·0	−·30	485·5
1.55	123	90	450	74·5	0·0	−·30	373
2.10	120	93	430	74	−·02	−·30	437
2.25	107	95	425	74	0·0	−·30	448·5
2.40	118	95	475	74	+·15	−·30	304
2.55	116	95	475	74	+·1	−·30	474
3.10	120	97	490	74	+·2	−·30	477·5
3.25	122	96	540	74	+·2	−·30	581
3.40	106	94	430	73·5	+·4	−·30	513
3.55	107	96	500	73	0·0	−·30	536·5
4.10	110	94	455	73	0·0	−·30	472·5
4.25	117	91	475	73·5	+·25	−·30	392
4.40	114	92	530	73·5	+·45	−·30	583·5
4.55	122	95	620	73·5	+·35	−·30	458·5
5.10	117	101	515	74	+·30	−·35	650·5
5.25	114	95	540	73	0·0	−·30	393·5
5.40	116	97	490	73	0·0	−·35	384·5
5.55	120	94	560	73	0·0	−·30	510
6.10	107	94	545	72·5	0·0	−·30	578·5
6.25	114	92·	525	73	0·0	−·35	474·5
6.40	120	93	575	72·5	0·0	−·30	538·5
6.55	86	90	495	73	0·0	−·35	521·5
	114·9	93·7	474·0	73·9	+·09	−·30	17,950 net

SUMMARY OF OBSERVATIONS

Date—July 24, 1907.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.55 a.m.	Ended—6.55 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural and forced
3.	Condition of boiler and date of last cleaning. Fresh water, July 18.	Thoroughly cleaned June, 1907.
4.	Tubes cleaned	7.40 a.m.
5.	Fire cleaned	7.30 a.m., 12.29 and 5.30 p.m.

Fuel.

6.	Kind of coal	No. 207—Chignecto Colliery, Maritime Ry., Coal & Power Co., Cumberland Co., N.S. Hand picked sample.
7.	Analysis of dry coal by weight (%)	C = 70·0, H = 5·0, S = 6·2, N = 1·0, O = 8·7, Ash = 9·1
8.	Calorific value of dry coal B.T.U. per lb	12890
9.	Moisture in coal as fired (%)	5·3
10.	Weight of coal fired (lbs.)	3344
11.	Combustible matter in ash and clinker (%)	17·1
12.	Weight of clinker (lbs.)	113
13.	Weight of ash (lbs.)	117

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	+0·09
15.	" above fire " "	−0·21
16.	" at damper " "	−0·30
17.	Amount of damper opening	Full
18.	Temperature of air in boiler house (°F.)	93·7
19.	Flue temperature (°F.)	474
20.	Analysis of dry flue gas by volume (%)	$CO_2 = 8·4$, $O_2 = 9·9$, $CO = 0·8$, $N_2 = 80·9$

Water and Steam.

21.	Temperature of feed water (°F.)	73·9
22.	Total weight of feed water, corrected for difference of level (lbs.)	17950
23.	Water level in gauge at start (inches)	$4\frac{9}{16}$
24.	Water level in gauge at finish (inches)	$4\frac{11}{16}$
25.	Correction for difference of level included above (lbs.)	0·19
26.	Steam pressure by gauge per sq. in. (lbs.)	114·9
27.	Barometer reading (inches)	29·56
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	17·5
29.	Temperature in steam calorimeter (°F.)	284·5

Notes.

Fire sliced 11.34 a.m. Air admitted over fire from 10.10 to 11.3 a.m. and from 1.18 to 2.33 p.m. Draft forced from 11.45 a.m. to 12.29 p.m. and from 2.33 to 5.30 p.m. Steam blown under grate from 2.33 to 5.30 p.m. Clinker formed a thin hard sheet over bars, conditions improved by use of steam. Fire bar from back row knocked out during cleaning at 5.30 p.m. Weather warm and still, thunderstorm in afternoon.

Proximate analysis of dry coal by weight %

Fixed carbon	49·6
Volatile matter	41·3
Ash	9·1

SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 207 washed. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·63. At finish—29·49. Mean—29·56.

Total Quantities.

1.	Date of trial	24/7/07
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	3344
4.	Percentage of moisture in coal as fired (%)	5·3
5.	Total weight of dry coal fired (lbs.)	3166
6.	Total ash and refuse (lbs.)	230
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 11·0; (*b*) weighed	7·3
8.	Total weight of combustible consumed from analyses (lbs.)	2818
9.	Total weight of water fed to the boiler corrected for difference of level (lbs.)	17950
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17790
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	21110

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	316·6
13.	Dry coal per square foot of grate surface per hour (lbs.)	18·9
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1779
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2111
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·30

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	114·9
18.	Temperature of feed water entering boiler (deg. F.)	73·9
19.	Temperature of escaping gases from boiler (deg. F.)	474
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·39
21.	Percentage of moisture in steam	1·0

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	61·1
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	102

Economic Results.

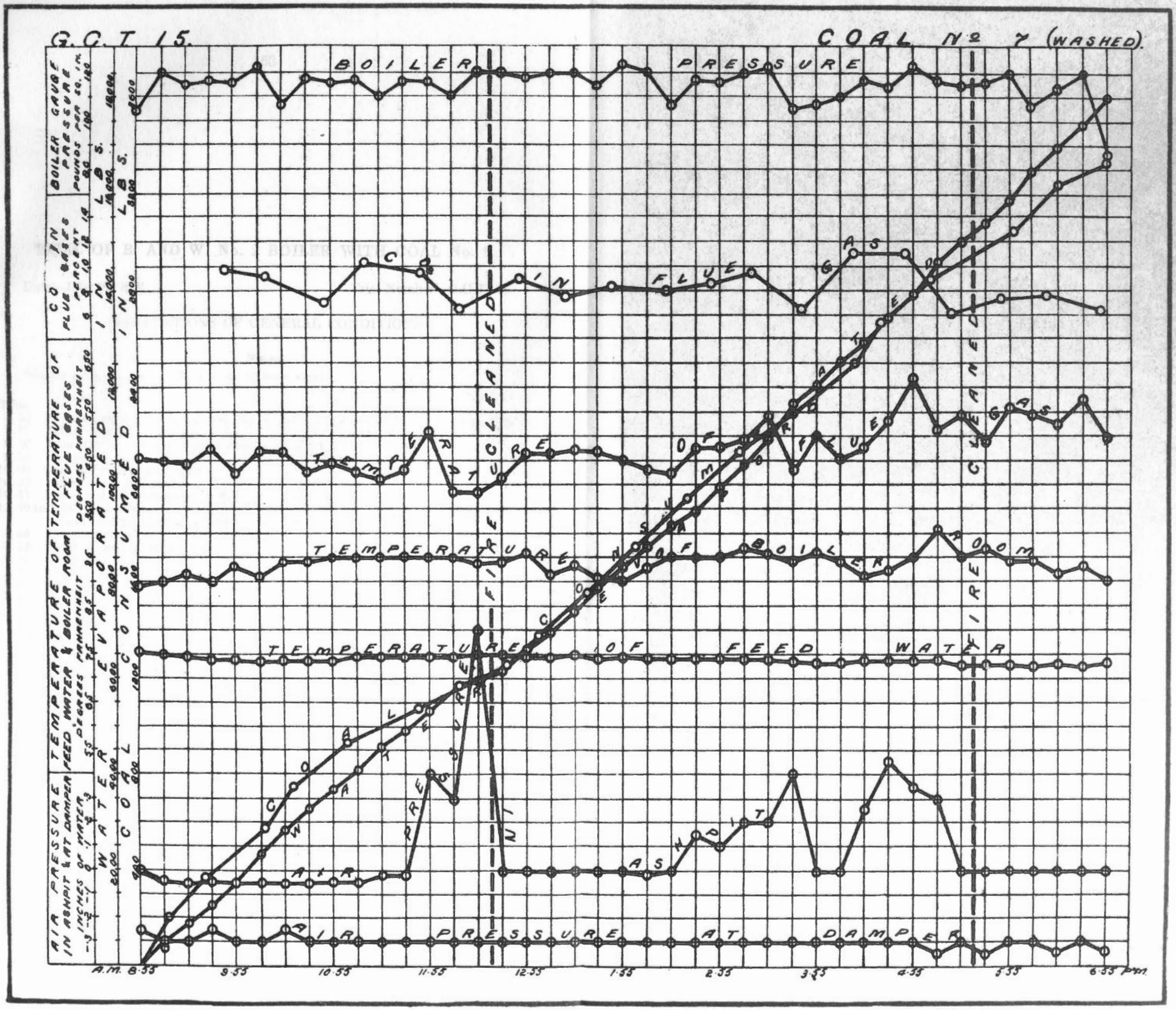
25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	5·37
26.	Equivalent evaporation from and at 212° F. per lb. dry coal as fired (Item 11 ÷ Item 3)	6·31
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	6·67
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	7·50

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	12890
30.	Calorific value of the combustible per lb. (B.T.U.)	14190
31.	Efficiency of boiler (based on combustible consumed) (%)	51·1
32.	Efficiency of boiler, including grate (based on dry coal) (%)	50·0

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	26·9
34.	Dry flue gas per lb. of combustible consumed (from gas analyses) (lbs.)	21·2
35.	Dry flue gas per lb. dry coal (from gas analyses) (lbs.)	18·9
36.	Proportion of heat of fuel in escaping dry flue gases (%)	13·4


G.C.T 15.
COAL Nº 7 (WASHED).
BOILER PRESSURE
BOILER GAUGE PRESSURE POUNDS PER SQ. IN.
CO2 IN FLUE GASES PERCENT
TEMPERATURE OF FLUE GASES DEGREES FAHRENHEIT
TEMPERATURE OF FEED WATER & BOILER ROOM DEGREES FAHRENHEIT
AIR PRESSURE IN ASHPIT & AT DAMPER INCHES OF WATER
WATER EVAPORATED
COAL CONSUMED
CO2 IN FLUE GAS
TEMPERATURE OF FLUE GASES
TEMPERATURE OF BOILER ROOM
TEMPERATURE OF FEED WATER
AIR PRESSURE AT DAMPER
AIR PRESSURE IN ASHPIT
FIRE CLEANED
FIRE CLEANED
A.M. 8:33
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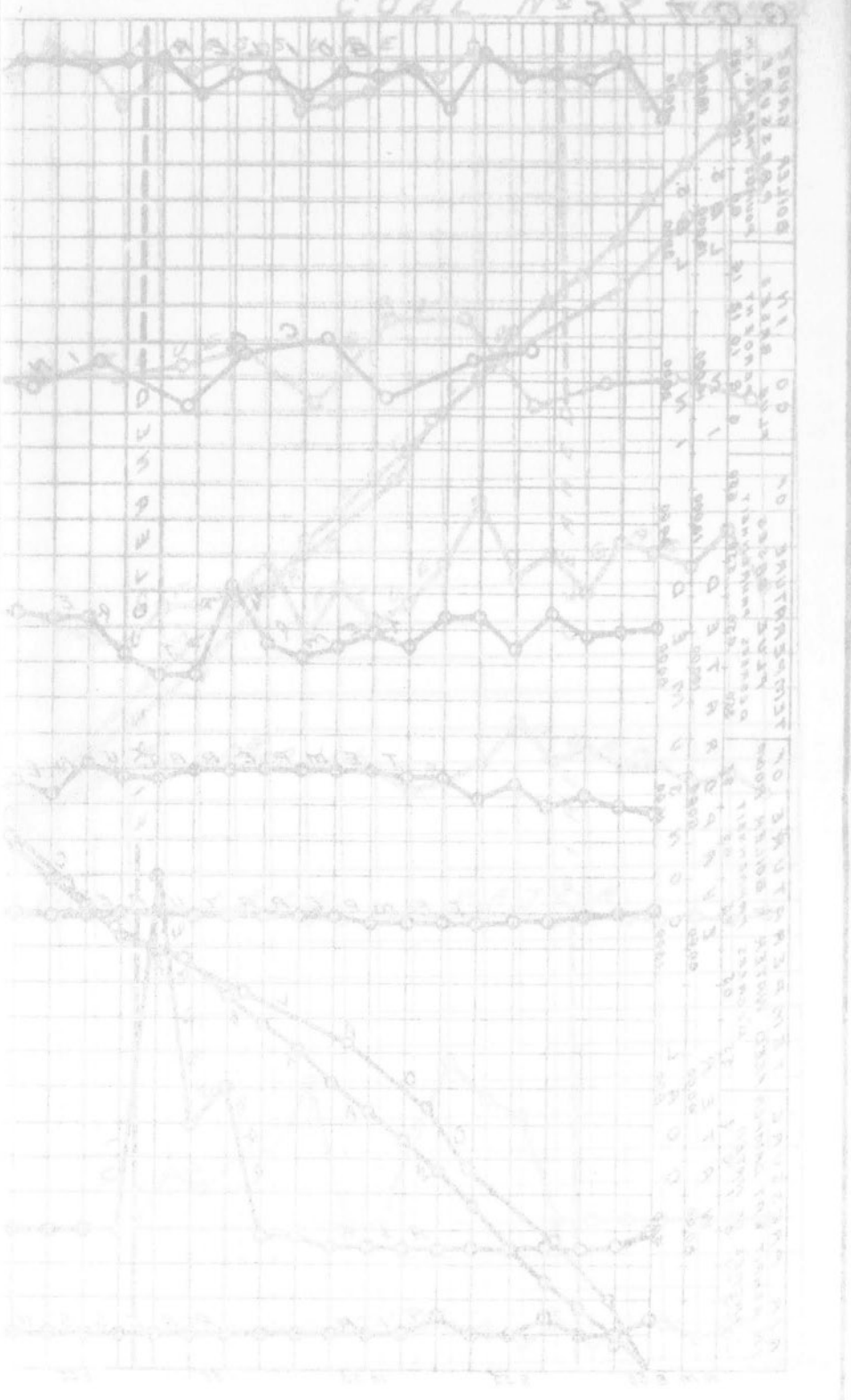


TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 9.

Date—July 16, 1907. Trial Number—G.C.T. 13.

OBSERVATIONS OF GENERAL CONDITIONS

Notes.

Weather warm, light breeze. No. 1 B. and W. boiler working.

Time.
7.50 Fire cleaned and made up with No. 9 coal. Pressure, 55 lbs. Flue temp.400°.
7.57 Tubes cleaned. Pressure, 85 lbs.
8.50 Trial started. Fire 2″ thick, some flame and smoke.
9.53 Fire sliced.
10.00 Grill in fire door half open.
10.23 Fan started, grill closed.
10.41 Fire sliced. Commenced to blow steam into ash-pit.
12.49 to 1.00 Fan stopped. Steam in ash-pit stopped. Fire cleaned. 138 lbs. of clinker and cinders removed. Clinker fairly thick, and adhering to bars.
1.38 Fan started.
2.14 Steam turned on under bars.
2.37 Fire sliced.
2.45 Fire sliced.
3.50 Fan stopped owing to fuse blowing out in motor circuit.
3.55 Fire sliced. 33 lbs. of clinker removed.
4.04 Fan restarted.
4.58 Fire sliced.
5.50 Fan stopped. Steam to ash-pit stopped. Fire cleaned. 169 lbs. clinker and cinders removed.
6.20 Fan started.
6.56 Trial stopped. Fire 2½″ thick, fairly well burnt through. 98 lbs of ashes raked from pit.
Blow-off examined and found quite tight.

CLINKER AND ASH.

340 lbs. clinker.
98 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 13

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.50 a.m.			9.03	8·2	9·1	0·7
8.55	80	80	9.35	11·6	5.7	1·0
9.14	164	244	10.00	10·8	8·9	0·0
9.37	180	424	10.28	7·7	11·1	0·0
10.05	137	561	11.00	13·6	2·4	1·0
10.37	154	715	11.30	10·4	8·8	0·0
11.03	177	892	11.58	10·8	6·8	0·9
11.12	154	1046	12.30	11·2	6·8	0·4
11.42	178	1224	1.26	7·3	12·5	0·0
12.10	151	1375	2.00	9·3	8·3	0·2
12.36	161	1536	2.33	10·6	6·8	1·2
1.09	160	1696	3.06	18·1	1·5	0·0
1.44	208	1904	3.30	10·8	5·8	1·4
2.04	195	2099	4.03	12·1	7·3	0·0
2.21	155	2254	4.30	9·2	8·6	0·2
3.08	184	2438	4.58	12·3	5·1	0·6
3.25	148	2586	5.30	9·6	9·4	0·0
4.05	175	2761	6.18	9·2	9·8	0·0
4.21	150	2911	6.38	8·4	11·2	0·1
4.45	157	3068				
5.00	164	3232		10·6	7·7	0·3
5.40	159	3391				
6.13	146	3537				
6.56	158	3695				

OBSERVATIONS MADE DURING BOILER TRIAL No. 13

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.50	107	97	500	72	0·0	−·25	.....
9.05	106	95	470	70·5	0·0	−·30	413
9.20	109	95	450	70·5	0·0	−·30	499
9.35	112	95	460	71	0·0	−·30	360
9.50	117	94	420	71	−·02	−·30	387·5
10.05	110	96	470	71	−·02	−·30	401·5
10.20	99	96	400	71	−·02	−·30	385
10.35	105	96	425	71	+·20	−·30	281
10.50	116	96	840	71·5	+·20	−·25	263·5
11.05	110	96	735	71·5	+·50	−·30	584·5
11.20	117	96	620	71·5	+·20	−·30	565·5
11.35	110	96	525	72	+·15	−·30	520
11.50	110	96	525	72	+·20	−·30	494·5
12.05	107	95	525	70·5	+·15	−·25	455
12.20	115	95	560	70·5	+·20	−·25	372
12.35	104	94	675	71	+·40	−·25	451·5
12.50	112	93	520	71	+·05	−·20	490·5
1.05	110	97	530	71·5	+·05	−·25	316·5
1.20	106	96	460	72	+·02	−·30	442
1.35	112	97	415	72	+·02	−·30	292·5
1.50	112	97	435	72·5	+·15	−·25	369·5
2.05	114	98	460	72·5	+·30	−·30	366
2.20	114	99	525	72·5	+·80	−·30	356·5
2.35	119	100	595	73·5	+·50	−·25	449
2.50	108	100	615	73·5	+·10	−·30	483·5
3.05	112	98	735	73·5	+·20	−·25	465·5
3.20	115	98	625	73·5	+·30	−·25	592·5
3.35	117	96	560	73·5	+·30	−·30	625·5
3.50	100	96	490	73	0·0	−·30	559
4.05	110	97	670	72·5	+·30	−·30	239·5
4.20	101	97	530	72·5	+·20	−·25	639·5
4.35	105	97	485	73	+·20	−·30	315·5
4.50	111	98	600	73	+·30	−·25	422
5.05	104	97	680	74·5	+·20	−·25	529
5.20	102	98	590	73	+·20	−·30	556·5
5.35	107	96	565	72·5	+·15	−·30	476
5.50	111	96	535	72·5	+·40	−·25	462·5
6.05	112	102	540	72·5	+·05	−·30	219
6.20	116	98	510	73	+·30	−·30	422
6.35	112	98	435	73	+·25	−·30	540
6.56	101	96	415	74	+·05	−·30	521·5
	109·7	97·0	539·5	72·2	+·18	−·28	17,625 net

SUMMARY OF OBSERVATIONS

Date—July 16, 1907. Boiler—B. and W. No. 2. At McGill University.
Commenced—8.50 a.m. Ended—6.56 p.m. Duration—606 mins.

General.

1. Method of stoking.....Hand-spreading on alternate sides
2. Kind of draft.....Forced and natural
3. Condition of boiler and date of last cleaning....Thoroughly cleaned June, 1907. Fresh water, July 4.
4. Tubes cleaned.....7.57 a.m.
5. Fire cleaned.....7.50 a.m., 12.50 and 5.50 p.m.

Fuel.

6. Kind of coal.....No. 9—Minudie Colliery, Minudie Coal Co., River Hebert, Cumberland Co., N.S. Over $\frac{3}{4}$" screen and picking belt
7. Analysis of dry coal by weight (%).....C=64·8, H=4·4, S=6·7, N=1·1, O=7·5, Ash=15·5
8. Calorific value of dry coal B.T.U. per lb.....11830
9. Moisture in coal as fired (%).....2·8
10. Weight of coal fired (lbs.).....3695
11. Combustible matter in ash and clinker (%).....10·7
12. Weight of clinker (lbs.).....340
13. Weight of ash (lbs.).....98

Air and Flue Gas.

14. Air pressure under fire (inches of water).....+0·18
15. " above fire " " .....−0·19
16. " at damper " " .....−0·28
17. Amount of damper opening.....Full
18. Temperature of air in boiler house (°F.).....97
19. Flue temperature (°F.).....539·5
20. Analysis of dry flue gas by volume (%)..CO_2=10·6,O_2=7·7, CO=0·3, N_2=81·4

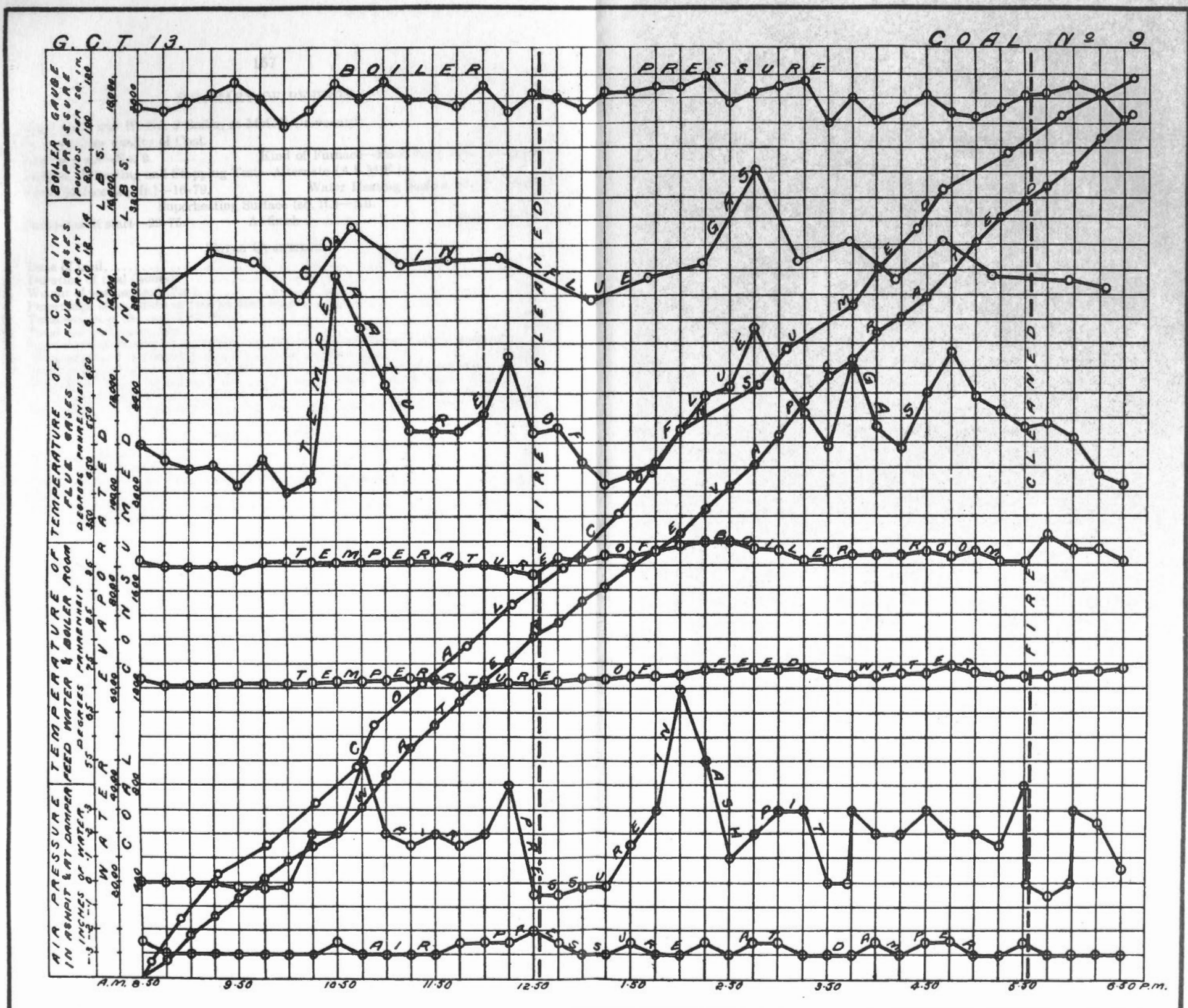
Water and Steam.

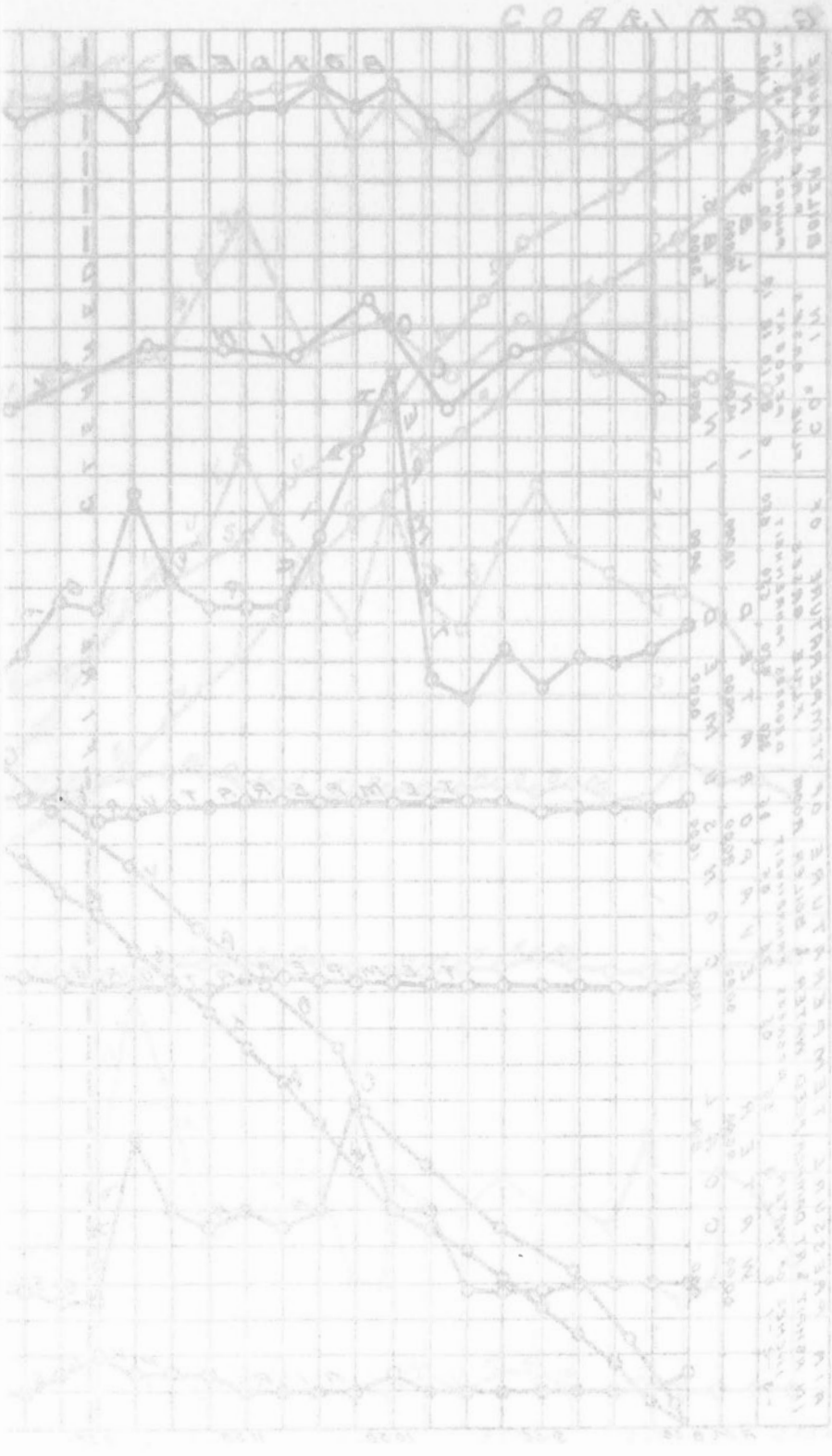
21. Temperature of feed water (°F.).....72·2
22. Total weight of feed water, corrected for difference of level (lbs.).....17625
23. Water level in gauge at start (inches).....$3\frac{13}{16}$
24. Water level in gauge at finish (inches).....$3\frac{5}{8}$
25. Correction for difference of level included above (lbs.).....28·5
26. Steam pressure by gauge (lbs. per sq. in.).....109·7
27. Barometer reading (inches).....29·75
28. Pressure in steam calorimeter by gauge (lbs. per sq. in.).....13·3
29. Temperature in steam calorimeter (°F.).....277·1

Notes.

Fire sliced 9.53, 10.40 a.m., 2.37, 2.45, 3.55, and 4.58 p.m. Forced draft from 10.23 a.m. to 12.49 p.m. and from 1.38 p.m. to 3.50 p.m. and from 4.04 p.m. to 5.50 p.m. and from 6.20 p.m. to close. Steam blown under grate bars from 10.41 a.m. to 12.49 p.m., and from 2.14 p.m. to 5.50 p.m. Clinker fairly thick and adhering to bars. Weather warm, light breeze.

Proximate analysis of dry coal by weight %: Fixed carbon..... 48·8; Volatile matter..... 35·7; Ash..... 15·5


G. C. T. 13.
COAL No. 9
BOILER PRESSURE
CO2 IN FLUE GASES PERCENT
TEMPERATURE OF FLUE GASES DEGREES FAHRENHEIT
TEMPERATURE OF BOILER ROOM
TEMPERATURE OF FEED WATER & BOILER ROOM DEGREES FAHRENHEIT
AIR PRESSURE IN ASHPIT & AT DAMPER INCHES OF WATER
BOILER GAUGE PRESSURE POUNDS PER SQ. IN.
WATER EVAPORATED
WATER CONSUMED
COAL
FIRE CLEANED
FIRE CLEANED
A.M. 8·30
9·30
10·30
11·30
12·30
1·30
2·30
3·30
4·30
5·30
6·30 P.M.



SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 9. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·75. At finish—.... Mean—29·75.

Total Quantities.

1.	Date of trial	16/7/07
2.	Duration of trial (hours)	10·10
3.	Weight of coal as fired (lbs.)	3695
4.	Percentage of moisture in coal as fired (%)	2·8
5.	Total weight of dry coal fired (lbs.)	3591
6.	Total ash and refuse (lbs.)	438
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 17·4; (*b*) weighed 12·2	
8.	Total weight of combustible consumed, from analyses (lbs.)	2968
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	17625
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17450
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	20720

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	356
13.	Dry coal per square foot of grate surface per hour (lbs.)	21·2
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1728
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2052
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·21

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	109·7
18.	Temperature of feed water entering boiler (deg. F.)	72·2
19.	Temperature of escaping gases from boiler (deg. F.)	539·5
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·46
21.	Percentage of moisture in steam	1·0

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	59·4
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	99

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	4·78
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	5·61
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	5·78
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	6·98

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	11830
30.	Calorific value of the combustible per lb. (B.T.U.)	14010
31.	Efficiency of boiler (based on combustible consumed) (%)	48·1
32.	Efficiency of boiler, including grate (based on dry coal) (%)	47·1

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	22·9
34.	" " of combustible consumed (from gas analyses) (lbs.)	18·0
35.	" " dry coal (from gas analyses) (lbs.)	14·8
36.	Proportion of heat of fuel in escaping dry flue gases (%)	13·2

TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 209.

Date—July 15, 1907 Trial Number—G.C.T. 12.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Weather fine, still warm.

Time.	
a.m.	
7.10	Tubes cleaned.
7.30	Fire cleaned out and made up with No. 209 coal. Pressure, 25 lbs.
9.15	Fire 1½″ thick, well burnt through. Trial started.
9.20	Grill in fire door half open.
10.25	Grill closed.
10.55	Fan started.
11.09	Fire sliced.
11.10	Commenced to blow steam under bars.
11.25	Fire sliced.
11.35	6 lbs. thin, hard, blue vitreous clinker removed in above slicings.
12.31	Fan stopped.
12.32 to 12.40	Fire thoroughly cleaned. 88 lbs. of thin, hard clinker removed with difficulty from bars.
12.43	Fan started.
1.46	Fan stopped owing to hot bearing.
2.20	Fire sliced.
2.50	Fan started.
4.19	Fire sliced. Fan stopped.
5.30 to 5.40	Fire cleaned. 105 lbs. of clinker removed. Fan restarted.
6.35	Fan stopped.
7.15	Trial stopped. Fire similar to start. 116 lbs. of ash weighed as raked from pit. Blow-off examined and found to be tight.

CLINKER AND ASH.

105 lbs. clinker.
116 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 12

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 9.15 a.m.						
9.22	98	98	9.30	5·8	14·0	.....
9.42	151	249	10.00	7·2	11·9	0·0
10.09	134	383	10.35	8·1	10·9	0·0
10.30	177	560	11.00	8·8	8·6	0·6
11.24	155	715	11.30	.....	.....	.....
11.45	170	885	11.45	10·6	6·5	0·0
12.08	162	1047	12.20	7·4	13·2	0·0
12.45	165	1212	1.00	12·2	4·8	1·0
12.57	162	1374	1.27	7·4	12·5	0·0
1.15	155	1529	2.03	12·1	7·7	0·0
1.43	166	1695	2.30	12·0	7·4	0·0
2.25	161	1856	3.03	10·9	6·9	0·3
2.53	160	2016	3.33	10·4	6·6	1·3
3.24	166	2182	4.03	11·2	7·0	0·0
3.44	165	2347	4.35	14·6	3·2	0·0
4.10	144	2491	5.00	10·4	6·8	0·9
4.48	180	2671	5.30	4·1	16·5	0·0
5.16	181	2852	6.00	13·4	1·4	2·2
5.46	152	3004	6.30	12·5	7·3	0·0
6.08	151	3155	6.58	8·6	10·2	0·4
6.46	154	3309				
7.15	88	3397		9·9	8·6	0·4

OBSERVATIONS MADE DURING BOILER TRIAL No. 12

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
9.15	109	88	415	68	−·05	−·25	.....
9.30	113	90	440	68	−·05	−·20	304
9.45	108	90	435	68·5	−·05	−·25	388
10.00	106	92	445	69	−·05	−·30	362·5
10.15	113	93	425	70	−·05	−·20	261·5
10.30	116	93	425	70	−·02	−·30	302·5
10.45	114	94	385	70·5	−·05	−·25	460
11.00	100	94	395	71	+·25	−·30	181·5
11.15	116	103	745	71	+·25	−·30	241·5
11.30	118	104	710	71	+·45	−·25	706
11.45	118	102	620	71·5	+·55	−·25	599
12.00	106	102	485	71	+·30	−·25	753·5
12.15	113	99	450	70·5	+·30	−·25	211·5
12.30	114	98	520	71	+·20	−·25	448
12.45	121	103	660	71	+·30	−·25	238
1.00	110	103	580	72·5	+·25	−·30	673
1.15	119	100	540	72·5	+·10	−·25	631·5
1.30	109	101	585	72·5	+·20	−·25	401
1.45	121	102	585	72·5	+·05	−·20	431·5
2.00	116	105	540	72	+·05	−·25	426
2.15	116	103	505	71·5	+·05	−·25	431·5
2.30	108	104	535	72	+·02	−·25	695
2.45	116	102	480	72·5	+·02	−·25	284
3.00	107	102	515	73·5	+·20	−·25	444
3.15	121	104	505	72	+·20	−·25	353·5
3.30	116	102	510	72	+·30	−·25	488
3.45	114	104	510	72	+·20	−·25	433·5
4.00	94	104	480	72·5	+·30	−·25	534·5
4.15	110	104	480	72·5	+·25	−·25	260
4.30	117	104	680	72·5	+·45	−·25	497·5
4.45	108	102	580	72·5	+·45	−·30	573·5
5.00	116	103	520	72·5	+·25	−·30	521·5
5.15	106	101	470	72·5	+·30	−·30	420·5
5.30	103	102	420	72·5	+·02	−·20	397
5.45	106	105	585	73	+·10	−·30	88·5
6.00	119	101	650	72·5	+·15	−·25	494·5
6.15	107	100	530	72·5	+·10	−·30	510
6.30	121	100	530	73	+·02	−·30	682
6.45	102	98	555	72·5	0·0	−·30	551
7.00	108	98	500	71·5	0·0	−·30	449
7.15	116	95	465	72	0·0	−·30	388
	112	99·8	522	71·6	+·15	−·26	17,581·5 net

SUMMARY OF OBSERVATIONS

Date—July 15, 1907.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—9.15 a.m	Ended—7.15 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural and forced
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned June, 1907. Fresh water, July 4.
4.	Tubes cleaned	7.10 a.m.
5.	Fire cleaned	7.30 a.m., 12.32 and 5.30 p.m.

Fuel.

6.	Kind of coal	No. 209—Minudie Colliery, Minudie Coal Co., River Hebert, Cumberland Co., N.S. Over $\frac{1}{4}$" screen and picking belt.
7.	Analysis of dry coal by weight (%)	C = 68·2, H = 4·6, S = 6·3, N = 0·8, O = 9·1, Ash = 11·0
8.	Calorific value of dry coal B.T.U. per lb	12600
9.	Moisture in coal as fired (%)	3·5
10.	Weight of coal fired (lbs.)	3397
11.	Combustible matter in ash and clinker (%)	14·2
12.	Weight of clinker (lbs.)	299
13.	Weight of ash (lbs.)	116

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	+0·15
15.	" above fire " "	−0·20
16.	" at damper " "	−0·26
17.	Amount of damper opening	Full
18.	Temperature of air in boiler house (°F.)	99·8
19.	Flue temperature (°F.)	522
20.	Analysis of dry flue gas by volume (%)	CO_2 = 9·9, O_2 = 8·6, CO = 0·4, N_2 = 81·1

Water and Steam.

21.	Temperature of feed water (°F.)	71·6
22.	Total weight of feed water corrected for difference of level (lbs.)	17581
23.	Water level in gauge at start (inches)	$5\frac{3}{4}$
24.	Water level in gauge at finish (inches)	$6\frac{1}{16}$
25.	Correction for difference of level included above (lbs.)	47·5
26.	Steam pressure by gauge (lbs. per sq. in.)	112·0
27.	Barometer reading (inches)	29·82
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	14·2
29.	Temperature in steam calorimeter (°F.)	278

Notes.

Fire sliced 11.09 and 11.25 a.m., 2.20 and 4.19 p.m. Air admitted over fire from 9.20 to 10.25 a.m. Draft forced from 10.55 a.m. to 1.46 p.m. and from 2.50 p.m. to 6.35 p.m. Steam blown under grate from 11.10 a.m. to close. Clinker thin, hard, and adherent. Weather fine, still, and warm.

Proximate analysis of dry coal by weight %: Fixed carbon..... 51·7; Volatile matter..... 37·3; Ash..... 11·0

SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 209. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·88. At finish—29·76. Mean—29·82.

Total Quantities.

1.	Date of trial	15/7/07
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	3397
4.	Percentage of moisture in coal as fired (%)	3·5
5.	Total weight of dry coal fired (lbs.)	3277
6.	Total ash and refuse (lbs.)	415
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 12·8; (*b*) weighed 12·7	
8.	Total weight of combustible consumed, from analyses (lbs.)	2857
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	17581
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17410
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	20680

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	327·7
13.	Dry coal per square foot of grate surface per hour (lbs.)	19·5
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1741
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2068
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·24

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	112·0
18.	Temperature of feed water entering boiler (deg. F.)	71·6
19.	Temperature of escaping gases from boiler (deg. F.)	522
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·41
21.	Percentage of moisture in steam	1·0

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	59·9
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	99·8

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	5·18
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	6·09
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	6·32
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	7·26

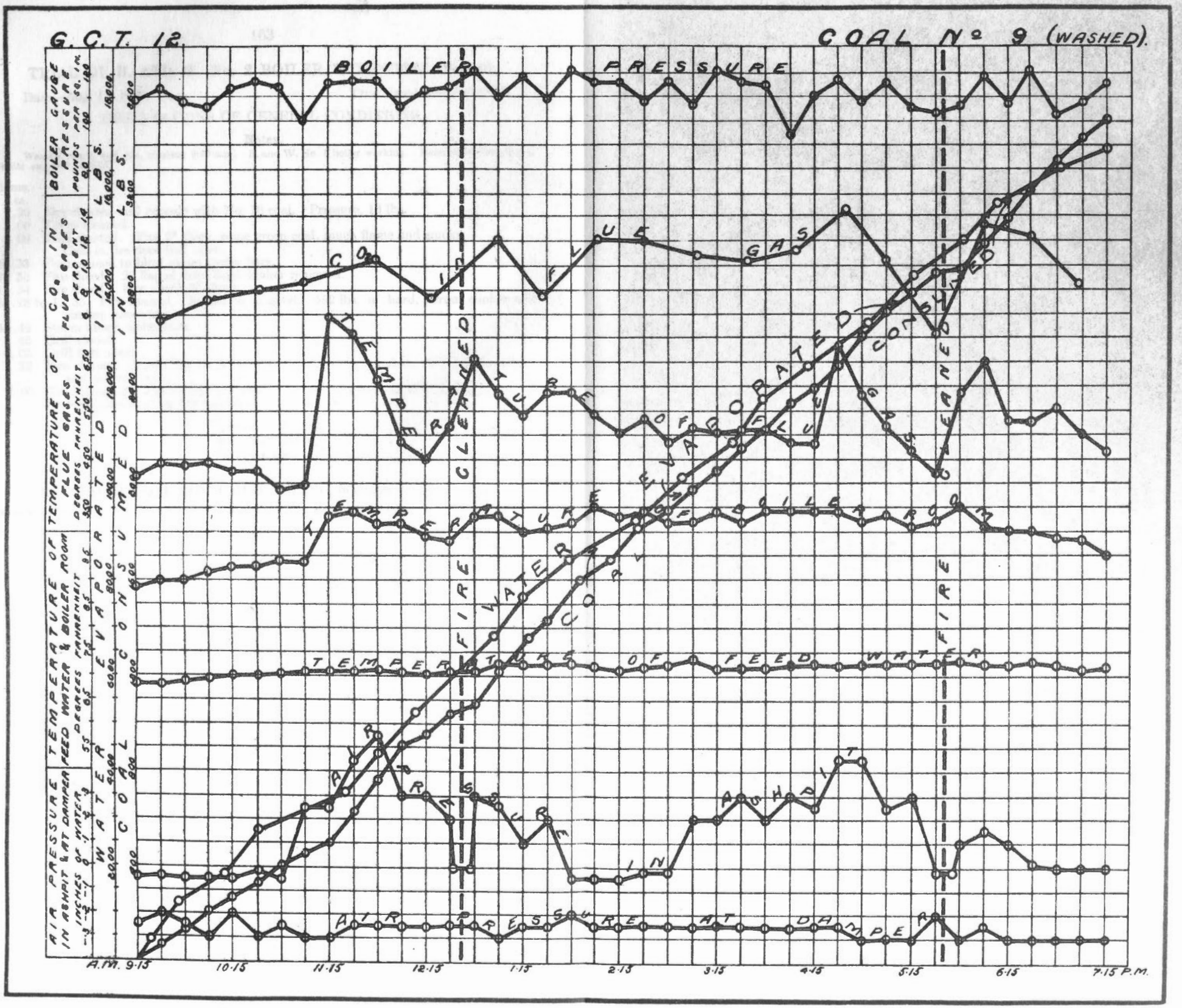
Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	12600
30.	Calorific value of the combustible per lb. (B.T.U.)	14170
31.	Efficiency of boiler (based on combustible consumed) (%)	49·5
32.	Efficiency of boiler, including grate (based on dry coal) (%)	48·5

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	24·2
34.	" of combustible consumed (from gas analyses) (lbs.)	18·9
35.	" dry coal (from gas analyses) (lbs.)	16·5
36.	Proportion of heat of fuel in escaping dry flue gases (%)	13·3

GRAPHIC RECORD OF BOILER TRIAL.



TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 10.

Date—Aug. 12, 1907. Trial Number—G.C.T. 22.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Weather warm and wet, clearing 9.30 a.m. B. and W. No. 1 boiler working. Robb boiler shut down. Boiler emptied 10/8/07.

Time.
a.m.
7.30 Fire cleaned and remade with No. 10 coal. Pressure, 10 lbs.
8.00 Tubes cleaned.
9.00 Trial started. Fire 2″ thick, some green coal, much flame and smoke. Grill in fire door half open.
10.33 Commenced to blow steam under bars.
10.53 Fire sliced. 23 lbs. of thin, hard clinker removed.
11.34 Fire sliced. Fire about 6″ thick.
12.28 to 12.35 Fire cleaned. Steam jet stopped. 152 lbs. of hard, porous clinker and cinders removed.
12.46 Steam blown under bars.
1.45 Grill closed.
2.03 Grill half open.
5.32 Fire cleaned. A thin bed of fuel on top of 4″ to 5″ of clinker. 232 lbs. of clinker and ash removed.
7.00 Trial stopped. Fire similar to start. 137 lbs. of ashes raked from pit. Blow-off examined and found tight.

CLINKER AND ASH.
407 lbs. clinker.
137 lbs ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 22

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 9.00 a.m.						
9.20	234	234	9.25	6·0	11·6	0·4
9.40	200	434	10.00	8·0	10·2	0·0
10.05	161	595	10.32	7·8	10·4	0·0
10.45	201	796	11.02	15·4	3·4	0·0
11.25	201	997	11.28	9·0	10·3	0·0
11.47	170	1167	11.52	8·6	11·3	0·1
12.24	152	1319	12.27	6·6	12·6	0·2
12.46	174	1493	12.55	5·6	14·4	0·0
1.03	169	1662	1.25	8·8	9·3	0·7
1.23	182	1844	1.55	11·0	8·8	0·2
2.00	171	2015	2.25	6·8	12·7	0·1
2.24	164	2179	2.58	6·9	12·7	0·1
2.50	166	2345	3.30	5·2	15·2	0·0
3.25	187	2532	4·00	14·6	4·6	0·1
3.51	187	2719	4.25	13·7	14·7	0·4
4.16	171	2890	5.04	11·4	6·9	0·0
4.48	176	3066	5.25	9·4	10·3	0·4
5.21	173	3239	5.53	6·4	13·6	0·0
5.55	168	3407	6.25	10·2	10·4	0·3
6.10	190	3597				
6.31	168	3765		9·0	10·7	0·2
7.00	16	3781				

OBSERVATIONS MADE DURING BOILER TRIAL No. 22

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
9.00	88	89	478	75·5	—·05	—·30	.....
9.15	102	88	500	75·5	—·05	—·30	438·5
9.30	108	91	525	75	—·05	—·30	346·5
9.45	108	92	540	75	—·05	—·30	456
10·00	97	92	580	74·5	—·05	—·30	625·5
10.15	110	94	520	75	—·05	—·30	359·5
10.30	109	94	460	75	—·05	—·30	548
10.45	99	94	460	74·5	—·05	—·30	303
11.00	90	96	600	74·5	—·05	—·30	253
11.15	103	96	740	74·5	—·05	—·30	628
11.30	104	95	620	74	—·05	—·30	495
11.45	113	97	650	73·5	—·05	—·30	590
12.00	102	97	580	74	—·05	—·30	466
12.15	113	97	550	73·5	—·05	—·30	407
12.30	101	97	520	73·5	—·05	—·30	598·5
12.45	111	98·5	575	74·5	—·05	—·30	173·5
1.00	123	98	675	74·5	—·05	—·30	362
1.15	121	98	650	74·5	—·05	—·30	649
1.30	109	97	625	74·5	—·05	—·30	567·5
1.45	119	98	590	74·5	—·05	—·30	502·5
2.00	103	100	570	74·5	—·05	—·30	586·5
2.15	117	100	580	74·5	—·05	—·30	457
2.30	88	100	525	74·5	—·05	—·30	570·5
2.45	110	100	535	74·5	—·05	—·30	388
3.00	103	100	510	74·5	—·05	—·30	571·5
3.15	110	100	500	74·5	—·05	—·30	284
3.30	98	99	480	74·5	—·05	—·30	473·5
3.45	110	99	550	74·5	—·05	—·30	306·5
4.00	122	98	700	74·5	—·05	—·30	425
4.15	120	98	675	74	—·05	—·30	496
4.30	113	98	650	74	—·05	—·30	549·5
4.45	113	98	610	74	—·05	—·30	521
5.00	122	99	650	74	—·05	—·30	466·5
5.15	98	97	530	74	—·05	—·30	601·5
5.30	103	97	500	74	—·05	—·30	498·5
5.45	107	97	560	74	—·05	—·30	131·5
6.00	123	97	550	74	—·05	—·30	329
6.15	122	98	570	74	—·05	—·30	446
6.30	122	97	650	74	—·05	—·30	531
6.45	102	96	615	74	—·05	—·30	494
7.00	120	96	650	74	—·05	—·30	425
	108·8	96·0	575	74·4	—·05	—·30	18,233 net

SUMMARY OF OBSERVATIONS

Date—Aug. 12, 1907. Boiler—B. and W. No. 2. At McGill University.
Commenced—9.00 a.m. Ended—7.00 p.m. Duration—600 mins.

General.

1. Method of stoking ..... Hand-spreading on alternate sides
2. Kind of draft ..... Natural
3. Condition of boiler and date of last cleaning .... Thoroughly cleaned June, 1907. Fresh water, August 10.
4. Tubes cleaned ..... 8.00 a.m.
5. Fire cleaned ..... 7.30 a.m., 12.30 and 5.30 p.m.

Fuel.

6. Kind of coal ..... No. 10—Joggins Colliery, Canada Coal & Ry. Co., Cumberland Co., N.S. Over $\frac{3}{4}$" screen and picking belt
7. Analysis of dry coal by weight (%) ..... C = 63·5, H = 4·1, S = 5·4, N = 1·3, O = 7·1, Ash = 18·6
8. Calorific value of dry coal B.T.U. per lb 11590
9. Moisture in coal as fired (%) ..... 2·0
10. Weight of coal fired (lbs.) 3781
11. Combustible matter in ash and clinker (%) ..... 13·4
12. Weight of clinker (lbs.) 407
13. Weight of ash (lbs.) 137

Air and Flue Gas.

14. Air pressure under fire (inches of water) ..... −0·05
15. " above fire " " ..... −0·25
16. " at damper " " ..... −0·30
17. Amount of damper opening ..... Full
18. Temperature of air in boiler house (°F.) 96
19. Flue temperature (°F.) 575
20. Analysis of dry flue gas by volume (%) .. $CO_2 = 9·0$, $O_2 = 10·7$, $CO = 0·2$, $N_2 = 80·1$

Water and Steam.

21. Temperature of feed water (°F.) ..... 74·4
22. Total weight of feed water corrected for difference of level (lbs.) 18233
23. Water level in gauge at start (inches) ..... $3\frac{2}{16}$
24. Water level in gauge at finish (inches) ..... $3\frac{1}{2}$
25. Correction for difference of level included above (lbs.) ..... 9·5
26. Steam pressure by gauge (lbs. per sq. in.) ..... 108·8
27. Barometer reading (inches) ..... 29·48
28. Pressure in steam calorimeter by gauge (lbs. per sq. in.) ..... 23·2
29. Temperature in steam calorimeter (°F.) ..... 290·5

Notes.

Fire sliced 10.53 and 11.34 a.m. Air admitted over fire throughout trial. Steam blown under grate from 10.33 to close. Clinker hard and porous. Weather warm and wet, clearing during morning.

Proximate analysis of dry coal by weight %: Fixed carbon ..... 44·8; Volatile matter ..... 36·6; Ash ..... 18·6

SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 10. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·53. At finish—29·44. Mean—29·48.

Total Quantities.

1.	Date of trial	12/8/07
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	3781
4.	Percentage of moisture in coal as fired (%)	2·9
5.	Total weight of dry coal fired (lbs.)	3671
6.	Total ash and refuse (lbs.)	544
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 21·5; (*b*) weighed	14·8
8.	Total weight of combustible consumed from analyses (lbs.)	2882
9.	Total weight of water fed to the boiler corrected for difference of level (lbs.)	18233
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	18113
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	21410

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	367
13.	Dry coal per square foot of grate surface per hour (lbs.)	21·8
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1811
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2141
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·35

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	108·8
18.	Temperature of feed water entering boiler (deg. F.)	74·4
19.	Temperature of escaping gases from boiler (deg. F.)	575
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·25
21.	Percentage of moisture in steam	1·0

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	62·1
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	103·6

Economic Results.

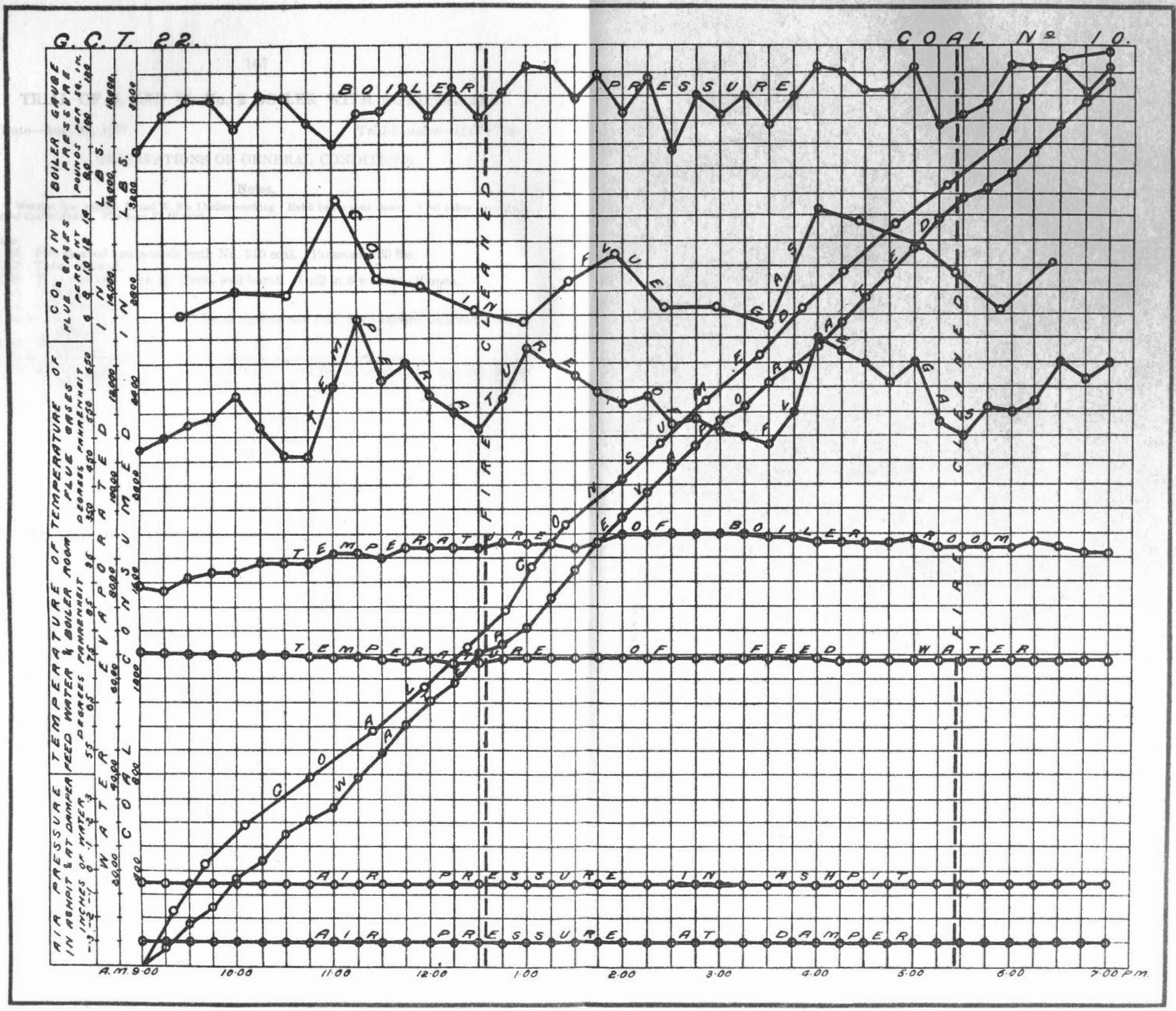
25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	4·82
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	5·66
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	5·84
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	7·44

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	11590
30.	Calorific value of the combustible per lb. (B.T.U.)	14220
31.	Efficiency of boiler (based on combustible consumed) (%)	50·6
32.	Efficiency of boiler, including grate (based on dry coal) (%)	48·7

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	27·0
34.	" " of combustible consumed (from gas analyses) (lbs.)	21·8
35.	" " dry coal (from gas analyses) (lbs.)	17·1
36.	Proportion of heat of fuel in escaping dry flue gases (%)	17·0


G. C. T. 22.
COAL No 10.
BOILER PRESSURE
CLEANED FIRE
UNCLEANED FIRE
FLUE GASES
TEMPERATURE OF FLUE GASES
TEMPERATURE OF BOILER ROOM
TEMPERATURE OF FEED WATER
AIR PRESSURE IN ASHPIT
AIR PRESSURE AT DAMPER
BOILER GAUGE PRESSURE
CO2 IN FLUE GASES
COAL
WATER
EVAPORATION
A.M. 9:00
10:00
11:00
12:00
1:00
2:00
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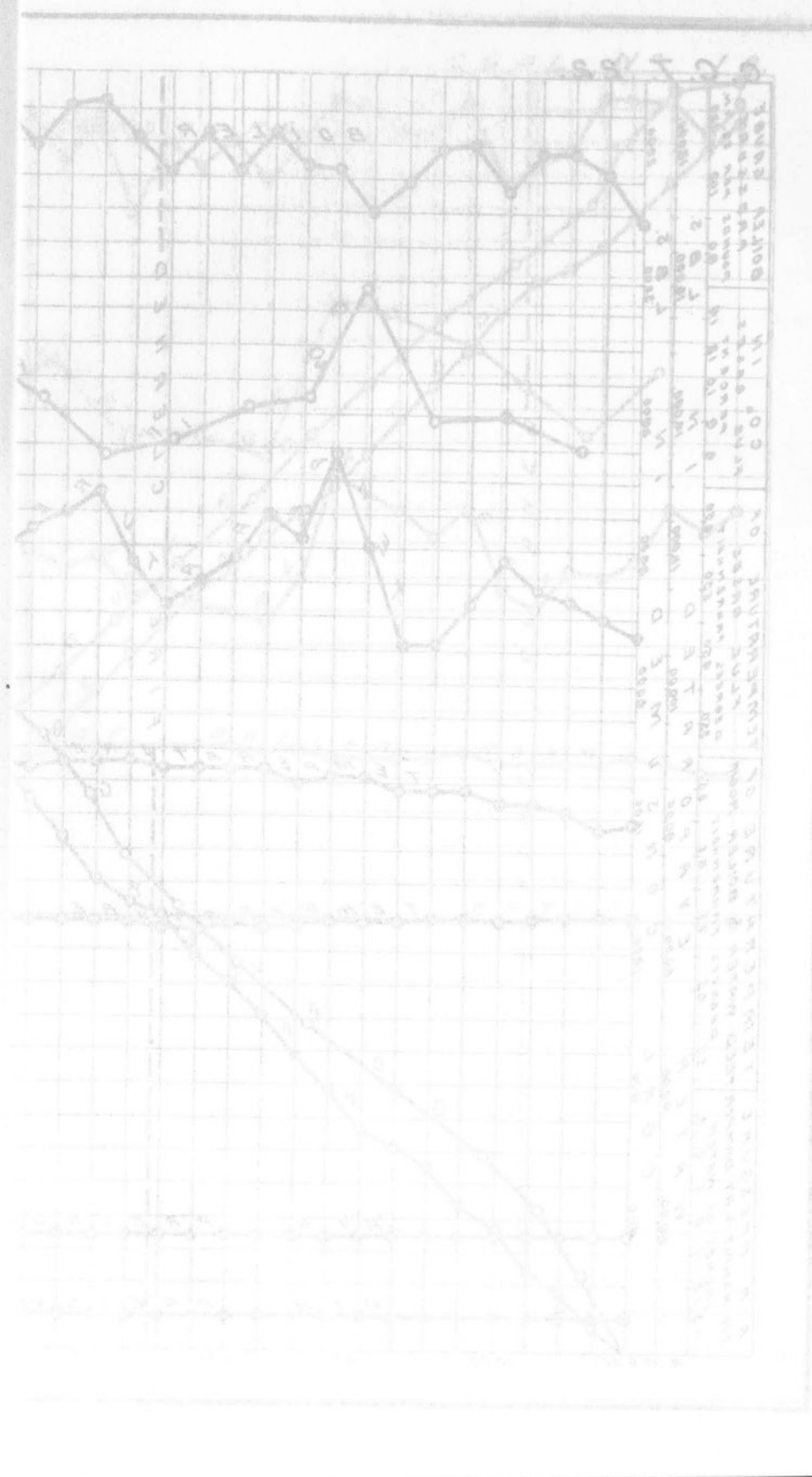


TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 210.

Date—Aug. 13, 1907. Trial Number—G.C.T. 23.

OBSERVATIONS OF GENERAL CONDITIONS

Notes.

Weather fine, breezy. B. and W. No. 1 boiler working. Robb boiler shut down. Coal cokes when fired A good deal of flame. Fire kept 3"-4" thick.

Time
7.35 Fire cleaned and remade with No. 210 coal. Pressure, 100 lbs.
7.57 Tubes cleaned.
8.55 Trial started. Fire 1½" thick, well burnt. Grill in fire door half open.
9.55 Grill shut.
11.03 Grill half open.
12.31 to 12.40 Fire cleaned. 80 lbs of cinders and thin, hard clinker removed without difficulty.
4.30 Fire sliced.
5.33 to 5.41 Fire cleaned. 86 lbs. of cinders and clinker removed.
6.58 Trial stopped. Fire very similar to start. 97 lbs. of ashes raked from pit. Blow-off examined and found tight.

CLINKER AND ASH.

166 lbs. clinker.
97 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 23

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.55 a.m.						
9.18	208	208	9.20	4·4	14·5	0·0
9.43	156	364	9.50	8·4	10·8	0·0
10.12	176	540	10.25	9·4	9·1	0·7
10.34	162	702	10.50	8·6	9·8	0·6
10.57	164	866	11.22	9·0	11·0	0·8
11.34	194	1060	11.54	7·8	11·2	0·6
12.10	179	1239	12.22	6·1	13·8	0·4
12.56	201	1440	12.52	10·2	7·8	0·6
1.27	162	1602	1.22	8·4	10·8	0·4
1.56	195	1797	1.54	9·3	9·3	0·7
2 22	172	1969	2.35	8·2	10·8	0·6
2.56	180	2149	3.08	9·0	8·4	1·2
3.24	161	2310	3.35	6·8	13·0	0·2
4.04	180	2490	4.05	8·4	10·0	0·8
4.40	195	2685	4.35	16·2	4·0	0·2
5.13	154	2839	5.06	8·6	8·4	1·3
5.47	185	3024	5.35	5·4	13·8	0·2
6.20	172	3196	6.03	13·2	4·8	0·8
6.58	153	3349	6.28	10·7	8·5	0·2
				8·8	10·0	0·5

OBSERVATIONS MADE DURING BOILER TRIAL No. 23

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.55	106	86	527	73	—·07	—·35	.....
9.10	118	86	500	73·5	—·07	—·35	341·5
9.25	101	87	550	73·5	—·07	—·35	556·5
9.40	105	88	540	73	—·07	—·35	458·5
9.55	122	89	540	73	—·07	—·35	496·5
10.10	122	89	500	73	—·07	—·35	496·5
10.25	119	90	515	73·5	—·07	—·35	515·5
10.40	101	89	495	73·5	—·07	—·35	666·5
10.55	113	90	480	74	—·07	—·35	414·5
11.10	106	90	465	74	—·07	—·35	449·5
11.25	108	90	450	74	—·07	—·35	495·5
11.40	110	90	465	74·5	—·07	—·35	471
11.55	113	91	440	74	—·07	—·35	359
12.10	119	92	450	73·5	—·07	—·35	288
12.25	119	89	435	73·5	—·07	—·35	338
12.40	119	95	450	73·5	—·07	—·35	267·5
12.55	120	90	510	73·5	—·07	—·35	355·5
1.10	122	91	580	74	—·07	—·35	528
1.25	114	91	555	74	—·07	—·35	521
1.40	119	91	510	74	—·07	—·35	512
1.55	114	92	550	74	—·07	—·35	473
2.10	119	91	600	74	—·07	—·35	535·5
2.25	122	90	580	74·5	—·07	—·35	577·5
2.40	120	90	500	74·5	—·07	—·35	469·5
2.55	119	89	480	74	—·07	—·35	454
3.10	113	88	460	74	—·07	—·35	447
3.25	118	89	450	74	—·07	—·35	437
3.40	113	89	450	74	—·07	—·35	335
3.55	122	89	460	74	—·07	—·40	407
4.10	103	88	475	74	—·07	—·40	489·5
4.25	108	87	450	74·5	—·07	—·40	338
4.40	123	87	620	74·5	—·07	—·40	403
4.55	108	87	465	74·5	—·07	—·40	534
5.10	98	87	435	74·5	—·07	—·40	388·5
5.25	118	85	440	74	—·07	—·40	249·5
5.40	107	91	465	74	—·07	—·40	391·5
5.55	122	87	520	74·5	—·07	—·40	326
6.10	121	87	525	74·5	—·07	—·40	550
6.25	122	86	560	74·5	—·07	—·40	450·5
6.40	120	87	490	74·5	—·07	—·40	442·5
6.58	111	84	530	74·5	—·07	—·40	552
	114·6	88·8	499·	74	—·07	—·37	17,691·5 net

SUMMARY OF OBSERVATIONS

Date—Aug. 13, 1908.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.55 a.m.	Ended—6.58 p.m.	Duration—603 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned June, 1907. Fresh water, Aug. 10.
4.	Tubes cleaned	7.57 a.m.
5.	Fire cleaned	7.35 a.m., 12.35 and 5.35 p.m.

Fuel.

6.	Kind of coal	No. 210, Joggins Colliery, Canada Coal & Railway Co., Cumberland Co., N.S Over $\frac{3}{4}$" screen and picking belt.
7.	Analysis of dry coal by weight (%)	C = 70·3, H = 4·9, S = 4·8, N = 0·9, O = 8·8, Ash = 10·3
8.	Calorific value of dry coal B.T.U. per lb	12740
9.	Moisture in coal as fired (%)	3·8
10.	Weight of coal fired (lbs.)	3349
11.	Combustible matter in ash and clinker (%)	14·6
12.	Weight of clinker (lbs.)	166
13.	Weight of ash (lbs.)	97

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−0·07
15.	" above fire " "	−0·29
16.	" at damper " "	−0·37
17.	Amount of damper opening	Various
18.	Temperature of air in boiler house (°F.)	88·8
19.	Flue temperature (°F.)	499
20.	Analysis of dry flue gas by volume (%)	$CO_2 = 8·8$, $O_2 = 10·0$, $CO = 0·5$, $N_2 = 80·7$

Water and Steam.

21.	Temperature of feed water (°F.)	74
22.	Total weight of feed water, corrected for difference of level (lbs.)	17691
23.	Water level in gauge at start (inches)	$4\frac{3}{8}$
24.	Water level in gauge at finish (inches)	$4\frac{1}{8}$
25.	Correction for difference of level included above (lbs.)	0·38
26.	Steam pressure by gauge (lbs. per sq. in.)	114·6
27.	Barometer reading (inches)	29·58
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	20·3
29.	Temperature in steam calorimeter (°F.)	289

Notes.

Fire sliced 4.30 p.m. Air admitted over fire throughout trial. Clinker thin and hard, removed without difficulty. Coal cokes readily and burns with much flame. Weather fine and breezy.

Proximate analysis of dry coal by weight %

Fixed carbon	51·6
Volatile matter	38·1
Ash	10·3

SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 210. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·56. At finish—29·60. Mean—29·58.

Total Quantities.

1.	Date of trial	13/8/07
2.	Duration of trial (hours)	10·05
3.	Weight of coal as fired (lbs.)	3349
4.	Percentage of moisture in coal as fired (%)	3·8
5.	Total weight of dry coal fired (lbs.)	3222
6.	Total ash and refuse (lbs.)	263
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 12·1; (*b*) weighed	8·2
8.	Total weight of combustible consumed, from analyses (lbs.)	2832
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	17691
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17558
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	20820

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	282
13.	Dry coal per square foot of grate surface per hour (lbs.)	16·8
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1747
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2072
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	324

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	114·6
18.	Temperature of feed water entering boiler (deg. F.)	74·0
19.	Temperature of escaping gases from boiler (deg. F.)	499
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·3
21.	Percentage of moisture in steam	1·0

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	60
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	100

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	5·28
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	6·22
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	6·47
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	7·37

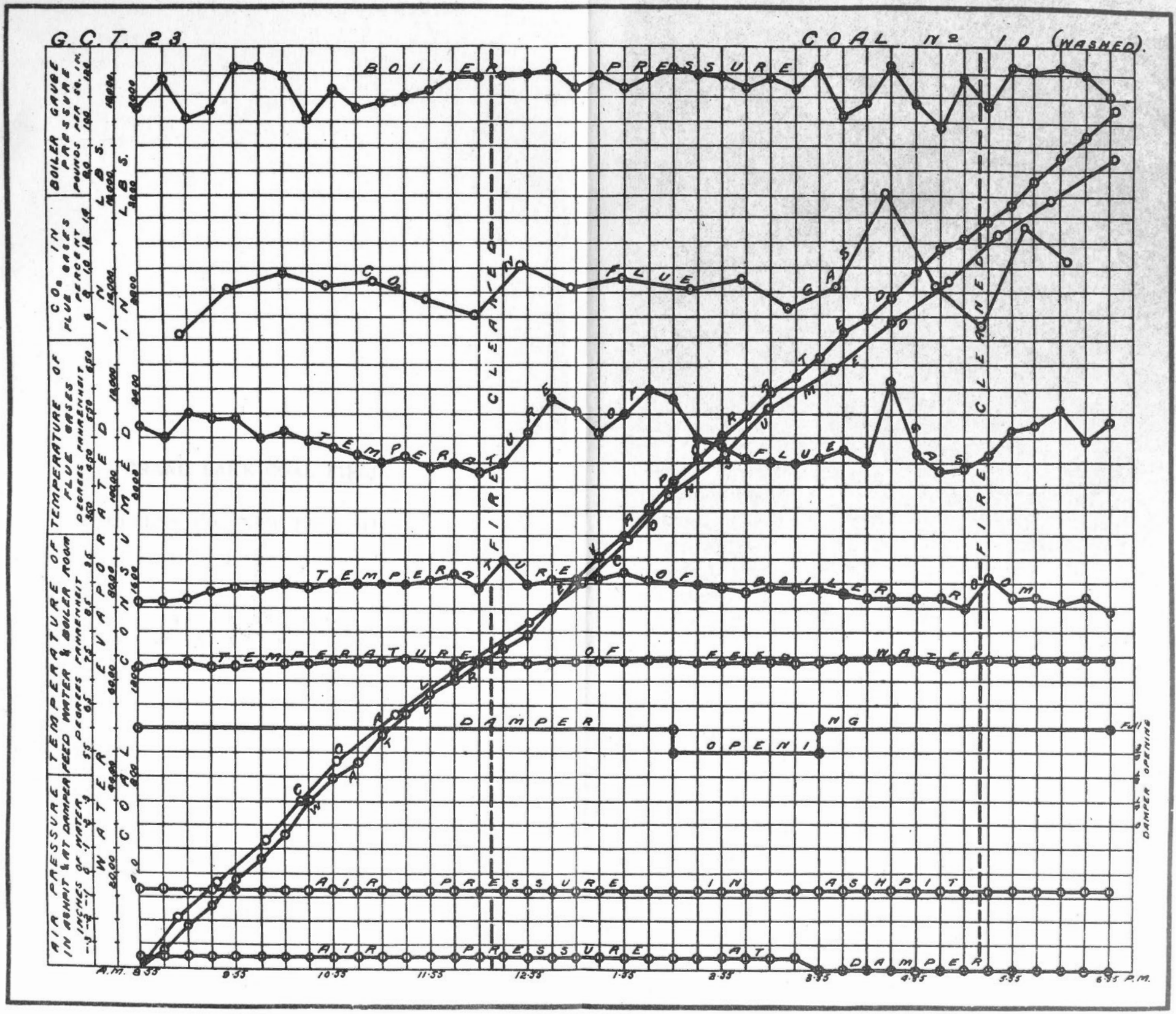
Efficiency.

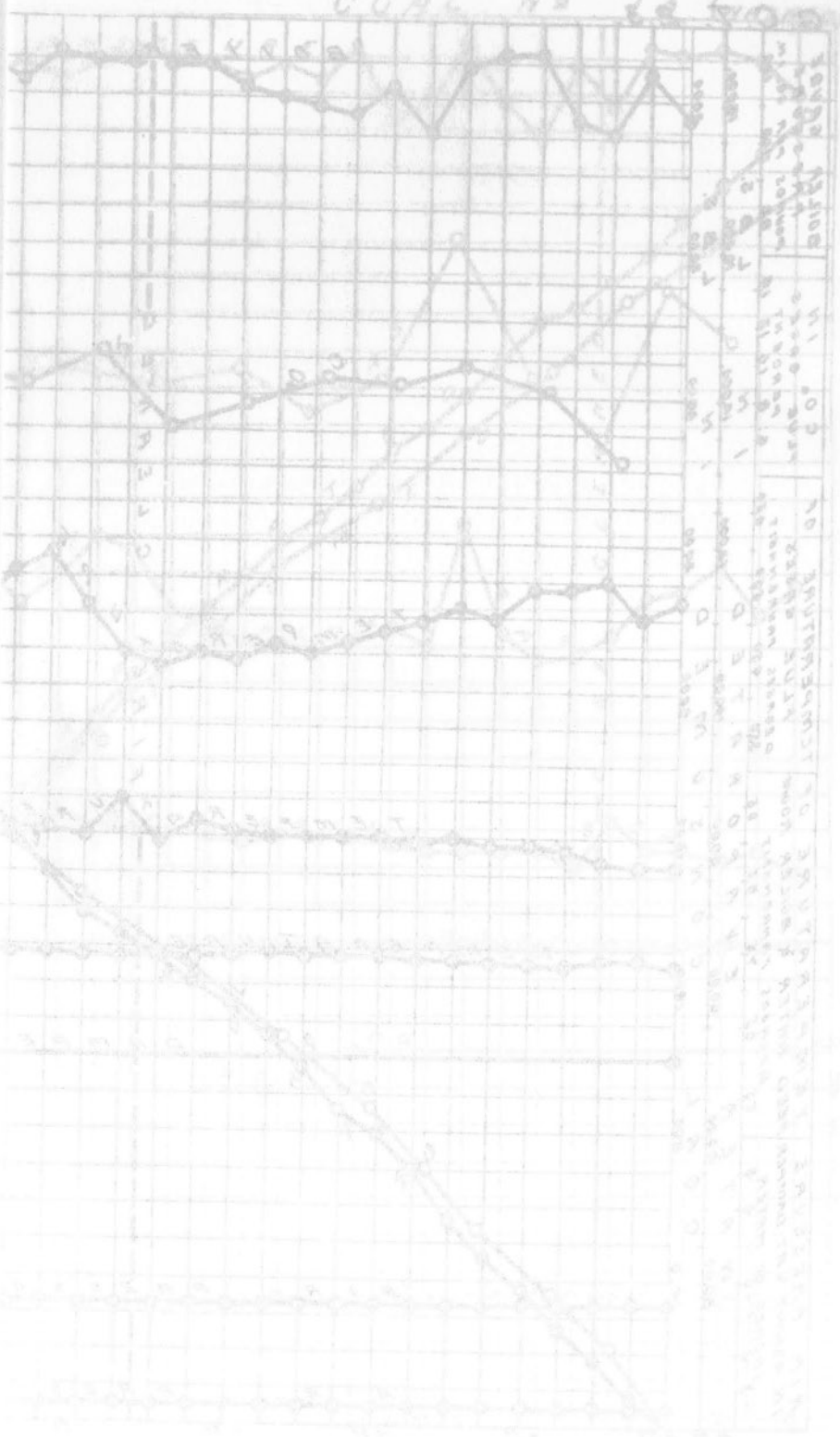
29.	Calorific value of dry coal per lb. (B.T.U.)	12740
30.	Calorific value of the combustible per lb. (B.T.U.)	14210
31.	Efficiency of boiler (based on combustible consumed) (%)	50·1
32.	Efficiency of boiler, including grate (based on dry coal) (%)	48·9

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	26·7
34.	" " of combustible consumed (from gas analyses) (lbs.)	21·4
35.	" " dry coal (from gas analyses) (lbs.)	18·8
36.	Proportion of heat of fuel in escaping dry flue gases (%)	14·5

GRAPHIC RECORD OF BOILER TRIAL.





GRAND LAKE COAL FIELD.

QUEENS CO., NEW BRUNSWICK.

TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 11.

Date—June 28, 1907. Trial Number—G.C.T. 5.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Small fire in B. and W. No. 1 boiler. Weather clear and still. Two sacks of coal burnt before trial.

Time.
a.m.
7.30 Fire raked out and remade with No. 11 coal. Pressure, 50 lbs.
7.53 Tubes cleaned.
8.10 Small fire lighted in B. and W. No. 1 boiler furnace.
8.55 Fire raked over and a little clinker removed.
9.00 Trial started. Fire 3″ to 4″ thick, considerable flame.
10.32 Fire sliced.
10.48 Fire 10″ thick. 4 lbs. of blue, vitreous clinker removed.
10.50 Fire sliced.
11.42 Fire sliced. 8 lbs. of clinker removed.
11.54 Commenced to blow steam into ash-pit.
12.04 to 12.13 Fire cleaned. Clinker adhering closely to bars. 65 lbs. of clinker removed.
1.41 Fan started.
2.30 Fire 13″ thick.
3.40 Fire 14″ thick.
4.00 Fire 11″ thick.
4.45 Fire 9″ thick.
5.25 to 5.31 Fan stopped and fire cleaned, 119+60 lbs. of clinker and cinders removed.
5.35 Fan started.
7.00 Fan stopped.
7.05 Trial stopped. Fire 4½″ thick, but very little flame.
93 lbs. of ashes raked out of pit.
Blow-off examined and found tight.

CLINKER AND ASH.

256 lbs. cinker.
93 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 5

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 9.00.						
9.18	169	169	9.15	6·2	11·8	0·6
9.46	167	336	9.45	6·2	12·0	0·5
10.27	172	508	10.15	7·9	11·1	0·4
11.18	170	678	10.45	10·2	8·0	1·1
12.24	188	866	11.15	6·9	12·6	0·2
1.00	183	1049	11.46	7·0	12·9	0·0
1.38	175	1224	12.30	11·3	7·7	0·4
1.53	183	1407	1.05	9·6	9·0	0·6
2.08	177	1584	1.33	8·7	9·9	0·6
2.27	194	1778	1.59	9·7	7·4	1·3
3.04	177	1955	2.30	10·7	7·7	0·4
4.08	180	2135	2.58	10·1	7·3	0·2
4.57	180	2315	3.30	8·4	10·7	0·0
5.37	160	2475	4.02	10·4	9·0	0·2
5.50	203	2678	4.30	11·1	8·1	0·6
6.15	188	2866	5.00	9·3	7·7	1·9
6.34	179	3045	5.45	9·0	9·0	0·6
7.05	59	3104	6.18	8·8	10·2	0·1
			6.47	12·2	6·0	0·8
				9·1	9·4	0·5

OBSERVATIONS MADE DURING BOILER TRIAL No. 5

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
9.00	109	91·5	410	68·5	−·05	−·20	.....
9.15	110	91·5	400	66·0	−·05	−·18	243·5
9.30	110	92·0	380	65·0	−·05	−·20	395·5
9.45	112	92·5	370	65·0	−·04	−·20	427·5
10.00	113	93·0	370	65·0	−·04	−·20	289
10.15	107	95·0	357	65·0	−·04	−·18	275
10.30	98	95·5	365	65·5	−·03	−·20	335
10.45	123	96	425	66·0	−·02	−·20	240·5
11.00	102	96	415	66·0	−·02	−·20	427
11.15	94	96·5	370	65·0	−·03	−·20	411
11.30	99	98	407	65·0	−·04	−·20	141·0
11.45	107	97	380	65·2	−·04	−·20	344·5
12.00	122	97	365	65·6	−·05	−·20	192·0
12.15	117	104	465	66·0	−·05	−·20	366·5
12.30	123	100	490	66·0	−·05	−·20	
12.45	115	98	490	66·0	−·04	−·20	471
1·00	120	97	485	66·5	−·05	−·20	423
1.15	113	96	450	66·5	−·04	−·20	368
1.30	123	95	445	67·0	−·02	−·20	312
1.45	122	95	575	67·0	+·20	−·20	506
2.00	123	97	575	66·5	+·25	−·20	449
2.15	119	96	550	67·0	+·26	−·20	503·5
2.30	120	95	510	67·0	+·20	−·20	524·5
2.45	110	97	490	67·0	+·10	−·20	523·5
3.00	113	96	480	67·0	+·10	−·20	381·5
3.15	114	97	475	67·0	+·07	−·20	456
3.30	107	95	465	67·0	+·07	−·20	388·5
3.45	122	95	545	67·5	+·16	−·20	1068·5
4.00	107	96	540	67·0	+·15	−·20	
4.15	114	94	535	67·2	+·16	−·20	461·5
4.30	117	96	572	67·5	+·17	−·20	482·5
4.45	119	96	585	67·5	+·18	−·20	406
5.00	122	95	580	67·5	+·16	−·20	476
5.15	119	96	620	67·5	+·16	−·20	499
5.30	102	100	485	68·0	+·12	−·20	481
5.45	103	95	585	68·0	+·11	−·18	329·5
6.00	99	92	502	68·5	+·16	−·20	505·5
6.15	122	91	510	67·0	+·10	−·20	465·5
6.30	122	93	505	67·0	+·10	−·18	1097
6.45	114	92	510	67·2	+·10	−·20	
7.05	122	92	575	67·0	0·0	−·18	419·5
	113·4	95	478	66·0	+·06	−·20	16,070 net

SUMMARY OF OBSERVATIONS

Date—June 28, 1907.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—9.00 a.m.	Ended—7.05 p.m.	Duration—605 mins.

General.

1. Method of stoking.....Hand-spreading on alternate sides
2. Kind of draft.....Natural and forced
3. Condition of boiler and date of last cleaning....Thoroughly cleaned June, 1907. Fresh water, June 20.
4. Tubes cleaned.....7.53 a.m.
5. Fire cleaned .....7.30 a.m., 12.4 and 5.25 p.m.

Fuel.

6. Kind of coal.....{No. 11, King's Mine, G. H. King, Esq., Minto, N. B. Over $\frac{1}{4}$" screen. No picking belt
7. Analysis of dry coal by weight (%).....{C=70·3, H=4·6, S=5·8 N=0·6, O=4·3, Ash=14·4
8. Calorific value of dry coal B.T.U. per lb.....12890
9. Moisture in coal as fired (%).....0·7
10. Weight of coal fired (lbs.).....3104
11. Combustible matter in ash and clinker (%).....16·8
12. Weight of clinker (lbs.).....256
13. Weight of ash (lbs.).....93

Air and Flue Gas.

14. Air pressure under fire (inches of water).....+0·06
15. " above fire " " .....−0·18
16. " at damper " " .....−0·20
17. Amount of damper opening.....Full
18. Temperature of air in boiler house (°F.).....95
19. Flue temperature (°F.).....478
20. Analysis of dry flue gas by volume (%)...CO_2=9·1, O2=9·4, CO=0·5, N_2=80·9

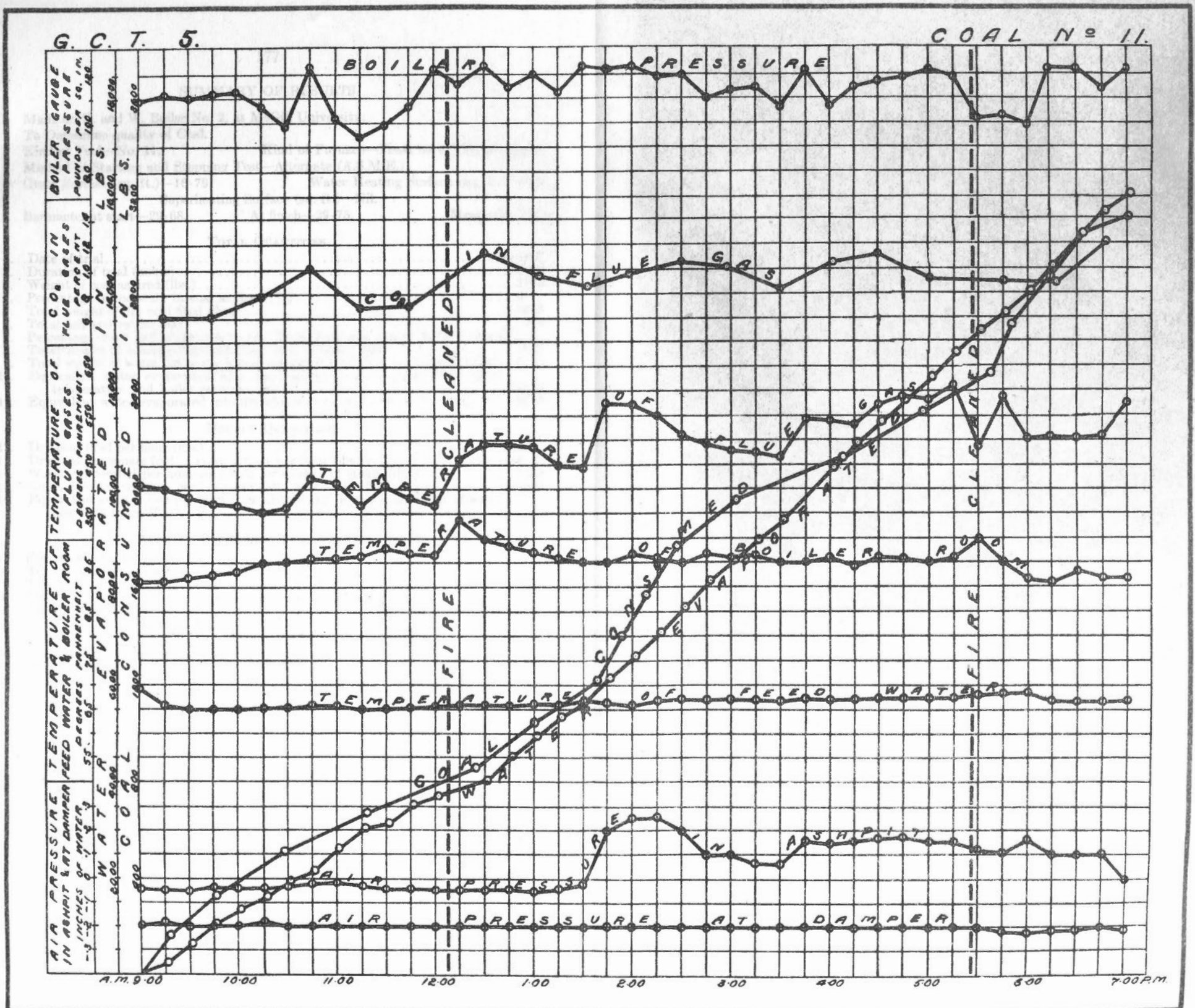
Water and Steam.

21. Temperature of feed water (°F.).....66
22. Total weight of feed water corrected for difference of level (lbs.).....16070
23. Water level in gauge at start (inches).....5
24. Water level in gauge at finish (inches).....$4\frac{11}{16}$
25. Correction for difference of level included above (lbs.).....47·5
26. Steam pressure by gauge (lbs. per sq. in.).....113·4
27. Barometer reading (inches).....29·715
28. Pressure in steam calorimeter by gauge (lbs. per sq. in.).....11·3
29. Temperature in steam calorimeter (°F.).....247

Notes.

Fire sliced 10.32, 10.50, 11.42 a.m. Draft forced from 1.41 p.m. to close. Clinker blue, vitreous, and adherent. Steam blown under grate from 11.54 a.m. to close. Weather clear and still.

Proximate analysis of dry coal by weight %: Fixed carbon..... 53·4; Volatile matter..... 32·2; Ash..... 14·4


G. C. T. 5.
COAL Nº 11.
BOILER PRESSURE
CO2 IN FLUE GASES PERCENT
TEMPERATURE OF FLUE GASES DEGREES FAHRENHEIT
TEMPERATURE OF BOILER ROOM
TEMPERATURE OF FEED WATER
AIR PRESSURE IN ASHPIT & AT DAMPER
BOILER GAUGE PRESSURE POUNDS PER SQ. IN.
LBS. IN 1000
WATER EVAPORATED
COAL CONSUMED
CO2 IN FLUE GASES
TEMPERATURE OF FLUE GASES
TEMPERATURE OF BOILER ROOM
TEMPERATURE OF FEED WATER
AIR PRESSURE IN ASHPIT
AIR PRESSURE AT DAMPER
CLEANED FIRE
CLEANED FIRE
A.M. 9.00
10.00
11.00
12.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00 P.M.

SUMMARY OF RESULTS

Made on B. and W. Boiler No. 2, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 11. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·68. At finish—29·75. Mean—29·715.

Total Quantities.

1.	Date of trial	28/6/07
2.	Duration of trial (hours)	10·08
3.	Weight of coal as fired (lbs.)	3104
4.	Percentage of moisture in coal as fired (%)	0·7
5.	Total weight of dry coal fired (lbs.)	3082
6.	Total ash and refuse (lbs.)	349
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 17·3; (*b*) weighed 11·3	
8.	Total weight of combustible consumed, from analyses (lbs.)	2548
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	16070
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	15680
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	18700

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	305·8
13.	Dry coal per square foot of grate surface per hour (lbs.)	18·2
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1555
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	1860
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	2·91

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	113·4
18.	Temperature of feed water entering boiler (deg. F.)	66
19.	Temperature of escaping gases from boiler (deg. F.)	478
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·26
21.	Percentage of moisture in steam	3·0

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	54
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	90

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	5·18
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	6·03
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	6·07
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	7·34

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	12890
30.	Calorific value of the combustible per lb. (B.T.U.)	15050
31.	Efficiency of boiler (based on combustible consumed) (%)	47·1
32.	Efficiency of boiler, including grate (based on dry coal) (%)	45·5

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	25·9
34.	" " of combustible consumed (from gas analyses) (lbs.)	22·0
35.	" " dry coal (from gas analyses) (lbs.)	18·2
36.	Proportion of heat of fuel in escaping dry flue gases (%)	13·0

TRIAL OF B. AND W. No 2 BOILER WITH COAL No. 211.

Date—July 2, 1907. Trial Number—G.C.T. 6.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Weather damp and still, overcast. Coal appears to coke readily. Small fire lighted in No. 1 B. and W. boiler furnace.

Time.
a.m.
6.15 Grate raked clean and new fire lighted with screenings.
7.30 Pressure, 65 lbs. Flue temperature 550°. Started firing with No. 211 washed coal.
7.55 Tubes cleaned.
8.25 Fire raked over. No clinker found.
8.50 Trial started. Fire 3″ thick, a good deal of flame.
10.00 Fan started.
11.30 Fire 12″ thick.
1.00 Fire 15″ thick.
2.35 Fire 9″ thick.
3.17 Fire sliced. A few pounds of hard blue clinker removed (included below).
3.49 Fire cleaned. 107 lbs. clinker and cinders removed.
5.26 to 5.36 Fire cleaned. 89 lbs. of clinker and cinders removed.
6.40 Fan stopped.
6.53 Trial stopped. 74 lbs. of ashes raked out of pit. Fire very similar to start. Blow-off cock examined and found to be tight.

CLINKER AND ASH.
196 lbs. clinker.
74 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 6

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.50						
8.50	.....	.....	9.00	9·8	9·6	0·0
9.13	170	170	9.30	3·5	16·1	0·0
9.39	172	342	10.00	4·0	15·4	0·0
10.13	189	531	10.30	5·2	13·7	0·5
10.37	195	726	11.00	5·8	13·6	0·0
10·58	161	887	11.30	5·7	14·2	0·0
11.38	165	1052	12.02	6·6	12·3	0·1
12·05	157	1209	12.34	6·7	12·8	0·1
12·51	174	1383	1.01	8·6	10·4	0·5
1.33	173	1156	1.30	7·7	10·7	.....
2.21	197	1753	2.00	7·6	11·8	0·3
3.04	177	1930	2.32	7·1	12·0	0·3
3.41	154	2084	3.00	6·8	12·9	0·0
4.30	163	2247	3.30	9·8	9·5	0·1
5.05	194	2441	4.19	7·0	12·6	0·0
5.50	167	2608	4.47	6·8	12·7	0·2
6.07	174	2782	5.16	6·6	12·2	0·3
6.53	156	2938	6.00	11·4	6·5	0·4
			6.33	7·0	12·8	0·2
				7·0	12·3	0·2

OBSERVATIONS MADE DURING BOILER TRIAL No. 6

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.50	108	86·5	435	68	−·01	−·20	.....
9.05	109	88	435	67	−·02	−·14	584
9.20	113	88.5	405	67	−·02	−·20	404·5
9.35	107	90	390	67	−·01	−·20	407
9.50	111	90	360	66·5	−·02	−·22	285·5
10.05	113	90	445	66	+·20	−·21	323·5
10.20	117	90	450	66	+·32	−·20	520·5
10.35	104	91	465	66·5	+·20	−·22	720
10.50	117	91	410	66·2	+·15	−·21	340
11.05	110	91	425	65·5	+·09	−·20	571
11.20	119	92	405	65·2	+·05	−·21	363·5
11.35	113	91	407	65·5	+·10	−·22	523·5
11.50	114	93	420	65·5	+·18	−·22	398·5
12.05	112	95	415	66·0	+·11	−·22	513
12.20	110	95	395	66·5	+·15	−·15	455
12.35	109	94	390	67·0	+·09	−·21	490
12.50	112	92	400	67·0	+·10	−·22	433·5
1.05	123	97	425	67·5	+·18	−·20	331·5
1.20	122	92	420	68·0	+·19	−·20	472·5
1.35	122	88	425	68·0	+·12	−·20	444·5
1.50	120	88	415	68·0	+·18	−·20	463
2.05	117	88	415	68·0	+·20	−·21	456·5
2.20	114	89	425	67·7	+·30	−·21	401·5
2.35	114	89	420	68·0	+·27	−·22	443·5
2.50	117	88	395	68·0	+·22	−·21	506
3.05	111	89	410	68·0	+·22	−·22	383
3.20	114	92	500	68·5	+·30	−·22	192·5
3.35	123	91	455	69·5	+·60	−·21	308·5
3.50	112	95	425	69·0	0·00	−·18	497·5
4.05	110	90	480	69·0	+·20	−·22	136
4.20	113	89	450	69·5	+·40	−·20	376
4.35	112	90	415	69·5	+·30	−·19	358·5
4.50	118	92	390	69·0	+·40	−·22	300
5.05	123	92	470	69·5	+·70	−·20	340·5
5.20	123	89	480	69·5	+1·10	−·23	536·5
5.35	110	100	440	69·5	0·0	−·15	198·5
5.50	123	89	825	69·5	+·30	−·18	381·5
6.05	123	88	580	69·0	+·18	−·20	1014
6.20	121	88	610	69·0	+·20	−·22	444
6.35	103	87	520	68·5	+·18	−·22	285·5
6.53	112	86	470	68·0	0·0	−·20	627·5
	114·6	90·5	447	67·7	+·21	−·20	17,205·5 net

SUMMARY OF OBSERVATIONS

Date—July 2, 1908.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.50 a.m.	Ended—8.53 p.m.	Duration—603 mins.

General.

1. Method of stoking.....Hand-spreading on alternate sides
2. Kind of draft.....Natural and forced
3. Condition of boiler and date of last cleaning.....Thoroughly cleaned June, 1907. Fresh water, June 20.
4. Tubes cleaned.....7.55 a.m.
5. Fire cleaned.....6.15 a.m., 3.49 and 5.26 p.m.

Fuel.

6. Kind of coal.....No. 211 washed—King's Mine, G.H.King, Esq., Minto, N.B. Over $\frac{1}{4}$" screen, no picking belt.
7. Analysis of dry coal by weight (%) .C=75·4, H=5·0, S=4·9, N=0·5, O=4·8, Ash=9·4
8. Calorific value of dry coal B.T.U. per lb.....13820
9. Moisture in coal as fired (%).....1·7
10. Weight of coal fired (lbs.).....2938
11. Combustible matter in ash and clinker (%).....20·5
12. Weight of clinker (lbs.).....196
13. Weight of ash (lbs.).....74

Air and Flue Gas.

14. Air pressure under fire (inches of water).....+0·21
15. " above fire " " .....−0·18
16. " at damper " " .....−0·20
17. Amount of damper opening.....Full
18. Temperature of air in boiler house (°F.).....90·5
19. Flue temperature (°F.).....447
20. Analysis of dry flue gas by volume (%)..CO_2=7·0, O_2=12·3, CO=0·2, N_2=80·5

Water and Steam.

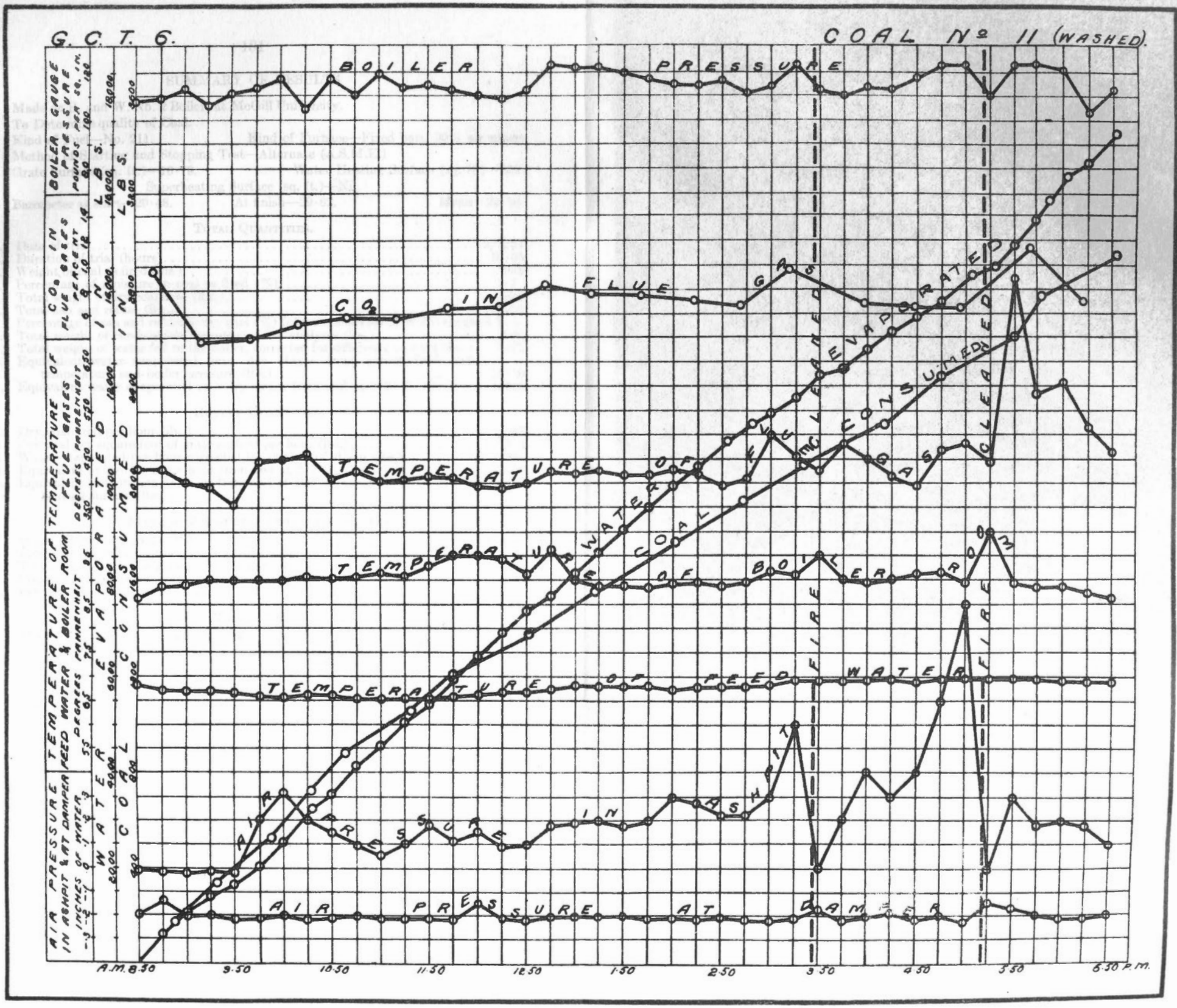
21. Temperature of feed water (°F.).....67·7
22. Total weight of feed water corrected for difference of level (lbs.).....17205
23. Water level in gauge at start (inches).....4 $\frac{9}{16}$
24. Water level in gauge at finish (inches).....4 $\frac{7}{8}$
25. Correction for difference of level included above (lbs.).....47·5
26. Steam pressure by gauge (lbs. per sq. in.).....114·5
27. Barometer reading (inches).....29·55
28. Pressure in steam calorimeter by gauge (lbs. per sq. in.).....8·8
29. Temperature in steam calorimeter (°F.).....238

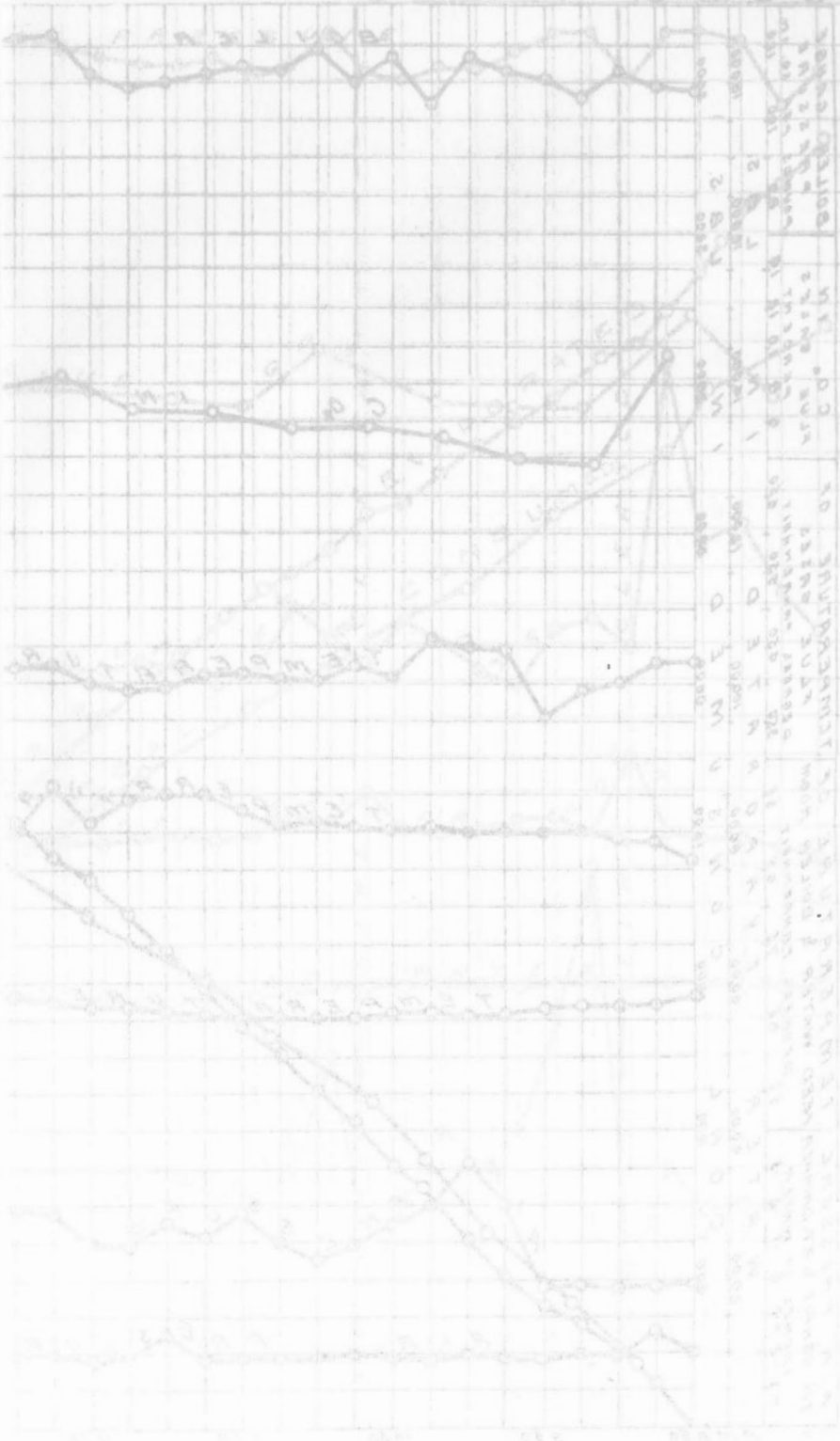
Notes.

Fire sliced 3.17 p.m. Draft forced from 10.00 a.m. to 6.40 p.m. Clinker hard and blue. Coal appears to coke readily. Weather damp, still, and overcast.

Proximate analysis of dry coal by weight %: Fixed carbon..... 56·6; Volatile matter..... 34·0; Ash..... 9·4

GRAPHIC RECORD OF BOILER TRIAL.





SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 211. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·48. At finish—29·62. Mean—29·55.

Total Quantities.

1.	Date of trial	2/7/07
2.	Duration of trial (hours)	10·05
3.	Weight of coal as fired (lbs.)	2938
4.	Percentage of moisture in coal as fired (%)	1·7
5.	Total weight of dry coal fired (lbs.)	2888
6.	Total ash and refuse (lbs.)	270
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 11·8; (*b*) weighed	9·4
8.	Total weight of combustible consumed, from analyses (lbs.)	2546
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	17205
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	16720
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	19930

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	287
13.	Dry coal per square foot of grate surface per hour (lbs.)	17·1
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1664
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	1983
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·1

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	114·6
18.	Temperature of feed water entering boiler (deg. F.)	67·7
19.	Temperature of escaping gases from boiler (deg. F.)	447
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·41
21.	Percentage of moisture in steam	4·0

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	57·5
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	96

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	5·87
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	6·80
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	6·90
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	7·84

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	13820
30.	Calorific value of the combustible per lb. (B.T.U.)	15270
31.	Efficiency of boiler (based on combustible consumed) (%)	49·5
32.	Efficiency of boiler, including grate (based on dry coal) (%)	48·3

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	34·3
34.	" " of combustible consumed (from gas analyses) (lbs.)	29·3
35.	" " dry coal (from gas analyses) (lbs.)	25·8
36.	Proportion of heat of fuel in escaping dry flue gases (%)	16·0

SOURIS COAL FIELD.

SASKATCHEWAN.

TRIAL OF B. AND W. No. 2 BOILER WITH LIGNITE No. 40.

Date—Aug. 12, 1908. Trial Number—G.C.T. 63.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Day fine and clear. Boilers on both sides working. Lignite in fairly large lumps with some small stuff. Lumps are cracked and brownish on outside.

Time.

7.25 Fire cleaned and made up with No. 40 coal. Fire so thin that it seemed at first as if it might become extinguished. Boiler pressure, 90 lbs.
7.45 Tubes blown.
8.25 Trial started. Fire 2″ thick, half burnt through. Lignite burns with a long flame and not much smoke. On firing the fire becomes very much deadened.
9.00 Fire about 3″ thick. Find it difficult to build up fire.
9.25 Grill half open.
9.40 Forced draught on. Fire 5″ thick.
10.00 Coal not coking at all.
10.43 Fire sliced, finding a thin hard cake of clinker over bars.
11.00 Fire about 6″ thick.
11.05 Stopped fan owing to hot bearing.
11.15 Fire sliced. 26 lbs. thin hard clinker removed. Not sticking to bars.
11.20 Fan on again. Coal burns at front and along the sides.
1.25 Sliced fire. 11 lbs. hard clinker removed. Could be used with a shaking grate.
2.35 Sliced fire.
4.00 Cleaned fire. Lignite burning with very bright yellow flame and in places a green flame. Clinker hard and easily removed.
4.40 Joint in feed pump has failed.
5.00 Shut off fan. On again until 5.07.
5.7 Finished trial. Fire as at start.

CLINKER AND ASH.
152 lbs. clinker.
113 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 63

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.25 a.m.						
8.30	70	70	8.30	10·6	8·5	0·4
9.00	281	351	9.00	13·3	4·3	2·1
9.17	282	633	9.30	10·3	8·2	1·3
9.45	256	889	10.00	11·2	6·1	1·9
10.15	390	1279	10.30	13·6	5·2	0·2
11.00	324	1603	11.00	11·0	7·4	1·2
11.35	268	1871	11.30	9·4	10·3	0·0
11.50	266	2137	12.00	11·7	5·4	3·2
12.15	312	2449	12.30	12·5	5·8	1·3
12.40	297	2746	1.00	11·1	7·7	1·1
1.15	309	3055	1.30	7·2	12·6	0·0
2.17	386	3441	2.00	9·5	10·5	0·0
3.10	321	3762	2.30	11·0	8·4	0·0
3.58	267	4029	3.00	9·3	10·7	0·0
4.20	291	4320	3.30	13·4	5·9	0·0
5.07	260	4580	4.00	13·3	5·8	0·4
			4.30	13·7	3·9	3·0
				11·3	7·4	1·0

OBSERVATIONS MADE DURING BOILER TRIAL No. 63

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.25	108	83	505	72	−·01	−·23	.....
8.40	107	83	510	72	−·01	−·25	470
8.55	111	83	510	72	−·01	−·25	331
9.10	106	84	490	72·5	−·01	−·28	382
9.25	111	85	625	72·5	−·01	−·30	360
9.40	111	85	505	72·5	−·01	−·28	341·5
9.55	111	85	725	72·5	+·25	−·30	261
10.10	113	85	760	72·5	+·25	−·30	433
10.25	115	85	650	73	+·25	−·28	430·5
10.40	112	85	590	73	+·30	−·28	379
10.55	108	85	900	73	+·50	−·28	400
11.10	113	85	490	73	−·01	−·26	632
11.25	118	87	560	73	+·40	−·28	133
11.40	123	87	650	73	+1·00	−·28	352
11.55	123	87	680	73	+1·10	−·28	562
12.10	116	85	630	73	+·80	−·28	512·5
12.25	123	87	660	73	+1·10	−·28	512
12.40	123	87	560	73	+·90	−·26	501·5
12.55	123	86	560	73	+·85	−·26	492·5
1.10	118	87	540	73	+·90	−·26	525·5
1.25	122	86	465	73	+·75	−·26	433·5
1.40	123	89	530	73	+1·20	−·26	410
1.55	120	87	550	73	+1·00	−·26	414·5
2.10	118	87	490	73	+·90	−·26	431
2.25	116	87	550	73	+1·20	−·26	451·5
2.40	120	87	560	73·5	+·90	−·26	492·5
2.55	123	87	510	73·5	+·90	−·26	449
3.10	117	87	545	73·5	+·90	−·26	493·5
3.25	123	85	530	73·5	+·90	−·26	422·5
3.40	121	85	520	73·5	+1·00	−·26	561·5
3.55	119	85	440	73·5	+1·00	−·26	463·5
4.10	121	93	560	73·5	+·70	−·26	152·5
4.25	123	88	630	73·5	+·70	−·26	540
4.40	119	88	700	73·5	+·80	−·28	583
5.07	122	87	560	73·5	+·60	−·26	475
	117·1	85	578	73·0	+·63	−·27	15,164 net

SUMMARY OF OBSERVATIONS

Date—Aug. 8, 1908.	Boiler B. and W. No. 2.	At McGill University.
Commenced—8.25 a.m.	Ended—5.07 p.m.	Duration—522 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Forced, fan feeding into ash-pit
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned May, 1908
4.	Tubes cleaned	7.45 a.m.
5.	Fire cleaned	7.25 a.m., 4.00 p.m.

Fuel.

6.	Kind of coal	No. 40 coal—Western Dominion Collieries Co., Taylorton, Sask.
7.	Analysis of dry coal by weight (%)	$\begin{cases} C=59\cdot8, & H=4\cdot8, & S=0\cdot6 \\ N_2=1\cdot0, & O_2=25\cdot7, & Ash=8\cdot1 \end{cases}$
8.	Calorific value of dry coal B.T.U. per lb	10690
9.	Moisture in coal as fired (%)	29·7
10.	Weight of coal fired (lbs.)	4580
11.	Weight of unburnt coal left (lbs.)	
12.	Weight of clinker (lbs.)	152
13.	Weight of ash (lbs.)	113

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	+0·63
15.	" above fire " "	−0·22
16.	" at damper " "	−0·27
17.	Amount of damper opening	Full
18.	Temperature of air in boiler house (°F.)	85
19.	Flue temperature (°F.)	578
20.	Analysis of dry flue gas by volume (%)	$CO_2=11\cdot3$, O=7·4, CO=1·0, N=80·3

Water and Steam.

21.	Temperature of feed water (°F.)	73
22.	Total weight of feed water corrected for difference of level (lbs.)	15164
23.	Water level in gauge at start (inches)	$6\frac{9}{16}$
24.	Water level in gauge at finish (inches)	$1\frac{11}{16}$
25.	Correction for difference of level, included above (lbs.)	740
26.	Steam pressure by gauge (lbs. per sq. in.)	117·1
27.	Barometer reading (inches)	29·79
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	16·1
29.	Temperature in steam calorimeter (°F.)	292·1

Notes.

This lignite burnt with a fairly long flame and very little smoke. It was not very difficult to work, the clinker being hard but easy to remove. It did not coke at all. It seemed to burn near the dead plate and sides, which seemed to indicate that the air did not penetrate the coal in the centre in spite of the good air pressure.

It could probably be burnt to advantage on a shaking grate. Air admitted over fire. Little smoke. Fire sliced 10.43, 11.15, 1.25, 2.35. Weather fine and clear.

Proximate analysis of dry coal by weight %

Fixed carbon	42·9
Volatile matter	49·0
Ash	8·1

SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 40. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·85. At finish—29·73. Mean—29·79.

Total Quantities.

1.	Date of trial	12/8/08
2.	Duration of trial (hours)	8·7
3.	Weight of coal as fired (lbs.)	4580
4.	Percentage of moisture in coal as fired (%)	29·7
5.	Total weight of dry coal fired (lbs.)	3219
6.	Total ash and refuse (lbs.)	265
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 12·03; (*b*) weighed 8·24	
8.	Total weight of combustible consumed (lbs.)	2832
9.	Total weight of water fed to the boiler corrected for difference of level (lbs.)	15164
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	15100
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	17930

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	370
13.	Dry coal per square foot of grate surface per hour (lbs.)	22·1
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1736
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2061
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·23

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	117·1
18.	Temperature of feed water entering boiler (deg. F.)	73·0
19.	Temperature of escaping gases from boiler (deg. F.)	578
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·90
21.	Percentage of moisture in steam	0·6

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	59·7
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	99

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	3·31
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	3·91
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	5·57
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	6·33

Efficiency.

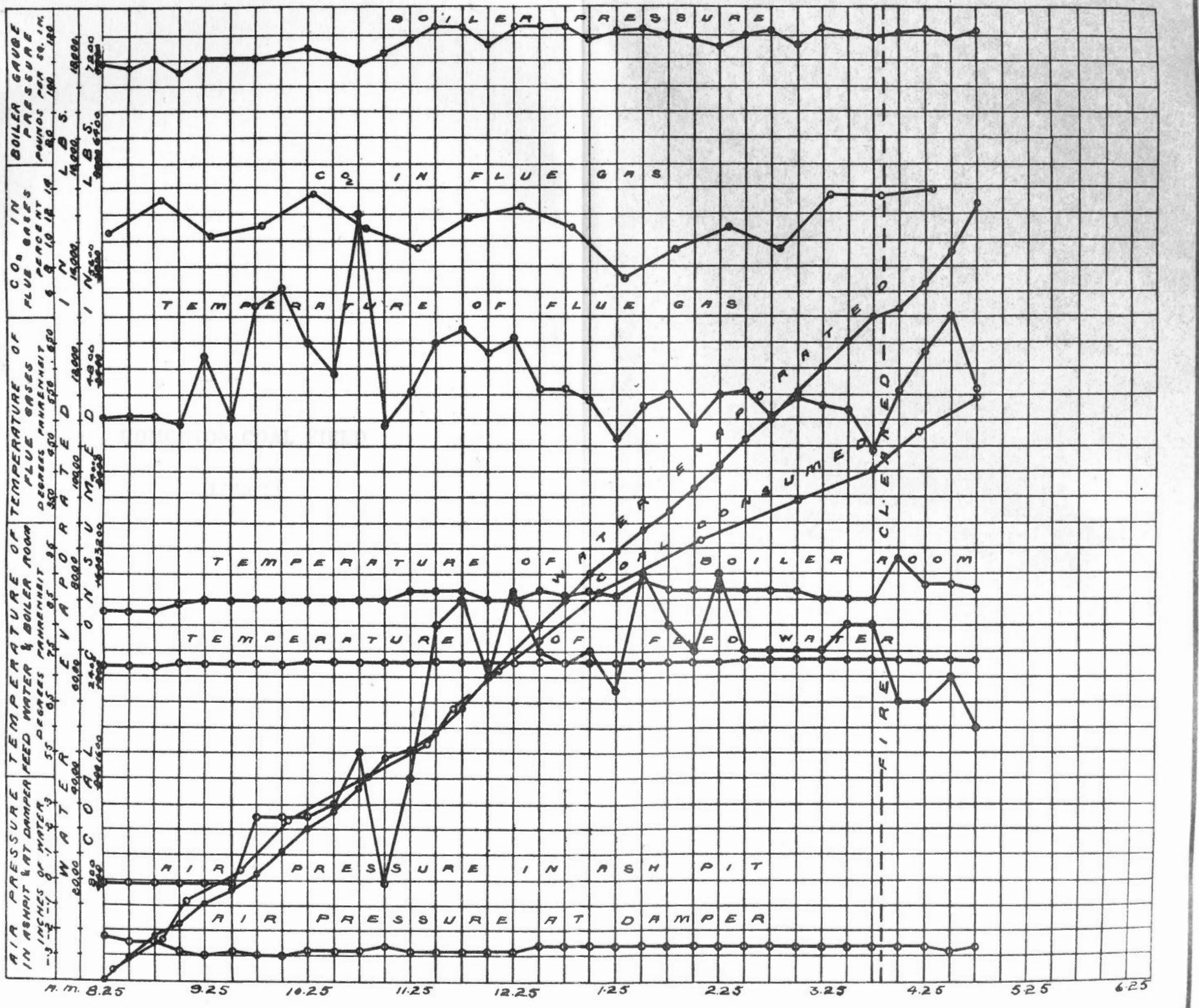
29.	Calorific value of dry coal per lb. (B.T.U.)	10690
30.	Calorific value of the combustible per lb. (B.T.U.)	11640
31.	Efficiency of boiler (based on combustible consumed) (%)	52·5
32.	Efficiency of boiler, including grate (based on dry coal) (%)	50·3

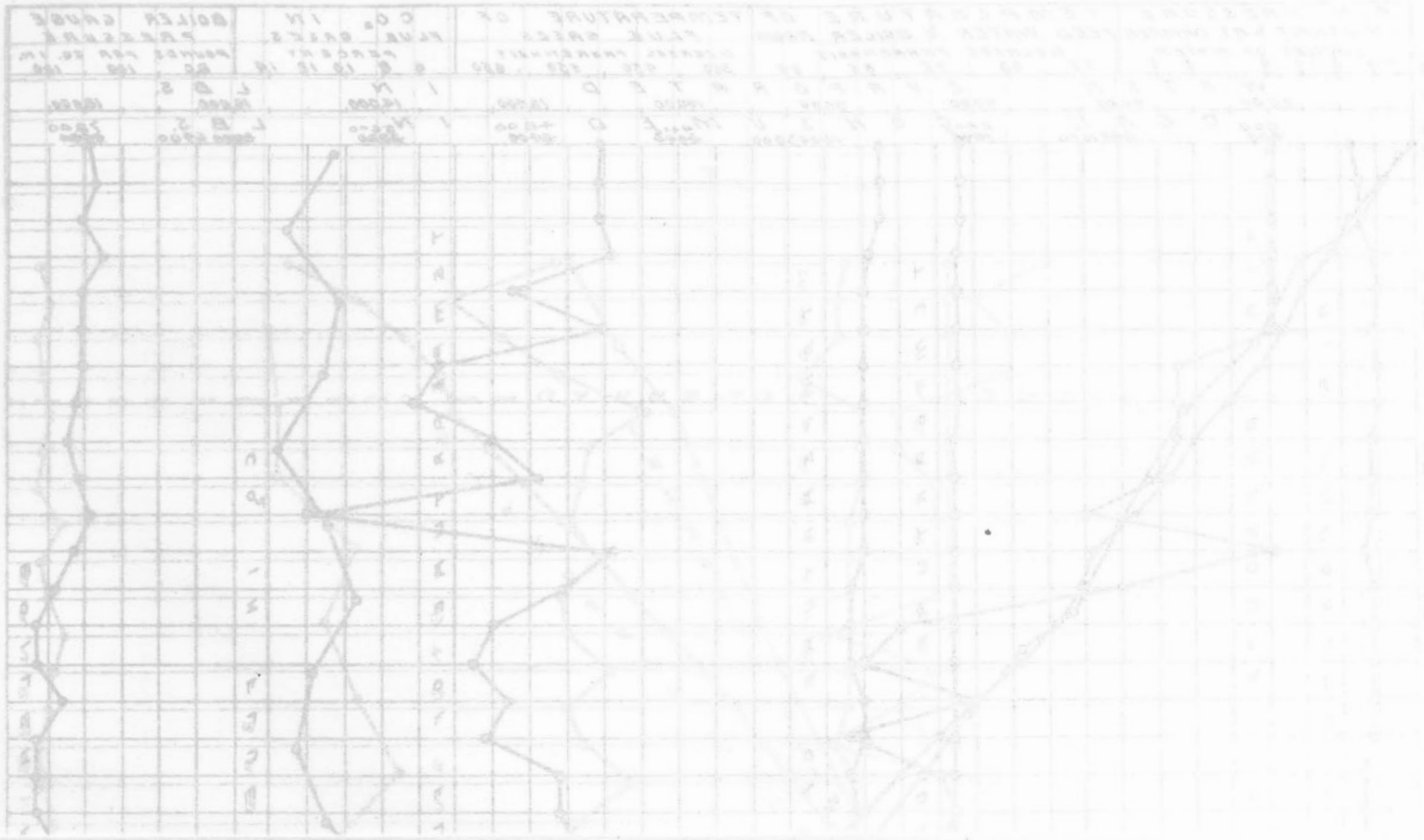
Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	20·4
34.	" " of combustible consumed (from gas analyses) (lbs.)	13·87
35.	" " dry coal (from gas analyses) (lbs.)	12·2
36.	Proportion of heat of fuel in escaping dry flue gases (%)	13·5

G.C.T. 63

COAL Nº 40





EDMONTON COAL FIELD

ALBERTA.

TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 42.

Date—Sept. 10, 1908. Trial—No. G.C.T. 65.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Day fine but cloudy. Coal black, fairly small, not very much dust. Burns with a medium flame.

Time.

7.30 Cleaned fire. Pressure, 125 lbs.
7.40 Cleaned tubes.
8.30 1½" fire, some flame, half burnt through.
9.00 Fire 3" thick.
9.40 Grill one-fourth open.
10.20 Grill closed. As with other lignites not coking at all.
10.55 Sliced fire. Clinker fairly hard and adhering together.
11.25 Sliced fire again. Clinker could not have been removed by shaking grate, very troublesome, forming quickly and keeping air back.
11.50 Sliced, nothing removed.
12.30 Cleaned fire. Clinker in hard slabs, not sticking to bars.
12.40 Steam on under grate.
2.10 Grill one-fourth open.
2.30 Sliced fire. Nothing removed.
5.30 Cleaned fire. Steam having been put on rendered much better fire, the clinker not having caked together so much. With steam under bars shaking grate might be used.
6.30 Finished trial. Fire as at start. No smoke was visible.

CLINKER AND ASH.

265 lbs. clinker.
115 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 65

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.30 a.m.						
8.45	236	236	8.35	12·2	6·2	1·0
9.35	394	630	9.05	13·0	5·3	1·3
10.05	236	866	9.35	9·6	10·2	0·0
10.30	197	1063	10.05	11·3	6·9	1·4
11.00	245	1308	10.35	9·7	9·3	1·1
11.30	167	1475	11.05	9·7	9·5	0·7
12.00	167	1642	11.35	10·6	8·5	0·7
12.30	138	1780	12.05	8·9	10·4	0·6
12.45	129	1909	12.30	7·7	12·3	0·0
1.15	178	2087	1.00	10·8	5·9	3·8
1.45	284	2371	1.30	11·0	7·7	0·9
2.15	216	2587	2.00	10·4	7·6	2·2
2.40	209	2796	2.30	11·7	6·4	1·2
3.20	291	3087	3.00	12·7	5·8	0·5
4.15	315	3400	3.30	9·0	11·1	0·0
4.45	173	3573	4.00	12·5	6·1	0·4
5.10	142	3715	4.30	9·1	10·1	0·1
5.30	84	3799	5.00	8·0	12·2	0·0
6.05	257	4056	5.30	7·5	12·1	0·1
6.30	98	4154	6.00	9·4	11·0	0·0
				10·3	8·7	0·8

OBSERVATIONS MADE DURING BOILER TRIAL No. 65

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.30	116	83	480	67·5	—·01	—·25	.....
8.45	105	85	560	67	—·01	—·28	430
9.00	116	87	570	67·5	—·01	—·28	491·5
9.15	120	86	540	67·5	—·01	—·28	599
9.30	115	86	570	67·5	—·01	—·28	405·5
9.45	103	89	540	67·5	—·01	—·28	570·5
10.00	113	87	570	67·5	—·01	—·28	361·5
10.15	105	88	480	67·5	—·01	—·28	572
10.30	113	87	460	67·5	—·01	—·28	401
10.45	108	87	510	67·5	—·01	—·28	338
11.00	106	91	450	67·5	—·01	—·28	483
11.15	108	90	450	68	—·01	—·28	323
11.30	108	90	450	68	—·01	—·28	303
11.45	107	88	490	68·5	—·01	—·28	313
12.00	111	88	450	68·5	—·01	—·28	399
12.15	115	91	440	68·5	—·01	—·28	404
12.30	102	87	400	68·5	—·01	—·26	342
12.45	112	89	410	68·5	—·01	—·26	223
1.00	119	87	490	68·5	—·01	—·26	270·5
1.15	120	87	590	68·5	—·01	—·26	462
1.30	113	87	570	68·5	—·01	—·26	532·5
1.45	120	87	540	68·5	—·01	—·26	410
2.00	108	87	500	68·5	—·01	—·26	465
2.15	102	88	610	68·5	—·01	—·26	478·5
2.30	113	89	630	68·5	—·01	—·26	411
2.45	118	89	690	68·5	—·01	—·26	483
3.00	116	89	690	68·5	—·01	—·26	480·5
3.15	108	89	650	68·5	—·01	—·26	568·5
3.30	110	89	560	68·5	—·01	—·26	550·5
3.45	118	89	580	68·5	—·01	—·26	455
4.00	122	89	600	68	—·01	—·26	412·5
4.15	118	89	530	68	—·01	—·26	493
4.30	122	90	550	68	—·01	—·26	445
4.45	114	90	540	68·5	—·01	—·26	532
5.00	121	91	530	68·5	—·01	—·26	410
5.15	115	89	480	68·5	—·01	—·26	512
5.30	116	89	470	68·5	—·01	—·26	394
5.45	118	89	540	68·5	—·01	—·26	242·5
6.00	123	89	590	68·5	—·01	—·26	532·5
6.15	117	88	560	68·5	—·01	—·26	472
6.30	116	88	490	68·5	—·01	—·26	450·5
	113·4	88	532	68·1	—·01	—·27	17,431 net

SUMMARY OF OBSERVATIONS

Date—Sept. 10, 1908.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.30 a.m.	Ended—6.30 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned May, 1908
4.	Tubes cleaned	7.40 a.m.
5.	Fire cleaned	7.30 a.m., 12.30 and 5.30 p.m.

Fuel.

6.	Kind of coal	No. 42—Parkdale Coal Co., Edmonton, Alberta.
7.	Analysis of dry coal by weight (%)	C = 65·3, H = 4·6, S = 0·4 N_2 = 1·2, O_2 = 17·6, Ash = 10·9
8.	Calorific value of dry coal B.T.U. per lb	10910
9.	Moisture in coal as fired (%)	19·7
10.	Weight of coal fired (lbs.)	4154
11.	Combustible matter in ash and clinker (%)	44·7
12.	Weight of clinker (lbs.)	115
13.	Weight of ash (lbs.)	265

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−·01
15.	" above fire " "	−·23
16.	" at damper " "	−·27
17.	Amount of damper opening	Full
18.	Temperature of air in boiler house (°F.)	88·0
19.	Flue temperature (°F.)	532·0
20.	Analysis of dry flue gas by volume (%)	CO_2 = 10·3, O_2 = 8·7, CO = 0·8, N = 80·2

Water and Steam.

21.	Temperature of feed water (°F.)	68·1
22.	Total weight of feed water corrected for difference of level (lbs.)	17431
23.	Water level in gauge at start (inches)	$2\frac{5}{16}$
24.	Water level in gauge at finish (inches)	$2\frac{3}{8}$
25.	Correction for difference of level included above (lbs.)	−10
26.	Steam pressure by gauge (lbs. per sq. in.)	113·4
27.	Barometer reading (inches)	29·86
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	15·2
29.	Temperature in steam calorimeter (°F.)	290·1

Notes.

The clinker proved very troublesome, caking together and necessitating frequent slicing. Upon putting steam on the fire, was much more easily worked; the coal could be used with a shaking grate if steam were used. The coal did not coke. No smoke. Grill was kept open a little. Fire kept about 3" thick. Sliced 10.55, 11.50, 12.30, 2.30. Weather, fine but cloudy.

Proximate analysis of dry coal by weight %

Fixed carbon	51·3
Volatile matter	37·8
Ash	10·9

SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 42. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·92. At finish—29·81. Mean—29·86.

Total Quantities.

1.	Date of trial	10/9/08
2.	Duration of trial (hours)	10·0
3.	Weight of coal as fired (lbs.)	4154
4.	Percentage of moisture in coal as fired (%)	19·7
5.	Total weight of dry coal fired (lbs.)	3336
6.	Total ash and refuse (lbs.)	380
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 19·72; (*b*) weighed.	11·4
8.	Total weight of combustible consumed from analyses (lbs.)	2677
9.	Total weight of water fed to the boiler corrected for difference of level (lbs.)	17431
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17350
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	20690

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	335
13.	Dry coal per square foot of grate surface per hour (lbs.)	19·95
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1735
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2069
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·39

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	113·4
18.	Temperature of feed water entering boiler (deg. F.)	68·1
19.	Temperature of escaping gases from boiler (deg. F.)	532
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·26
21.	Percentage of moisture in steam	0·60

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	60·0
23.	Builders' rated horse-power	60·0
24.	Percentage of builders' rated horse-power developed	100·0

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	4·2
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	4·98
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	6·18
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	7·73

Efficiency.

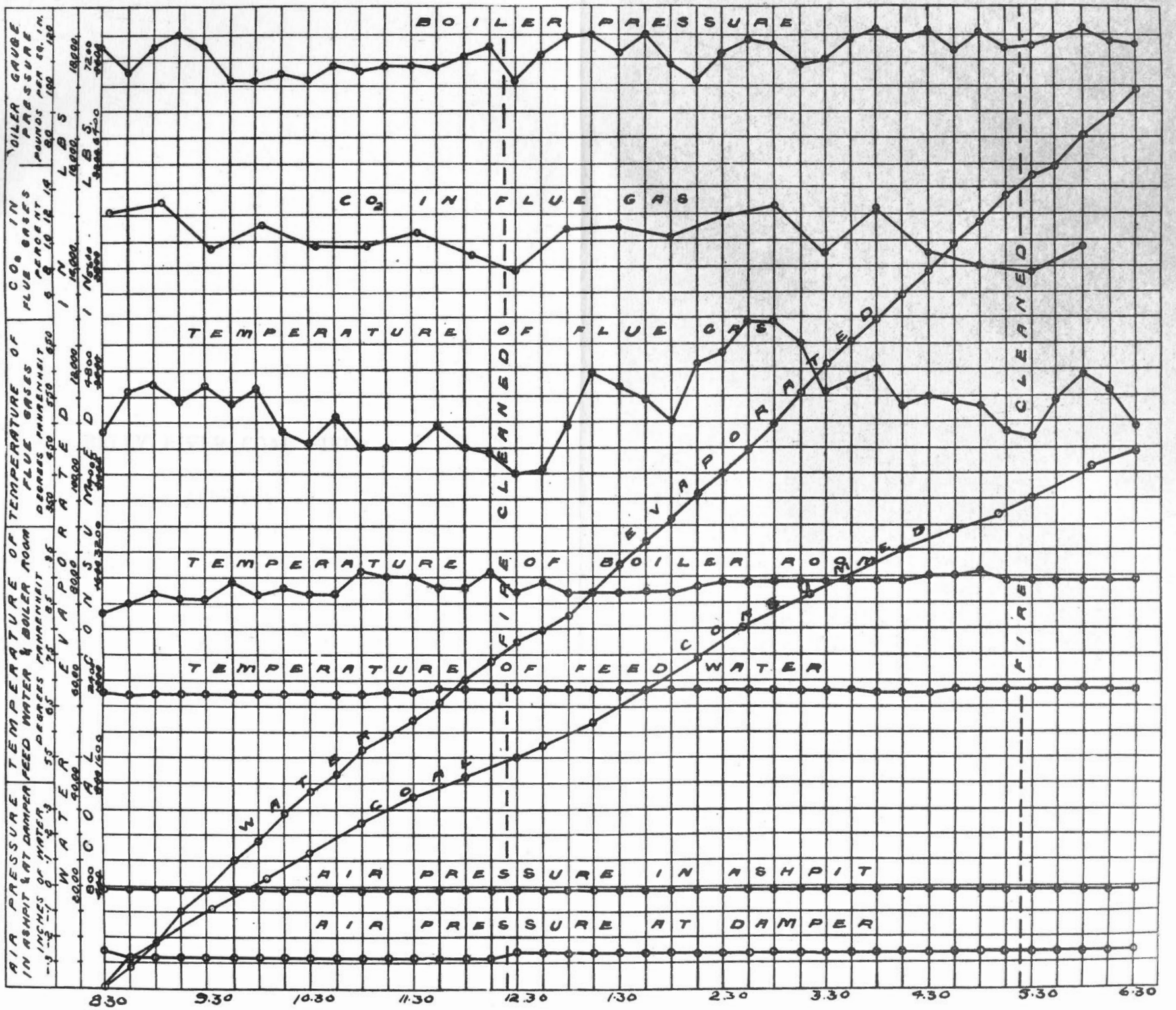
29.	Calorific value of dry coal per lb. (B.T.U.)	10910
30.	Calorific value of the combustible per lb. (B.T.U.)	12240
31.	Efficiency of boiler (based on combustible consumed) (%)	60·8
32.	Efficiency of boiler, including grate (based on dry coal) (%)	54·7

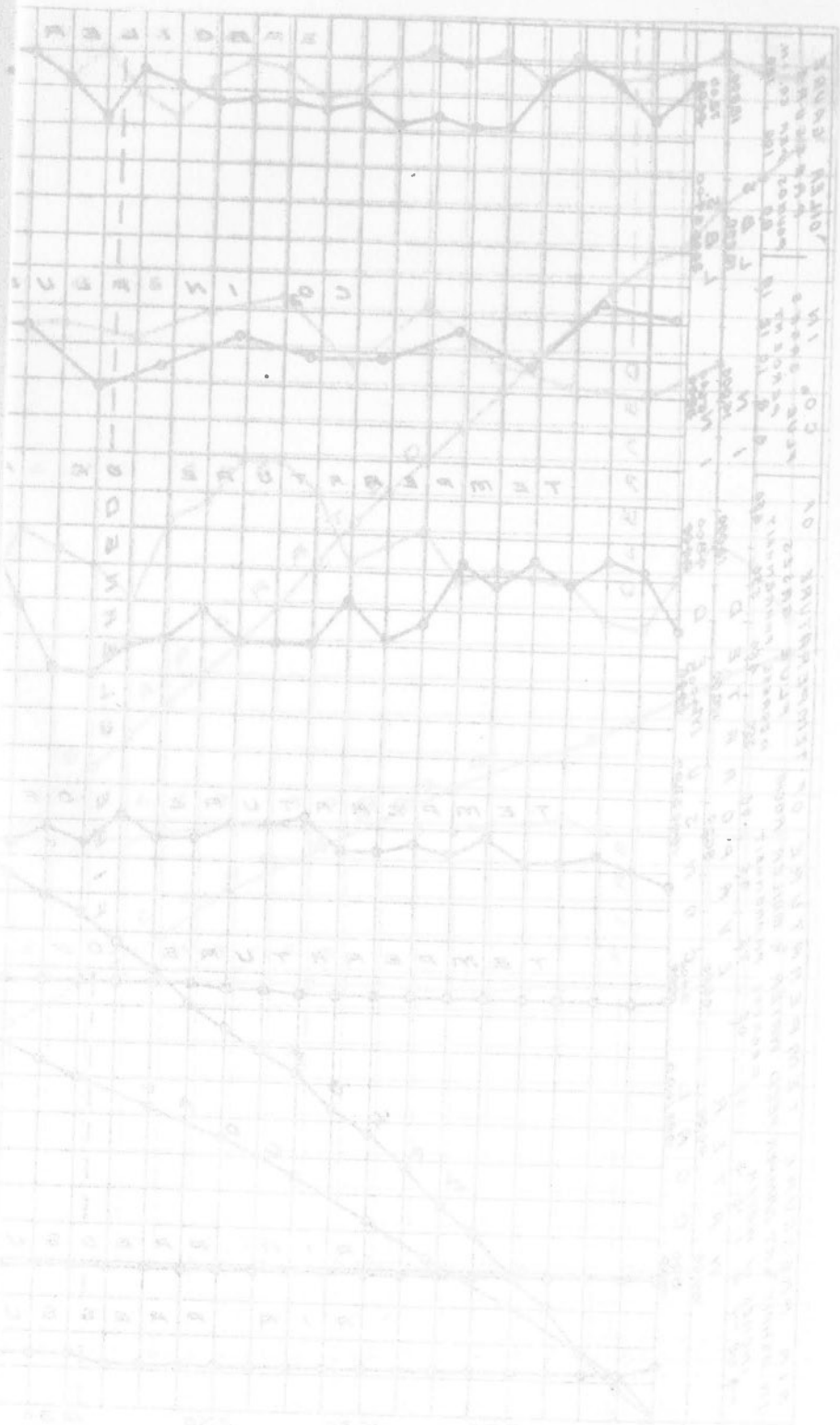
Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	22·5
34.	" " of combustible consumed (from gas analyses) (lbs.)	18·3
35.	" " dry coal (from gas analyses) (lbs.)	14·69
36.	Proportion of heat of fuel in escaping dry flue gases (%)	14·4

G.C.T. 65

COAL No. 42





BELLY RIVER COAL FIELD

ALBERTA.

TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 43.

Date—Sept. 8, 1908. Trial Number—G.C.T. 64.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Coal in bright lumps with fair amount of dust. Burns with considerable flame. Very little smoke.

Time.	
7.00	Steam on boiler.
8.10	Cleaned fire. Pressure, 105 lbs. Made up with No. 43 lignite.
8.25	Tubes blown.
9.05	Started trial. Fire 1½″ thick, well burnt through.
9.55	6″ fire, including dirt—about 3½″ actual.
11.25	Sliced fire. 46 lbs. soft viscous clinker removed, clinker sticks together but not to bars.
12.00	Fire still rather dead, sliced again. Removed 52 lbs.
12.30	Steam on.
12.45	Cleaned out fire. 131 lbs. clinker removed easily. Would do well on a shaking grate, with steam under bars.
1.15	Fire still dull. Put fan on.
1.50	Grill opened.
3.45	Raked a great deal of dirt out as fire had a large amount at the bottom, forming thick bed.
4.25	As before, raked much dirt from front of fire.
5.55	Shut down fan.
6.10	Cleaned fire. Easily removed 116 lbs. of clinker. Very soft dirt in small pieces.
7.05	Finished trial. Fire as at start. 119 lbs. of ash were removed from below the grate.

CLINKER AND ASH.

556 lbs. clinker.
119 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 64

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 9.05 a.m.						
9.07	179	179	9.00	8·0	11·8	0·4
9.55	448	627	9.30	10·9	5·7	4·0
10.25	270	897	10.00	9·5	9·5	0·3
10.55	175	1072	10.30	10·1	8·4	1·2
11.25	223	1295	11.00	8·8	9·0	2·2
12.10	239	1534	11.30	7·3	12·0	0·3
12.45	194	1728	12.00	7·7	11·7	0·6
1.15	49	1977	12.30	7·2	11·3	1·3
1.45	299	2276	1.00	5·7	14·8	0·2
2.00	167	2443	1.30	11·8	2·8	6·6
2.30	112	2555	2.00	14·4	4·3	0·0
3.00	246	2801	2.30	10·7	8·8	0·0
3.30	200	3001	3.00	9·4	10·4	0·0
4.00	231	3232	3.30	10·6	8·7	0·0
4.30	147	3379	4.00	10·4	8·6	0·2
5.05	272	3651	4.30	15·0	4·3	0·0
5.35	241	3892	5.00	11·6	7·8	0·0
6.10	160	4052	5.30	12·1	5·8	1·5
6.15	77	4129	6.00	8·8	10·9	0·6
7.05	274	4403	6.30	14·0	2·7	2·7
				10·2	8·5	1·1

OBSERVATIONS MADE DURING BOILER TRIAL No. 64

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
9.05	104	77	490	65	−·02	−·32	.....
9.20	115	78	590	65	−·02	−·32	430
9.35	110	77	550	65·5	−·02	−·28	505
9.50	108	77	510	66	−·02	−·30	513·5
10.05	106	79	500	66·5	−·02	−·30	452
10.20	108	78	550	66·5	−·02	−·30	322
10.35	118	79	480	66·5	−·02	−·30	419·5
10.50	108	79	450	66·5	−·02	−·30	453
11.05	108	79	450	66·5	−·02	−·30	445
11.20	107	79	420	66·5	−·02	−·30	341·5
11.35	103	79	440	66·5	−·02	−·30	404
11.50	108	77	440	66·5	−·02	−·30	260
12.05	110	83	450	66·5	−·02	−·30	375
12.20	109	77	410	67	−·02	−·26	194
12.35	116	77	430	67	−·02	−·28	321
12.50	107	83	430	67	−·02	−·22	330
1.05	103	79	400	67	−·02	−·24	98
1.20	119	79	860	67	+·30	−·36	285
1.35	123	79	900	67	+·10	−·34	530
1.50	113	77	850	67	+·10	−·34	650
2.05	123	78	820	66·5	0·0	−·34	495
2.20	110	78	750	66·5	0·0	−·34	553·5
2.35	123	79	780	66·5	0·0	−·34	407·5
2.50	119	78	730	66·5	0·0	−·34	451
3.05	106	78	750	66·5	0·0	−·34	601
3.20	123	78	880	66·5	0·0	−·36	450
3.35	118	78	760	66·5	0·0	−·34	530·5
3.50	108	80	600	66·5	0·0	−·34	488
4.05	115	78	700	66·5	0·0	−·34	370·5
4.20	121	78	890	66·5	0·0	−·34	513
4.35	118	78	750	66·5	+·05	−·36	720·5
4.50	116	78	930	66·5	+·05	−·36	573
5.05	123	78	720	66·5	+·05	−·32	685·5
5.20	111	77	590	66·5	+·05	−·32	532
5.35	118	78	850	66·5	0·0	−·36	472
5.50	108	78	560	66·5	0·0	−·34	671·5
6.05	123	77	630	66·5	−·02	−·34	415·5
6.20	114	80	660	66·5	−·02	−·34	371
6.35	118	77	700	66·5	−·02	−·34	633
6.50	120	77	600	66·5	−·02	−·34	513
7.05	119	77	450	66·5	−·02	−·34	424
	113·6	78·3	627	66·5	+·01	−·32	18,199·5 net

SUMMARY OF OBSERVATIONS

Date—Sept. 8, 1908. Boiler—B. and W. No. 2. At McGill University.
Commenced—9.05 a.m. Ended—7.05 p.m. Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural and forced—fan feeding into ash-pit
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned May, 1908
4.	Tubes cleaned	8.25 a.m.
5.	Fire cleaned	8.10 a.m., 12.45 and 6.10 p.m.

Fuel.

6.	Kind of coal	No. 43 coal—Canada West Coal and Coke Co., Taber, Alta.
7.	Analysis of dry coal by weight (%)	$\begin{cases} C=64\cdot5, \quad H=4\cdot7, \quad S=1\cdot4 \\ N_2=1\cdot5, \quad O_2=13\cdot8, \quad Ash=14\cdot1 \end{cases}$
8.	Calorific value of dry coal B.T.U. per lb	11040
9.	Moisture in coal as fired (%)	11·3
10.	Weight of coal fired (lbs.)	4403
11.	Weight of unburnt coal left (lbs.)	53·6
12.	Weight of clinker (lbs.)	556
13.	Weight of ash (lbs.)	119

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	+0·01
15.	" above fire " "	−0·28
16.	" at damper " "	−0·32
17.	Amount of damper opening	Full
18.	Temperature of air in boiler house (°F.)	78·3
19.	Flue temperature (°F.)	627
20.	Analysis of dry flue gas by volume (%)	$CO_2=10\cdot2$, $O=8\cdot5$, $CO=1\cdot1$, $N=80\cdot2$

Water and Steam.

21.	Temperature of feed water (°F.)	66·5
22.	Total weight of feed water, corrected for difference of level (lbs.)	18200
23.	Water level in gauge at start (inches)	$3\frac{1}{16}$
24.	Water level in gauge at finish (inches)	4
25.	Correction for difference of level (lbs.)	−10
26.	Steam pressure by gauge (lbs. per sq. in.)	113·6
27.	Barometer reading (inches)	30·03
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	16·2
29.	Temperature in steam calorimeter (°F.)	290·2

Notes.

This lignite looked very much like a coal, being in fairly bright lumps with dust. It burns with a long flame and but a little light white smoke. The clinker at first was viscous and adhered together but not to the bars. The rapid formation of dirt and clinker was a source of somewhat irregular evaporation. Steam under the bars rendered the clinker suitable for use with a shaking grate. It is necessary to admit air above the bars. Fire sliced 11.25. Very little smoke. Weather, fine.

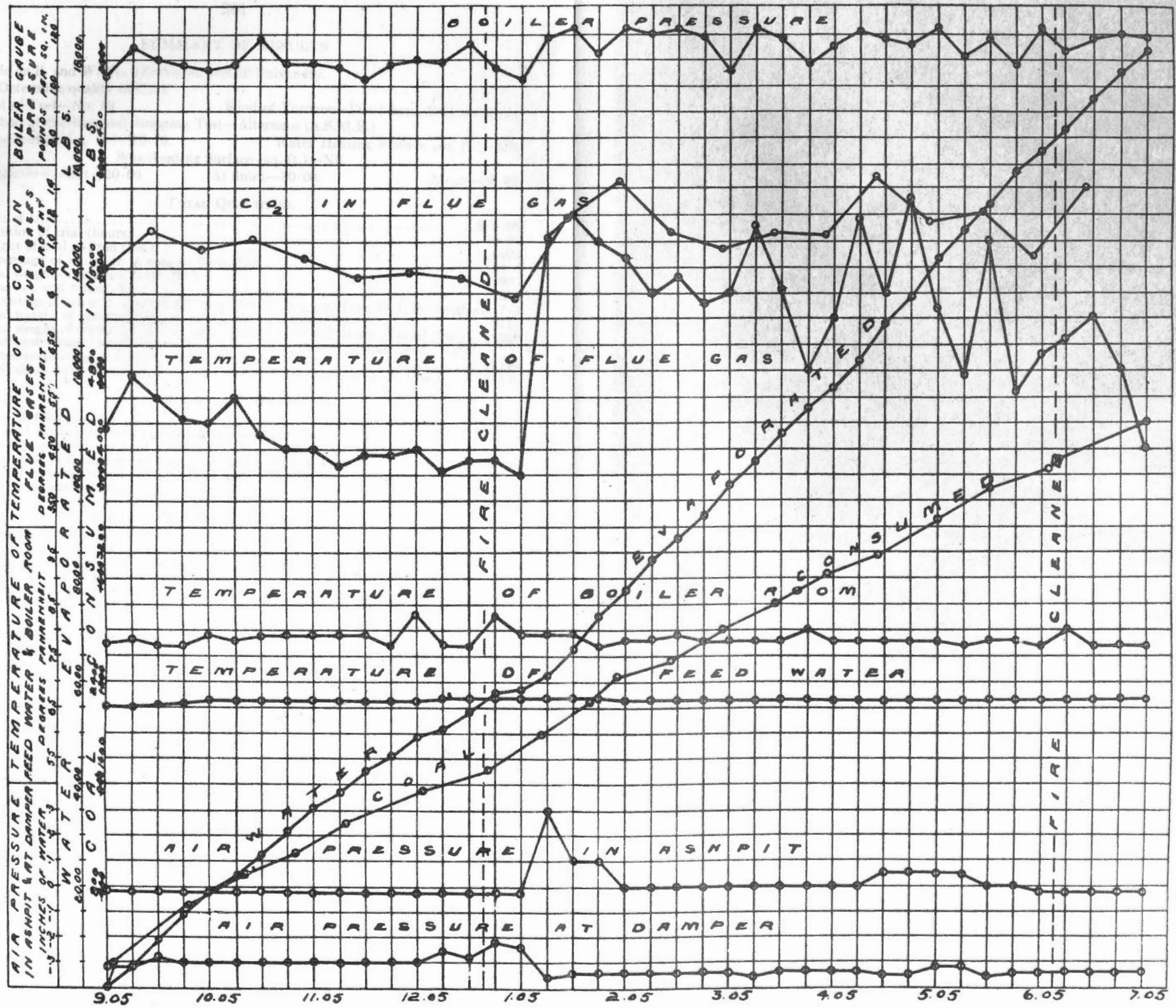
Proximate analysis of dry coal by weight %

Fixed carbon	49·9
Volatile matter	36·0
Ash	14·1

GRAPHIC RECORD OF BOILER TRIAL.

G.C.T. 64

COAL NO. 43



SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 43. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—30·06. At finish—30·00. Mean—30·03.

Total Quantities.

1.	Date of trial	8/9/08
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	4403
4.	Percentage of moisture in coal as fired (%)	11·3
5.	Total weight of dry coal fired (lbs.)	3905
6.	Total ash and refuse (lbs.)	675
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 30·4; (*b*) weighed	17·3
8.	Total weight of combustible consumed, from analyses (lbs.)	2717
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	18200
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	18120
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	21630

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	390·5
13.	Dry coal per square foot of grate surface per hour (lbs.)	23·3
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1812
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2163
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·38

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	113·6
18.	Temperature of feed water entering boiler (deg. F.)	66·5
19.	Temperature of escaping gases from boiler (deg. F.)	627
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·33
21.	Percentage of moisture in steam	0·6

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	62·7
23.	Builders' rated horse-power	60·0
24.	Percentage of builders' rated horse-power developed	100·4

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	4·15
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	4·91
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	5·54
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	7·97

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	11040
30.	Calorific value of the combustible per lb. (B.T.U.)	12850
31.	Efficiency of boiler (based on combustible consumed) (%)	59·9
32.	Efficiency of boiler, including grate (based on dry coal) (%)	48·4

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	22·1
34.	" " of combustible consumed (from gas analyses) (lbs.)	20·5
35.	" " dry coal (from gas analyses) (lbs.)	14·25
36.	Proportion of heat of fuel in escaping dry flue gases (%)	17·0

TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 44.

Date—Sept. 11, 1908. Trial Number—G.C.T. 66.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Day fine but cloudy. Blow-off examined and found tight. Lignite of black and fairly bright appearance, medium sized lumps and fair amount of dust.

Time.
7.30 Cleaned fire and made up with No. 44 coal—105 lbs.
7.40 Tubes cleaned.
8.35 Started trial. Fire 1″ well burnt through.
8.40 Burns with a fairly long flame.
9.05 Keeping 3″ fire.
9.15 Grill half open.
9.50 Sliced. Viscous clinker over bars, none removed.
10.20 Sliced. Removed 28 lbs. viscous clinker, which was very hard on cooling, could not use on shaking grate.
10.35 Steam on under bars.
2.10 Fire cleaned. Clinker had been rendered more porous by steam and very little difficulty was experienced after turning the steam on. Clinker was in hard lumps, would not be suitable for shaking grate. No smoke.
3.05 Finished trial. Fire as at start.
Trial concluded, all available coal having been burnt.

Clinker and Ash.

187 lbs. clinker.
46 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 66

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.35 a.m.						
8.40	227	227	8.40	10·1	4·4	5·8
9.25	317	544	9.10	10·1	4·8	6·1
9.50	186	730	9.40	8·0	11·6	0·3
10.25	215	945	10.10	10·0	8·4	1·0
10.55	145	1090	10.40	11·0	6·8	1·2
11.25	205	1295	11.10	12·9	5·7	0·5
11.55	148	1443	11.40	11·1	7·4	0·7
12.30	188	1631	12.10	9·4	10·4	0·0
1.00	282	1913	12.40	10·4	7·7	1·7
1.35	87	2000	1.10	12·0	5·1	2·5
1.57	145	2145	1.40	10·7	8·9	0·2
3.05	297	2442	2.10	8·4	11·4	0·0
			2.40	12·3	5·3	2·3
				10·5	7·5	1·7

OBSERVATIONS MADE DURING BOILER TRIAL No. 66

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.35	102	85	480	68	—·01	—·26	.....
8.50	115	84	500	68	—·01	—·26	330
9.05	108	87	520	68	—·01	—·28	590·5
9.20	102	87	470	68	—·01	—·28	573
9.35	107	87	480	68	—·01	—·28	353
9.50	113	87	480	68	—·01	—·30	371·5
10.05	108	87	580	68	—·01	—·30	421
10.20	118	89	500	68	—·01	—·30	430·5
10.35	121	89	640	68·5	—·01	—·28	350
10.50	121	87	690	68·5	—·01	—·28	493
11.05	122	89	690	68·5	—·01	—·28	503
11.20	111	90	650	68·5	—·01	—·30	630
11.35	118	89	610	68·5	—·01	—·28	414·5
11.50	113	89	690	68·5	—·01	—·28	534
12.05	121	88	620	68·5	—·01	—·28	500
12.20	123	87	590	68·5	—·01	—·28	450
12.35	123	87	560	68·5	—·01	—·24	524
12.50	123	87	560	68·5	—·01	—·24	455·5
1.05	123	87	590	68·5	—·01	—·24	492
1.20	123	87	620	68·5	—·01	—·26	521
1.35	123	87	610	68·5	—·01	—·26	400
1.50	123	88	590	68·5	—·01	—·24	449
2.05	119	90	540	68·5	—·01	—·26	463
2.20	116	93	540	68·5	—·01	—·26	338
2.35	123	90	600	68·5	—·01	—·25	500
2.50	123	90	570	68·5	—·01	—·25	612
3.05	118	90	460	68·5	—·01	—·25	471
	117	88	571	68·3	—·01	—·27	12,169·5 net

SUMMARY OF OBSERVATIONS

Date—Sept. 11, 1908.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.35 a.m.	Ended—3.05 p.m.	Duration—390 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Forced fan-feeding into ash-pit.
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned May, 1908
4.	Tubes cleaned	7.40 a.m.
5.	Fire cleaned	7.30 a.m., 2.10 p.m.

Fuel.

6.	Kind of coal, No. 44,	Galt Colliery, Alberta Railway & Irrigation Co., Lethbridge, Alta.
7.	Analysis of dry coal by weight (%)	C = 66·5, H = 4·9, S = 0·8, N_2 = 1·7, O = 15·1, Ash = 11·0
8.	Calorific value of dry coal B.T.U. per lb	11710
9.	Moisture in coal as fired (%)	8·3
10.	Weight of coal fired (lbs.)	2442
11.	Weight of unburnt coal left (lbs.)	26·6
12.	Weight of clinker (lbs.)	187
13.	Weight of ash (lbs.)	46

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−0·01
15.	" above fire " "	−0·23
16.	" at damper " "	−0·27
17.	Amount of damper opening	Full
18.	Temperature of air in boiler house (°F.)	88
19.	Flue temperature (°F.)	571
20.	Analysis of dry flue gas by volume (%)	CO_2 = 10·5, O = 7·5, CO = 1·7, N = 80·3

Water and Steam.

21.	Temperature of feed water (°F.)	68·3
22.	Total weight of feed water corrected for difference of level (lbs.)	12170
23.	Water level in gauge at start (inches)	3½
24.	Water level in gauge at finish (inches)	3⅛
25.	Correction for difference of level included above (lbs.)	+20
26.	Steam pressure by gauge (lbs. per sq. in.)	117
27.	Barometer reading (inches)	29·83
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	15·8
29.	Temperature in steam calorimeter (°F.)	292

Notes.

Short trial due to insufficiency of fuel. To work fire easily steam should be used. Previous to using steam clinker was viscous and difficult to remove. Could not use on a shaking grate. No smoke. Sliced 9.50, 10.20. Weather fine but cloudy.

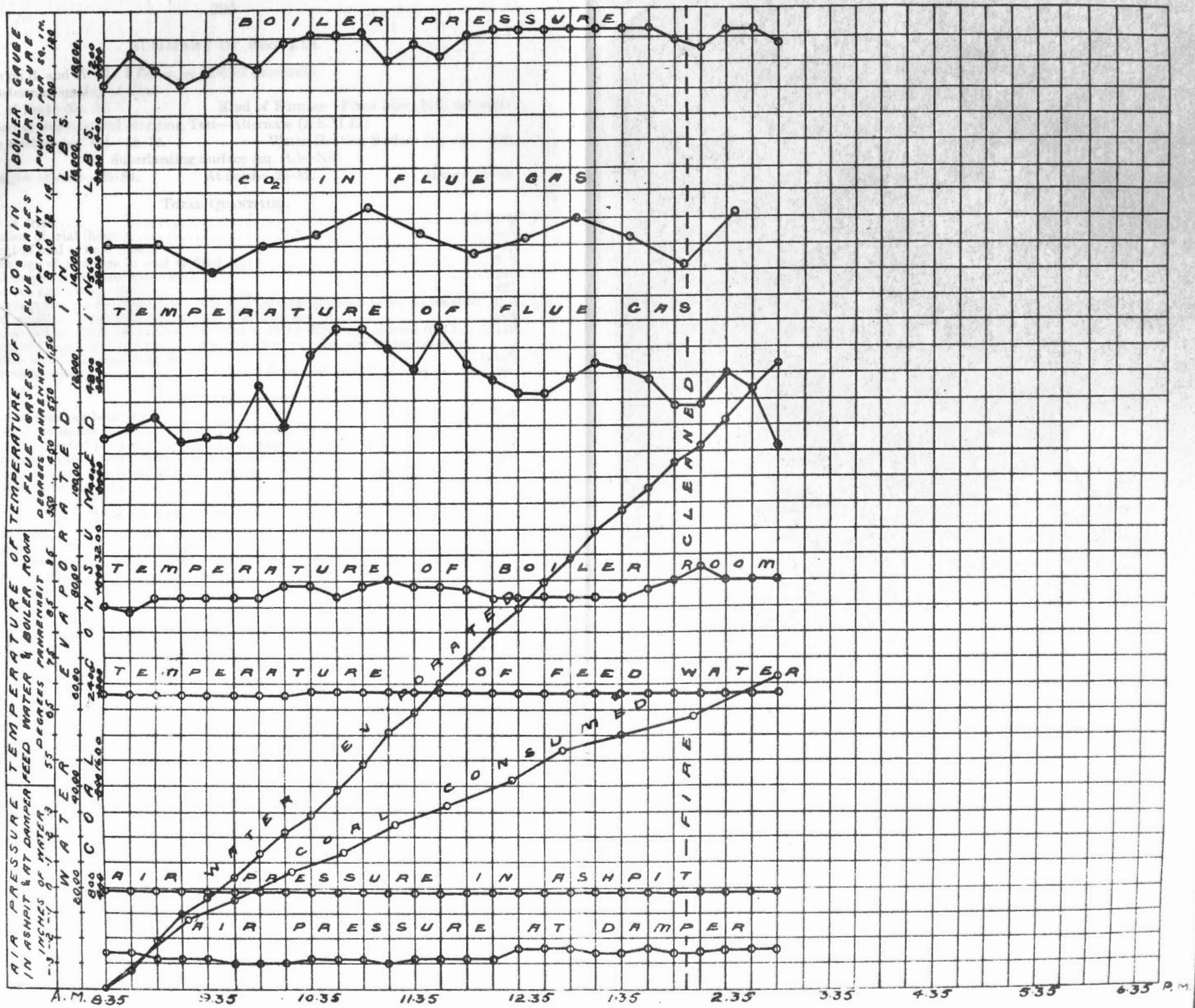
Proximate analysis of dry coal by weight %

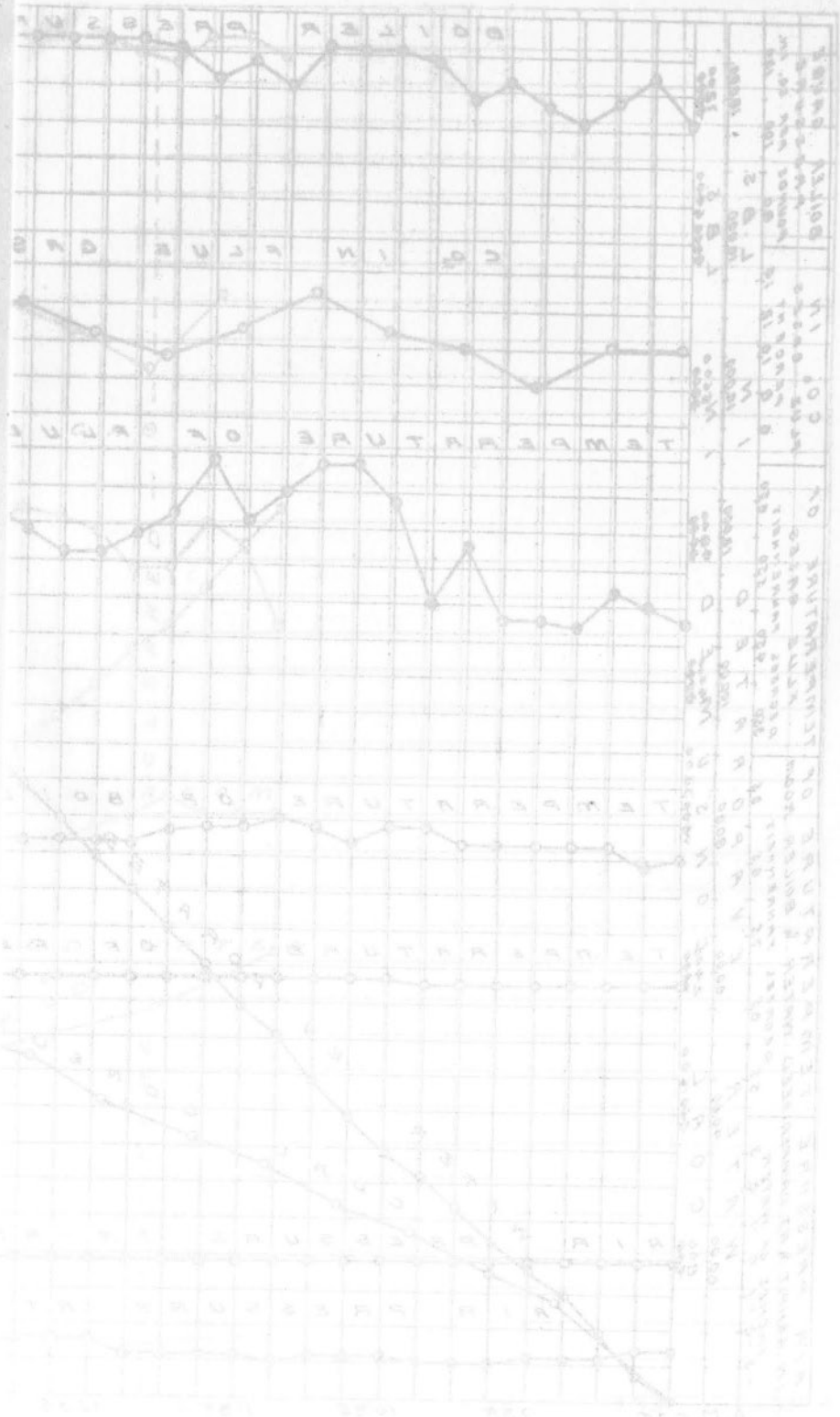
Fixed carbon	51·5
Volatile matter	37·5
Ash	11·0

GRAPHIC RECORD OF BOILER TRIAL.

G.C.T. 66

COAL No. 44





SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 44. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·84. At finish—29·82. Mean—29·83.

Total Quantities.

1.	Date of trial	11/9/08
2.	Duration of trial (hours)	6·5
3.	Weight of coal as fired (lbs.)	2442
4.	Percentage of moisture in coal as fired (%)	8·3
5.	Total weight of dry coal fired (lbs.)	2240
6.	Total ash and refuse (lbs.)	233
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 15·0; (*b*) weighed	10·4
8.	Total weight of combustible consumed from analyses (lbs.)	1904
9.	Total weight of water fed to the boiler corrected for difference of level (lbs.)	12170
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	12110
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	14450

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	345
13.	Dry coal per square foot of grate surface per hour (lbs.)	20·5
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1863
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2220
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·5

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	117
18.	Temperature of feed water entering boiler (deg. F.)	68·3
19.	Temperature of escaping gases from boiler (deg. F.)	571
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·26
21.	Percentage of moisture in steam	0·6

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	64·4
23.	Builders' rated horse-power	60·0
24.	Percentage of builders' rated horse-power developed	107

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	4·98
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	5·92
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	6·45
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	7·58

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	11710
30.	Calorific value of the combustible per lb. (B.T.U.)	13160
31.	Efficiency of boiler (based on combustible consumed) (%)	55·7
32.	Efficiency of boiler, including grate (based on dry coal) (%)	53·0

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	20·5
34.	" " of combustible consumed (from gas analyses) (lbs.)	16·0
35.	" " dry coal (from gas analyses) (lbs.)	13·6
36.	Proportion of heat of fuel in escaping dry flue gases (%)	13·46

EASTERN CROWSNEST PASS.

FRANK-BLAIRMORE COAL FIELD.

ALBERTA.

TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 48.

Date—Sept. 14, 1908. Trial Number—G.C.T. 67.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Bars have been changed from ½" to ⅜", air space to suit coal; fines from ¾" screen. Day fine and clear.

Time.
a.m.
7.30 Cleaned out. Pressure, 80 lbs.
7.45 Tubes blown. (Pressure, 105 lbs.)
8.45 Trial started. Fire 2" thick, well burnt through. Burns with a fairly short flame. The coal cokes considerably.
9.10 Fire 3" thick.
9.45 Forced draught in ash-pit.
10.00 Fire 4½" thick. Still coking very badly.
12.30 Fire cleaned. No clinker, only a fine soft white ash, all of which would pass through a shaking grate. Fan off.
12.45 Fan on.
1.30 Grill one-fourth open. Smoke—not very heavy and brown.
2.10 Fire about 6" thick.
3.40 Grill closed.
5.30 Fan off. Cleaned fire—all soft ash as before.
5.50 Fan on again.
6.35 Fan stopped.
7.00 Fire as start. Stopped test.

CLINKER AND ASH.
412 lbs. clinker.
95 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 67

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.45 a.m.						
9.00	124	124	8.45	7·6	10·0	1·0
9.30	160	284	9.15	7·8	10·5	1·2
10.00	187	471	9.45	7.4	10·7	1·1
10.25	142	613	10.15	11·1	7·3	1·1
10.55	153	766	10.45	8·3	10·3	1·1
11.35	161	927	11.15	12·7	6·5	0·3
12.05	164	1091	11.45	6·7	13·0	0·5
12.30	101	1192	12.15	8·1	11·5	0·8
12.50	75	1267	12.45	5·9	13·8	0·0
1.30	325	1592	1.15	4·8	15·5	0·0
2.00	217	1809	1.45	10·3	9·2	0·3
2.25	87	1896	2.15	8·0	12·6	0·0
2.55	140	2036	2.45	6·6	13·1	0·4
3.35	179	2215	3.15	11·7	6·8	0·6
4.05	140	2355	3.45	8·3	11·4	0·2
4.45	204	2559	4.15	8·3	10·7	0·5
5.30	173	2732	4.45	7·2	13·0	0·0
5.50	135	2867	5.15	4·8	15·8	0·0
6.20	100	2967	5.45	5·0	14·6	0·0
7.00	37	3004	6.15	6·8	13·1	0·0
				7·9	11·5	0·4

OBSERVATIONS MADE DURING BOILER TRIAL No. 67

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.45	116	76	450	66	−·01	−·28	.....
9.00	113	75	450	66	−·01	−·28	430
9.15	114	77	370	66·5	−·01	−·28	374
9.30	113	77	410	66·5	−·01	−·28	320
9.45	123	79	410	66·5	+·05	−·30	363
10.00	119	80	450	67	+·15	−·30	355
10.15	120	82	520	67	+·10	−·30	450·5
10.30	123	82	460	67	+·05	−·30	543
10.45	116	80	510	67·5	+·10	−·28	414·5
11·00	123	80	460	67·5	+·10	−·28	494·5
11.15	117	80	460	67·5	+·05	−·28	370
11.30	109	79	530	67·5	+·10	−·28	493·5
11.45	123	80	540	67·5	+·30	−·28	513·5
12.00	123	81	590	67·5	+·40	−·28	444
12.15	123	81	540	67·5	+·45	−·24	554
12.30	113	77	490	67·5	+·40	−·22	452
12.45	115	79	390	67·5	−·01	−·25	200·5
1.00	123	82	650	67·5	+·60	−·25	221·5
1.15	123	82	550	67·5	+·35	−·25	587
1.30	123	81	540	67·5	+·35	−·25	371
1.45	123	81	600	67·5	+·45	−·26	363·5
2.00	123	84	610	67·5	+·45	−·28	543
2.15	123	83	650	67·5	+·45	−·28	613
2.30	123	85	550	67·5	+·30	−·26	498·5
2.45	118	83	520	67·5	+·25	−·26	579
3.00	118	83	525	67·5	+·20	−·26	331
3.15	122	85	500	67·5	+·40	−·26	433
3.30	110	83	500	67·5	+·45	−·26	563·5
3.45	116	85	530	67·5	+·40	−·26	378·5
4.00	123	85	510	67·5	+·40	−·26	482·5
4.15	123	85	500	67·5	+·40	−·26	503
4.30	122	85	490	67·5	+·40	−·26	422
4.45	115	83	520	67·5	+·50	−·26	361
5.00	110	82	450	67·5	+·55	−·26	442
5.15	113	82	460	67·5	+·40	−·26	398
5.30	108	81	450	67·5	+·40	−·26	372·5
5.45	96	81	380	68	−·01	−·25	224
6.00	98	79	450	68	+·80	−·28	221
6.15	113	79	500	67·5	+·35	−·28	300
6.30	108	77	460	67·5	+·30	−·28	322·5
7.00	90	77	370	67·5	−·01	−·26	480·5
	116·2	80·9	495	67·3	+·28	−·27	16,783·5 net

SUMMARY OF OBSERVATIONS

Date—Sept. 14, 1908. Boiler—B. and W. No. 2. At McGill University.
Commenced—8.45 a.m. Ended—7.00 p.m. Duration—615 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Forced—fan feeding in ash-pit
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned May, 1908
4.	Tubes cleaned	7.45 a.m.
5.	Fire cleaned	7.30 a.m., 12.30 and 5.30 p.m.

Fuel.

6.	Kind of coal	No. 48—Leitch Colliery, Leitch Collieries Ltd., Passburg, Alta.
7.	Analysis of dry coal by weight (%)	C = 70·0, H = 4·4, S = 0·6 N_2 = 1·0, O_2 = 6·1, Ash = 17·9
8.	Calorific value of dry coal B.T.U. per lb	12240
9.	Moisture in coal as fired (%)	0·9
10.	Weight of coal fired (lbs.)	3004
11.	Combustible matter in ash and clinker (%)	16·2
12.	Weight of clinker (lbs.)	412
13.	Weight of ash (lbs.)	95·0

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	+0·28
15.	" above fire " "	−0·21
16.	" at damper " "	−0·28
17.	Amount of damper opening	Full
18.	Temperature of air in boiler house (°F.)	80·9
19.	Flue temperature (°F.)	495
20	Analysis of dry flue gas by volume (%)	CO_2 = 7·9, O = 11·5, CO = 0·4, N = 80·2

Water and Steam.

21.	Temperature of feed water (°F.)	67·3
22.	Total weight of feed water, corrected for difference of level (lbs.)	16783
23.	Water level in gauge at start (inches)	6⅜
24.	Water level in gauge at finish (inches)	6¼
25.	Correction for difference of level included above (lbs.)	20
26.	Steam pressure by gauge (lbs. per sq. in.)	116·2
27.	Barometer reading (inches)	30·01
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	15·6
29.	Temperature in steam calorimeter (°F.)	291·2

Notes.

Very fine coal, necessitating reduction of air space from ½" to ¼"; burnt with but little trouble Ash only formed which could be passed through a shaking grate. Fire kept 4" to 6" thick. Fan on for a short period. Air over fire. Coal cokes considerably. Not very heavy smoke. Weather fine and clear.

Proximate analysis of coal by weight %: Fixed carbon..... 55·1; Volatile matter..... 27·0; Ash..... 17·9

SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 48. Kind of Furnace—Fixed bars, 15% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·98. At finish—30·04. Mean—30·01.

Total Quantities.

1.	Date of trial	14/9/08
2.	Duration of trial (hours)	10·25
3.	Weight of coal as fired (lbs.)	3004
4.	Percentage of moisture in coal as fired (%)	0·9
5.	Total weight of dry coal fired (lbs.)	2977
6.	Total ash and refuse (lbs.)	507
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 21·35; (*b*) weighed 17·0	
8.	Total weight of combustible consumed, from analyses (lbs.)	2340
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	16783
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	16710
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	19850

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	290
13.	Dry coal per square foot of grate surface per hour (lbs.)	17·3
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1620
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	1936
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·03

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	116·2
18.	Temperature of feed water entering boiler (deg. F.)	67·3
19.	Temperature of escaping gases from boiler (deg. F.)	495
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·55
21.	Percentage of moisture in steam	0·6

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	56·1
23.	Builders' rated horse-power	60·0
24.	Percentage of builders' rated horse-power developed	94

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	5·59
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	6·61
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	6·67
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	8·48

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	12240
30.	Calorific value of the combustible per lb. (B.T.U.)	14900
31.	Efficiency of boiler (based on combustible consumed) (%)	55·0
32.	Efficiency of boiler, including grate (based on dry coal) (%)	52·6

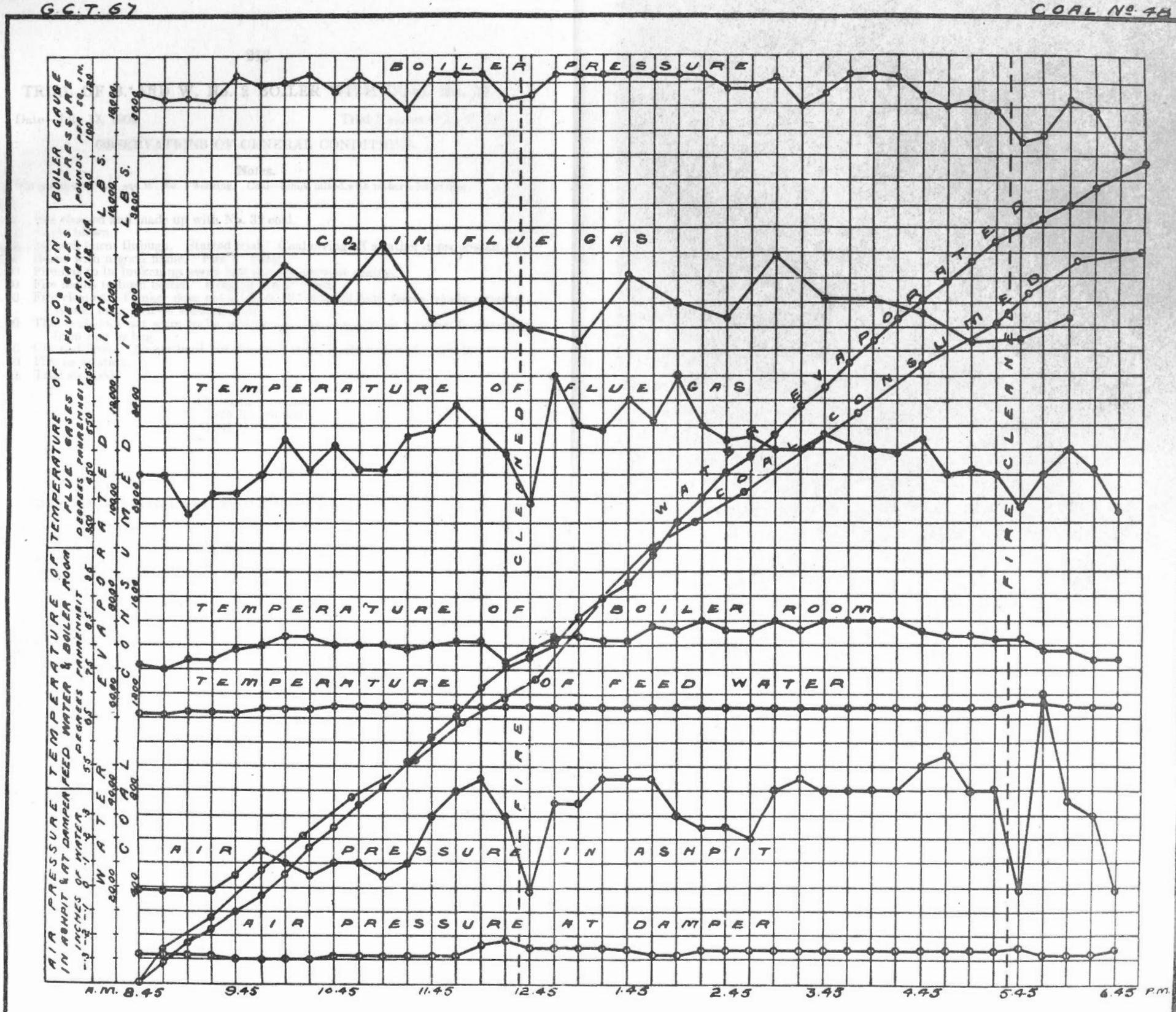
Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	29·9
34.	Dry flue gas per lb. of combustible consumed (from gas analyses) (lbs.)	26·6
35.	Dry flue gas per lb. dry coal (from gas analyses) (lbs.)	20·9
36.	Proportion of heat of fuel in escaping dry flue gases (%)	16·97

GRAPHIC RECORD OF BOILER TRIAL.

G.C.T. 67

COAL No. 48



TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 32.

Date—July 13, 1908. Trial Number—G.C.T. 50.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Fine but cloudy. B. and W. No. 1 working. Coal—lumps mixed with rather a lot of dust.

Time.
7.50 Fire cleaned and made up with No. 32 coal.
7.55 Tubes blown.
8.50 2½″ well burnt through. Started trial. Coal giving off a rather dense smoke.
9.10 Burns with a good flame. Fire 4″ thick.
10.00 Fire has to be broken up every half hour to prevent coking.
11.30 Fire seems to burn better. Keeping fire 4″ thick.
12.50 Fire cleaned. Clinker does not stick at all, in small hard pieces, easily removed. Would burn well on shaking grate.
3.00 This coal does not seem to be well mixed, the evaporation apparently changing from bag to bag.
5.50 Cleaned fires. Clinker hard but does not stick, easily removed. 159 lbs.
6.50 Fire as at start.
6.51 Trial stopped.

CLINKER AND ASH.
282½ lbs. clinker.
128½ lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 50

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.50 a.m.						
9.20	98	98	8.50	7·1	10·2	2·2
9.55	197	295	9.20	8·1	11·3	0·4
10.25	151	446	9.50	10·4	8·1	0·9
11.00	171	617	10.20	11·3	7·8	0·3
11.30	129	746	10.50	11·8	7·5	0·7
12.00	136	882	11.20	8·5	10·5	0·4
12.10	61	943	11.50	9·7	9·6	0·4
12.50	84	1027	12.20	9·6	10·3	0·2
1.05	102	1129	12.40	6·0	14·2	0·1
1.35	130	1259	1.10	7·3	12·7	0·1
2.05	128	1387	1.40	9·7	8·9	1·0
2.35	132	1519	2.10	7·8	12·2	0·2
2.55	60	1579	2.40	11·0	8·7	0·2
3.25	200	1779	3.10	11·4	6·4	2·2
3.50	137	1916	3.40	11·0	8·2	0·4
4.20	135	2051	4.10	12·3	7·1	0·3
4.55	159	2210	4.40	8·8	8·9	2·5
5.25	106	2316	5.10	8·9	10·3	0·5
5.50	31	2347	5.40	7·5	12·6	0·2
6.20	185	2532	6.10	5·9	13·9	0·2
6.50	133	2665	6.25	7·8	11·8	0·2
				9·1	10·1	0·6

OBSERVATIONS MADE DURING BOILER TRIAL No. 50

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.50	111	86	510	71	—·02	—·26	.....
9.05	110	85	510	71	—·02	—·26	480
9.20	102	85	475	71	—·02	—·26	464
9.35	111	87	500	71	—·02	—·26	383
9.50	106	87	520	71	—·02	—·27	442
10.05	104	87	550	71	—·02	—·28	455
10.20	109	87	565	71	—·02	—·28	431·5
10.35	108	87	570	71	—·02	—·28	465
10.50	114	88	590	71	—·02	—·30	425·5
11.05	118	88	560	71	—·02	—·30	473·5
11.20	113	88	520	71	—·02	—·30	522·5
11.35	106	87	560	71	—·02	—·30	438·5
11.50	115	86	530	71	—·02	—·26	425·5
12.05	116	85	525	71	—·02	—·28	374
12.20	115	85	520	71	—·02	—·28	445
12.35	123	85	520	71	—·02	—·26	391
12.50	118	85	490	71	—·02	—·26	373·5
1.05	122	86	470	71·5	—·02	—·24	101·5
1.20	118	87	500	71·5	—·02	—·24	380
1.35	123	87	510	71·5	—·02	—·25	370
1.50	123	87	520	71·5	—·02	—·24	412·5
2.05	122	87	510	71·5	—·02	—·24	462
2.20	123	87	530	71·5	—·02	—·25	364
2.35	120	88	550	71·5	—·02	—·30	358·5
2.50	120	89	600	72	—·02	—·30	510
3.05	122	89	650	72	—·02	—·32	513·5
3.20	118	88	630	72	—·02	—·32	553
3.35	121	89	620	72	—·02	—·30	433·5
3.50	123	88	600	72·5	—·02	—·30	542
4.05	119	88	610	72·5	—·02	—·30	523
4.20	123	87	630	72·5	—·02	—·30	580·5
4.35	118	89	575	72·5	—·02	—·28	483
4.50	123	87	595	72·5	—·02	—·30	484
5.05	123	87	570	72·5	—·02	—·30	514
5.20	119	87	550	72·5	—·02	—·28	445
5.35	116	87	575	72·5	—·02	—·30	385
5.50	111	88	510	73	—·02	—·30	402
6.05	90	88	560	73	—·02	—·30	331·5
6.20	107	87	600	73	—·02	—·30	225·5
6.35	123	85	550	73	—·02	—·30	394
6.51	120	85	590	73	—·02	—·30	413·5
	115·7	87·0	552	71·7	—·02	—·28	17,171 net

SUMMARY OF OBSERVATIONS

Date—July 13, 1908.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.50 a.m.	Ended—6.51 p.m.	Duration—601 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned May, 1908
4.	Tubes cleaned	7.55 a.m.
5.	Fire cleaned	7.50 a.m., 12.50 and 5.50 p.m.

Fuel.

6.	Kind of coal	No. 32—Hillcrest Colliery, Alberta, Hillcrest Coal and Coke Co.
7.	Analysis of dry coal by weight (%)	$\begin{cases} C=70\cdot4, & H=4\cdot2, & S=0\cdot6 \\ N_2=1\cdot0, & O_2=8\cdot5, & Ash=15\cdot3 \end{cases}$
8.	Calorific value of dry coal B.T.U. per lb	12460
9.	Moisture in coal as fired (%)	0·8
10.	Weight of coal fired (lbs.)	2665
11.	Combustible matter in ash and clinker (%)	13·9
12.	Weight of clinker (lbs.)	282
13.	Weight of ash (lbs.)	128

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−0·02
15.	" above fire " "	−0·21
16.	" at damper " "	−0·28
17.	Amount of damper opening	Full
18.	Temperature of air in boiler house (°F.)	87·
19.	Flue temperature (°F.)	552
20.	Analysis of dry flue gas by volume (%)	$CO_2=9\cdot1$, $O_2=10\cdot1$, $CO=0\cdot6$, $N=80\cdot2$

Water and Steam.

21.	Temperature of feed water (°F.)	71·7
22.	Total weight of feed water (lbs.), corrected for difference of level	17171
23.	Water level in gauge at start (inches)	$4\frac{3}{8}$"
24.	Water level in gauge at finish (inches)	$4\frac{7}{16}$"
25.	Correction for difference of level included above (lbs.)	−10
26.	Steam pressure by gauge (lbs. per sq. in.)	115·7
27.	Barometer reading (inches)	29·59
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	15·8
29.	Temperature in steam calorimeter (°F.)	291·8

Notes.

This coal contains much dust. It burns with rather a heavy smoke. A 4" fire seemed to be the most suitable. The clinker consisted of small and very hard lumps. It did not cling to the bars. Could be used to advantage on a shaking grate. The coal cokes a good deal necessitating it being broken up with a rake about every half hour. Weather fine but cloudy.

Proximate analysis of coal by weight %

Fixed carbon	55·4
Volatile matter	29·3
Ash	15·3

SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 32. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·63. At finish—29·55. Mean—29·59.

Total Quantities.

1.	Date of trial	13/7/08
2.	Duration of trial (hours)	10·02
3.	Weight of coal as fired (lbs.)	2665
4.	Percentage of moisture in coal as fired (%)	0·8
5.	Total weight of dry coal fired (lbs.)	2644
6.	Total ash and refuse (lbs.)	411
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 17·77; (*b*) weighed.	15·5
8.	Total weight of combustible consumed, from analyses (lbs.)	2173
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	17171
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17100
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	20330

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	264
13.	Dry coal per square foot of grate surface per hour (lbs.)	15·7
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1705
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2029
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·18

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	115·7
18.	Temperature of feed water entering boiler (deg. F.)	71·7
19.	Temperature of escaping gases from boiler (deg. F.)	552
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·26
21.	Percentage of moisture in steam	0·5

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	58·8
23.	Builders' rated horse-power	60·0
24.	Percentage of builders' rated horse-power developed	98·2

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	6·43
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	7·63
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	7·69
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	9·36

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	12460
30.	Calorific value of the combustible per lb. (B.T.U.)	14720
31.	Efficiency of boiler (based on combustible consumed) (%)	61·4
32.	Efficiency of boiler, including grate (based on dry coal) (%)	59·6

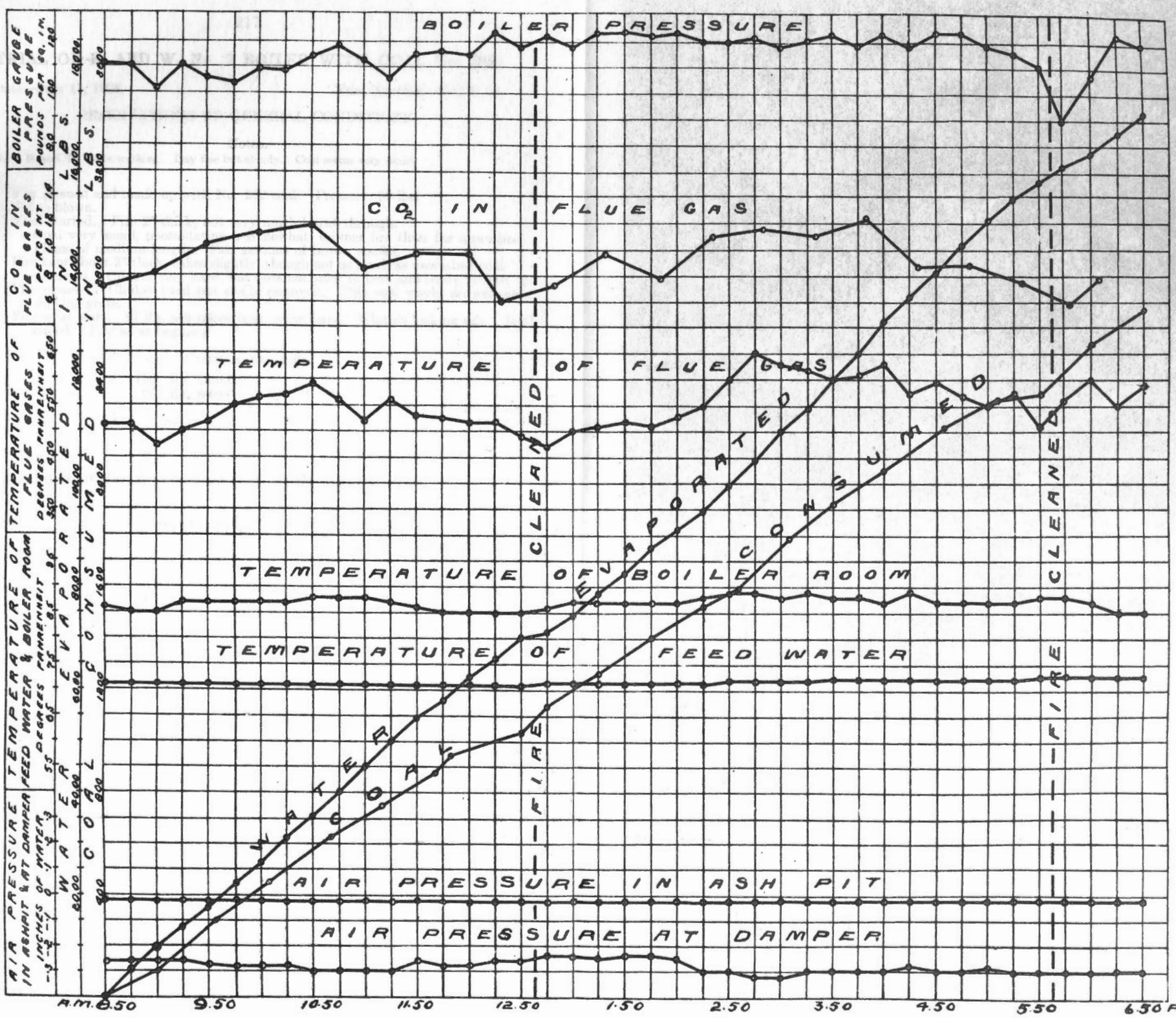
Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	25·6
34.	" " of combustible consumed (from gas analyses) (lbs.)	21·9
35.	" " dry coal (from gas analyses) (lbs.)	18·0
36.	Proportion of heat of fuel in escaping dry flue gases (%)	16·6

GRAPHIC RECORD OF BOILER TRIAL.

G.C.T. 50

COAL No. 32



TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 232.

Date—July 15, 1908. Trial Number—G.C.T. 51.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

No. 1 B. and W. boiler working. Day fine but cloudy. Coal seems very moist.

Time.

7.30 Fire cleaned and made up with No. 232 coal. Pressure, 90 lbs.
7.45 Tubes blown.
8.35 Trial started. Fire 2″ thick, not very much burnt through. Coal very small, necessitating a somewhat thinner fire than for unwashed. Flame of medium length. Fair amount of brown smoke.
10.00 Fire kept about 3″ thick, cakes slightly, though not as much as unwashed coal.
12.30 Fire cleaned. Clinker very hard, but does not stick to bars and easily broken up.
5.30 Fire cleaned. Clinker hard but easily removed. This coal would do well on a shaking grate.
6.35 Fire as at start. 97 lbs. ash taken from under bars. Whitish looking ash. Trial ended. Fire as at begining.

CLINKER AND ASH.

156 lbs. clinker.
97 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 51

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.35 a.m.						
9.00	171	171	8.35	8·8	10·0	1·2
9.30	145	316	9.05	9·0	9·5	0·8
9.55	144	460	9.35	10·0	9·7	0·3
10.25	148	608	10.05	10·4	7·6	1·5
11.00	170	778	10.35	9·9	9·6	0·2
11.30	98	876	11.05	11·9	7·1	1·0
12.00	147	1023	11.35	11·0	8·4	0·2
12.20	56	1079	12.05	10·4	7·8	1·4
12.30	10	1089	12.35	7·4	11·4	0·8
1.00	144	1233	1.05	7·5	10·1	0·8
1.30	165	1398	1.35	8·4	11·0	0·3
2.00	130	1528	2.05	10·1	7·5	2·3
2.30	145	1673	2.35	8·2	11·4	0·5
3.00	118	1791	3.05	9·8	9·8	0·5
3.30	141	1932	3.35	7·5	12·8	0·0
3.40	39	1971	4.05	11·4	8·0	0·3
4.10	158	2129	4.35	10·2	9·3	0·5
4.40	150	2279	5.05	8·7	10·7	0·5
5.10	96	2375	5.35	6·4	14·1	0·0
5.20	34	2409	6.00	8·0	11·7	0·4
5.50	116	2525	6.15	8·2	9·5	1·7
6.20	145	2670				
6.25	36	2706		9·2	9·9	0·7
6.35	16	2722				

OBSERVATIONS MADE DURING BOILER TRIAL No. 51

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.35	123	81	490	70	−·02	−·30	.....
8.50	113	80	480	70	−·02	−·30	425
9.05	121	80	500	70	−·02	−·30	485
9.20	122	81	560	70·5	−·02	−·32	386·5
9.35	123	80	600	70·5	−·02	−·32	462
9.50	123	81	600	70·5	−·02	−·32	521·5
10.05	120	81	590	70·5	−·02	−·32	464·5
10.20	115	83	560	71	−·02	−·32	453
10.35	120	85	585	71	−·02	−·32	480·5
10.50	118	82	550	71	−·02	−·30	406·5
11.05	105	83	620	71	−·02	−·30	490
11.20	115	83	620	70·5	−·02	−·32	490
11.35	122	84	580	70·5	−·02	−·32	453
11.50	122	83	620	70·5	−·02	−·32	469·5
12.05	110	83	595	71	−·02	−·30	544
12.20	115	81	575	71	−·02	−·30	475·5
12.35	121	85	475	70·5	−·02	−·28	256
12.50	123	81	530	70·5	−·02	−·30	186
1.05	123	81	550	71	−·02	−·30	490
1.20	123	81	590	71	−·02	−·30	412
1.35	123	82	560	71	−·02	−·30	573
1.50	120	84	555	71·5	−·02	−·30	420
2.05	122	85	600	71·5	−·02	−·32	531
2.20	121	84	600	71·5	−·02	−·30	511
2.35	120	87	600	71·5	−·02	−·30	521·5
2.50	116	84	610	71·5	−·02	−·30	413
3.05	114	83	595	71·5	−·02	−·30	446
3.20	122	83	580	71·5	−·02	−·30	451·5
3.35	115	83	555	71·5	−·02	−·30	492·5
3.50	110	84	555	72	−·02	−·32	402·5
4.05	107	84	610	72	−·02	−·32	444·5
4.20	123	83	570	72	−·02	−·32	346
4.35	123	82	620	72	−·02	−·32	494·5
4.50	123	82	650	71·5	−·02	−·36	422
5.05	123	80	630	71·5	−·02	−·32	560
5.20	122	79	650	71·5	−·02	−·32	456
5.35	110	83	490	71·5	−·02	−·25	441
5.50	122	80	590	71·5	−·02	−·32	353
6.05	123	79	585	71·5	−·02	−·30	393·5
6.20	108	79	600	71·5	−·02	−·30	514
6.35	123	79	640	71·5	−·02	−·32	323·5
	118·7	82	578	71·1	−·02	−·31	17,860·5 net

SUMMARY OF OBSERVATIONS

Date—July 15, 1908.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.35 a.m.	Ended—6.35 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned May, 1908
4.	Tubes cleaned	7.45 a.m.
5.	Fire cleaned	7.30 a.m., 12.30 and 5.30 p.m.

Fuel.

6.	Kind of coal	No. 232 washed—Hillcrest Colliery, Alberta, Hillcrest Coal & Coke Co.
7.	Analysis of dry coal by weight (%)	C = 77·0, H = 4·7, S = 0·5, N_2 = 1·1, O_2 = 6·9, Ash = 9·8
8.	Calorific value of dry coal B.T.U. per lb	13410
9.	Moisture in coal as fired (%)	3·8
10.	Weight of coal fired (lbs.)	2722
11.	Combustible matter in ash and clinker (%)	19·9
12.	Weight of clinker (lbs.)	156
13.	Weight of ash (lbs.)	97

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−0·02
15.	" above fire " "	−0·21
16.	" at damper " "	−0·31
17.	Amount of damper opening	Full
18.	Temperature of air in boiler house (°F.)	82
19.	Flue temperature (°F.)	578
20.	Analysis of dry flue gas by volume (%)	CO_2 = 9·2, O_2 = 9·9, CO = 0·7, N = 80·2

Water and Steam.

21.	Temperature of feed water (°F.)	71·1
22.	Total weight of feed water, corrected for difference of level (lbs.)	17860
23.	Water level in gauge at start (inches)	$4\frac{13}{16}$
24.	Water level in gauge at finish (inches)	$4\frac{11}{16}$
25.	Correction for difference of level included above (lbs.)	+20
26.	Steam pressure by gauge (lbs. per sq. in.)	118·7
27.	Barometer reading (inches)	29·60
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	15·9
29.	Temperature in steam calorimeter (°F.)	292·5

Notes.

This coal gives off a fair amount of smoke. Does not coke so much as unwashed coal. Clinker very hard and does not stick to bars. Would be good coal for a shaking grate. Weather fine but cloudy.

Proximate analysis of dry coal by weight %: Fixed carbon 60·4; Volatile matter 29·8; Ash 9·8

SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 232. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·60. At finish—29·60. Mean—29·60.

Total Quantities.

1.	Date of trial	15/7/08
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	2722
4.	Percentage of moisture in coal as fired	3·8
5.	Total weight of dry coal fired (lbs.)	2618
6.	Total ash and refuse (lbs.)	253
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 12·2; (*b*) weighed 9·64	
8.	Total weight of combustible consumed, from analyses (lbs.)	2299
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	17860
10.	Water actually evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17780
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	21140

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	262
13.	Dry coal per square foot of grate surface per hour (lbs.)	15·6
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1778
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2114
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·31

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	118·7
18.	Temperature of feed water entering boiler (deg. F.)	71·1
19.	Temperature of escaping gases from boiler (deg. F.)	578
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·29
21.	Percentage of moisture in steam	0·60

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	61·3
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	102

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	6·56
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	7·77
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	8·06
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	9·18

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	13410
30.	Calorific value of the combustible per lb. (B.T.U.)	14880
31.	Efficiency of boiler (based on combustible consumed) (%)	59·6
32.	Efficiency of boiler, including grate (based on dry coal) (%)	58·0

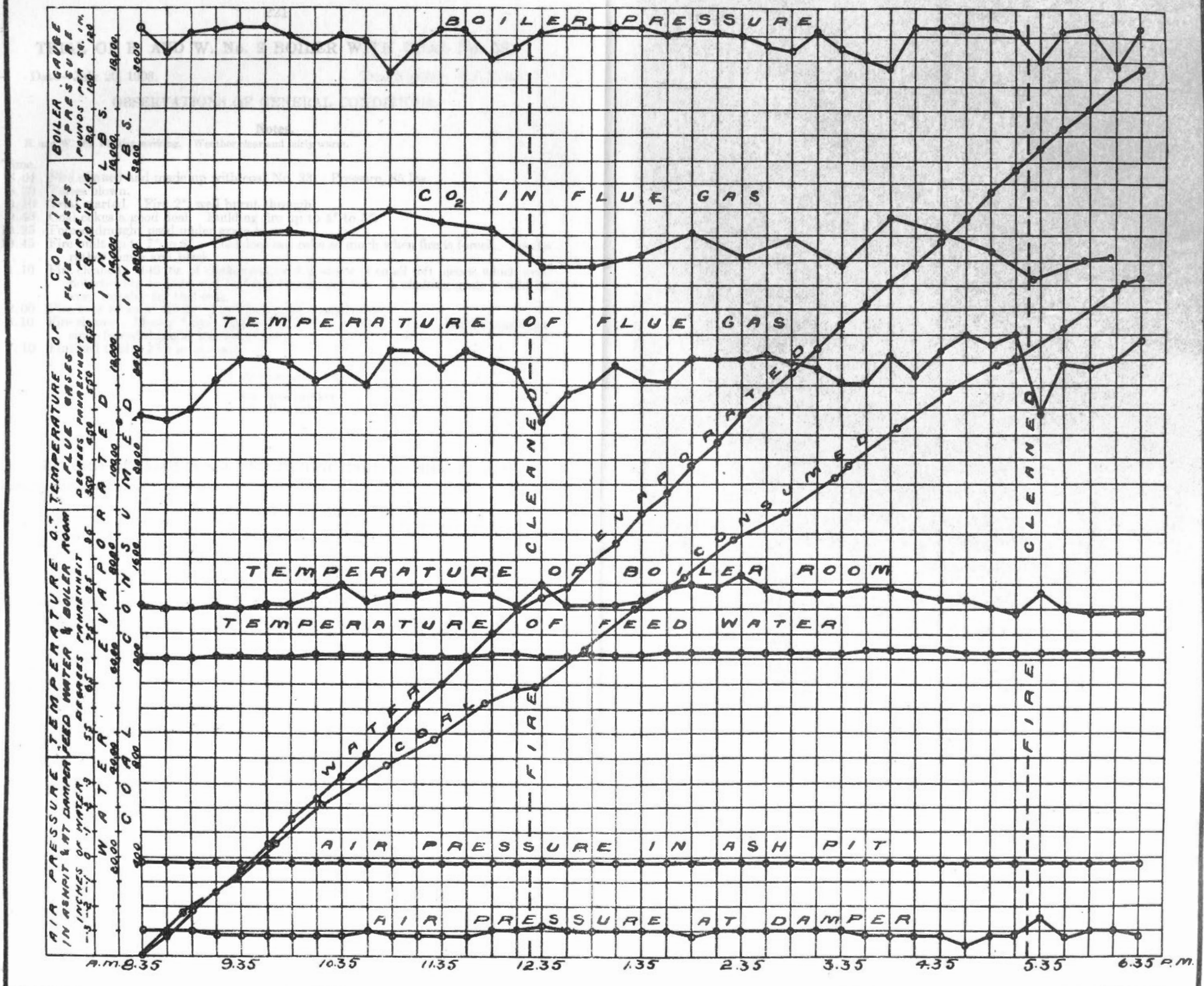
Flue Gas.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	25·1
34.	" " of combustible consumed (from gas analyses) (lbs.)	22·0
35.	" " dry coal (from gas analyses) (lbs.)	19·3
36.	Proportion of heat of fuel in escaping dry flue gases (%)	17·13

GRAPHIC RECORD OF BOILER TRIAL.

G.C.T. 51

COAL Nº 32/00



TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 33.

Date—July 20, 1908. Trial Number—G.C.T. 53.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

B. and W. No. 1 boiler working. Weather clear and fairly warm.

Time.

8.04 Fire cleaned and made up with coal No. 33. Pressure, 85 lbs.
8.20 Tubes blown.
9.10 Trial started. Fire 2″, well burnt through
9.40 Coal cokes a good deal. Building fire up to 4″ to 5″.
10.25 Forced draught used under grate bars.
10.45 Fire built up to 7″ to 8″. Coal does not cake so much when fire is forced. Smoke rather dense and black.
1.10 Fire cleaned. 140 lbs. of clinker removed in shape of small soft pieces, which were not sticking to bars and had not fused together. A shaking grate would be very suitable for this coal.
2.00 Fire kept 8″ to 9″ thick. Forced draught on as before.
6.10 Fire cleaned. Mostly "dirt" taken out, nothing sticking to bars. Smoke much less since forced draught has been used.
7.10 Finished trial. Fire as at start.

CLINKER AND ASH.

305 lbs. clinker.
89 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 53

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 9.10 a.m.						
9.20	91	91	9.10	7·6	10·3	1·3
9.50	172	263	9.40	7·4	12·1	0·1
10.20	130	393	10.10	8·1	9·0	2·0
10.35	113	506	10.40	10·4	8·9	0·0
11.05	200	706	11.10	10·4	7·2	1·7
11.35	167	873	11.40	9·3	10·4	0·1
12.05	49	922	12.10	7·1	13·0	0·2
12.35	134	1056	12.40	9·6	8·8	0·6
12.45	59	1115	1.00	7·2	12·8	0·5
1.20	80	1195	1.30	6·3	13·5	0·3
1.45	112	1307	2.00	5·8	13·1	0·4
2.10	203	1510	2.30	12·8	5·3	0·8
2.40	225	1735	3.00	9·0	10·2	0·3
3.10	75	1810	3.30	12·0	7·5	0·3
3.40	94	1904	4.00	8·9	9·4	1·2
4.10	238	2142	4.30	9·3	10·7	0·3
4.40	52	2194	5.00	12·4	5·7	1·7
5.00	84	2278	5.30	5·5	14·7	0·2
5.30	69	2347	6.00	8·6	10·8	0·4
6.00	110	2457	6.20	8·1	10·2	0·2
6.30	189	2646	6.40	10·0	9·0	0·3
7.10	165	2811				
				8·9	10·1	0·6

OBSERVATIONS MADE DURING BOILER TRIAL No. 53

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
9.10	123	82	500	70·5	−·02	−·30	.....
9.25	120	82	525	70·5	−·02	−·30	380
9.40	117	82	510	70·5	−·02	−·30	393
9.55	122	82	520	70	−·02	−·30	385
10.10	122	81	560	70	−·02	−·30	381
10.25	120	82	600	70	−·02	−·28	320
10.40	117	83	640	70	0·0	−·28	483
10.55	120	83	620	70	+·10	−·25	492
11.10	114	83	600	70	+·10	−·25	429
11.25	120	83	610	70	+·10	−·25	484·5
11.40	115	83	570	70	+·02	−·24	470
11.55	122	86	625	70	+·15	−·25	502·5
12.10	121	86	585	70	+·05	−·24	476
12.25	121	85	650	70	+·08	−·22	431
12.40	113	83	625	70	+·15	−·20	570
12.55	113	83	640	70	+·12	−·20	541
1.10	118	83	500	70	+·10	−·20	441·5
1.25	118	85	500	70	−·02	−·20	154
1.40	119	83	540	70	+·15	−·20	253·5
1.55	123	82	530	70	+·05	−·20	389·5
2.10	118	82	475	70	+·02	−·20	352·5
2.25	107	82	500	70	+·02	−·20	330
2.40	123	83	650	70	+·50	−·20	470
2.55	123	85	630	69·5	+·30	−·20	512·5
3.10	113	85	625	69·5	+·25	−·22	500·5
3.25	108	83	730	69·5	+·25	−·22	482
3.40	123	83	680	69·5	+·20	−·22	589·5
3.55	123	83	630	69·5	+·30	−·22	632·5
4.10	113	83	600	69·5	+·22	−·22	550
4.25	114	83	680	69·5	+·12	−·22	441
4.40	106	83	610	69·5	+·12	−·22	521·5
4.55	106	82	580	69·5	+·12	−·22	421
5.10	123	83	710	69·5	+·22	−·22	434
5.25	121	83	630	69·5	+·24	−·22	521·5
5.40	122	83	620	69·5	+·30	−·22	412
5.55	113	82	580	69·5	+·35	−·22	441
6.10	102	85	460	69·5	0·0	−·20	391·5
6.25	105	80	610	69·5	+·25	−·22	262
6.40	123	81	700	69·5	+·15	−·22	358·5
6.55	123	80	670	69·5	+·15	−·22	518
7.10	112	80	600	69·5	0·0	−·22	438
	117·0	82·8	596	69·8	+·12	−·23	17,556 net

SUMMARY OF OBSERVATIONS

Date—July 20, 1908.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—9.10 a.m.	Ended—7.10 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Forced
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned May, 1908
4.	Tubes cleaned	8.20 a.m.
5.	Fire cleaned	8.04 a.m., 1.10 and 6.10 p.m.

Fuel.

6.	Kind of coal	No. 33—No. 1 Seam, Bellevue Colliery, West Canadian Collieries, Blairmore.
7.	Analysis of dry coal by weight (%)	C = 71·5, H = 4·3, S = 0·8, N_2 = 1·0, O_2 = 6·9, Ash = 15·5
8.	Calorific value of dry coal B.T.U. per lb	12380
9.	Moisture in coal as fired (%)	0·8
10.	Weight of coal fired (lbs.)	2811
11.	Combustible matter in ash and clinker (%)	17·7
12.	Weight of clinker (lbs.)	305
13.	Weight of ash (lbs.)	89

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	+·12
15.	" above fire " "	−·19
16.	" at damper " "	−·23
17.	Amount of damper opening	Full
18.	Temperature of air in boiler house (°F.)	82·8
19.	Flue temperature (°F.)	596
20.	Analysis of dry flue gas by volume (%)	CO_2 = 8·9, O_2 = 10·1, CO = 0·6, N = 80·4

Water and Steam.

21.	Temperature of feed water (°F.)	69·8
22.	Total weight of feed water corrected for difference of level (lbs.)	17556
23.	Water level in gauge at start (inches)	$4\frac{15}{16}$
24.	Water level in gauge at finish (inches)	$4\frac{9}{16}$
25.	Correction for difference of level included above (lbs.)	+60
26.	Steam pressure by gauge (lbs. per sq. in.)	117·0
27.	Barometer reading (inches)	29·90
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	15·5
29.	Temperature in steam calorimeter (°F.)	291·7

Notes.

Coal very variable, having much refuse and small stuff in it. Smoke at first dense and black, later, however, with forced draught not so bad. Coal coked considerably at first. Clinker was composed of small soft pieces, which were easily removed. This coal would be suitable for a shaking grate. Weather clear and fairly warm.

Proximate analysis of dry coal by weight %: Fixed carbon..... 56·9; Volatile matter..... 27·6; Ash..... 15·5

SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 33. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·89. At finish—29·90. Mean—29·90.

Total Quantities.

1.	Date of trial	20/7/08
2.	Duration of trial (hours)	10·0
3.	Weight of coal as fired (lbs.)	2811
4.	Percentage of moisture in coal as fired (%)	0·8
5.	Total weight of dry coal fired (lbs.)	2789
6.	Total ash and refuse (lbs.)	394
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 18·83; (*b*) weighed	14·1
8.	Total weight of combustible consumed, from analyses (lbs.)	2264
9.	Total weight of water fed to the boiler corrected for difference of level (lbs.)	17556
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17480
11	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	20830

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	279
13.	Dry coal per square foot of grate surface per hour (lbs.)	16·6
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1748
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2083
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·26

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. 1/ sq. in.)	117·0
18.	Temperature of feed water entering boiler (deg. F.)	69·8
19.	Temperature of escaping gases from boiler (deg. F.)	596
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·35
21.	Percentage of moisture in steam	0·6

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	60·3
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	100·5

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	6·25
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	7·41
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	7·48
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	9·20

Efficiency.

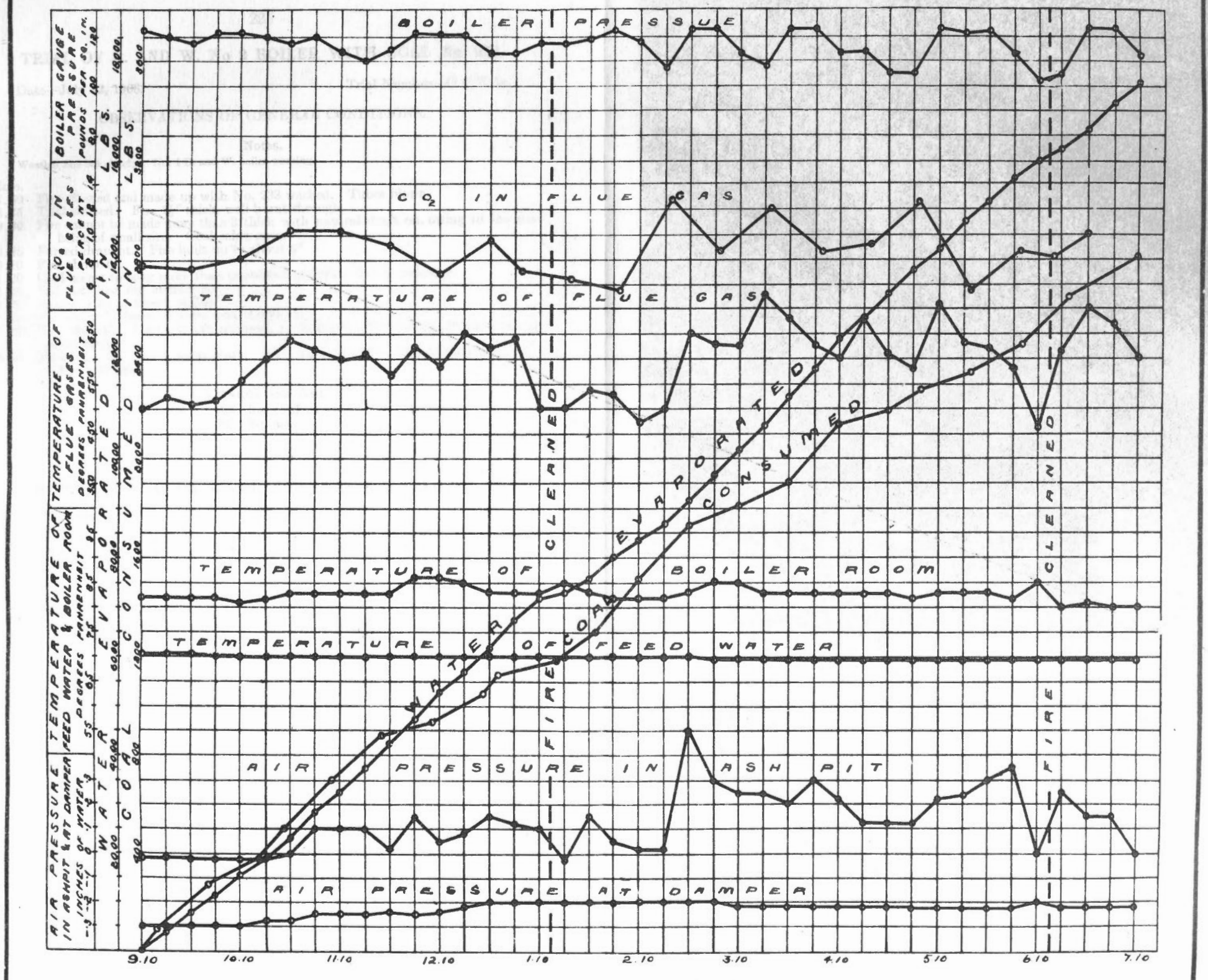
29.	Calorific value of dry coal per lb. (B.T.U.)	12380
30.	Calorific value of the combustible per lb. (B.T.U.)	14660
31.	Efficiency of boiler (based on combustible consumed) (%)	60·6
32.	Efficiency of boiler, including grate (based on dry coal) (%)	58·3

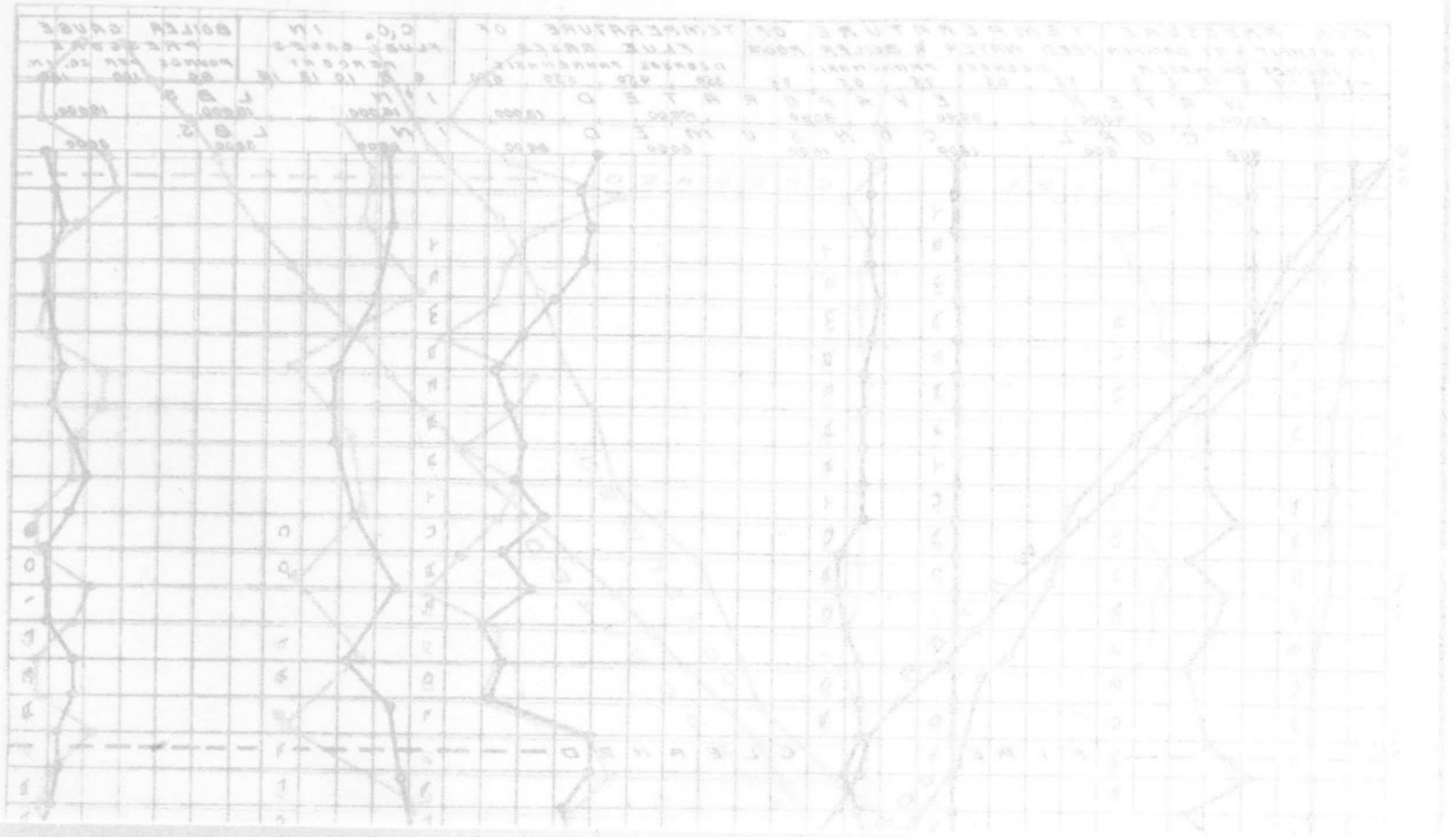
Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	26·2
34.	" " of combustible consumed (from gas analyses) (lbs.)	23·1
35.	" " dry coal (from gas analyses) (lbs.)	18·73
36.	Proportion of heat of fuel in escaping dry flue gases (%)	18·76

G.C.T. 53

COAL Nº 33





TRIAL OF B. AND W. No 2 BOILER WITH COAL No. 233.

Date—July 22, 1908. Trial Number—G.C.T. 54.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Weather fine but cloudy. No. 1 B. and W. boiler working.

Time.
7.30 Fire cleaned and made up with No. 233 washed. Tubes blown.
8.35 Trial started. Fire 1½″ thick, well burnt through.
9.00 Fire cannot be made more than 3″thick with natural draft on, owing to the coal being of small size. Coal cakes somewhat.
9.35 Forced draught. Fire built up to about 6″.
10.10 Fire about 6″.
11.00 Coal seems to coke more than unwashed, probably due to moisture.
1.00 Did not clean out at mid-day.
1.20 Rather a lot of brown smoke.
5.00 Fire about 7″, burning down from this to clean.
5.30 Fire cleaned. Very soft ash removed, no clinker. All would go through shaking grate easily.
6.37 Finished trial. Fire as at start. Fan shut off 6.25. Ash removed was very fine and light.

CLINKER AND ASH.
199 lbs. clinker.
87 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL NO. 54

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.35 a.m.						
8.53	116	116	8.40	9·3	8·4	1·6
9.20	123	239	9.10	12·5	6·9	0·3
10.00	248	487	9.40	10·8	4·6	3·6
10.30	200	687	10.10	11·0	8·0	0·1
11.00	93	780	10.40	12·4	7·2	0·2
11.10	38	818	11.10	9·1	10·7	0·0
11.40	209	1027	11.40	11·2	7·2	1·0
12.20	153	1180	12.10	11·3	7·3	0·3
12.50	152	1332	12.40	8·2	11·6	0·2
1.20	87	1419	1.10	10·0	9·0	0·0
1.35	68	1487	1.40	10·3	8·8	0·4
2.10	173	1660	2.10	8·3	11·1	0·1
2.40	160	1820	2.40	10·6	7·4	1·1
3.10	128	1948	3.10	7·4	12·5	0·3
3.30	60	2008	3.40	11·1	7·3	0·3
4.00	144	2152	4.10	8·5	10·5	0·7
4.30	137	2289	4.40	12·1	6·1	1·1
4.50	80	2379	5.10	7·7	11·2	0·3
5.20	94	2473	5.40	3·5	16·4	0·2
5.40	66	2539	6.10	8·5	11·2	0·3
6.10	203	2742				
7.37	95	2837		9·7	9·2	0·6

OBSERVATIONS MADE DURING BOILER TRIAL No. 54

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.35	105	82	460	71	−·02	−·20	.....
8.50	107	82	495	71	−·02	−·20	220
9.05	110	82	480	70·5	−·02	−·20	324
9.20	98	83	520	70·5	−·02	−·20	459
9.35	104	84	530	70·5	−·02	−·20	307·5
9.50	119	84	600	70·5	+·20	−·20	359
10.05	121	85	670	70·5	+·20	−·20	541·5
10.20	113	85	690	70·5	+·35	−·20	540·5
10.35	111	85	575	70·5	+·10	−·20	497·5
10.50	123	86	585	70·5	+·04	−·20	311·5
11.05	123	86	680	70·5	+·10	−·25	510·5
11.20	123	86	590	70·5	+·05	−·25	511·5
11.35	123	87	650	70·5	+·10	−·25	463·5
11.50	120	87	630	70·5	+·10	−·26	502
12.05	122	87	680	70·5	+·10	−·25	449
12.20	122	86	690	70·5	+·20	−·25	507
12.35	113	85	610	70·5	+·10	−·25	538
12.50	123	85	660	70·5	+·20	−·25	438·5
1.05	113	85	575	70·5	+·15	−·25	469
1.20	114	85	570	70·5	+·15	−·25	440
1.35	122	85	580	70·5	+·20	−·25	398·5
1.50	120	86	580	70·5	+·20	−·24	441
2.05	119	86	590	70·5	+·35	−·24	414
2.20	123	86	670	71	+·52	−·24	473
2.35	119	86	650	71	+·46	−·24	645
2.50	123	88	630	71	+·30	−·24	452·5
3.05	118	89	555	71	+·20	−·24	442
3.20	120	88	590	71	+·20	−·20	445
3.35	120	91	620	71	+·40	−·22	460
3.50	105	89	675	71·5	+·44	−·24	591·5
4.05	114	88	625	71·5	+·50	−·23	428
4.20	109	88	620	71	+·50	−·25	421
4.35	111	88	630	71	+·70	−·24	455
4.50	115	88	660	71	+·72	−·24	469
5.05	106	88	625	71	+·75	−·23	460
5.20	107	86	600	71	+·75	−·23	440
5.35	78	86	430	71	0·0	−·20	384·5
5.50	68	85	590	70·5	+·20	−·22	180·5
6.05	120	85	685	70·5	+·15	−·22	186·5
6.20	103	85	800	70·5	+·10	−·23	590
6.37	123	84	630	70·5	0·0	−·23	564
	113·4	86	609	70·7	+·24	−·23	17,730·5 net

SUMMARY OF OBSERVATIONS

Date—July 22, 1908.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.35 a.m.	Ended—6.37 p.m.	Duration—602 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Forced
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned May, 1908
4.	Tubes cleaned	7.30 a.m.
5.	Fire cleaned	7.30 a.m., 5.30 p.m.

Fuel.

6.	Kind of coal	No. 233 washed—No. 1 seam, Bellevue Colliery, West Canadian Collieries, Blairmore.
7.	Analysis of dry coal by weight (%)	C = 75·1; H = 4·4, S = 0·5, N_2 = 1·1, O_2 = 6·2, Ash = 12·7
8.	Calorific value of dry coal B.T.U. per lb	12980
9.	Moisture in coal as fired (%)	3·6
10.	Weight of coal fired (lbs.)	2837
11.	Combustible matter in ash and clinker (%)	11·5
12.	Weight of clinker (lbs.)	199
13.	Weight of ash (lbs.)	87

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	+0·24
15.	" above fire " "	−0·19
16.	" at damper " "	−0·23
17.	Amount of damper opening	Full
18.	Temperature of air in boiler house (°F.)	86
19.	Flue temperature (°F.)	609
20.	Analysis of dry flue gas by volume (%)	CO_2 = 9·7, O_2 = 9·2, CO = 0·6, N = 80·5

Water and Steam.

21.	Temperature of feed water (°F.)	70·7
22.	Total weight of feed water corrected for difference of level (lbs.)	17730
23.	Water level in gauge at start (inches)	$2\frac{7}{16}$
24.	Water level in gauge at finish (inches)	$2\frac{9}{16}$
25.	Correction for difference of level included above (lbs.)	−20
26.	Steam pressure by gauge (lbs. per sq. in.)	113·4
27.	Barometer reading (inches)	29·8
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	15·1
29.	Temperature in steam calorimeter (°F.)	290·7

Notes.

This coal seemed to be very wet, and was very small. Forced draught had to be used. Coal cokes a good deal. Fair amount of brown smoke. Only cleaned out once during the trial. No clinker was formed, but a soft ash which was easily removed. A shaking grate could be used to advantage. Weather fine but cloudy.

Proximate analysis of dry coal by weight %

Fixed carbon	58·9
Volatile matter	28·4
Ash	12·7

SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 233. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·81. At finish—29·80. Mean—29·80.

Total Quantities.

1.	Date of trial	22/7/08
2.	Duration of trial (hours)	10·03
3.	Weight of coal as fired (lbs.)	2837
4.	Percentage of moisture in coal as fired (%)	3·6
5.	Total weight of dry coal fired (lbs.)	2734
6.	Total ash and refuse (lbs.)	286
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 14·36; (*b*) weighed.	10·5
8.	Total weight of combustible consumed, from analyses (lbs.)	2341
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	17730
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17660
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	20990

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	273
13.	Dry coal per square foot of grate surface per hour (lbs.)	16·2
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1761
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2093
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·27

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	113·4
18.	Temperature of feed water entering boiler (deg. F.)	70·7
19.	Temperature of escaping gases from boiler (deg. F.)	609
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·47
21.	Percentage of moisture in steam	0·50

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	60·6
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	101

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	6·25
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	7·40
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	7·66
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	8·96

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	12980
30.	Calorific value of the combustible per lb. (B.T.U.)	14860
31.	Efficiency of boiler (based on combustible consumed) (%)	58·2
32.	Efficiency of boiler, including grate (based on dry coal) (%)	56·9

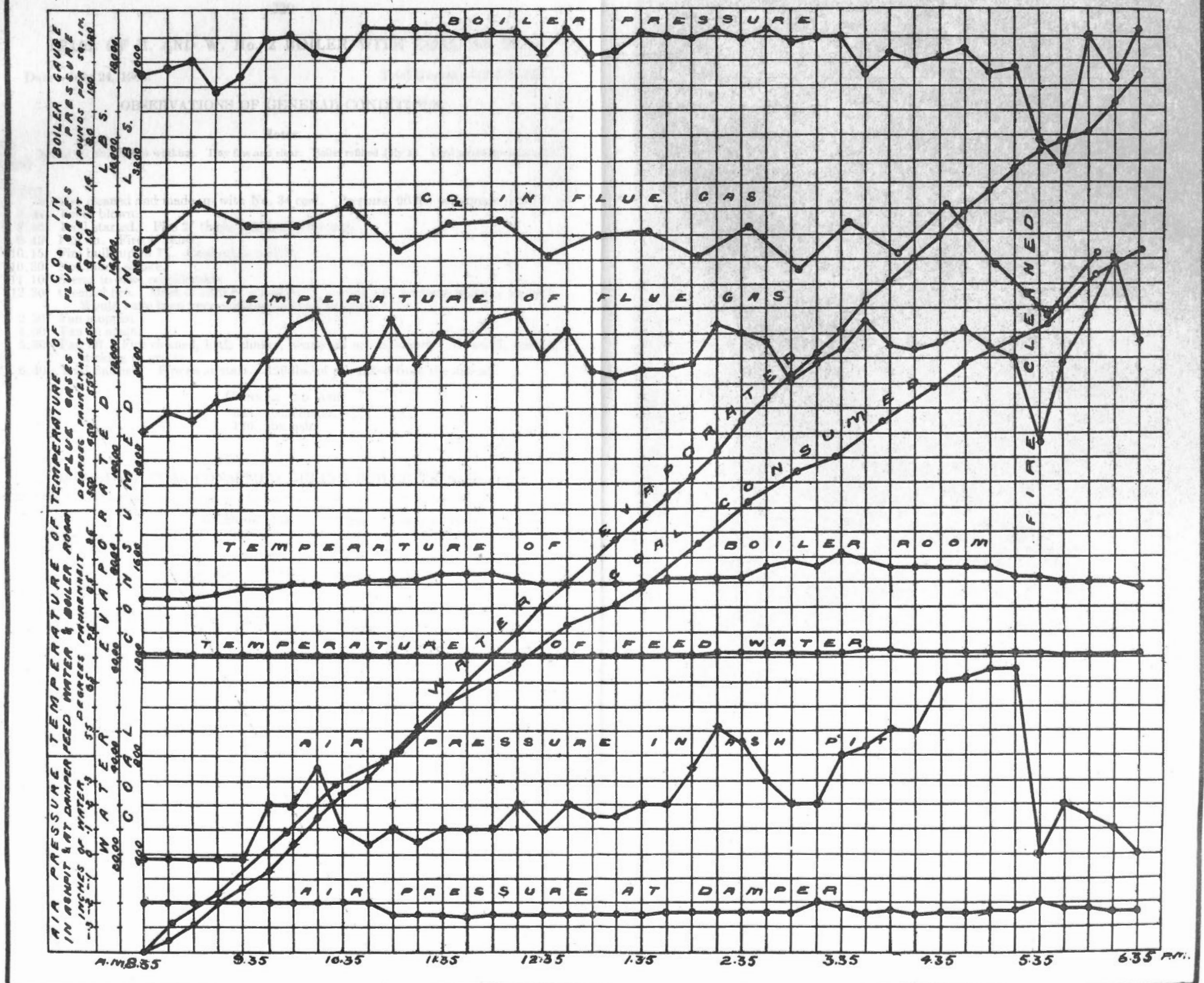
Flue Gases.

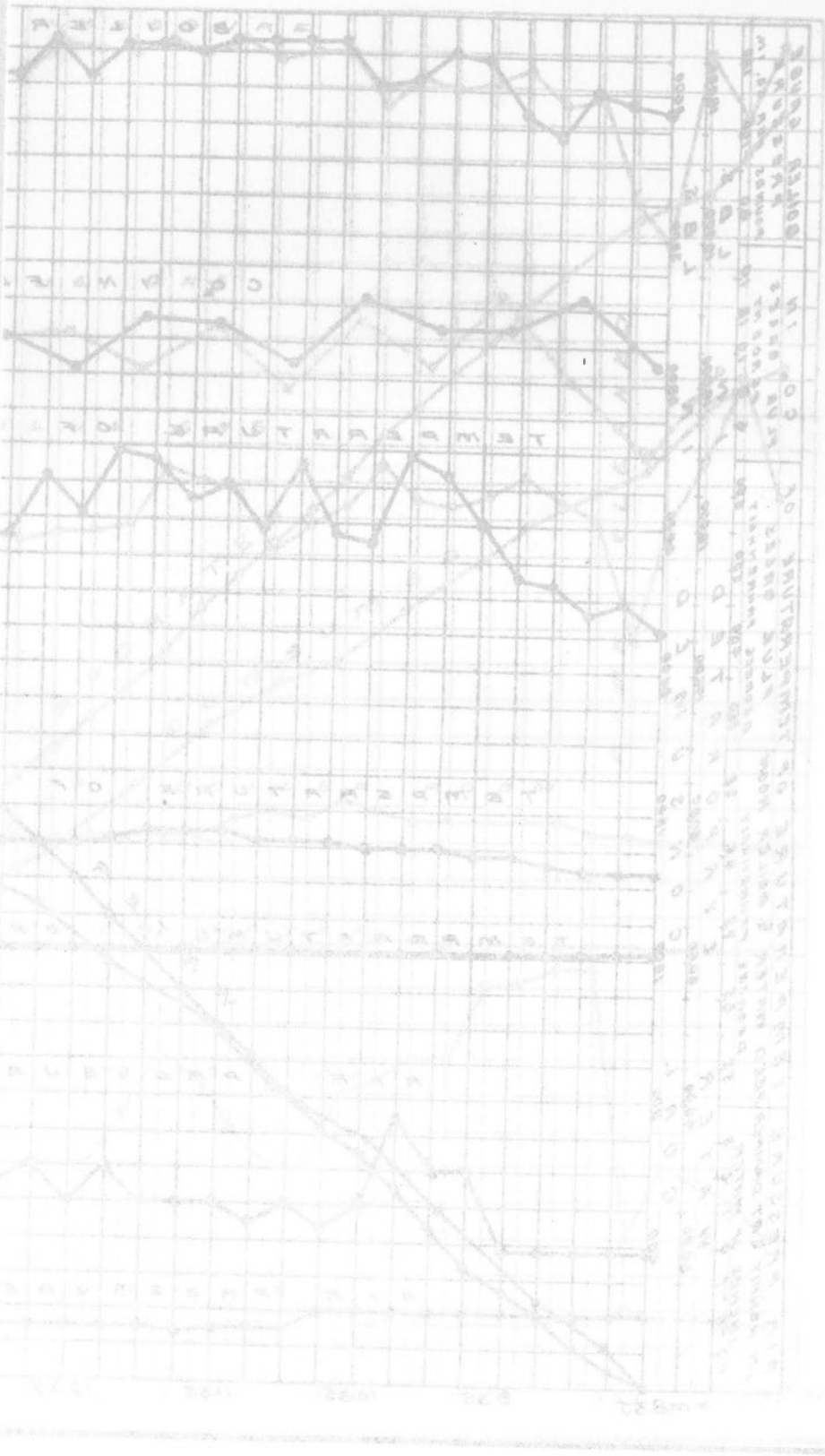
33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	24·2
34.	" " of combustible consumed (from gas analyses) (lbs.)	21·3
35.	" " dry coal (from gas analyses) (lbs.)	18·2
36.	Proportion of heat of fuel in escaping dry flue gases (%)	17·6

GRAPHIC RECORD OF BOILER TRIAL.

G.C.T. 54.

COAL Nº 33/00





TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 34.

Date—July 24, 1908. Trial Number—G.C.T. 55.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

B. and W. No. 1 boiler working. Day fine and clear. Boiler refilled July 23. Coal contains much small stuff.

Time.

7.30 Fire cleaned and made up with No. 34 coal. Pressure, 90 lbs per square inch.
7.45 Tubes blown.
8.40 Trial started. Fire 2″ thick, half burnt through.
9.45 Fan on. Fire 4″ thick.
10.15 Fire built up to 7″. Coal cakes a little.
10.30 Not much smoke.
11.10 Seems to cake considerably.
12.30 Cleaned fire. Most of clinker consisted of a small ash, nothing sticking to bars. Would have been very suitable for shaking grate.
2.50 Fan stopped.
4.00 Fan on again.
5.30 Fan off. Fire cleaned, little clinker, nearly all ash removed. All small, nothing sticking to grates.
6.40 Trial finished. Fire as at start. 126 lbs. of ash raked from the ash-pit.

CLINKER AND ASH.

399 lbs. clinker.
126 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 55.

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.40 a.m.						
8.50	85	85	8.40	6·6	12·1	0·4
9.25	161	246	9.10	9·8	8·5	0·9
9.55	202	448	9.40	8·2	10·6	0·4
10.15	107	555	10.10	7·3	11·5	0·5
10.40	149	704	10.40	12·4	6·4	0·3
11.10	147	851	11.10	8·3	11·1	0·2
11.40	112	963	11.40	7·9	11·9	0·0
12.10	89	1052	12.10	6·8	13·3	0·2
12.30	102	1154	12.40	6·9	12·9	0·0
1.00	181	1335	1.10	5·7	14·2	0·1
1.15	50	1385	1.40	6·0	14·0	0·2
1.45	223	1608	2.10	10·9	8·4	0·2
2.15	154	1762	2.40	7·1	12·5	0·1
2.25	98	1860	3.10	9·4	9·7	0·7
2.55	101	1961	3.40	7·7	12·5	0·1
3.25	94	2055	4.10	7·9	11·5	0·1
3.55	86	2141	4.40	9·0	10·5	0·2
4.20	194	2335	5.10	9·3	10·7	0·0
4.50	157	2492	5.40	7·4	12·3	0·2
5.20	57	2549	6.10	10·1	7·5	1·4
6.00	105	2654				
6.40	157	2811		8·2	11·1	0·3

OBSERVATIONS MADE DURING BOILER TRIAL No. 55

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.40	123	87	510	70·5	−·02	−·26	.....
8.55	118	85	520	70·5	−·02	−·26	340
9.10	117	85	550	70·5	−·02	−·26	410·5
9.25	121	86	545	70·5	−·02	−·27	316
9.40	108	87	515	70·5	−·02	−·28	440
9.55	120	89	615	70·5	+·15	−·29	303·5
10.10	108	89	600	71	+·15	−·29	484·5
10.25	123	91	625	71	+·15	−·30	400·5
10.40	119	90	675	71	+·15	−·30	450·5
10.55	120	89	620	71	+·12	−·30	481·5
11.10	116	87	605	71	+·10	−·30	471·5
11.25	113	87	680	71	+·12	−·30	503·5
11.40	116	88	600	71	+·10	−·30	443·5
11.55	118	88	680	71	+·15	−·29	411
12.10	116	90	660	71	+·30	−·29	540
12.25	118	89	630	71	+·25	−·29	492·5
12.40	110	93	500	71	0·0	−·28	361
12.55	117	88	580	71	+·15	−·28	242·5
1.10	119	87	625	71	+·25	−·28	376·5
1.25	122	87	700	71	+·10	−·28	553
1.40	123	89	650	71	+·05	−·28	511·5
1.55	122	89	710	71·5	+·15	−·28	500·5
2.10	121	90	680	71·5	+·15	−·28	524
2.25	120	92	670	71·5	+·15	−·30	552·5
2.40	115	90	605	71·5	+·02	−·30	632·5
2.55	115	89	570	71·5	0·0	−·28	334·5
3.10	120	87	570	71·5	−·02	−·28	455
3.25	119	87	570	71·5	−·02	−·28	394·5
3.40	118	87	570	71·5	−·02	−·28	448
3.55	116	89	565	71·5	−·02	−·28	392
4.10	121	89	565	72	+·05	−·28	351·5
4.25	112	90	615	72	+·14	−·28	423·5
4.40	103	86	595	72	+·08	−·28	586
4.55	98	86	590	72	+·08	−·28	414
5.10	122	87	580	72	+·08	−·28	344·5
5.25	120	87	600	71·5	+·05	−·28	405·5
5.40	93	95	475	71·5	−·02	−·26	376
5.55	108	87	590	71·5	−·02	−·26	243
6.10	123	88	590	71·5	−·02	−·27	283
6.25	121	85	600	71·5	−·02	−·28	440
6.40	120	85	610	71·5	−·02	−·28	384
	116·4	88·2	600	71·2	+·07	−·28	17,018 net

SUMMARY OF OBSERVATIONS

Date—July 24, 1908.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.40 a.m.	Ended—6.40 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Forced
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned May, 1908
4.	Tubes cleaned	7.45 a.m.
5.	Fire cleaned	7.30 a.m., 12.30 and 5.30 p.m

Fuel.

6.	Kind of coal	No. 34—No. 2 seam, Denison Colliery, International Coal and Coke Co., Denison, Alberta
7.	Analysis of dry coal by weight (%)	C = 68·5, H = 4·0, S = 0·4 N_2 = 1·0, O_2 = 6·3, Ash = 19·8
8.	Calorific value of dry coal B.T.U. per lb	11720
9.	Moisture in coal as fired (%)	0·80
10.	Weight of coal fired (lbs.)	2811
11.	Combustible matter in ash and clinker (%)	18·6
12.	Weight of clinker (lbs.)	399
13.	Weight of ash (lbs.)	126

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	+0·07
15.	" above fire " "	−0·25
16.	" at damper " "	−0·28
17.	Amount of damper opening	Full
18.	Temperature of air in boiler house (°F.)	88·2
19.	Flue temperature (°F.)	600
20.	Analysis of dry flue gas by volume (%)	CO_2 = 8·2, O_2 = 11·1, CO = 0·3, N = 80·4

Water and Steam.

21.	Temperature of feed water (°F.)	71·2
22.	Total weight of feed water, corrected for difference of level (lbs.)	17018
23.	Water level in gauge at start (inches)	$5\frac{4}{16}$
24.	Water level in gauge at finish (inches)	$5\frac{1}{8}$
25.	Correction for difference of level included above (lbs.)	+30
26.	Steam pressure by gauge (lbs. per sq. in.)	116·4
27.	Barometer reading (inches)	30·04
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	15·7
29.	Temperature in steam calorimeter (°F.)	290·1

Notes.

This coal coked a little at first with a thin fire and later with forced draught and thick bed coked considerably. The clinker consisted of ash chiefly and was very easily removed, not adhering to bars at all. Would be very suitable for a shaking grate. Weather fine and clear.

Proximate analysis of dry coal by weight %

Fixed carbon	55·1
Volatile matter	25·1
Ash	19·8

SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 34. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—30·09. At finish—30·00. Mean—30·04.

Total Quantities.

1.	Date of trial	24/7/08
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	2811
4.	Percentage of moisture in coal as fired (%)	0·8
5.	Total weight of dry coal fired (lbs.)	2789
6.	Total ash and refuse (lbs.)	525
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 24·3; (*b*) weighed	18·8
8.	Total weight of combustible consumed, from analyses (lbs.)	2111
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	17018
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	16930
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	20140

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	279
13.	Dry coal per square foot of grate surface per hour (lbs.)	16·6
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1693
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2014
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·15

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	116·4
18.	Temperature of feed water entering boiler (deg. F.)	71·2
19.	Temperature of escaping gases from boiler (deg. F.)	600
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·35
21.	Percentage of moisture in steam	0·7

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	58·4
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	97

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	6·05
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	7·17
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	7·22
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	9·54

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	11720
30.	Calorific value of the combustible per lb. (B.T.U.)	14614
31.	Efficiency of boiler (based on combustible consumed) (%)	63
32.	Efficiency of boiler, including grate (based on dry coal) (%)	59·5

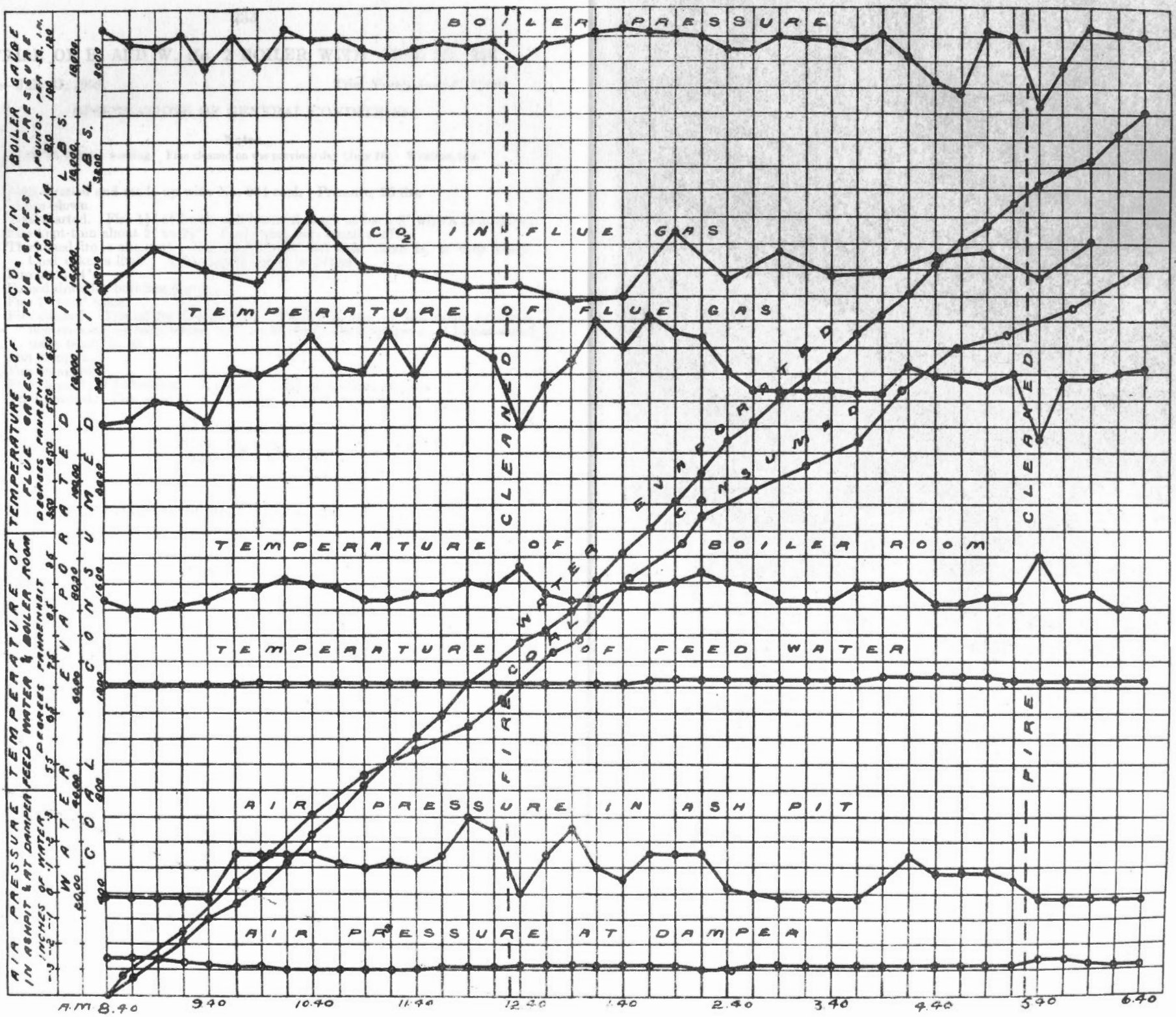
Flue Gases.

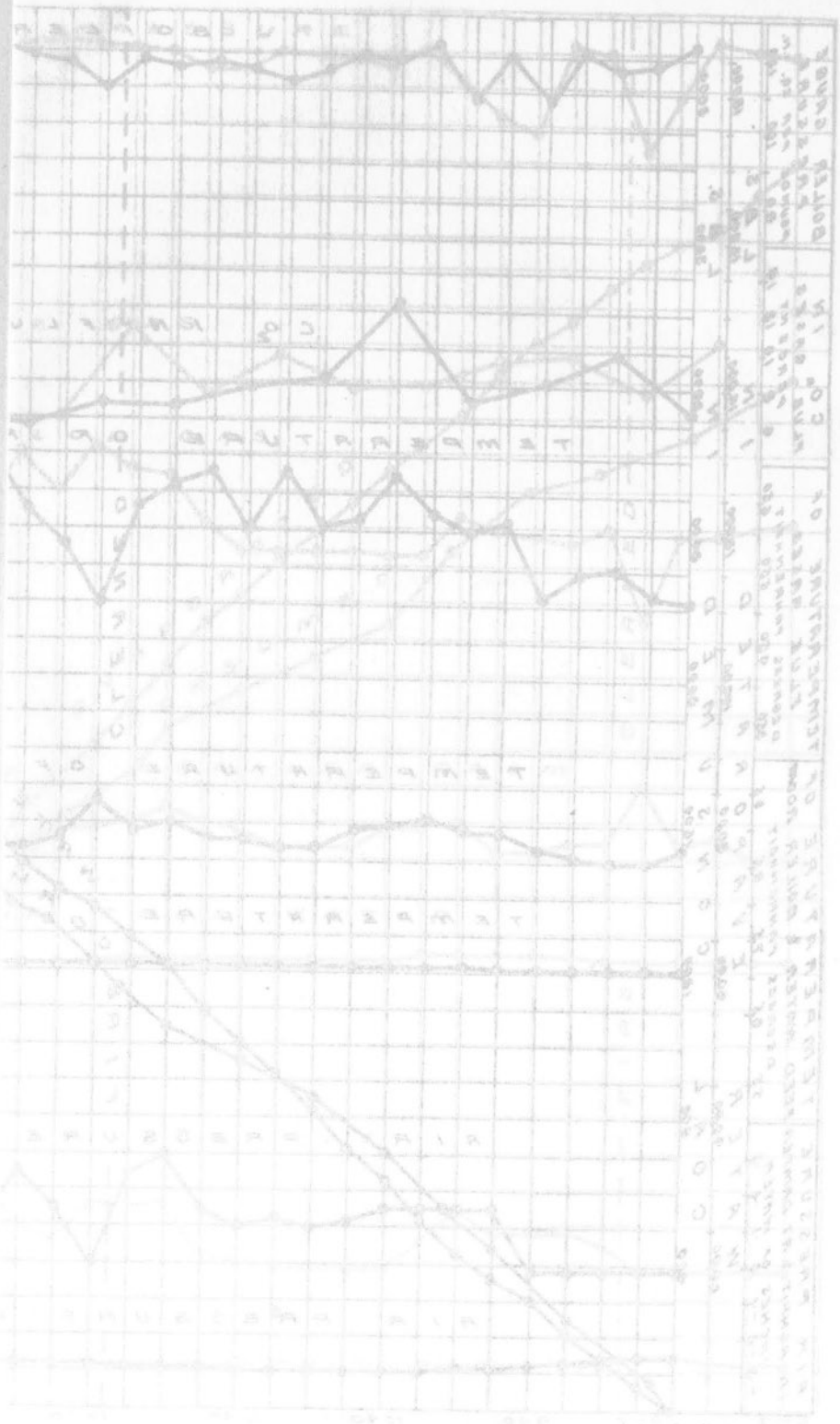
33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	29·1
34.	" " of combustible consumed (from gas analyses) (lbs.)	26·3
35.	" " dry coal (from gas analyses) (lbs.)	19·9
36.	Proportion of heat of fuel in escaping dry flue gases (%)	20·9

GRAPHIC RECORD OF BOILER TRIAL.

G.C.T. 55

COAL Nº 34





TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 234.

Date—July 27, 1908. Trial Number—G.C.T. 56.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

B. and W. No. 1 boiler working. Flue cleaned on the previous day (July 26). Weather, fair.

Time.
7.30 Fires cleaned and made up with No. 234 coal. Pressure, 95 lbs.
7.45 Tubes blown.
8.40 Trial started. Fire 1½″ at front, well burnt through at back 2″ with a little flame.
9.15 Fire kept thin about 2″ to 2½″. Coal being very small stuff.
9.45 Thickened fire to about 3″. Not much smoke, but what there is, is very black. Coal cokes a little. A finer grate would be better.
10.30 Fire about 4″.
11.15 Forced draught, building fire up.
11.30 Fire 7″ to 8″ thick.
12.31 Fire cleaned. Fan off for five minutes. Clinker broken up and easily removed, not sticking to bars, would be suitable for a shaking grate. Clinker caked more than No. 34.
1.00 Fan stopped.
4.10 Fan on again.
5.30 Fire cleaned. Clinker easily removed. Nothing sticking to bars.
6.43 Trial finished. Fire as at start. 120 lbs. fine ash removed.

CLINKER AND ASH.
164 lbs. clinker.
120 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 56

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.40 a.m.						
9.10	195	195	8.45	7·0	11·3	0·9
9.35	111	306	9.15	9·4	9·2	0·4
10.05	124	430	9.45	8·6	8·4	2·6
10.30	139	569	10.15	10·9	8·3	0·3
11·00	197	766	10.45	9·5	8·0	1·0
11.15	109	875	11.15	10·6	8·6	0·0
11.45	117	992	11.45	8·0	11·5	0·0
12.15	114	1106	12.15	11·5	8·2	0·2
12.50	200	1306	12.45	7·9	10·7	0·3
1.20	125	1431	1.15	8·8	9·6	0·3
1.50	112	1543	1.45	9·2	10·3	0·3
2.20	109	1652	2.15	13·6	5·2	0·7
2.40	90	1742	2.45	10·0	10·5	0·0
3.10	135	1877	3.15	11·5	6·2	0·8
3.40	130	2007	3.45	8·0	10·2	1·6
3.50	63	2070	4.15	11·7	4·0	2·4
4.20	167	2237	4.45	13·0	5·6	0·8
4.50	95	2332	5.15	12·3	5·8	0·7
5.20	165	2498	5.45	7·7	11·8	0·0
6.00	221	2719	6.15	7·9	10·7	0·6
6.43	63	2782				
				9·9	8·7	0·7

OBSERVATIONS MADE DURING BOILER TRIAL No. 56

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.40	98	81	515	70	−·02	−·27	.....
8.55	110	83	545	70	−·02	−·28	350
9.10	114	83	550	70·5	−·02	−·27	482
9.25	120	83	590	70·5	−·02	−·26	333
9.40	116	84	600	70·5	−·02	−·26	410
9.55	115	83	600	70·5	−·02	−·28	487
10.10	112	84	605	70·5	−·02	−·28	471·5
10.25	112	84	640	70·5	−·02	−·28	462·5
10.40	110	84	620	71	−·02	−·28	534
10.55	123	85	510	71	−·02	−·26	375
11.10	116	85	520	71	−·02	−·25	375·5
11.25	123	87	700	71	+·40	−·25	311·5
11.40	113	85	640	71	+·10	−·25	554
11.55	123	85	670	71·5	+·10	−·25	431
12.10	114	84	760	71·5	+·10	−·26	522
12.25	116	84	720	71·5	0·0	−·26	544·5
12.40	113	85	570	71	+·30	−·25	364
12.55	120	85	640	71	+·20	−·25	382·5
1.10	118	84	600	71	0·0	−·26	454
1.25	118	84	565	71	−·01	−·25	373·5
1.40	119	86	630	71	−·02	−·26	451·5
1.55	116	85	640	71	−·02	−·27	417
2.10	122	85	660	71·5	−·02	−·28	454·5
2.25	118	85	725	71·5	−·02	−·28	512
2.40	119	85	720	71·5	−·02	−·28	563
2.55	104	85	650	72	−·02	−·28	550
3.10	113	86	605	72	−·02	−·28	404·5
3.25	113	87	610	72	−·02	−·28	480·5
3.40	115	87	585	72	−·02	−·28	426·5
3.55	119	87	565	72·5	−·02	−·28	413
4.10	116	87	675	72·5	−·02	−·28	407·5
4.25	113	86	715	72·5	+·12	−·29	550
4.40	123	86	630	72·5	+·06	−·29	470·5
4.55	123	87	675	72·5	+·10	−·28	501·5
5.10	113	86	650	72·5	+·20	−·28	571·5
5.25	118	87	690	72·5	+·10	−·28	540
5.40	98	85	560	72·5	−·02	−·28	390·5
5.55	117	85	630	72·5	−·02	−·28	353·5
6.10	123	85	590	72·5	−·02	−·26	428·5
6.25	113	85	570	72·5	−·02	−·26	318·5
6.43	123	85	620	72·5	−·02	−·26	436
	115·7	85	623	71·5	+·03	−·27	17,858 net

SUMMARY OF OBSERVATIONS

Date—July 27, 1908.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.40 a.m.	Ended—6.43 p.m.	Duration—603 mins.

General.

1. Method of stoking.....Hand-spreading on alternate sides
2. Kind of draft.....Forced
3. Condition of boiler and date of last cleaning.....Thoroughly cleaned May, 1908
4. Tubes cleaned.....7.45 a.m.
5. Fire cleaned.....7.30 a.m., 12.30 and 5.30 p.m.

Fuel.

6. Kind of coal.....No. 234—No. 2 seam, Denison Colliery, International Coal & Coke Co., Coleman, Alberta.
7. Analysis of dry coal by weight (%).....C = 76·5, H = 4·3, S = 0·4, N_2 = 1·0, O_2 = 6·2, Ash = 11·6
8. Calorific value of dry coal B.T.U. per lb.....13180
9. Moisture in coal as fired (%).....3·7
10. Weight of coal fired (lbs.).....2782
11. Combustible matter in ash and clinker (%).....19·6
12. Weight of clinker (lbs.).....164
13. Weight of ash (lbs.).....120

Air and Flue Gas.

14. Air pressure under fire (inches of water).....+0·03
15. " above fire " " .....−0·21
16. " at damper " " .....−0·27
17. Amount of damper opening.....Full
18. Temperature of air in boiler house (°F.).....85
19. Flue temperature (°F.).....623
20. Analysis of dry flue gas by volume (%). CO_2 = 9·9, O_2 = 8·7, CO = 0·7, N = 80·7

Water and Steam.

21. Temperature of feed water (°F.).....71·5
22. Total weight of feed water, corrected for difference of level (lbs.).....17858
23. Water level in gauge at start (inches).....5 $\frac{1}{16}$
24. Water level in gauge at finish (inches).....4 $\frac{13}{16}$
25. Correction for difference of level, included above (lbs.).....+40
26. Steam pressure by gauge (lbs. per sq. in.).....115·7
27. Barometer reading (inches).....29·76
28. Pressure in steam calorimeter by gauge (lbs. per sq. in.).....14·9
29. Temperature in steam calorimeter (°F.).....290·6

Notes.

The effect of washing seems to have occasioned the formation of a harder clinker and larger pieces. Not however, too large, and could be passed through a shaking grate. Forced draught became necessary soon after cleaning. The coal was very small and a lot found its way through the grates. Cleaned out twice. Smoke not very heavy. Weather fair.

Proximate analysis of dry coal by weight %: Fixed carbon..... 62·0; Volatile matter..... 26·4; Ash..... 11·6

SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 234. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·80. At finish—29·72. Mean—29·76.

Total Quantities.

1.	Date of trial	27/7/08
2.	Duration of trial (hours)	10·05
3.	Weight of coal as fired (lbs.)	2782
4.	Percentage of moisture in coal as fired (%)	3·7
5.	Total weight of dry coal fired (lbs.)	2679
6.	Total ash and refuse (lbs.)	284
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 14·4; (*b*) weighed	10·6
8.	Total weight of combustible consumed, from analyses (lbs.)	2290
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	17858
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17780
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	21150

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	266
13.	Dry coal per square foot of grate surface per hour (lbs.)	15·8
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1769
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2104
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·28

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	115·7
18.	Temperature of feed water entering boiler (deg. F.)	71·5
19.	Temperature of escaping gases from boiler (deg. F.)	623
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·30
21.	Percentage of moisture in steam	0·6

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	60·9
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	102

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	6·42
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	7·60
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	7·89
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	9·22

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	13180
30.	Calorific value of the combustible per lb. (B.T.U.)	14900
31.	Efficiency of boiler (based on combustible consumed) (%)	59·7
32.	Efficiency of boiler, including grate (based on dry coal) (%)	57·8

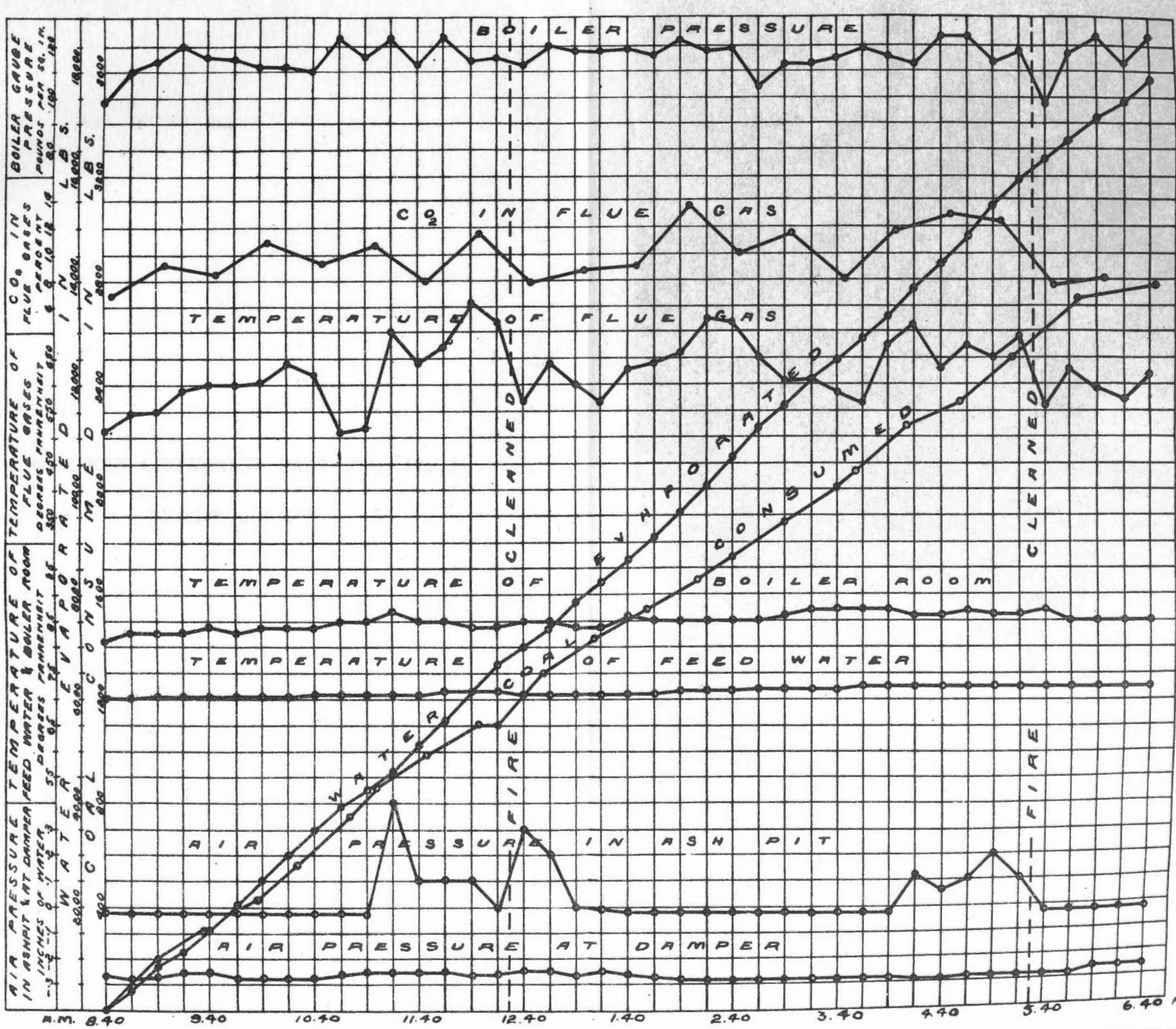
Flue Gases.

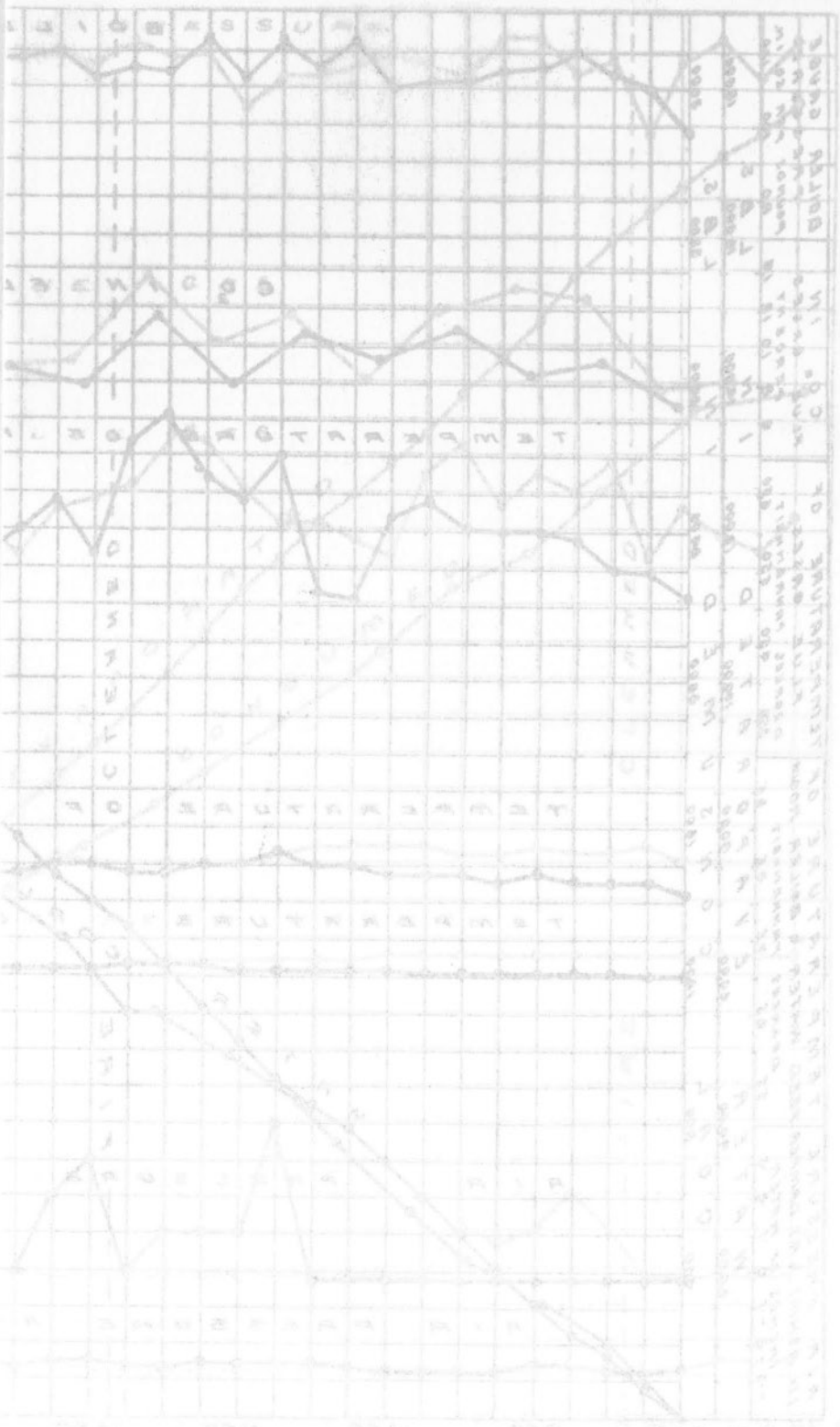
33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	23·4
34.	" " of combustible consumed (from gas analyses) (lbs.)	20·9
35.	" " dry coal (from gas analyses) (lbs.)	17·9
36.	Proportion of heat of fuel in escaping dry flue gases (%)	17·6

GRAPHIC RECORD OF BOILER TRIAL.

G.C.T. 56

COAL Nº 34/00





WESTERN CROWSNEST PASS COAL FIELD.

BRITISH COLUMBIA.

TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 31.

Date—June 5, 1908. Trial Number—G.C.T. 34.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Weather fine and moderately warm. Slight breeze.

Time.
a.m.
6.30 Fire opened out.
7.50 Fire cleaned. Pressure, 90 lbs., and made up with No. 31 coal.
8.00 Tubes blown.
8.45 Trial started. Fire 2″ thick, flaming slightly. Pressure, 123 lbs. Coal in lumps up to 4″ with moderate amount of dust. Burns freely with considerable flame, and cokes considerably. Smoke light.
12.40 Fire sliced. 19 lbs. of clinker removed.
2.05 Fire sliced.
2.36 Steam admitted under grate-bars.
2.44 to 2.48 Fire sliced. 58 lbs. of hard, heavy, and fairly adherent clinker removed.
5.49 Steam under grate stopped.
5.50 to 5.59 Fire cleaned. 152 lbs. of clinker removed. Clinker hard, heavy, friable, and not adherent (with steam in ash-pit). Fire kept about 4″ thick up to 1.30 p. m. then about 6″ up to 5.00 p.m. Coal may be used on shaking grate with steam in ash-pit.
6.45 Trial ended. Fire similar to start. 78 lbs of ashes raked out of ash-pit. Blow-off examined and found tight.

CLINKER AND ASH.

229 lbs.clinker.
78 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL NO. 34

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.45 a.m.						
9.15	255	255	8.50	7·1	12·3	0·1
9.30	57	312	9.25	7·5	12·2	0·0
9.45	112	424	9.50	9·7	8·9	0·0
10.15	133	557	10.20	9·1	9·8	0·0
10.45	137	694	10.50	8·3	11·2	0·0
11.15	128	822	11.20	8·8	10·0	0·0
11.45	92	914	11.50	9·8	8·2	0·4
12.15	125	1039	12.20	9·5	8·0	0·4
12.45	144	1183	12.50	11·7	6·1	0·2
1.15	133	1316	1.20	9·1	9·2	0·1
1.35	82	1398	1.50	9·1	8·8	0·4
1.45	53	1451	2.20	10·9	7·7	0·0
2.15	168	1619	2.50	12·6	7·2	0·0
2.50	137	1756	3.20	11·1	8·0	0·1
3.15	160	1916	3.50	8·3	11·3	0·0
3.45	124	2040	4.20	11·5	8·7	0·1
4.00	75	2115	4.50	6·6	13·3	0·0
4.15	35	2150	5.20	8·3	11·2	0·0
4.45	156	2306	5.50	9·2	11·0	0·2
5.15	67	2373	6.10	8·1	11·0	0·3
5.45	112	2485	6.30	8·0	11·4	0·1
6.10	151	2636				
6.45	66	2702		9·2	9·8	0·1

OBSERVATIONS MADE DURING BOILER TRIAL No. 34

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.45	121	79	535	58·5	0·0	—·22	.....
9.00	120	79	540	58·5	—·05	—·22	490
9.15	121	79	520	58·5	—·05	—·26	472
9.30	123	79	565	58	—·05	—·26	617
9.45	121	81	540	58	—·03	—·25	496·5
10.00	121	81	510	67·5	—·02	—·18	410
10.15	121	83	520	57·5	—·02	—·18	496
10.30	122	83	525	58	—·02	—·18	569
10.45	123	85	500	57·5	—·02	—·18	584
11.00	114	85	490	57·5	—·02	—·15	430
11.15	122	85	480	57·5	—·02	—·15	627
11.30	123	83	480	58	—·02	—·15	268·5
11.45	119	85	460	58	—·02	—·15	297
12.00	121	85	450	58	—·02	—·15	370
12.15	121	81	480	58	—·02	—·18	375·5
12.30	121	81	460	58	—·02	—·18	343
12.45	123	87	540	58	—·02	—·18	391
1.00	123	87	550	58	—·02	—·18	500
1.15	121	85	520	58	—·02	—·18	497·5
1.30	120	85	500	58	—·02	—·18	449
1.45	120	85	500	58	—·02	—·19	399
2.00	123	85	500	58·5	—·02	—·23	380
2.15	123	85	570	58·5	—·02	—·23	462
2.30	123	81	510	59	—·02	—·20	381
2.45	112	93	580	59	—·02	—·20	422
3.00	122	87	660	59	0·0	—·26	325
3.15	123	83	680	59·5	0·0	—·27	494·5
3.30	123	85	640	59·5	0·0	—·27	725·5
3.45	123	85	600	60	0·0	—·24	472·5
4.00	122	85	580	60	0·0	—·20	578·5
4.15	122	87	590	60	0·0	—·21	372·5
4.30	121	89	560	60	0·0	—·20	604·5
4.45	105	87	530	60	0·0	—·20	484·5
5.00	104	87	510	60·5	0·0	—·20	431·5
5.15	123	83	540	60·5	0·0	—·24	424
5.30	106	81	540	60·5	0·0	—·23	444·5
5.45	115	81	570	60·5	0·0	—·24	419
6.00	81	93	570	60·5	0·0	—·24	446·5
6.15	95	81	570	60·5	0·0	—·23	293
6.30	123	81	660	60·5	0·0	—·23	382
6.45	121	81	640	60·5	0·0	—·23	508
	118·0	84	541	58·7	—·02	—·21	18,233 net.

SUMMARY OF OBSERVATIONS

Date—June 5, 1908.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.45 a.m.	Ended—6.45 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned May, 1908
4.	Tubes cleaned	8.00 a.m.
5.	Fire cleaned	7.50 a.m., 5.50 p.m.

Fuel.

6.	Kind of coal	Coal No. 31—No. 3 mine, Michel Colliery, Crowsnest Pass Coal Co., Fernie, B.C.
7.	Analysis of dry coal, by weight (%)	C=75·5, H=4·3, S=0·5 / N_2=1·2, O_2=6·0, Ash=12·5
8.	Calorific value of dry coal B.T.U. per lb	13270
9.	Moisture in coal as fired (%)	0·7
10.	Weight of coal fired (lbs.)	2702
11.	Combustible matter in ash and clinker (%)	13·6
12.	Weight of clinker (lbs.)	229
13.	Weight of ash (lbs.)	78

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−0·02
15.	" above fire " "	−0·18
16.	" at damper " "	−0·20
17.	Amount of damper opening	Various
18.	Temperature of air in boiler house (°F.)	84
19.	Flue temperature (°F.)	541
20.	Analysis of dry flue gas by volume (%)	CO_2=9·2, O_2=9·8, CO=0·1, N=80·9

Water and Steam.

21.	Temperature of feed water (°F.)	58·7
22.	Total weight of feed water, corrected for difference of level (lbs.)	18233
23.	Water level in gauge at start (inches)	3 7/8
24.	Water level in gauge at finish (inches)	3 15/16
25.	Correction for difference of level, included above (lbs.)	−10
26.	Steam pressure by gauge (lbs. per sq. in.)	118
27.	Barometer reading (inches)	30·00
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	15·4
29.	Temperature in steam calorimeter (°F.)	294

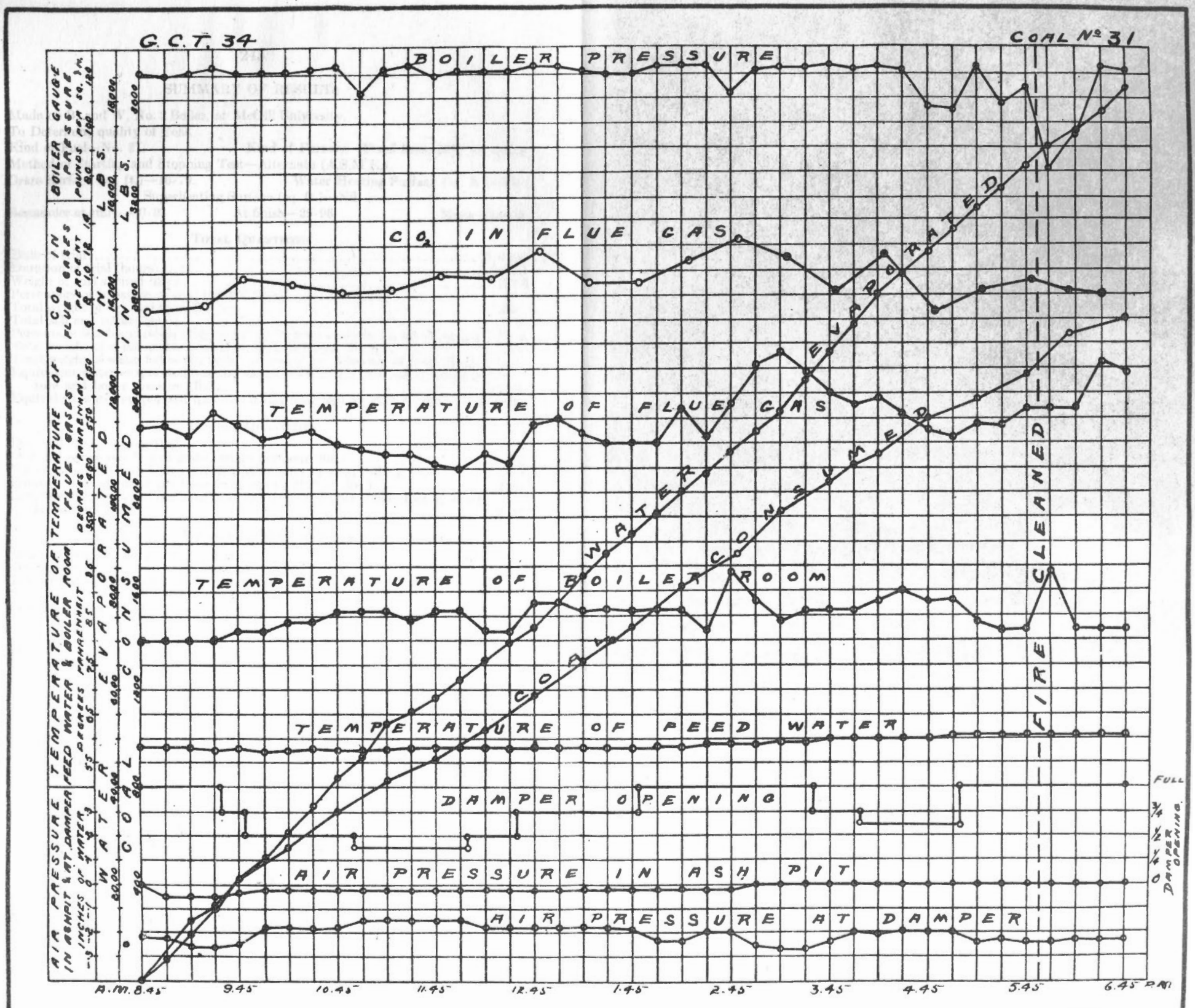
Notes.

This coal clinkers considerably, the fire requiring to be sliced from time to time.

It is advisable to have a steam jet turned on under the bars. With a steam jet this coal could be worked on a shaking grate. Fire sliced 12.40, 2.05, 2.44. Weather, fine and moderately warm. Slight breeze.

Proximate analysis of dry coal by weight %:

Fixed carbon	62·7
Volatile matter	24·8
Ash	12·5


G. C. T. 34
COAL Nº 31
BOILER PRESSURE
CO₂ IN FLUE GAS
TEMPERATURE OF FLUES GAS
TEMPERATURE OF BOILER ROOM
TEMPERATURE OF FEED WATER
DAMPER OPENING
AIR PRESSURE IN ASH PIT
AIR PRESSURE AT DAMPER
WATER EVAPORATED
WATER CONSUMED
COAL
FIRE CLEANED
BOILER GAUGE PRESSURE POUNDS PER SQ. IN.
CO₂ IN FLUE GASES PERCENT
TEMPERATURE OF FLUE GASES DEGREES FAHRENHEIT
TEMPERATURE OF BOILER ROOM DEGREES FAHRENHEIT
TEMPERATURE OF FEED WATER DEGREES FAHRENHEIT
WATER LBS.
COAL LBS.
AIR PRESSURE IN ASHPIT & AT DAMPER INCHES OF WATER
FULL
¾
½
¼
0
DAMPER OPENING.
A.M. 8.45 9.45 10.45 11.45 12.45 1.45 2.45 3.45 4.45 5.45 6.45 P.M.

SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 31. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—30·03 At finish—29·96. Mean—30·00.

Total Quantities.

1.	Date of trial	5/6/08
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	2702
4.	Percentage of moisture in coal as fired (%)	0·7
5.	Total weight of dry coal fired (lbs.)	2683
6.	Total ash and refuse (lbs.)	307
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 14·48; (*b*) weighed.	11·4
8.	Total weight of combustible consumed, from analyses (lbs.)	2294
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	18233
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	18140
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	21840

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	268
13.	Dry coal per square foot of grate surface per hour (lbs.)	15·9
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1814
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2184
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·42

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	118
18.	Temperature of feed water entering boiler (deg. F.)	58·7
19.	Temperature of escaping gases from boiler (deg. F.)	541
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·19
21.	Percentage of moisture in steam	0·5

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	63·3
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	105

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	6·74
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	8·08
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	8·15
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	9·53

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	13270
30.	Calorific value of the combustible per lb. (B.T.U.)	15170
31.	Efficiency of boiler (based on combustible consumed) (%)	60·5
32.	Efficiency of boiler, including grate (based on dry coal) (%)	59·3

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	26·4
34.	" " of combustible consumed (from gas analyses) (lbs.)	23·3
35.	" " dry coal (from gas analyses) (lbs.)	19·9
36.	Proportion of heat of fuel in escaping dry flue gases (%)	16·5

TRIAL OF B. AND W. No. 1 BOILER WITH COAL No. 231.

Date—July 17, 1908. Trial Number—G.C.T. 52.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Day fine but cloudy. B. and W. No. 1 boiler working. Coal consists of very small stuff.

Time.
7.30 Fire cleaned and started with No. 231 coal.
7.40 Tubes cleaned.
8.35 Trial started. 2½" fire. Rather green, much flame.
8.55 Coal coking considerably. Keeping thin fire of about 2½".
10.20 Building up fire to about 4". Not very much smoke.
12.35 Fire cleaned. 35 lbs. of clinker removed. This clinker was in a hard layer, perforated by many small holes so that air could get through it fairly well. It is in too hard a layer to be used on a shaking grate.
3.30 Fire still kept about 4" thick, which seems to be right thickness.
5.35 Cleaned fire. Removed 85 lbs. hard clinker which stuck to the bars.. It consisted of large slabs—thin with small holes.
6.35 Finished. Fire as at start.

CLINKER AND ASH.

85 lbs. clinker.
98 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 52

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.35 a.m.						
.....	.....	.....	8.35	7·8	11·8	0·0
8.50.....	97	97	9.05	10·8	8·8	0·2
9.20.....	137	234	9.35	7·8	11·4	0·5
9.50.....	170	404	10.05	8·0	9·9	0·9
10.20.....	167	571	10.35	10·4	8·2	0·6
10.50.....	114	685	11.05	9·0	11·1	0·0
11.05.....	60	745	11.35	10·0	10·2	0·0
11.35.....	112	857	12.05	9·6	9·0	0·4
12.05.....	158	1015	12.35	8·3	11·5	0·6
12.25.....	62	1077	1.05	9·1	10·5	0·4
1.25.....	194	1271	1.35	9·4	9·7	0·2
2.05.....	140	1411	2.05	10·4	7·4	1·4
2.35.....	121	1532	2.35	7·9	11·7	0·2
2.50.....	70	1602	3.05	8·9	10·5	0·3
3.20.....	160	1762	3.35	11·8	7·4	0·4
3.45.....	170	1932	4.05	9·0	10·8	0·4
4.15.....	112	2044	4.35	8·9	8·7	1·9
4.45.....	118	2162	5.05	8·5	11·5	0·0
4.55.....	60	2222	5.35	7·0	12·4	0·4
5.30.....	125	2347	6.05	9·8	10·0	0·0
5.40.....	60	2407				
6.10.....	108	2515		9·1	10·1	0·5
6.35.....	89	2604				

OBSERVATIONS MADE DURING BOILER TRIAL No. 52

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.35	123	80	560	68·5	—·02	—·30	.....
8.50	118	80	550	68·5	—·02	—·30	420
9.05	116	81	525	69	—·02	—·30	386
9.20	116	79	580	69·5	—·02	—·30	446·5
9.35	122	81	585	69·5	—·02	—·30	365
9.50	119	81	600	70	—·02	—·32	430
10.05	123	83	590	70	—·02	—·32	521·5
10.20	104	82	560	70·5	—·02	—·32	482
10.35	120	82	630	70·5	—·02	—·32	262
10.50	112	83	630	70·5	—·02	—·32	571·5
11.05	123	83	680	70·5	—·02	—·32	639
11.20	121	83	740	71	—·02	—·35	337
11.35	120	83	660	71	—·02	—·32	510
11.50	115	83	650	71	—·02	—·32	480·5
12.05	115	83	610	71	—·02	—·30	460·5
12.20	115	82	600	71	—·02	—·30	361
12.35	104	83	550	71	—·02	—·25	571·5
12.50	121	81	590	71	—·02	—·30	154
1.05	114	81	650	71	—·02	—·30	429·5
1.20	118	80	605	71	—·02	—·30	426·5
1.35	121	80	650	70·5	—·02	—·30	482
1.50	121	79	625	70·5	—·02	—·30	527·5
2.05	119	79	630	70·5	—·02	—·30	449·5
2.20	121	80	675	70·5	—·02	—·30	479
2.35	122	79	630	70·5	—·02	—·30	449·5
2.50	121	79	610	70·5	—·02	—·30	401·5
3.05	121	79	630	70·5	—·02	—·30	480
3.20	121	78	625	70·5	—·02	—·30	539
3.35	123	78	710	70·5	—·02	—·35	492·5
3.50	118	77	690	70·5	—·02	—·35	505
4.05	108	78	650	70·5	—·02	—·34	653·5
4.20	118	78	690	70	—·02	—·34	413
4.35	108	78	620	70	—·02	—·34	533
4.50	103	77	610	70	—·02	—·34	457·5
5.05	113	77	640	70	—·02	—·32	497
5.20	104	77	600	70	—·02	—·32	461·5
5.35	103	79	540	70	—·02	—·25	483·5
5.50	106	77	600	70	—·02	—·32	189·5
6.05	110	77	640	70	—·02	—·32	433
6.20	104	76	600	70	—·02	—·32	395
6.35	118	76	650	70	—·02	—·34	357·5
	115·7	79·8	621	70·3	—·02	—·31	17,933·5 net

SUMMARY OF OBSERVATIONS

Date—July 17, 1908.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.35 a.m.	Ended—6.35 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned May, 1908
4.	Tubes cleaned	7.40 a.m.
5.	Fire cleaned	7.30 a.m., 12.30 and 5.30 p.m.

Fuel.

6.	Kind of coal	No. 231; No. 3 mine, Michel Colliery, Crowsnest Pass Coal Co., Fernie, B.C.
7.	Analysis of dry coal by weight (%)	C=82·4, H=4·8, S=0·5, N_2=1·3, O_2=4·8, Ash=6·2
8.	Calorific value of dry coal B.T.U. per lb	14310
9.	Moisture in coal as fired (%)	4·9
10.	Weight of coal fired (lbs.)	2604
11.	Combustible matter in ash and clinker (%)	39·3
12.	Weight of clinker (lbs.)	85
13.	Weight of ash (lbs.)	98

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−0·02
15.	" above fire " "	−0·20
16.	" at damper " "	−0·31
17.	Amount of damper opening	Full
18.	Temperature of air in boiler house (°F.)	79·8
19.	Flue temperature (°F.)	621
20.	Analysis of dry flue gas by volume (%)	CO_2=9·1, O_2=10·1, CO=0·5, N=80·3

Water and Steam.

21.	Temperature of feed water (°F.)	70·3
22.	Total weight of feed water, corrected for difference of level (lbs.)	17933
23.	Water level in gauge at start (inches)	$4\frac{13}{16}$
24.	Water level in gauge at finish (inches)	$4\frac{7}{8}$
25.	Correction for difference of level, included above (lbs.)	−10
26.	Steam pressure by gauge (lbs. per sq. in.)	115·7
27.	Barometer reading (inches)	29·58
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	15·5
29.	Temperature in steam calorimeter (°F.)	291·3

Notes.

This coal burns with a good deal of flame but not a great deal of smoke. The clinker formed was very hard and in a thin layer perforated with holes. Could not be used on a shaking grate. Coal coked considerably. Cleaned out twice during trial. Weather, fine but cloudy.

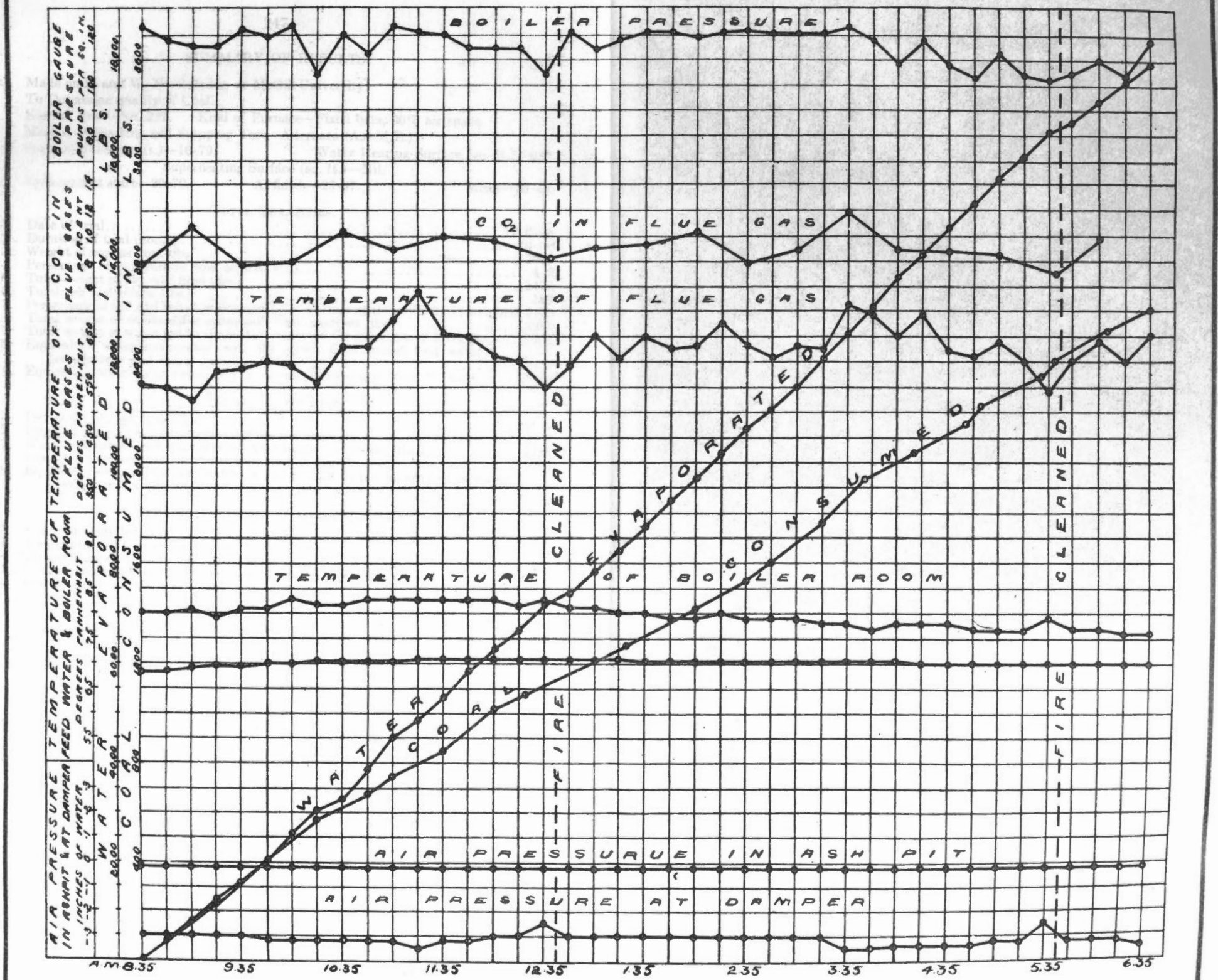
Proximate analysis of dry coal by weight %

Fixed carbon	68·6
Volatile matter	25·2
Ash	6·2

GRAPHIC RECORD OF BOILER TRIAL.

G.C.T. 52

COAL № 31/00



SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 231. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·70. At finish—29·47. Mean—29·58.

Total Quantities.

1.	Date of trial	17/6/08
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	2604
4.	Percentage of moisture in coal as fired (%)	4·9
5.	Total weight of dry coal fired (lbs.)	2476
6.	Total ash and refuse (lbs.)	183
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 10·2; (*b*) weighed	7·39
8.	Total weight of combustible consumed, from analyses (lbs.)	2223
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	17933
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17850
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	21250

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	247·6
13.	Dry coal per square foot of grate surface per hour (lbs.)	14·7
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1785
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2125
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·32

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	115·7
18.	Temperature of feed water entering boiler (deg. F.)	70·3
19.	Temperature of escaping gases from boiler (deg. F.)	621
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·29
21.	Percentage of moisture in steam	0·6

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	61·5
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	103

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	6·89
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	8·16
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	8·58
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	9·56

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	14310
30.	Calorific value of the combustible per lb. (B.T.U.)	15260
31.	Efficiency of boiler (based on combustible consumed) (%)	60·4
32.	Efficiency of boiler, including grate (based on dry coal) (%)	57·9

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	25·9
34.	" " of combustible consumed (from gas analyses) (lbs.)	23·8
35.	" " dry coal (from gas analyses) (lbs.)	21·4
36.	Proportion of heat of fuel in escaping dry flue gases (%)	19·4

TRIAL OF No. 2 B. AND W. BOILER WITH COAL No. 30.

Date—June 9, 1908. Trial Number—G.C.T. 35.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Coal very friable, fairly bright in appearance, in lumps up to 4" with large amount of dust and fine stuff. Smoke light. Weather fine and warm.

Time.

5.30 Fire started.
7.30 Fire cleaned out and made up with No. 30 coal.
8.10 Tubes blown. Pressure, 120 lbs.
8.45 Trial started. Fire about 1½" thick, flaming considerably. Pressure, 99 lbs. Fire kept moderately thin, 4" to 6", during morning.
12.30 to 12.37 Fire cleaned. 96 lbs. of clinker and cinders removed. Clinker porous, friable, and easily removed. Coal cokes a very little. Coal very suitable for fine shaking grate. Coal burns easily with considerable flame. Fire thicker during afternoon, 8" to 10" mostly.
5.30 to 5.37 Fire cleaned. 133 lbs. of clinker, ash, and cinders removed. Clinker small in quantity, friable, and easily removed.
6.45 Trial ended. Fire similar to start. 104 lbs. of ashes raked from ash-pit. Blow-off examined and found tight.

CLINKER AND ASH.

229 lbs. clinker.
104 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 35

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.45 a.m.						
9.15	253	253	8.50	7·0	12·4	0·1
9.45	165	418	9.20	10·6	7·8	0·0
10.15	168	586	9.50	10·3	7·6	0·0
10.45	125	711	10.20	8·8	10·7	0·0
11.15	124	835	10.50	11·8	7·7	0·0
11.30	49	884	11.20	11·3	7·5	0·0
11.45	68	952	11.50	10·3	9·0	0·2
12.15	116	1068	12.20	7·9	12·3	0·0
12.45	132	1200	12.50	10·1	8·9	0·0
1.00	115	1315	1.20	6·2	13·5	0·0
1.15	129	1344	1.50	9·7	10·3	0·0
1.45	182	1526	2.20	10·1	8·1	0·1
2.15	141	1667	2.50	8·7	9·9	0·0
2.45	88	1755	3.20	8·6	11·2	0·0
2.50	24	1779	3.50	10·0	8·8	0·1
3.15	84	1863	4.20	7·2	13·1	0·1
3.45	99	1962	4.50	8·0	10·5	0·1
4.15	123	2085	5.20	7·8	12·9	0·0
4.45	87	2172	5.50	6·7	11·8	0·0
5.05	86	2258	6.10	8·8	11·2	0·0
5.45	161	2419	6.35	9·5	8·3	0·1
6.20	142	2561				
6 45	92	2653		9·01	10·15	0·04

OBSERVATIONS MADE DURING BOILER TRIAL No. 35

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.45	97	85	500	59·5	—·02	—·23	.....
9.00	98	85	510	60	—·02	—·23	280·5
9.15	110	85	500	60	—·02	—·23	419
9.30	110	87	520	60·5	—·02	—·23	512
9.45	110	85	570	60·5	—·02	—·23	559·5
10.00	122	87	620	60·5	—·02	—·23	514·5
10.15	110	85	550	60·5	—·02	—·23	564
10.30	102	87	540	60·5	—·02	—·22	494
10.45	114	86	580	60·5	—·02	—·22	537·5
11.00	122	86	590	60·5	—·02	—·22	599
11.15	106	86	540	60·5	—·02	—·22	570·5
11.30	100	85	550	60·5	—·02	—·20	617
11.45	123	87	540	60·5	—·02	—·20	317·5
12.00	121	87	510	60·5	—·02	—·20	509
12.15	120	85	500	61	—·02	—·20	458·5
12.30	123	85	490	61	—·02	—·20	353
12.45	122	85	470	61	—·02	—·20	163
1.00	118	87	490	61	—·02	—·20	425
1.15	122	87	500	61	—·02	—·20	340
1.30	123	87	490	61·5	—·02	—·20	343
1.45	123	87	480	61·5	—·02	—·20	337
2.00	113	87	500	61·5	—·02	—·21	358
2.15	117	87	500	61·5	—·02	—·20	399·5
2.30	118	89	580	62	—·02	—·22	521
2.45	113	87	550	62	—·02	—·22	554
3.00	121	87	550	62	—·02	—·22	492
3.15	116	87	550	62	—·02	—·22	532
3.30	116	87	570	62	—·02	—·22	507
3.45	123	87	580	62	—·02	—·22	472
4.00	115	87	580	62·5	—·02	—·22	565
4.15	100	87	550	63·5	—·02	—·22	649
4.30	120	87	530	63·5	—·02	—·22	321
4.45	121	87	510	63	—·02	—·22	391·5
5.00	123	87	520	63	—·02	—·22	419·5
5.15	123	87	560	63	—·02	—·22	427·5
5.30	111	87	500	63	—·02	—·22	386·5
5.45	82	85	460	63·5	—·02	—·22	297
6.00	105	85	570	63·5	—·02	—·22	250·5
6.15	123	87	640	63·5	—·02	—·22	540·5
6.30	118	87	590	63·5	—·02	—·20	565
6.45	123	87	640	63·5	—·02	—·20	438·5
	114·5	86·4	538	61·7	—·02	—·21	18,000·5 net

SUMMARY OF OBSERVATIONS

Date—June 10, 1908.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.45 a.m.	Ended—6.45 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned May, 1908
4.	Tubes cleaned	8.10 a.m.
5.	Fire cleaned	7.30 a.m., 12.30 and 5.30 p.m.

Fuel.

6.	Kind of coal	No. 30 coal—No. 7 mine, Michel colliery, Crowsnest Pass Coal Co., Fernie, B.C.
7.	Analysis of dry coal by weight (%)	C=76·5, H=4·5, S=0·4 / N_2=1·2, O_2=5·5, Ash=11·9
8.	Calorific value of dry coal B.T.U. per lb	13360
9.	Moisture in coal as fired (%)	1·0
10.	Weight of coal fired (lbs.)	2653
11.	Combustible matter in ash and clinker (%)	21·8
12.	Weight of clinker (lbs.)	229
13.	Weight of ash (lbs.)	104

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−0·02
15.	" above fire " "	−0·19
16.	" at damper " "	−0·21
17.	Amount of damper opening	Various
18.	Temperature of air in boiler house (°F.)	86·4
19.	Flue temperature (°F.)	538
20.	Analysis of dry flue gas by volume (%)	CO_2=9·01, O_2=10·15, CO=0·04, N=80·8

Water and Steam.

21.	Temperature of feed water (°F.)	61·7
22.	Total weight of feed water, corrected for difference of level (lbs.)	18000
23.	Water level in gauge at start (inches)	4
24.	Water level in gauge at finish (inches)	3¾
25.	Correction for difference of level included above (lbs.)	+20
26.	Steam pressure by gauge (lbs. per sq. in.)	114·5
27.	Barometer reading (inches)	29·44
28.	Pressure in steam calorimeter by gauge (lbs. per sq in.)	14·8
29.	Temperature in steam calorimeter (°F.)	290·6

Notes.

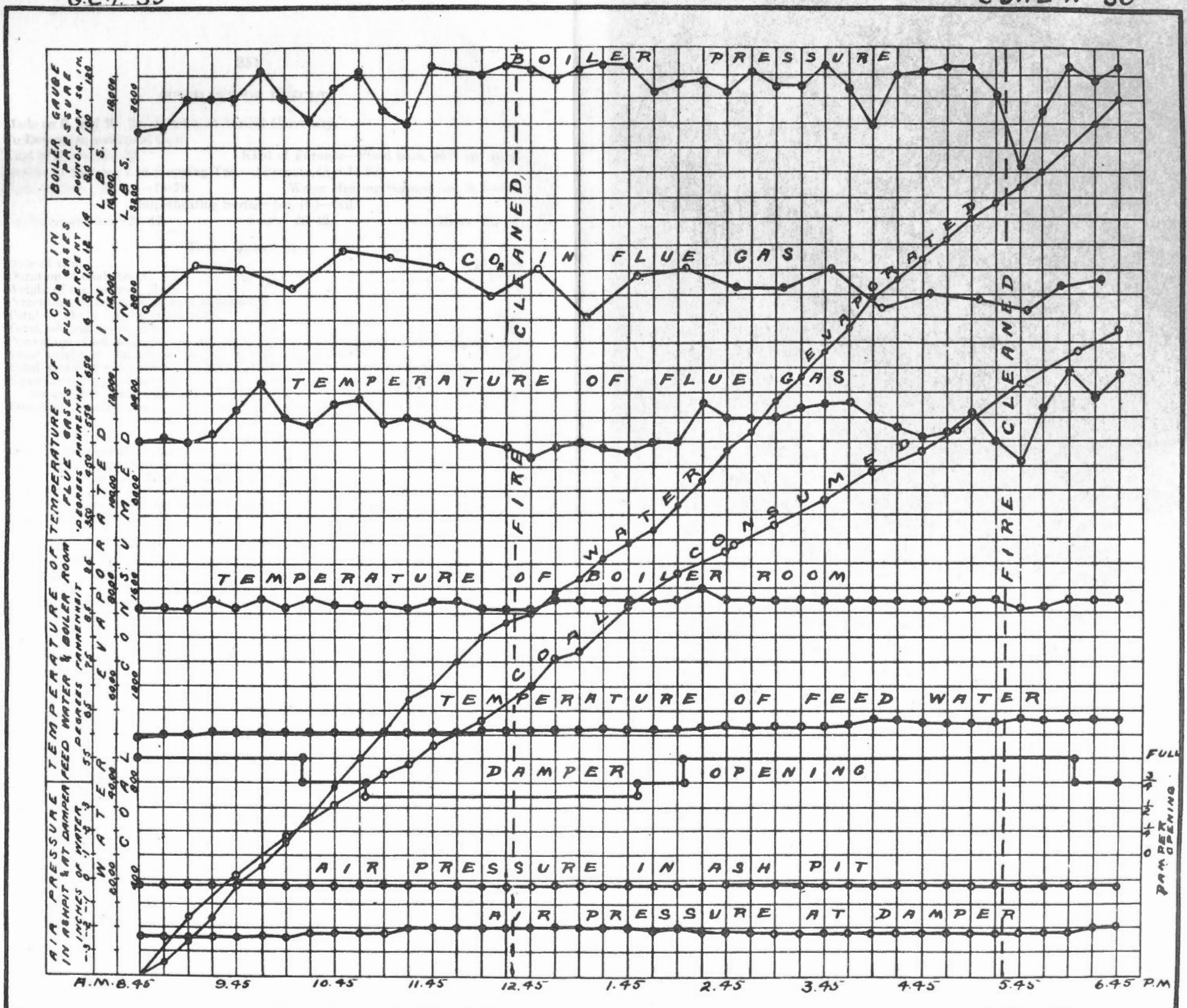
This coal is easily worked, the clinker being friable and easily removed. Could be worked to advantage on a fine shaking grate. Smoke light. Weather fine and warm.

Proximate analysis of dry coal by weight %: Fixed carbon..... 65·5; Volatile matter..... 22·6; Ash..... 11·9

GRAPHIC RECORD OF BOILER TRIAL.

G.C.T. 35

COAL Nº 30



SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 30. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate. (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·47. At finish—29·42. Mean—29·44.

Total Quantities.

1.	Date of trial	10/6/08
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	2653
4.	Percentage of moisture in coal as fired (%)	1
5.	Total weight of dry coal fired (lbs.)	2627
6.	Total ash and refuse (lbs.)	333
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 15·2; (*b*) weighed 12·7	
8.	Total weight of combustible consumed, from analyses (lbs.)	2230
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	18000
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17930
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	21510

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	263
13.	Dry coal per square foot of grate surface per hour (lbs.)	15·7
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1793
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2151
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·36

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	114·5
18.	Temperature of feed water entering boiler (deg. F.)	61·7
19.	Temperature of escaping gases from boiler (deg. F.)	538
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·19
21.	Percentage of moisture in steam	0·5

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	62·3
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	104

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	6·79
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	8·11
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	8·19
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	9·65

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	13360
30.	Calorific value of the combustible per lb. (B.T.U.)	15150
31.	Efficiency of boiler (based on combustible consumed) (%)	61·6
32.	Efficiency of boiler, including grate (based on dry coal) (%)	59·2

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	27·5
34.	" " of combustible consumed (from gas analyses) (lbs.)	24·8
35.	" " dry coal (from gas analyses) (lbs.)	21·0
36.	Proportion of heat of fuel in escaping dry flue gases (%)	17·1

TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 29.

Date—June 10, 1908. Trial Number—G.C.T. 36.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Coal nearly all fine stuff and dust with some lumps up to 4". Burns readily with considerable flame and some tendency to coke. Weather overcast; cloudy and moderately cool. Smoke moderate.

Time.

7.45 Fire cleaned and made up with No. 29 coal. Pressure, 95 lbs.
8.05 Tubes blown.
8.45 Trial started. Fire 1½" thick, flaming slightly, fairly well burnt through.
12.45 to 12.51 Fire cleaned. 71 lbs. of clinker removed. Clinker light, friable, and easily removed.
4.39 Fire sliced. Fire kept thin 4" to 6" during morning, somewhat thicker during afternoon, about 8".
5.45 to 5.52 Fire cleaned. 90 lbs. of clinker and cinders removed. Clinker as at noon. Coal suitable for shaking grate, if it had small air spaces. Much fine coal fell through bars during day.
6.47 Trial ended. Fire similar to start, somewhat thicker but flaming less. 100 lbs. of ash, raked from ash-pit.
Blow-off examined and found tight.

CLINKER AND ASH.

161 lbs. clinker.
100 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 36

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.45 a.m.						
9.15	228·5	228·5	8.50	8·5	10·2	0·0
9.45	135	363·5	9.20	7·0	12·9	0·2
10.15	113	476·5	9.50	7·2	12·7	0·0
10.30	71·5	548	10.20	8·8	10·2	0·0
10.45	78.5	626.5	10·50	9·0	10·1	0·0
11.15	104	730.5	11.20	7·9	12·1	0·1
11.45	123	853.5	11.50	8·9	9·9	0·0
12.15	149.5	1003	12.20	8·0	10·3	0·0
12.45	93	1096	12.50	4·7	15·1	0·0
1.15	125	1221	1.20	8·5	11·2	0·0
1.45	161	1382	1.50	7·5	12·3	0·2
2.00	90	1472	2.20	8·0	11·8	0·0
2.15	49	1521	2.50	10·3	9·1	0·0
2.45	133	1654	3.20	9·0	9·5	0·0
3.15	104	1758	3.50	8·8	9·1	0·1
3.50	171	1929	4.20	8·5	9·8	0·0
4.15	152	2081	4.50	13·0	6·4	0·0
4.45	79	2160	5.20	9·5	10·2	0·0
5.15	137	2297	5.50	8·9	10·9	0·1
5.45	81	2378	6.22	7·0	12·6	0·0
6.20	188	2566	6.35	10·3	9·7	0·0
6.47	49	2615				
				8·53	10·77	0·03

OBSERVATIONS MADE DURING BOILER TRIAL No. 36

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.45	112	81	550	61·5	—·02	—·25	.....
9.00	121	79	590	61·5	—·02	—·25	450
9.15	120	79	600	61·5	—·02	—·25	484
9.30	118	81	610	61·5	—·02	—·25	570
9.45	120	79	550	61	—·02	—·21	483
10.00	123	81	570	61	—·02	—·21	438·5
10.15	108	81	540	61	—·02	—·21	540·5
10.30	118	81	550	61	—·02	—·21	405
10.45	120	81	550	61	—·02	—·21	458·5
11.00	121	79	520	61	—·02	—·21	449
11.15	123	79	520	61	—·02	—·21	395·5
11.30	102	79	500	61	—·02	—·21	550·5
11.45	118	79	510	61	—·02	—·21	328
12.00	114	77	530	61	—·02	—·22	417
12.15	123	77	520	61	—·02	—·22	377
12.30	116	77	560	61	—·02	—·25	483·5
12.45	123	77	650	61	—·02	—·25	408
1.00	112	77	460	61	—·02	—·25	262
1.15	123	77	590	61	—·02	—·25	311·5
1.30	123	77	600	61	—·02	—·25	460
1.45	123	77	610	61	—·02	—·25	517·5
2.00	123	77	580	61	—·02	—·20	403
2.15	123	77	620	61	—·02	—·20	486
2.30	123	77	570	61	—·02	—·20	486·5
2.45	123	77	550	61	—·02	—·20	401·5
3.00	123	77	570	61·5	—·02	—·20	503
3.15	118	77	570	62	—·02	—·20	562
3.30	119	77	570	63	—·02	—·20	475·5
3.45	110	79	570	63	—·02	—·20	555·5
4.00	100	79	550	63	—·02	—·20	476·5
4.15	109	79	510	63·5	—·02	—·20	382
4.30	114	77	540	63·5	—·02	—·20	383·5
4.45	123	77	730	63·5	—·02	—·25	297
5.00	122	79	670	63·5	—·02	—·25	633
5.15	117	77	610	63·5	—·02	—·25	566
5.30	108	79	610	63·5	—·02	—·24	620·5
5.45	123	79	630	63·5	—·02	—·24	390
6.00	123	79	570	63·5	—·02	—·25	180
6.15	123	79	590	63·5	—·02	—·25	494·5
6.30	121	77	590	63·5	—·02	—·25	398·5
6.47	122	77	650	63·5	—·02	—·25	555
	118·0	78·2	57·3	61·8	—·02	—·23	18,038·5 net

SUMMARY OF OBSERVATIONS

Date—June 10, 1908.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.45 a.m.	Ended—6.47 p.m.	Duration—602 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned May, 1908
4.	Tubes cleaned	8.05 a.m.
5.	Fire cleaned	7.45 a.m., 12.45 and 5.45 p.m.

Fuel.

6.	Kind of coal	Coal No. 29—No. 8 mine, Michel Colliery, Crowsnest Pass Coal Co., Fernie, B.C.
7.	Analysis of dry coal by weight (%)	C=76·1, H=4·5, S=0·6 N_2=1·3, O_2=7·3, Ash=10·2
8.	Calorific value of dry coal B.T.U. per lb	13480
9.	Moisture in coal as fired (%)	1·0
10.	Weight of coal fired (lbs.)	2615
11.	Combustible matter in ash and clinker (%)	23·0
12.	Weight of clinker (lbs.)	161
13.	Weight of ash (lbs.)	100

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−0·02
15.	" above fire " "	−0·19
16.	" at damper " "	−0·22
17.	Amount of damper opening	Various
18.	Temperature of air in boiler house (°F.)	78·2
19.	Flue temperature (°F.)	573
20.	Analysis of dry flue gas by volume (%)	CO_2=8·5, O_2=10·8, CO=0, N=80·7

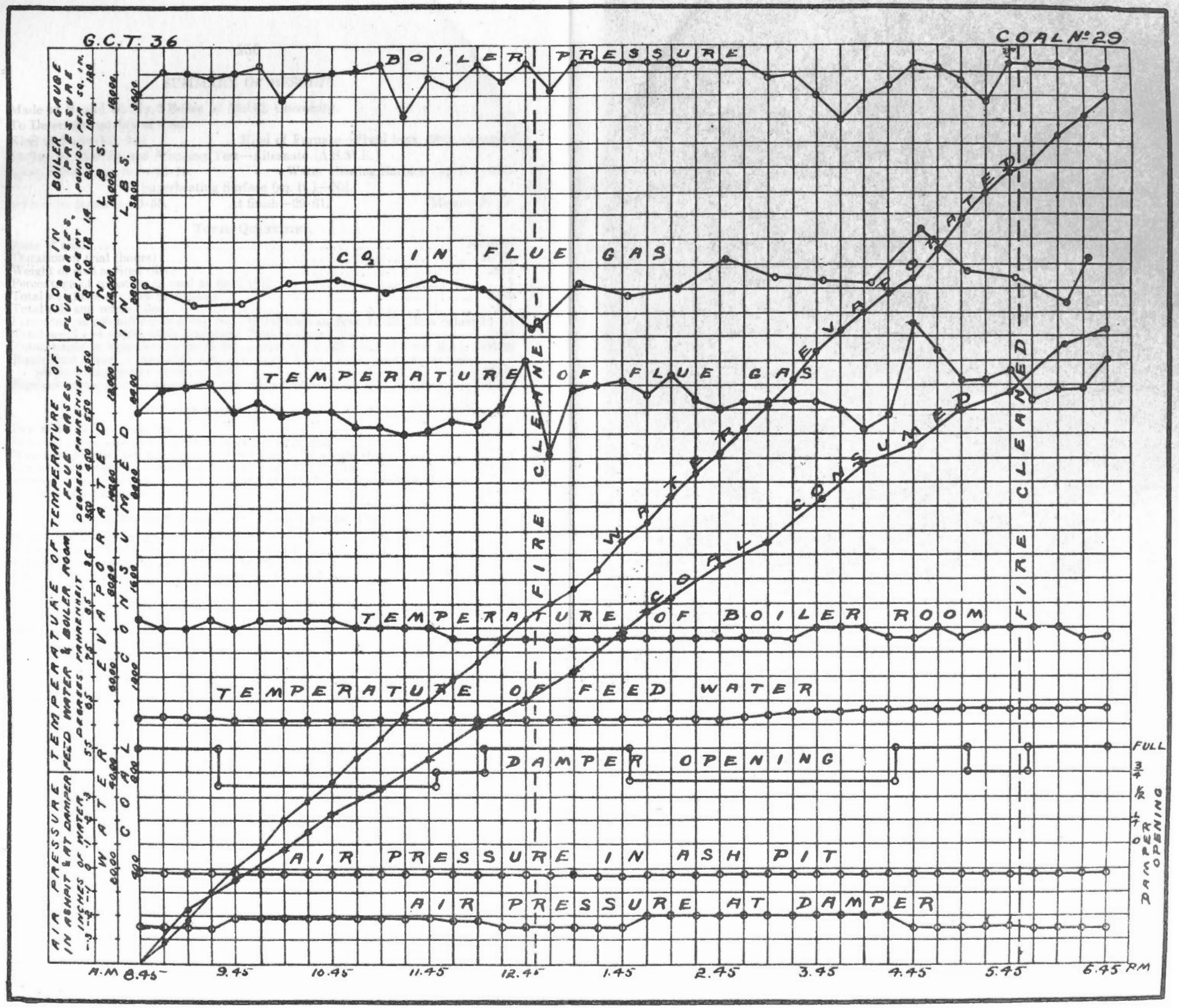
Water and Steam.

21.	Temperature of feed water (°F.)	61·8
22.	Total weight of feed water corrected for difference of level (lbs.)	18038
23.	Water level in gauge at start (inches)	$4\frac{11}{16}$
24.	Water level in gauge at finish (inches)	$4\frac{7}{16}$
25.	Correction for difference of level included above (lbs.)	+40
26.	Steam pressure by gauge (lbs. per sq. in.)	118
27.	Barometer reading (inches)	29·58
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	15·6
29.	Temperature in steam calorimeter (°F.)	292

Notes.

Coal suitable for shaking grate with small air spaces. Clinker very easily broken up. Burns readily with considerable flame and some tendency to coke. Moderate amount of smoke. Weather overcast.

Proximate analysis of dry coal by weight %: Fixed carbon..... 65·7; Volatile matter..... 24·1; Ash..... 10·2


G.C.T. 36
COAL Nº 29
BOILER PRESSURE
CO2 IN FLUE GAS
TEMPERATURE OF FLUE GAS
TEMPERATURE OF BOILER ROOM
TEMPERATURE OF FEED WATER
DAMPER OPENING
AIR PRESSURE IN ASH PIT
AIR PRESSURE AT DAMPER
WATER EVAPORATED
COAL CONSUMED
WATER EVAPORATED PER LB. COAL CONSUMED
FIRE CLEANED
FIRE CLEANED
BOILER GAUGE PRESSURE POUNDS PER SQ. IN.
CO2 IN FLUE GASES PER CENT
TEMPERATURE OF FLUE GASES DEGREES FAHRENHEIT
TEMPERATURE OF BOILER ROOM & FEED WATER DEGREES FAHRENHEIT
AIR PRESSURE IN ASHPIT & AT DAMPER INCHES OF WATER
WATER EVAPORATED LBS.
COAL CONSUMED LBS.
DAMPER OPENING
FULL
A.M 8.45 9.45 10.45 11.45 12.45 1.45 2.45 3.45 4.45 5.45 6.45 P.M

SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 29. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·55. At finish—29·61. Mean—29·58.

Total Quantities.

1.	Date of trial	10/6/08
2.	Duration of trial (hours)	10·03
3.	Weight of coal as fired (lbs.)	2615
4.	Percentage of moisture in coal as fired (%)	1
5.	Total weight of dry coal fired (lbs.)	2589
6.	Total ash and refuse (lbs.)	261
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 13·25; (*b*) weighed	10·05
8.	Total weight of combustible consumed, from analyses (lbs.)	2245
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	18038
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17920
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	21530

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	258
13.	Dry coal per square foot of grate surface per hour (lbs.)	15·4
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1784
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2145
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·36

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	118·0
18.	Temperature of feed water entering boiler (deg. F.)	61·8
19.	Temperature of escaping gases from boiler (deg. F.)	573
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·21
21.	Percentage of moisture in steam	0·7

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	62·2
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	104

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	6·9
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	8·24
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	8·32
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	9·58

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	13480
30.	Calorific value of the combustible per lb. (B.T.U.)	15040
31.	Efficiency of boiler (based on combustible consumed) (%)	61·5
32.	Efficiency of boiler, including grate (based on dry coal) (%)	59·6

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	29·0
34.	" " of combustible consumed (from gas analyses) (lbs.)	25·5
35.	" " dry coal (from gas analyses) (lbs.)	22·1
36.	Proportion of heat of fuel in escaping dry flue gases (%)	19·5

TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 51.

Date—Sept. 22, 1909. Trial Number—G.C.T. 69.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Weather fine but overcast. Coal brittle lumps, with much dust. Robb boiler not working; B. and W. No. 1 working. Blow-off examined and found tight.

Time.

6.40 Fire broken out from banked fire.
7.15 Ashes removed from combustion chamber.
7.25 Fire cleaned and made up with coal No. 51. All ash removed from pit. Sufficient fire to cover bars left from previous coal. Steam pressure, 120 lbs. per square in.
7.45 Tubes blown.
8.40 Trial starts. Fire 2″ thick and well burnt through. 18 lbs. ash removed from pit.
8.40 Coal burns with fair flame,and fair amount of smoke. Cokes a little.
9.00 Fire kept about 2″ thick.
11.00 Coal coking still.
11.20 Forced draught used. Thickness of fire increased to 5″ or 6″ with forced draught in ash-pit.
5.25 Fire cleaned. Soft ash. Would go through shaking grate. 319 lbs removed.
6.42 Finished. Fire as at start. 74 lbs. ash were removed from under bars.

CLINKER AND ASH.

319 lbs. clinker.
74 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL NO. 69.

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.40 a.m.						
9.17	219	219	9.05	7·1	13	0·0
9.45	118	337	9.33	6·6	13·2	0·2
10.35	230	567	10.00	6·7	12·2	0·7
11.05	132	699	10.35	7·3	12·0	0·8
11.40	219	918	11.00	7·6	12·0	0·4
12.10	108	1026	11.30	8·4	10·5	0·8
12.45	163	1189	12.00	9·0	10·4	0·6
1.15	164	1353	12.30	8·3	10·3	0·8
1.45	117	1470	1.00	6·6	13·4	0·1
2.25	151	1621	1.30	8·2	10·7	1·2
2.55	139	1760	2.00	7·7	12·1	0·3
3.25	106	1866	2.30	7·8	11·9	0·4
3.45	90	1956	3.00	7·8	12·2	0·2
4.30	179	2135	3.30	7·3	12·8	0·2
4.55	181	2316	4.00	6·5	13·5	0·1
5.25	18	2334	4.30	8·4	11·3	0·1
5.50	144	2478	5.00	5·7	14·6	0·0
6.20	50	2528	5.45	5·3	14·6	0·0
6.42	65	2593	6.15	6·0	14·2	0·0
				7·3	12·4	0·4

OBSERVATIONS MADE DURING BOILER TRIAL No. 69.

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.40	107	73	360	64	−·05	−·15	.....
8.55	103	75	402	64	−·05	−·20	460
9.10	114	73	400	64	−·05	−·20	459
9.25	117	75	375	64	−·05	−·20	373
9.40	120	74	404	64	−·05	−·20	422
9.55	115	75	395	64	−·05	−·20	405
10.10	117	74	405	64	−·05	−·20	450
10.25	112	74	395	64	−·10	−·25	466
10.40	121	75	380	65	−·10	−·20	551
10.55	119	75	380	65	−·10	−·20	232
11.10	117	75	420	64	+·05	−·20	334
11.25	115	75	450	65	0·0	−·20	454
11.40	107	76	435	65	0·0	−·20	455
11.55	117	76	405	65	−·05	−·20	498
12.10	102	77	450	65	−·05	−·20	494
12.25	119	79	400	65	−·05	−·15	496
12.40	102	79	400	65	−·05	−·20	486
12.55	117	79	400	65	0·0	−·20	472
1.10	112	80	410	65	0·0	−·15	394
1.25	117	79	435	65	0·0	−·20	426
1.40	118	81	430	65	0·0	−·20	476
1.55	105	79	425	65	0·0	−·20	452
2.10	122	78	420	65	0·0	−·20	354
2.25	113	77	425	66	+·05	−·20	533
2.40	107	78	445	66	0·0	−·20	477
2.55	109	78	440	65	+·10	−·20	589
3.10	112	80	415	65	+·10	−·20	358
3.25	114	79	415	66	+·10	−·20	474
3.40	114	79	405	65	+·10	−·20	327
3.55	113	78	405	65	+·10	−·20	498
4.10	116	78	425	66	+·10	−·20	345
4.25	122	78	500	66	+·25	−·20	487
4.40	117	.....	.....	.....	.....	.....	453
4.55	121	77	460	65	+·25	−·20	660
5.10	122	79	495	66	+·25	−·20	475
5.25	112	82	325	65	.....	.....	457
5.40	107	80	360	65	0·0	0·20	258
5.55	117	80	400	66	0·0	0·20	162
6.10	117	80	385	66	0·0	0·15	294
6.25	117	79	405	66	0·0	0·20	325
6.42	119	78	410	65	0·0	0·20	352
	114·2	77·4	412·3	65	+·15	−·20	17,133 net

SUMMARY OF OBSERVATIONS.

Date—Sept. 24, 1909.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.40 a.m.	Ended—6.42 p.m.	Duration—602 mins.

General.

1.	Method of stoking	Light spreading
2.	Kind of draft	Forced and natural
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned August, 1909
4.	Tubes cleaned	7.45 a.m.
5.	Fire cleaned	5.25 p.m.

Fuel.

6.	Kind of coal	No. 51
7.	Analysis of dry coal by weight (%)	C=74·4, H=4·2, S=0·3 N_2=1·0, O_2=4·8, Ash=15·3
8.	Calorific value of dry coal B.T.U. per lb	12710
9.	Moisture in coal as fired (%)	1·1
10.	Weight of coal fired (lbs.)	2593
11.	Combustible matter in ash and refuse (%)	9·3
12.	Weight of clinker (lbs.)	319
13.	Weight of ash (lbs.)	74

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	+0·15
15.	" above fire " "	−0·08
16.	" at damper " "	−0·20
17.	Amount of damper opening	Full open
18.	Temperature of air in boiler house (°F.)	77·4
19.	Flue temperature (°F.)	412·3
20.	Analysis of dry flue gas by volume (%)	CO_2=7·3, O_2=12·4, CO=0·4, N_2=79·9

Water and Steam.

21.	Temperature of feed water (°F.)	65
22.	Total weight of feed water corrected for difference of level (lbs.)	17133
23.	Water level in gauge at start (inches)	5 11/16
24.	Water level in gauge at finish (inches)	8 7/16
25.	Correction for difference of level included above (lbs.)	−420
26.	Steam pressure by gauge (lbs. per sq. in.)	114·2
27.	Barometer reading (inches)	29·72
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	5·96
29.	Temperature in steam calorimeter (°F.)	277·4

Notes.

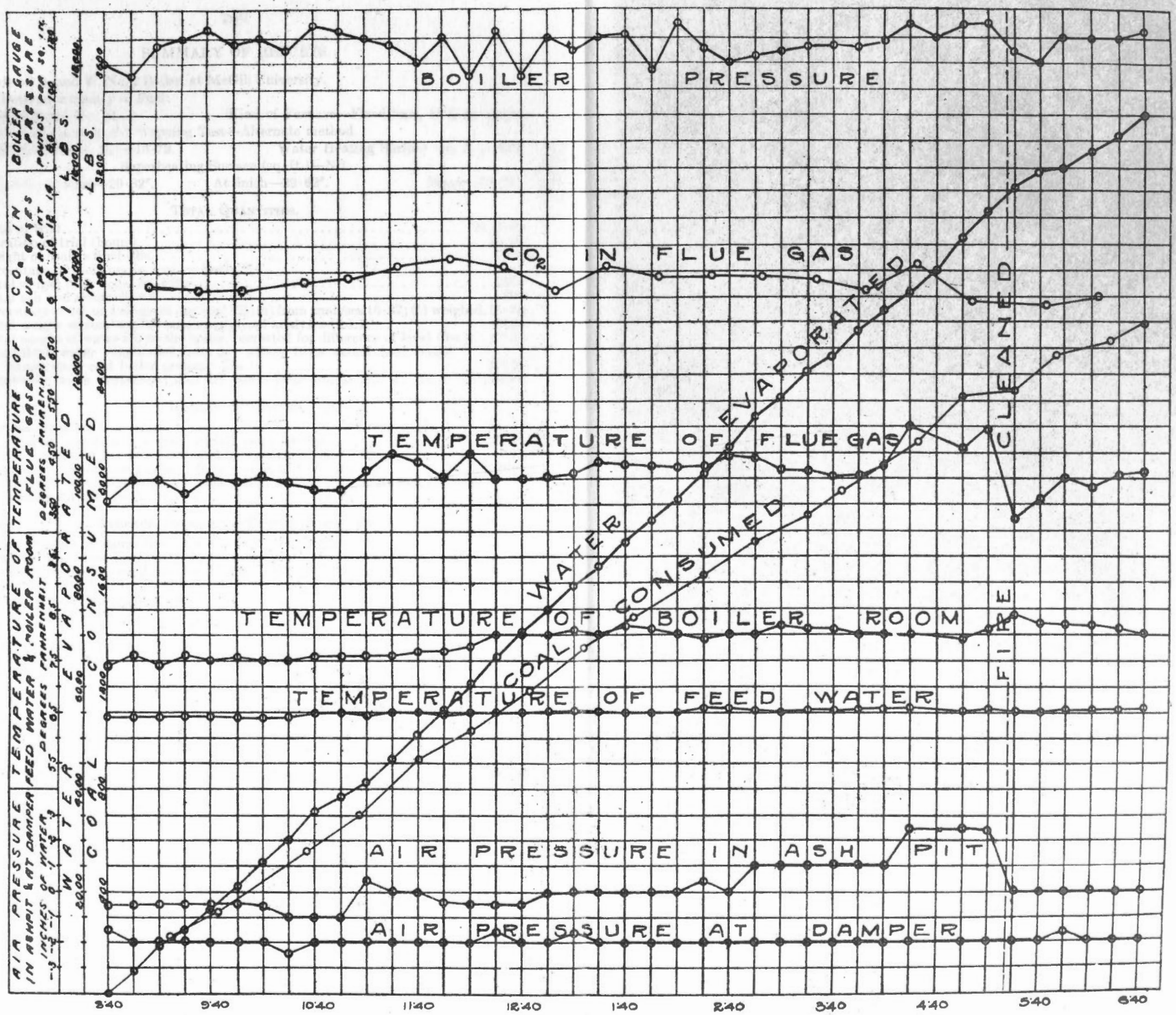
Coal burnt with fair amount of flame and smoke. Gave little trouble in firing, coking a little. Burnt at first in a thin fire with natural draught, on formation of dirt, however, forced draught was necessary. Would do better on a shaking grate, clinker being soft and easily removed.

Proximate analysis of dry coal by weight %

Fixed carbon	63·4
Volatile matter	21·3
Ash	15·3

GRAPHIC RECORD OF BOILER TRIAL

COAL Nº 51



SUMMARY OF RESULTS.

Made on B. and W. No. 2 Boiler, at McGill University.

To Determine quality of Fuel.

Kind of Fuel—No. 51. Kind of Furnace—Fixed bars, 15% air space.

Method of Starting and Stopping Test—Alternate method.

Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.

Superheating Surface (sq. ft.)—Nil.

Barometer at start—29·82″. At finish—29·62″. Mean—29·72″.

Total Quantities.

1.	Date of trial	24/9/09
2.	Duration of trial (hours)	10·03
3.	Weight of coal as fired (lbs.)	2593
4.	Percentage of moisture in coal as fired (%)	1·1
5.	Total weight of dry coal fired (lbs.)	2564
6.	Total ash and refuse (lbs.)	393
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 16·87; (*b*) weighed.	15·34
8.	Total weight of combustible consumed, from analyses (lbs.)	2133
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	17133
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17020
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	20340

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	255·8
13.	Dry coal per square foot of grate surface per hour (lbs.)	15·23
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1698
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2027
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·18

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	114·2
18.	Temperature of feed water entering boiler (deg. F.)	65
19.	Temperature of escaping gases from boiler (deg. F.)	412·3
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·35
21.	Percentage of moisture in steam	0·70

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	58·8
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	98

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	6·60
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	7·84
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	7·94
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	9·54

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	12710
30.	Calorific value of the combustible per lb. (B.T.U.)	15010
31.	Efficiency of boiler (based on combustible consumed) (%)	61·4
32.	Efficiency of boiler, including grate (based on dry coal) (%)	60·3

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	32·1
34.	" " of combustible consumed (from gas analyses) (lbs.)	28·7
35.	" " coal (from gas analyses) (lbs.)	23·9
36.	Proportion of heat of fuel in escaping dry flue gases (%)	15·1

TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 52.

Date—Sept. 24, 1909. Trial Number—G.C.T. 70.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Day overcast and raining. Blow-off examined and found tight. Coal consists mostly of dust.

Time. a.m.	
6.45	Banked fire broken open.
7.15	Fire cleaned and made up with No. 52 coal. Sufficient fire from banking left to start. Pressure, 85 lbs.
7.25	Combustion chamber cleaned out.
7.45	Tubes blown.
8.35	Trial started. Fire 2″ thick, well burnt through. 16 lbs. ash removed from combustion chamber.
9.00	Coal burns with fair amount of flame. Cokes rather badly. Considerable smoke is given off. Firing by light spreading. The fire is from 2″ to 3″ thick.
10.05	Building fire up to about 5″ to 6″.
11.30	Forced draught started.
12.15	Cleaned fires. A slab of hard clinker over grate easily removed. Weight removed 121 lbs.
12.20	Building fire up with forced draught.
12.35	Fan stopped. Fire built up to about 5″.
3.20	Clinker formed over bars in a slab, sliced and removed some.
5.15	Fan stopped. Fire cleaned. Clinker in hard slabs, porous and easily removed, except at sides of grate.
6.35	Trial finished. Fire as at start.
	13 lbs. of ash were removed from combustion chamber at the end of the trial.

CLINKER AND ASH.

248 lbs. clinker.
85 lbs. ash.

NOTE—The fire was drawn at the end of the trial, leaving a very scanty fire as at 7.15 a.m. the weight of the fire drawn was 152 lbs.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 70.

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.35 a.m.						
9.05	188	188	8.45	8·3	12·0	0·0
9.50	204	392	9.15	6·3	13·9	0·2
10.20	184	576	9.45	6·0	14·4	0·0
11.00	164	740	10.15	5·3	14·3	0·5
11.30	124	864	10.45	7·7	12·5	0·0
12.05	152	1016	11.15	7·7	12·5	0·0
12.30	186	1202	11.45	7·4	12·6	0·0
1.00	132	1334	12.30	8·0	11·5	0·4
1.35	153	1487	1.00	6·5	13·7	0·0
2.05	133	1620	1.30	7·3	12·5	0·4
2.35	124	1744	2.00	8·4	11·4	0·2
2.55	68	1810	2.30	5·9	14·3	0·2
3.35	172	1982	3.00	6·6	13·2	0·4
4.05	158	2140	3.30	8·1	12·0	0·1
4.35	168	2308	4.00	8·0	11·9	0·4
5.05	124	2432	4.30	8·0	12·0	0·3
5.35	114	2546	5.00	8·1	12·0	0·2
5.50	81	2627	5.30	6·2	13·9	0·2
6.20	111	2738	6.30	5·9	13·2	0·0
6.35	33	2771		7·1	12·8	0·2

OBSERVATIONS MADE DURING BOILER TRIAL No. 70.

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.35	117	71	415	66·5	0·0	−·20	.....
8.50	121	72	415	66	0·0	−·15	510
9.05	117	72	405	66	0·0	−·20	463
9.20	115	72	415	66	0·0	−·20	481
9.35	113	73	460	65·7	0·0	−·20	403
9.50	113	73	500	65·5	−·02	−·20	507
10.05	106	75	458	65	−·02	−·20	455
10.20	115	74	413	65	−·02	−·20	397
10.35	111	74	440	65	−·01	−·22	487
10.50	117	73	475	65	−·02	−·20	382
11.05	116	75	475	65	−·01	−·22	453
11.20	104	75	472	65·2	−·01	−·21	374
11.35	116	74	475	65·2	−·01	−·21	368
11.50	116	75	570	65·1	+·07	−·21	387
12.05	117	75	508	65	+·10	−·20	636
12.20	103	79	405	65·1	+·10	−·20	574
12.35	121	77	464	65	−·01	−·20	237
12.50	112	77	450	65·2	−·01	−·20	494
1.05	113	78	430	65·2	0·0	−·20	413
1.20	103	77	460	65·2	−·01	−·20	385
1.35	116	76	465	65·8	−·02	−·21	439
1.50	117	74	503	65·9	−·02	−·21	430
2.05	116	76	512	66	−·02	−·21	475
2.20	109	77	525	65·8	−·02	−·22	560
2.35	112	77	473	65·7	−·01	−·21	466
2.50	104	76	453	65·9	−·01	−·22	514
3.05	103	75	472	65·7	−·01	−·22	436
3.20	102	74	480	65·9	−·01	−·22	285
3.35	112	75	550	65·8	−·01	−·22	430
3.50	106	76	510	65·9	−·01	−·21	541
4.05	117	78	510	66	−·01	−·21	392
4.20	113	77	530	66	+·09	−·21	576
4.35	109	76	500	66	+·08	−·21	567
4.50	105	76	540	66·5	+·09	−·22	489
5.05	119	77	540	66	+·08	−·22	447
5.20	97	77	385	66	0·0	−·20	550
5.35	104	75	470	66·5	−·01	−·21	238
5.50	115	74	445	66·2	−·01	−·20	327
6.05	112	75	460	66·5	−·01	−·20	325
6.20	116	73	480	66·3	−·01	−·21	321
6.35	108	71	445	66·5	−·01	−·21	470
	111·6	74·9	472	65·8	+·01	−·20	17,674 net

SUMMARY OF OBSERVATIONS.

Date—Sept. 24, 1909.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.35 a.m.	Ended—6.35 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural and forced
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned August, 1909
4.	Tubes cleaned	7.45 a.m.
5.	Fire cleaned	7.15 a.m., 12.15 and 5.15 p.m.

Fuel.

6.	Kind of coal	No. 52
7.	Analysis of dry coal by weight (%)	C = 75·9, H = 4·5, O_2 = 5·4; S_2 = 0·6, N_2 = 1·2, Ash = 12·4
8.	Calorific value of dry coal B.T.U. per lb	13090
9.	Moisture in coal as fired (%)	1·5
10.	Weight of coal fired (lbs.)	2771
11.	Combustible matter in ash and refuse (%)	36·8
12.	Weight of clinker (lbs.)	248
13.	Weight of ash (lbs.)	85

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	+0·06
15.	" above fire " "	−0·10
16.	" at damper " "	−0·20
17.	Amount of damper opening	Full open
18.	Temperature of air in boiler house (°F.)	74·9
19.	Flue temperature (°F.)	472
20.	Analysis of dry flue gas by volume (%)	CO_2 = 7·1, CO = 0·2, O_2 = 12·8, N = 79·9

Water and Steam.

21.	Temperature of feed water (°F.)	65·8
22.	Total weight of feed water, corrected for difference of level (lbs.)	17674
23.	Water level in gauge at start (inches)	$5\frac{5}{16}$
24.	Water level in gauge at finish (inches)	$5\frac{9}{16}$
25.	Correction for difference of level, included above (lbs.)	40
26.	Steam pressure by gauge (lbs. per sq. in.)	111·6
27.	Barometer reading (inches)	29·83
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	6·12
29.	Temperature in steam calorimeter (°F.)	277

Notes.

Large amount of dust present in the coal. Burnt on bars with ½" air space only. Fire kept light at first, and natural draught used; later it was found necessary to build the fire up and use forced draught. The coal burnt with a fair amount of flame, and gave off a great deal of smoke. It coked rather badly. The clinker consisted of hard slabs spread over the bars, which were fairly easy to remove.

Proximate analysis of dry coal by weight %: Fixed carbon ..... 62·0; Volatile matter ..... 25·6; Ash ..... 12·4

SUMMARY OF RESULTS.

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 52 Coal. Kind of Furnace—Fixed bars, 15% air space.
Method of Starting and Stopping Test—Alternate method.
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·83. At finish—29·83. Mean—29·83.

Total Quantities.

1.	Date of trial	24/9/09
2.	Duration of trial (hours)	10
3.	Weight of coal as fired (lbs.)	2771
4.	Percentage of moisture in coal as fired (%)	1·5
5.	Total weight of dry coal fired (lbs.)	2730
6.	Total ash and refuse (lbs.)	333
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 19·62; (*b*) weighed 16·2	
8.	Total weight of combustible consumed, from analyses (lbs.)	2194
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	17674
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17560
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	20960

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	273
13.	Dry coal per square foot of grate surface per hour (lbs.)	16·26
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1756
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2096
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·28

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	114·6
18.	Temperature of feed water entering boiler (deg. F.)	65·8
19.	Temperature of escaping gases from boiler (deg. F.)	472
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·206
21.	Percentage of moisture in steam	0·6

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	60·8
23.	Builders' rated horse-power	60·0
24.	Percentage of builders' rated horse-power developed	101·3

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	6·38
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	7·57
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	7·68
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	9·56

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	13090
30.	Calorific value of the combustible per lb. (B.T.U.)	14950
31.	Efficiency of boiler (based on combustible consumed) (%)	61·7
32.	Efficiency of boiler, including grate (based on dry coal) (%)	56·6

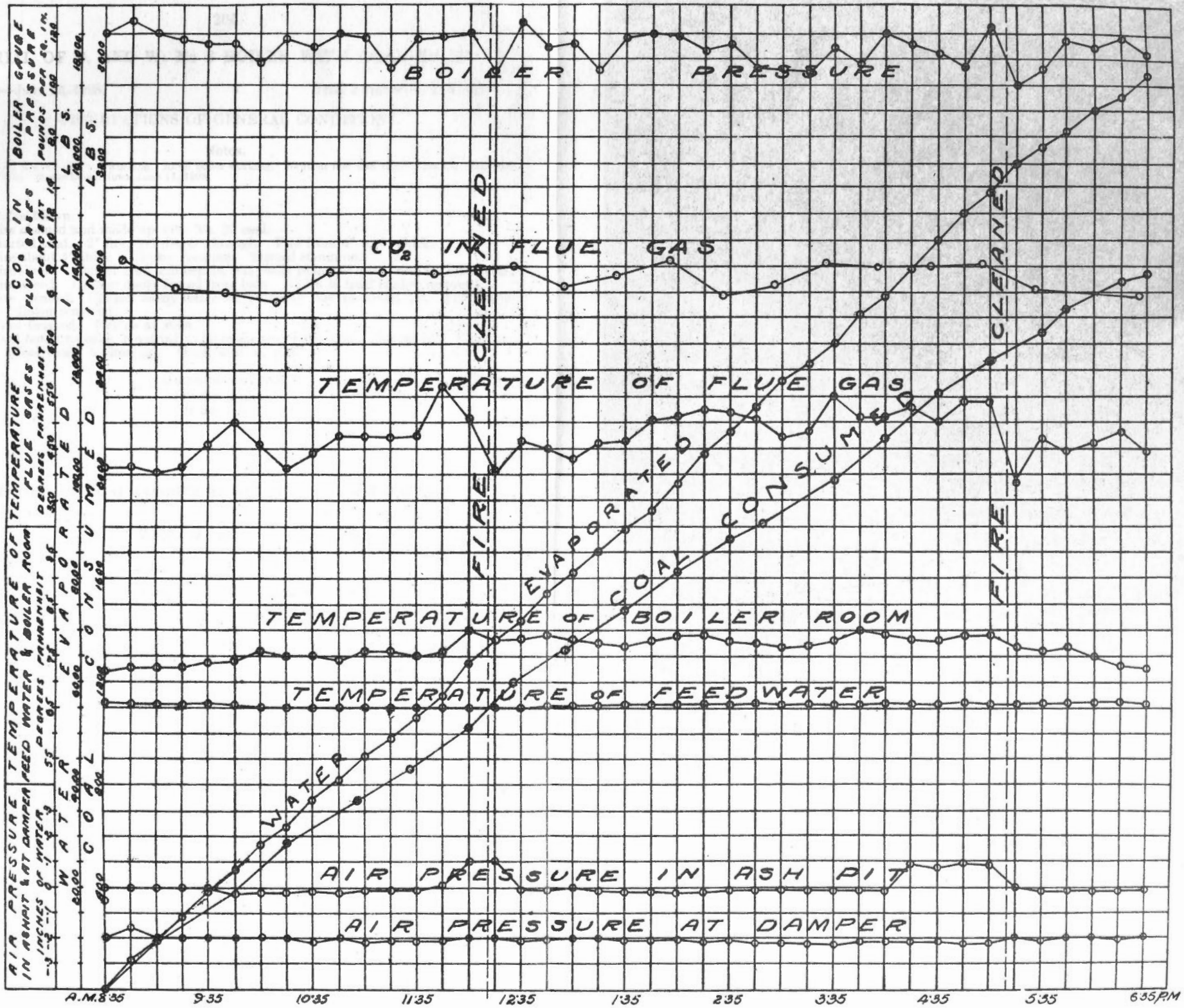
Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	33·9
34.	" " of combustible consumed (from gas analyses) (lbs.)	32·0
35.	" " dry coal as fired (from gas analyses) (lbs.)	25·7
36.	Proportion of heat of fuel in escaping dry flue gases (%)	18·7

GRAPHIC RECORD OF BOILER TRIAL.

G.C.T. 70.

COAL Nº52



TRIAL OF B. AND W. No 2 BOILER WITH COAL No. 27.

Date—June 12, 1908. Trial Number—G.C.T. 37.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

B. and W. No. 1 boiler not working. Robb boiler working. Weather fine and dry. Blow-off examined and found tight. Boiler blown down June 11, 1908.

Time.

7.37 Tubes blown.
7.30 Fire cleaned and made up with No. 27 coal.
8.35 Started trial. 2″ fire, well burnt through. Fire from 4″ to 6″ thick.
12.30 Fire about 4″ thick. Clinker forming. Turned steam on.
12.45 Fire sliced. Clinker hard and brittle, but easily removed from bars, in thin layers.
4.10 Fire sliced. Clinker easily forced from bars. 32 lbs of hard clinker removed.
5.30 Fire cleaned. Clinker easily removed, probably due to steam jet. 117 lbs. of clinker removed.
6.35 Trial finished. Fire as at start.
Coal tends to cake, requiring to be broken up with rake. Fair amount of smoke. Coal easily broken up. Much dust in coal.

CLINKER AND ASH.

149 lbs. clinker
91 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 37

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.35 a.m.						
8.42	90	90	8.50	6·7	12·1	0·0
9.05	152	242	9.20	11·4	8·0	0·0
9.45	200	442	9.50	10·8	8·6	0·0
10.00	106	548	10.20	9·0	9·3	0·0
10.30	130	678	10.50	9·0	10·5	0·0
11.00	135	813	11.20	10·9	8·2	0·0
11.30	107	920	11.50	8·8	9·5	0·0
11.50	81	1001	12.20	10·0	9·0	0·1
12.30	150	1151	12·50	14·6	5·2	0·0
1.00	209	1360	1.20	9·6	9·8	0·0
1.30	181	1441	1.50	8·3	10·5	0·0
2.00	140	1581	2.20	9·0	10·5	0·0
2.30	81	1662	2.50	9·0	10·5	0·0
3.00	108	1770	3.20	9·7	9·0	0·0
3.35	138	1908	3.50	8·6	10·2	0·0
4.00	93	2001	4.20	12·0	6·6	0·0
4.30	132	2133	4.50	11·2	7·6	0·1
5.00	104	2237	5.20	7·4	12·5	0·0
5.20	60	2297	5.50	8·2	10·8	0·0
5.50	103	2400	6.20	6·5	13·7	0·0
6.20	90	2490	6.30	7·3	12·5	0·0
6.35	30	2520				
				9·43	9·74	0·01

OBSERVATIONS MADE DURING BOILER TRIAL No. 37.

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.35	118	73	560	61·5	—·02	—·24	.....
8.50	123	73	530	61·5	—·02	—·24	340
9.05	123	77	570	61·5	—·02	—·23	506
9.20	123	77	610	62	—·02	—·23	573·5
9.35	123	77	580	62	—·02	—·22	529
9.50	123	77	590	62	—·02	—·22	616
10.05	118	75	570	62·5	—·02	—·20	653
10.20	122	75	550	62·5	—·02	—·20	414
10.35	123	75	580	62·5	—·02	—·20	455·5
10.50	118	77	560	62·5	—·02	—·20	480
11.05	122	73	550	62·5	—·02	—·20	438·5
11.20	123	75	570	62·5	—·02	—·20	437
11.35	118	75	560	62·5	—·02	—·20	427
11.50	122	75	540	62·5	—·02	—·20	424
12.05	115	75	570	62·5	—·02	—·21	450
12.20	113	77	570	62·5	—·02	—·21	369
12.35	111	75	540	62·5	—·02	—·24	383·5
12.50	123	77	780	63	—·02	—·26	381·5
1.05	123	79	640	63	—·02	—·25	570
1.20	123	79	620	63	—·02	—·24	530·5
1.35	123	81	650	63	—·02	—·24	540·5
1.50	113	79	550	63	—·02	—·21	504
2.05	113	79	540	63	—·02	—·21	461
2.20	118	79	540	63·5	—·02	—·21	442
2.35	122	79	590	63·5	—·02	—·21	454
2.50	122	79	560	63·5	—·02	—·21	535·5
3.05	120	79	550	63·5	—·02	—·21	451
3.20	118	79	530	63·5	—·02	—·22	455·5
3.35	123	81	520	63.5	—·02	—·22	451
3.50	113	81	520	63·5	—·02	—·22	342·5
4.05	112	81	560	63·5	—·02	—·22	408·5
4.20	115	85	600	63·5	—·02	—·22	392
4.35	116	79	610	63·5	—·02	—·22	522·5
4.50	111	81	620	63·5	—·02	—·22	525·5
5.05	118	79	600	63·5	—·02	—·22	487
5.20	102	79	580	63·5	—·02	—·22	516
5.35	81	79	490	63	—·02	—·22	427·5
5.50	96	79	620	63	—·02	—·24	266
6.05	101	79	630	63	—·02	—·24	367
6.20	117	79	700	63	—·02	—·24	380
6.35	123	79	680	63	—·02	—·24	388
	116·8	77·8	582	62·8	—·02	—·22	18,295 net

SUMMARY OF OBSERVATIONS.

Date—June 12, 1908.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.35 a.m.	Ended—6.35 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned May, 1908
4.	Tubes cleaned	7.37 a.m.
5.	Fire cleaned	7.30 a.m., 5.30 p.m.

Fuel.

6.	Kind of coal	No. 27—No. 2 mine, Coal Creek Colliery, Crowsnest Pass Coal Co., Fernie, B.C.
7.	Analysis of dry coal by weight (%)	C = 79·3, H = 4·4, S = 0·5, N_2 = 1·2, O_2 = 5·6, Ash = 9·0
8.	Calorific value of dry coal B.T.U. per lb	13820
9.	Moisture in coal as fired (%)	1·0
10.	Weight of coal fired (lbs.)	2520
11.	Combustible matter in ash and clinker (%)	25·5
12.	Weight of clinker (lbs.)	149
13.	Weight of ash (lbs.)	91

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−0·02
15.	" above fire " "	−0·18
16.	" at damper " "	−0·22
17.	Amount of damper opening	Various
18.	Temperature of air in boiler house (°F.)	77·8
19.	Flue temperature (°F.)	582
20.	Analysis of dry flue gas by volume (%)	CO_2 = 9·42, CO = 0·01, O_2 = 9·74, N = 80·83

Water and Steam.

21.	Temperature of feed water (°F.)	62·8
22.	Total weight of feed water, corrected for difference of level (lbs.)	18295
23.	Water level in gauge at start (inches)	$5\frac{7}{8}$
24.	Water level in gauge at finish (inches)	$5\frac{13}{16}$
25.	Correction for difference of level, included above (lbs.)	+10
26.	Steam pressure by gauge (lbs. per sq. in.)	116·8
27.	Barometer reading (inches)	29·88
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	15·2
29.	Temperature in steam calorimeter (°F.)	291·0

Notes.

This coal tends to coke, it being necessary to break fire up with rake from time to time. The clinker formed was hard and brittle, fire would be more easily worked with steam jet under bars, thus rendering the removal of clinker more easy. Under these conditions a shaking grate might be suitable. Fair amount of smoke. Fire sliced 12.45, 4.10. Weather fine and dry.

Proximate analysis of dry coal by weight %

Fixed carbon	64·7
Volatile matter	26·3
Ash	9·0

SUMMARY OF RESULTS.

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 27. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·90. At finish—29·87. Mean—29·88.

Total Quantities.

1.	Date of trial	12/6/08
2.	Duration of trial (hours)	10·0
3.	Weight of coal as fired (lbs.)	2520
4.	Percentage of moisture in coal as fired (%)	1·0
5.	Total weight of dry coal fired (lbs.)	2495
6.	Total ash and refuse (lbs.)	240
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 12·07; (*b*) weighed	9·6
8.	Total weight of combustible consumed, from analyses (lbs.)	2194
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	18295
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	18200
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	21820

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	249
13.	Dry coal per square foot of grate surface per hour (lbs.)	14·8
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1820
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2182
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·41

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	116·8
18.	Temperature of feed water entering boiler (deg. F.)	62·8
19.	Temperature of escaping gases from boiler (deg. F.)	582
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·20
21.	Percentage of moisture in steam	0·6

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	63·2
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	105

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	7·26
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	8·66
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	8·75
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	9·95

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	13820
30.	Calorific value of the combustible per lb. (B.T.U.)	15200
31.	Efficiency of boiler (based on combustible consumed) (%)	63·2
32.	Efficiency of boiler, including grate (based on dry coal) (%)	61·1

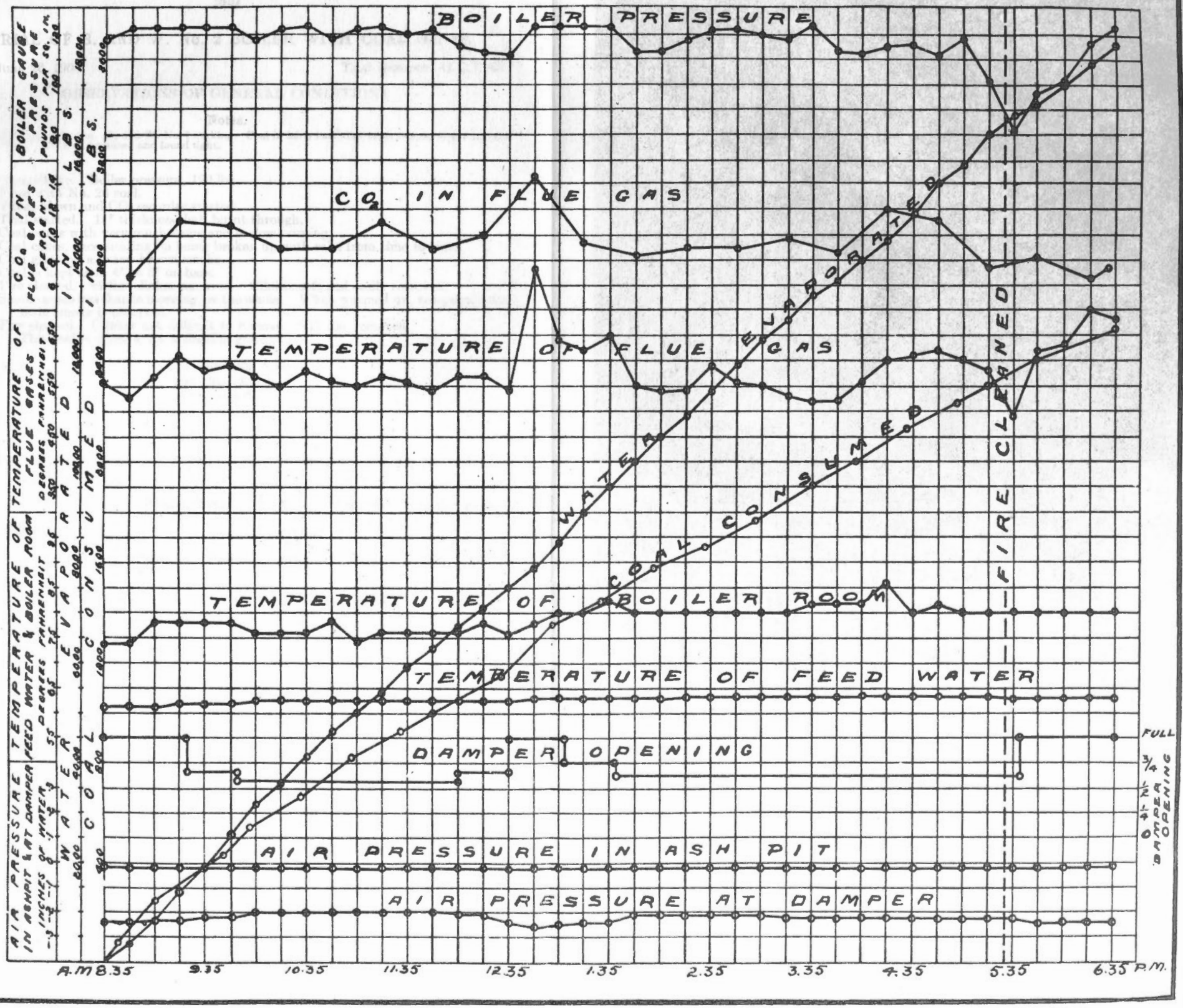
Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	26·4
34.	" " of combustible consumed (from gas analyses) (lbs.)	23·8
35.	" " dry coal (from gas analyses) (lbs.)	20·9
36.	Proportion of heat of fuel in escaping dry flue gases (%)	18·3

GRAPHIC RECORD OF BOILER TRIAL.

G.C.T. 37

COAL Nº 27



TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 26.

Date—June 26, 1908. Trial Number—G.C.T. 43.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Weather fine and clear. B. and W. No. 1 working. Coal in fairly hard dull black lumps, with a certain amount of dust. Blow-off examined and found tight.

Time.

7.33 Cleaned fire. Boiler pressure, 120 lbs.
7.38 Fired with No. 26 coal.
7.40 Tubes blown and CO_2 recorder started.
8.35 Trial started. 1½″ thickness, half burnt through.
9.00 Coal burns with very much flame and is slow burning.
9.20 Coal cakes, necessitating its being broken up with rake from time to time.
9.40 Coal gives off a heavy brown smoke.
10.00 Coal is kept from 4″ to 6″ on bars.
12.30 Fire cleaned. 92 lbs. clinker removed. Clinker soft and easily removed.
4.30 Smoke much less than in morning, on the whole. When warmed up, comparatively little smoke is observed.
5.30 Fire cleaned. Clinker not difficult to remove. 117 lbs. removed. This coal is suitable for a shaking grate.

CLINKER AND ASH.

209 lbs. clinker.
78 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 43

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.35 a.m.						
9.00	122	122	8.45	8·4	11·2	0·5
9.30	165	287	9.15	10·0	9·6	0·0
10.00	133	419	9.45	9·7	9·0	0·6
10.30	200	619	10.15	11·8	6·7	1·2
10.05	131	750	10.45	8·1	11·7	0·0
11.35	125	875	11.15	12·7	6·3	0·6
12.05	119	994	11.45	10·3	8·7	0·4
12.25	86	1080	12.15	11·5	6·7	1·2
12.55	103	1183	12.45	11·7	6·8	0·5
1.00	61	1244	1.15	10·8	6·9	1·0
1.30	105	1349	1.45	11·4	6·4	1·5
2.00	147	1496	2.15	10·7	8·6	0·5
2.10	73	1569	2.45	8·2	11·8	0·0
2.40	143	1712	3.15	13·0	4·9	1·9
3.10	125	1837	3.45	11·8	6·9	0·5
3.25	48	1885	4.15	10·0	9·5	0·2
3.55	188	2073	4.45	11·5	7·7	0·7
4.25	124	2197	5.15	10·3	9·6	0·5
4.55	133	2330	5.45	9·0	8·8	2·0
5.25	77	2407	6.10	11·6	7·1	0·8
5.55	178	2585				
6.10	38	2623		10·6	8·3	0·7
6.35	48	2671				

OBSERVATIONS MADE DURING BOILER TRIAL No. 43.

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	lbs.
8.35	122	81	510	65·5	—·03	—·23	.....
8.50	118	81	520	65·5	—·03	—·23	450
9.05	123	82	570	65·5	—·03	—·22	430·5
9.20	118	83	580	65·5	—·03	—·22	529
9.35	113	84	540	66	—·03	—·22	443·5
9.50	116	84	530	66	—·03	—·22	430
10.05	123	85	525	66	—·03	—·22	388·5
10.20	123	85	590	66	—·03	—·24	459·5
10.35	123	85	590	66	—·03	—·24	514
10.50	121	86	590	66	—·03	—·24	487
11.05	115	86	570	66·5	—·03	—·24	428·5
11.20	123	86	590	66·5	—·03	—·24	437·5
11.35	116	85	540	66·5	—·03	—·24	436·5
11.50	122	85	550	66·5	—·03	—·24	445·5
12.05	122	87	570	66·5	—·03	—·24	403
12.20	123	85	585	66·5	—·03	—·24	431·5
12.35	102	89	525	66	—·03	—·22	473·5
12.50	123	86	660	66	—·03	—·24	289·5
1.05	123	85	620	66·5	—·03	—·24	489·5
1.20	122	85	565	66·5	—·03	—·22	474
1.35	120	86	550	66·5	—·03	—·22	447
1.50	123	87	600	66·5	—·03	—·22	407·5
2.05	120	87	685	66·5	—·03	—·24	535
2.20	112	87	635	66·5	—·03	—·24	566
2.35	123	88	600	66·5	—·03	—·24	495
2.50	123	87	600	67	—·03	—·24	322
3.05	121	87	665	67	—·03	—·26	534
3.20	123	87	740	67·5	—·03	—·26	597
3.35	107	87	645	67·5	—·03	—·26	562
3.50	118	86	600	67·5	—·03	—·26	433
4.05	123	87	610	68	—·03	—·25	525·5
4.20	111	86	600	68	—·03	—·25	450
4.35	109	86	590	68	—·03	—·25	503
4.50	110	86	600	68·5	—·03	—·25	442
5.05	118	85	640	68·5	—·03	—·26	504·5
5.20	117	85	605	68·5	—·03	—·26	504·5
5.35	96	89	510	68	—·03	—·20	496·5
5.50	95	87	600	68	—·03	—·26	375·5
6.05	121	85	635	68	—·03	—·25	290
6.20	113	85	650	68	—·03	—·25	552
6.35	121	85	690	68	—·03	—·25	536
	117·4	85·0	594	66·8	—·03	—·24	18,519 net

SUMMARY OF OBSERVATIONS.

Date—June 26, 1908. Boiler—B. and W. No. 2. At McGill University.
Commenced—8.35 a.m. Ended—6.35 p.m. Duration—600 mins.

General.

1. Method of stoking.....Hand-spreading on alternate sides
2. Kind of draft.....Natural
3. Condition of boiler and date of last cleaning.....Thoroughly cleaned May, 1908
4. Tubes cleaned.....7.40 a.m.
5. Fire cleaned.....7.33 a.m., 12.30 and 5.30 p.m.

Fuel.

6. Kind of coal.....Coal No. 26—No. 5 mine, Coal Creek Colliery, Crowsnest Pass Coal Co., Fernie, B.C.
7. Analysis of dry coal by weight (%).....C = 77·1, H = 4·4, S = 0·5, N_2 = 1·3, O_2 = 5·9, Ash = 10·8
8. Calorific value of dry coal B.T.U. per lb.....13480
9. Moisture in coal as fired (%).....1·0
10. Weight of coal fired (lbs.).....2671
11. Combustible matter in ash and clinker (%).....26·0
12. Weight of clinker (lbs.).....209
13. Weight of ash (lbs.).....78

Air and Flue Gas.

14. Air pressure under fire (inches of water).....−0·03
15. " above fire ".....−0·20
16. " at damper ".....−0·24
17. Amount of damper opening.....Various
18. Temperature of air in boiler house (°F.).....85
19. Flue temperature (°F.).....594
20. Analysis of dry flue gas by volume (%)..CO_2 = 10·6, O_2 = 8·3, CO = 0·7, N = 80·4

Water and Steam.

21. Temperature of feed water (°F.).....66·8
22. Total weight of feed water corrected for difference of level (lbs.).....18519
23. Water level in gauge at start (inches).....$4\frac{5}{8}$
24. Water level in gauge at finish (inches).....$4\frac{5}{16}$
25. Correction for difference of level included above (lbs.).....+50
26. Steam pressure by gauge (lbs. per sq. in.).....117·4
27. Barometer reading (inches).....29·90
28. Pressure in steam calorimeter by gauge (lbs. per sq. in.).....15·6
29. Temperature in steam calorimeter (°F.).....293·7

Notes.

This coal would be suitable for a shaking grate. It cokes and it is necessary from time to time to break it up with a rake. Fire cleaned twice; clinker gave very little trouble. Not very much smoke. Weather fine and clear.

Proximate analysis of dry coal by weight %: Fixed carbon..... 65·2; Volatile matter..... 24·0; Ash..... 10·8

SUMMARY OF RESULTS.

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 26. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·93. At finish—29·86. Mean—29·90.

Total Quantities.

1.	Date of trial	26/6/08
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	2671
4.	Percentage of moisture in coal as fired (%)	0·1
5.	Total weight of dry coal fired (lbs.)	2644
6.	Total ash and refuse (lbs.)	287
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 14·6; (*b*) weighed	10·8
8.	Total weight of combustible consumed, from analyses (lbs.)	2260
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	18519
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	18450
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	22040

Hourly Quantities.

12.	Dry coal consumed per hour (lbs.)	264·4
13.	Dry coal per square foot of grate surface per hour (lbs.)	15·8
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1845
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2204
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·45

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	117·4
18.	Temperature of feed water entering boiler (deg. F.)	66·8
19.	Temperature of escaping gases from boiler (deg. F.)	594
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·21
21.	Percentage of moisture in steam	0·5

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	63·8
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	106

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	6·93
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	8·25
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	8·34
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	9·75

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	13480
30.	Calorific value of the combustible per lb. (B.T.U.)	15120
31.	Efficiency of boiler (based on combustible consumed) (%)	62·2
32.	Efficiency of boiler, including grate (based on dry coal) (%)	59·7

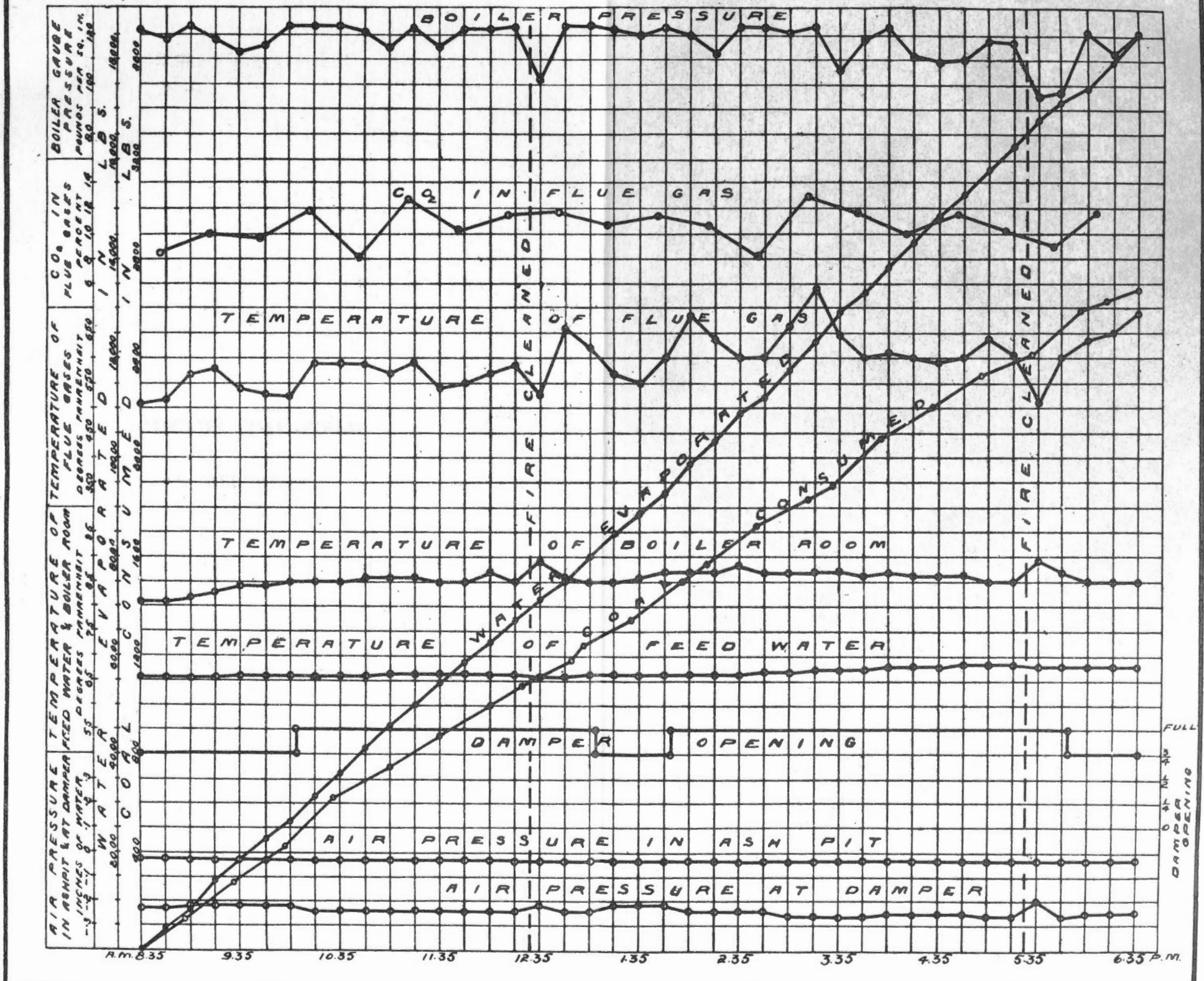
Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	22·3
34.	" " of combustible consumed (from gas analyses) (lbs.)	20·1
35.	" " dry coal (from gas analyses) (lbs.)	17·2
36.	Proportion of heat of fuel in escaping dry flue gases (%)	15·6

GRAPHIC RECORD OF BOILER TRIAL.

G.C.T. 43

COAL No. 26



CASCADE COAL FIELD.

ALBERTA.

TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 25.

Date—June 30, 1908. Trial Number—G.C.T. 45.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Day dull and cloudy, some rain. B. and W. No. 1 working. Blow-off examined and found tight.

Time.

7.30 Fire cleaned and made up with No. 25 coal. Pressure, 125 lbs.
7.45 Tubes cleaned.
8.30 2″ fire, nearly half burnt through, much flame. Coal in small lumps, with dust.
9.45 6″ fire. Remarkably little smoke at any time. Sliced fire, but found very little clinker.
10.00 Evaporation having fallen, forced draught put on.
10.30 Steam put on to prevent fire clinkering, as clinker was coming through bars a little.
10.35 Fire sliced. Two fairly large hard lumps amounting to 10 lbs. of clinker removed.
11.45 Fire sliced. 14 lbs. of very hard clinker removed.
12.30 Fire cleaned. 116 lbs. of ash and clinker removed. Trouble in slow combustion due to amount of dirt present which seemed to deaden fire. The clinker is very hard.
1.20 Fan on again after cleaning.
5.30 Fire cleaned, as before much dirt, but not as much hard clinker. Total removed 138 lbs.
6.33 Trial finished. Fire as at beginning. 153 lbs. of ash removed from ash-pit.

CLINKER AND ASH.

278 lbs. clinker.
153 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 45.

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.30 a.m.						
8.45	137	137	8.40	9·6	10·4	0·2
9.15	170	307	9.10	10·3	8·7	0·3
9.45	85	392	9.40	8·3	10·6	0·1
10.05	81	473	10.10	12·8	6·6	0·0
10.35	199	672	10.40	12·4	6·6	0·1
11.00	132	804	11.10	14·5	4·5	0·1
11.30	179	983	11.40	9·2	10·0	0·2
12.00	71	1054	12.10	10·3	9·7	0·0
12.20	20	1074	12.45	4·9	14·5	0·0
12.50	114	1188	1.10	8·3	11·4	0·0
1.20	122	1310	1.40	10·5	7·4	1·0
1.50	218	1528	2.10	9·5	10·4	0·0
2.10	123	1651	2.40	8·5	11·1	0·1
2.40	107	1758	3.10	8·0	11·9	0·1
3.10	83	1841	3.40	12·9	6·4	0·2
3.40	159	2000	4.10	8·5	11·4	0·0
4.10	197	2197	4.40	9·4	10·4	0·0
4.40	147	2344	5.10	5·6	11·6	0·3
5.10	96	2440	5.40	3·5	15·9	0·0
5.50	207	2647	6.10	7·5	12·4	0·1
6.30	135	2777				
				9·3	10·1	0·1

OBSERVATIONS MADE DURING BOILER TRIAL No. 45.

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.30	123	81	570	66·5	−·05	−·30	.....
8.45	123	81	590	66·5	−·05	−·30	370
9.00	108	81	570	67	−·05	−·30	465
9.15	108	81	500	67	−·05	−·30	455
9.30	123	81	510	67	−·05	−·30	189·5
9.45	123	82	580	67	−·05	−·30	340
10.00	123	83	585	67	+·10	−·30	290
10.15	123	84	710	67·5	+·13	−·32	550
10.30	116	86	680	67·5	+·10	−·31	402
10.45	120	85	720	67·5	+·10	−·31	472
11.00	123	85	775	67·5	+·10	−·31	509·5
11.15	114	85	680	67·5	+·05	−·30	624·5
11.30	111	85	600	67·5	+·10	−·30	494
11.45	113	85	660	67·5	+·10	−·30	281·5
12.00	103	85	580	67·5	+·13	−·30	488
12.15	118	84	600	67·5	+·10	−·28	321
12.30	114	83	550	67·5	+·10	−·28	352
12.45	100	85	500	68	−·03	−·28	263
1.00	115	84	580	68	−·03	−·28	254
1.15	123	84	610	68	−·02	−·28	371
1.30	123	86	630	68	+·02	−·30	388
1.45	118	85	680	68	+·05	−·30	594·5
2.00	123	85	750	68	+·10	−·30	641·5
2.15	123	86	825	68	+·05	−·30	606
2.30	123	83	670	68	+·02	−·30	511·5
2.45	118	83	685	68	0·0	−·30	490
3.00	114	83	645	68·5	0·0	−·30	528·5
3.15	113	85	635	68·5	0·0	−·30	438
3.30	119	85	625	68·5	0·0	−·30	428
3.45	123	85	780	68·5	+·12	−·30	453·5
4.00	123	85	700	69	+·16	−·30	693
4.15	105	85	750	68·5	+·10	−·30	490
4.30	113	85	850	68·5	+·13	−·32	569
4.45	120	85	800	68·5	+·13	−·32	566
5.00	115	84	700	68·5	+·08	−·32	599·5
5.15	93	83	630	68·5	+·10	−·30	554·5
5.30	93	83	565	68·5	+·08	−·30	395
5.45	70	84	560	68·5	+·05	−·28	278·5
6.00	105	83	700	68·5	0·0	−·30	279
6.15	98	82	640	68·5	0·0	−·30	440
6.33	86	83	570	68·5	0·0	−·28	644
	113·2	83·9	647	67·9	+·05	−·30	18,080·5 net

SUMMARY OF OBSERVATIONS.

Date—June 30, 1908.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.30 a.m.	Ended—6.33 p.m.	Duration—603 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Forced
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned May, 1908
4.	Tubes cleaned	7.45 a.m.
5.	Fire cleaned	7.30 a.m., 2.30 and 5.30 p.m.

Fuel.

6.	Kind of coal	No. 25—No. 1 or Old mine, H. McNeil Co., Canmore, Alberta
7.	Analysis of dry coal by weight (%)	$\begin{cases} C=74\cdot6, \quad H=3\cdot8, \quad S=0\cdot8 \\ N_2=1\cdot6, \quad O_2=6\cdot9, \quad Ash=12\cdot3 \end{cases}$
8.	Calorific value of dry coal B.T.U. per lb	13210
9.	Moisture in coal as fired (%)	0·8
10.	Weight of coal fired (lbs.)	2777
11.	Combustible matter in ash and clinker (%)	40·4
12.	Weight of clinker (lbs.)	278
13.	Weight of ash (lbs.)	153

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	+0·05
15.	" above fire " "	−0·20
16.	" at damper " "	−0·30
17.	Amount of damper opening	Full
18.	Temperature of air in boiler house (°F.)	83·9
19.	Flue temperature (°F.)	647
20.	Analysis of dry flue gas by volume (%)	$CO_2=9\cdot3$, $O_2=10\cdot1$, $CO=0\cdot1$, $N=80\cdot5$

Water and Steam.

21.	Temperature of feed water (°F.)	67·9
22.	Total weight of feed water corrected for difference of level (lbs.)	18080
23.	Water level in gauge at start (inches)	$4\frac{1}{2}$
24.	Water level in gauge at finish (inches)	$4\frac{7}{16}$
25.	Correction for difference of level, included above (lbs.)	−30
26.	Steam pressure by gauge (lbs. per sq. in.)	113·2
27.	Barometer reading (inches)	29·75
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	14·9
29.	Temperature in steam calorimeter (°F.)	291·8

Notes.

This coal was remarkably good from the point of view of smokeless combustion. However, it gave much trouble in attempting to keep up the normal rate of evaporation with natural draught only; this was largely due to an amount of dirt which did not find its way through the bars. At the first cleaning the clinker removed was very hard, but after putting steam on, the final clinker removed was soft. This coal could be used with a shaking grate if steam were turned under the bars. Forced draught was necessary to keep up the required rate of evaporation. Fire sliced 9,45, 10.35, and 11.45. Weather dull and cloudy, some rain.

Proximate analysis of dry coal by weight %

Fixed carbon	70·5
Volatile matter	17·2
Ash	12·3

SUMMARY OF RESULTS.

Made on B and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 25. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·69. At finish—29·82. Mean—29·75.

Total Quantities.

1.	Date of trial	30/6/08
2.	Duration of trial (hours)	10·05
3.	Weight of coal as fired (lbs.)	2777
4.	Percentage of moisture in coal as fired (%)	0·8
5.	Total weight of dry coal fired (lbs.)	2755
6.	Total ash and refuse (lbs.)	431
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 20·65; (*b*) weighed.	15·6
8.	Total weight of combustible consumed from analyses (lbs.)	2186
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	18080
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	18020
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	21480

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	274
13.	Dry coal per square foot of grate surface per hour (lbs.)	16·4
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1800·00
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2137·0
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·34

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	113·2
18.	Temperature of feed water entering boiler (deg. F.)	67·9
19.	Temperature of escaping gases from boiler (deg. F.)	647
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·35
21.	Percentage of moisture in steam	0·4

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	61·9
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	103

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	6·51
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	7·74
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	7·80
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	9·82

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	13210
30.	Calorific value of the combustible per lb. (B.T.U.)	15060
31.	Efficiency of boiler (based on combustible consumed) (%)	63·0
32.	Efficiency of boiler, including grate (based on dry coal) (%)	57·0

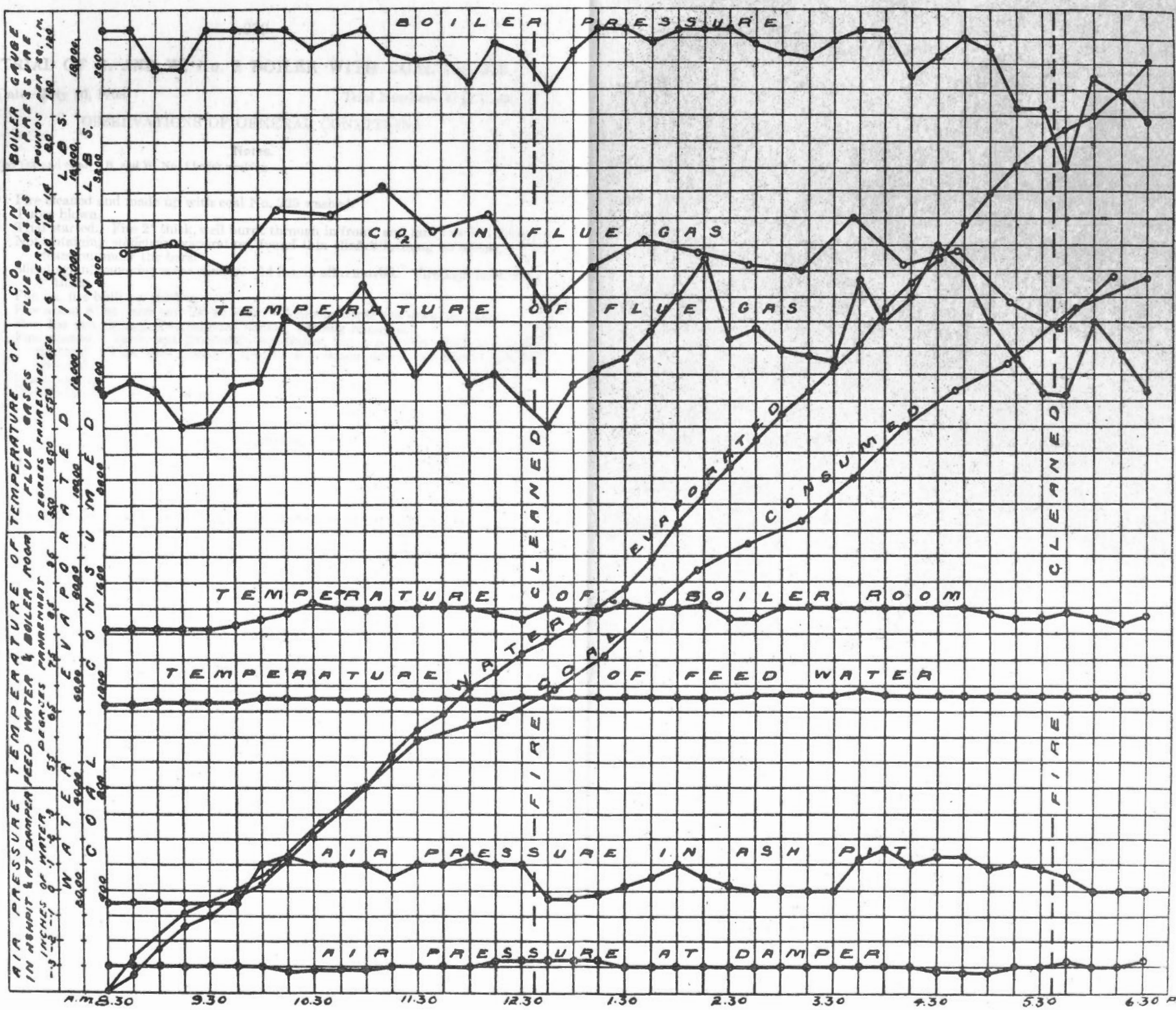
Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	26·5
34.	" " of combustible consumed (from gas analyses) (lbs.)	24·9
35.	" " dry coal (from gas analyses) (lbs.)	19·8
36.	Proportion of heat of fuel in escaping dry flue gases (%)	20·5

GRAPHIC RECORD OF BOILER TRIAL.

G.C.T. 45

COAL Nº 25.



TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 225.

Date—July 10, 1908. Trial Number—G.C.T. 49.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Day fine and clear. B. and W. No. 1 boiler working.

Time.

7.30 Fire cleaned and made up with coal No. 225 washed.
7.45 Tubes blown.
9.00 Trial started. Fire 2″ thick, well burnt through in front; and fairly well so behind.
10.5 Not obtaining sufficient evaporation, found thin clinker forming on slicing. Put steam on under the bars.
10.40 Sliced again, removing some clinker. 14 lbs. in all removed. Fire kept from 3″ to 4″ thick.
10.50 Fan on, fire built up thicker.
12.15 Fire about 8″ at front and 10″ at back. Coal smokeless and does not cake.
2.00 Slice bar run through fire, no hard clinker, nothing removed.
5.30 Fire cleaned. There was practically no clinker, but a soft dirt which was easily removed. This was probably due to the steam under the bars. 124 lbs. removed.
6.53 Fan stopped.
7.00 Trial finished. Fire as at start.

CLINKER AND ASH.

138 lbs. clinker.
76 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 49.

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 9.00 a.m.						
9.10	81	81	9.00	9·1	11·0	0·0
9.40	134	215	9.30	10·4	8·6	0·1
10.10	86	301	10.00	9·2	10·5	0·0
10.50	141	441	10.30	8·1	12·0	0·0
11.15	310	751	11.00	10·4	8·5	0·0
11.45	171	922	11.30	11·2	7·4	0·2
12.15	131	1053	12.00	10·6	9·3	0·1
12.45	124	1177	12.30	11·2	6·9	0·2
1.15	118	1295	1.00	9·8	10·1	0·2
1.45	73	1368	1.30	7·5	12·7	0·1
2.15	140	1508	2.00	7·5	12·4	0·0
2.45	136	1644	2.30	11·0	8·2	0·3
2.55	48	1692	3.00	9·8	10·4	0·1
3.25	100	1792	3.30	6·0	14·2	0·1
3.55	102	1894	4.00	10·0	10·3	0·1
4.30	150	2044	4.30	10·4	7·8	0·8
5.00	93	2137	5.00	8·5	11·5	0·2
5.30	72	2209	5.30	7·3	13·4	0·0
5.45	137	2346	6.00	8·4	10·9	0·2
6.00	61	2407	6.30	6·3	13·9	0·0
6.30	83	2490				
7.00	25	2515		9·1	10·5	0·1

OBSERVATIONS MADE DURING BOILER TRIAL No. 49.

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
9.00	111	83	430	71	−·02	−·30	.....
9.15	105	84	475	71	−·02	−·30	260
9.30	103	84	510	70·5	−·02	−·30	383·5
9.45	108	86	500	70·5	−·02	−·30	373
10.00	113	85	490	70·5	−·02	−·30	352
10.15	113	85	535	70·5	−·02	−·30	410
10.30	122	89	500	70·5	−·02	−·30	343
10.45	121	89	480	70·5	−·02	−·30	293
11.00	123	89	550	70·5	+·20	−·30	364
11.15	114	89	670	71	+·15	−·27	691·5
11.30	111	88	680	71	+·20	−·29	523·5
11.45	113	88	690	71	+·25	−·29	654
12.00	115	87	590	70·5	+·10	−·28	517
12.15	108	88	575	70·5	+·10	−·26	553
12.30	100	87	580	70·5	+·30	−·26	553
12.45	111	85	570	70·5	+·28	−·26	427
1.00	117	85	560	70·5	+·15	−·26	468
1.15	118	85	540	70·5	+·16	−·26	510·5
1.30	120	85	540	71	+·25	−·26	414
1.45	113	85	510	71	+·22	−·26	562·5
2.00	113	85	530	71·5	+·26	−·26	333·5
2.15	105	86	545	71·5	+·26	−·26	417·5
2.30	107	87	620	71·5	+·50	−·32	544
2.45	113	87	625	71·5	+·42	−·30	514·5
3.00	113	87	585	71·5	+·30	−·30	702
3.15	120	87	575	71·5	+·30	−·28	423
3.30	105	87	610	71·5	+·45	−·30	474·5
3.45	115	87	570	71·5	+·50	−·28	501·5
4.00	122	87	590	71·5	+·48	−·28	474
4.15	116	87	590	71·5	+·45	−·28	514·5
4.30	122	88	635	71·5	+·55	−·28	412
4.45	117	87	560	71·5	+·30	−·28	572
5.00	108	87	570	71·5	+·40	−·28	504
5.15	121	87	570	71·5	+·18	−·28	446
5.30	110	85	500	71·5	+·30	−·28	443·5
5.45	91	87	450	71·5	+·40	−·25	226·5
6.00	91	85	500	71·5	+·30	−·26	276
6.15	120	87	550	71·5	+·30	−·28	330
6.30	113	85	500	71·5	+·12	−·26	455·5
6.45	123	85	590	71·5	+·40	−·26	291·5
7.00	108	85	465	71·5	+·20	−·25	413·5
	112·5	86·4	554	71·1	+·23	−·28	17,922 net

SUMMARY OF OBSERVATIONS.

Date—June 10, 1908.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—9.00 a.m.	Ended—7.00 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Forced
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned May, 1908
4.	Tubes cleaned	7.45 a.m.
5.	Fire cleaned	7.30 a.m., 5.30 p.m.

Fuel.

6.	Kind of coal	No. 225.—No. 1 or Old mine, H. McNeil Co., Canmore, Alta.
7.	Analysis of dry coal by weight (%)	C = 85·2, H = 4·1, S = 0·7 N_2 = 1·7, O_2 = 2·4, Ash = 5·9
8.	Calorific value of dry coal B.T.U. per lb	14400
9.	Moisture in coal as fired (%)	4·3
10.	Weight of coal fired (lbs.)	2515
11.	Combustible matter in ash and clinker (%)	50·2
12.	Weight of clinker (lbs.)	138
13.	Weight of ash (lbs.)	76

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	+0·23
15.	" above fire " "	−0·21
16.	" at damper " "	−0·28
17.	Amount of damper opening	Full
18.	Temperature of air in boiler house (°F.)	86·4
19.	Flue temperature (°F.)	554
20.	Analysis of dry flue gas by volume (%)	CO_2 = 9·1, O_2 = 10·5, CO = 0·1, N = 80·3

Water and Steam.

21.	Temperature of feed water (°F.)	71·1
22.	Total weight of feed water, corrected for difference of level (lbs.)	17922
23.	Water level in gauge at start (inches)	$4\frac{3}{4}$
24.	Water level in gauge at finish (inches)	$4\frac{1}{4}$
25.	Correction for difference of level (lbs.)	0
26.	Steam pressure by gauge (lbs. per sq. in.)	112·5
27.	Barometer reading (inches)	29·77
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	15·0
29.	Temperature in steam calorimeter (°F.)	290·6

Notes.

This coal burnt in thick bed 8" to 10" with forced draught, much dirt formed in fire, which could be removed in a shaking grate provided steam jet were used. Coal does not coke. Steam was found beneficial in rendering the clinker softer and more easily removed. Sliced 10.05, 10.40, 2.00. Weather fine and clear.

Proximate analysis of dry coal by weight %: Fixed carbon..... 77·9; Volatile matter..... 16·2; Ash..... 5·9

SUMMARY OF RESULTS.

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—Coal No. 225. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·86. At finish—29·68. Mean—29·77.

Total Quantities.

1.	Date of trial	10/6/08
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	2515
4.	Percentage of moisture in coal as fired (%)	4·3
5.	Total weight of dry coal fired (lbs.)	2407
6.	Total ash and refuse (lbs.)	214
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 11·85; (*b*) weighed	8·9
8.	Total weight of combustible consumed, from analyses (lbs.)	2121
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	17922
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17850
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	21220

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	240·7
13.	Dry coal per square foot of grate surface per hour (lbs.)	14·3
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1785
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2122
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3 3

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	112·5
18.	Temperature of feed water entering boiler (deg. F.)	71·1
19.	Temperature of escaping gases from boiler (deg. F.)	554
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·51
21.	Percentage of moisture in steam	0·5

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	61·5
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	103

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	7·13
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	8·44
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	8·82
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	10·0

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	14400
30.	Calorific value of the combustible per lb. (B.T.U.)	15310
31.	Efficiency of boiler (based on combustible consumed) (%)	63·1
32.	Efficiency of boiler, including grate (based on dry coal) (%)	59·2

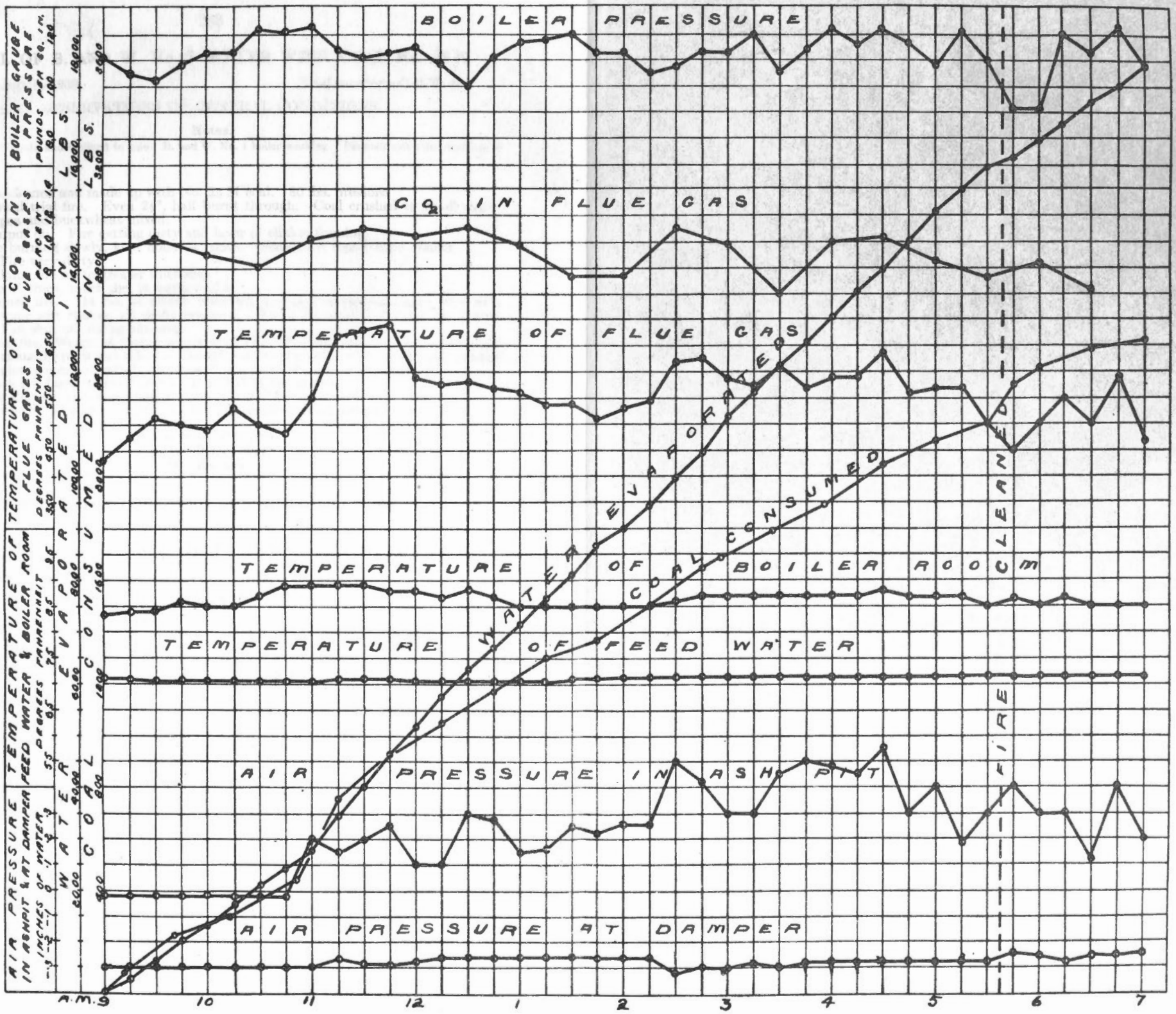
Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	27·0
34.	" " of combustible consumed (from gas analyses) (lbs.)	26·1
35.	" " dry coal (from gas analyses) (lbs.)	23·0
36.	Proportion of heat of fuel in escaping dry flue gases (%)	17·9

GRAPHIC RECORD OF BOILER TRIAL.

G.C.T. 49.

COAL Nº 25/00



TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 23 M.

Date—July 3, 1908. Trial number—G.C.T. 46.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Weather cloudy and inclined to rain. B. and W. No. 1 boiler working. Blow-off examined and found tight.

Time.

7.40 Fire cleaned and made up with No. 23 M coal. 80 lbs. pressure.
8.40 Started trial fire. Even 2½", half burnt through. Coal crushed to small size—pea and buckwheat mixed.
9.15 Fan put on. Fire getting dirty and layer of clinker forming.
9.30 Fire burning slowly, kept about 3" thick. Sliced, but found little clinker. Fire very dirty.
9.45 Building fire up to greater thickness.
10.40 Fire 8" thick, much dirt in bottom of it.
12.40 Cleaned fire. 114 lbs. of clinker removed, actually containing mostly dirt with some soft clinker, all easily removed. Would be suitable for shaking grates. Fan shut off during cleaning.
2.55 Sliced fire. Weight of clinker removed 22 lbs. This coal seems to burn principally along the front and sides, in other places over the body of the fire a dark, reddish glow seems to prevail, underneath this layer the fuel is incandescent.
4.10 Much ash forms at front of fire—removed 39 lbs. of this.
5.40 Fire cleaned, as before clinker very soft—137 lbs. removed.
6.40 Finished. Fire as at start. 80 lbs. ash removed from ash-pit.

CLINKER AND ASH.

312 lbs. clinker.
80 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 46.

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.40 a.m.						
9.10	130	130	8.50	9·3	9·6	0·5
9.40	178	308	9.15	6·5	13·2	0·0
10.10	352	660	9.50	13·5	5·1	0·3
10.40	212	872	10.20	11·8	5·4	0·5
11.00	114	984	10.50	8·1	11·9	0·0
11.30	142	1126	11.20	10·0	8·5	0·3
12.00	195	1321	11.50	10·0	9·4	0·0
12.30	100	1421	12.20	7·0	13·2	0·0
1.00	73	1494	12.55	6·6	12·7	0·0
1.20	80	1574	1.30	11·3	7·2	0·0
2.00	180	1754	2.00	9·7	9·7	0·0
2.30	100	1854	2.30	8·5	11·2	0·0
3.00	82	1936	3.05	9·7	10·2	0·1
3.30	93	2029	3.30	11·3	7·5	0·0
4.00	117	2146	4.00	9·6	10·4	0·0
4.30	66	2212	4.25	8·5	11·9	0·0
4.40	31	2243	5.00	5·7	14·7	0·0
5.00	76	2319	5.30	4·5	16·1	0·0
5.40	85	2404	6.00	4·9	15·3	0·2
6.10	52	2456	6.30	6·3	14·2	0·0
6.40	74	2530				
				8·6	10·9	0·1

OBSERVATIONS MADE DURING BOILER TRIAL No. 46.

Time.	Steam pressure gauge.	Temperatures °F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.40	108	85	450	69	−·01	−·30	.....
8.55	112	87	500	69	−·01	−·30	350
9.10	114	88	470	69	−·01	−·30	332·5
9.25	107	88	460	69·5	+·02	−·30	276
9.40	118	89	530	69·5	+·14	−·30	290
9.55	118	88	860	69·5	+·70	−·30	442
10.10	116	88	765	69·5	+·50	−·30	591
10.25	112	89	740	69·5	+·45	−·30	574
10.40	113	87	630	69·5	+·40	−·30	525
10.55	113	88	555	69·5	+·30	−·30	474·5
11.10	108	88	550	69·5	+·30	−·30	461
11.25	114	87	530	69·5	+·30	−·30	365
11.40	113	87	580	69·5	+·50	−·30	352
11.55	113	87	650	69·5	+·72	−·30	492
12.10	107	87	630	69·5	+·65	−·30	496
12.25	110	85	540	69·5	+·60	−·30	391
12.40	110	85	500	70	+·60	−·30	248
12.55	110	91	440	70	+·70	−·28	122
1.10	112	87	480	70	+·60	−·28	200
1.25	102	87	580	70	+·90	−·30	453·5
1.40	122	89	620	70·5	+1·00	−·30	441
1.55	123	87	650	70·5	+1·00	−·30	583
2.10	115	89	540	70·5	+·50	−·28	410
2.25	111	91	550	70	+·50	−·30	456·5
2.40	108	88	510	70	+·50	−·28	361·5
2.55	103	88	535	70	+·52	−·28	300·5
3.10	111	89	615	70·5	+1·00	−·28	353
3.25	116	88	700	70·5	+·90	−·30	474·5
3.40	122	89	650	70·5	+·72	−·30	533
3.55	115	90	700	70·5	+·75	−·28	563·5
4.10	108	91	550	70·5	+·52	−·28	475
4.25	118	93	615	71	+·75	−·27	282·5
4.40	103	90	555	71	+·55	−·25	501
4.55	112	89	600	71	+·70	−·26	373
5.10	118	87	580	71	+·90	−·28	345
5.25	120	89	600	71	+·70	−·26	392
5.40	106	87	500	71	+·75	−·26	302·5
5.55	88	93	450	71	+1·00	−·24	182·5
6.10	78	87	490	71	+·80	−·24	224
6.25	103	87	600	71	+·80	−·25	210
6.40	111	85	525	71	+·80	−·25	410
	110·3	88·0	575	70·1	+·58	−·29	15,609·5 net

SUMMARY OF OBSERVATIONS.

Date—July 3, 1908.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.40 a.m.	Ended—6.40 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Forced
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned May, 1908
4.	Tubes cleaned	7.30 a.m.
5.	Fire cleaned	7.40 a.m., 12.40 and 5.40 p.m.

Fuel.

6.	Kind of coal	No. 23 M.—Bankhead Colliery, Alberta
7.	Analysis of dry coal by weight (%)	C = 76·6, H = 3·6, S = 0·6; N_2 = 1·0, O_2 = 4·1, Ash = 14·1
8.	Calorific value of dry coal B.T.U. per lb	13080
9.	Moisture in coal as fired (%)	0·6
10.	Weight of coal fired (lbs.)	2530
11.	Combustible matter in ash and clinker (%)	42·1
12.	Weight of clinker (lbs.)	312
13.	Weight of ash (lbs.)	80

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	+0·58
15.	" above fire " "	−0·23
16.	" at damper " "	−0·29
17.	Amount of damper opening	Full
18.	Temperature of air in boiler house (°F.)	88
19.	Flue temperature (°F.)	575
20.	Analysis of dry flue gas by volume (%)	CO_2 = 8·6, O_2 = 10·9, CO = 0·1, N = 80·4

Water and Steam.

21.	Temperature of feed water (°F.)	70·1
22.	Total weight of feed water, corrected for difference of level (lbs.)	15609
23.	Water level in gauge at start (inches)	$5\frac{3}{8}$
24.	Water level in gauge at finish (inches)	$5\frac{1}{16}$
25.	Correction for difference of level, included above (lbs.)	+50
26.	Steam pressure by gauge (lbs. per sq. in.)	110·3
27.	Barometer reading (inches)	29·97
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	14·5
29.	Temperature in steam calorimeter (°F.)	291·2

Notes.

This coal would be very suitable for a shaking grate. More dirt than clinker seems to form, which tends to deaden the fire. This dirt could be very easily removed by a shaking grate. Burnt coal in a thick bed with forced draught. It appeared to burn chiefly at the dead plate and along the edges of the grate ; the rest being a dull red hue. Clinker very soft and easily removed. No smoke. Sliced fire 9.30 and 2.55. Weather cloudy and inclined to rain.

Proximate analysis of dry coal by weight %

Fixed carbon	73·3
Volatile matter	12·6
Ash	14·1

SUMMARY OF RESULTS.

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—Coal No. 23 M. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—30·01. At finish—29·93. Mean—29·97.

Total Quantities.

1.	Date of trial	3/7/08
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	2530
4.	Percentage of moisture in coal as fired (%)	0·6
5.	Total weight of dry coal fired (lbs.)	2515
6.	Total ash and refuse (lbs.)	392
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 24·4; (*b*) weighed 15·6	
8.	Total weight of combustible consumed, from analyses (lbs.)	1894
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	15609
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	15560
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	18500

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	251·5
13.	Dry coal per square foot of grate surface per hour (lbs.)	15·0
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1556
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	1850
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	2·90

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	110·3
18.	Temperature of feed water entering boiler (deg. F.)	70·1
19.	Temperature of escaping gases from boiler (deg. F.)	575
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·87
21.	Percentage of moisture in steam	0·5

Horse-Power.

22.	Horse-power developed (Item 15÷34½)	53·6
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	89·3

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9÷Item 3)	6·17
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11÷Item 3)	7·30
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11÷Item 5)	7·37
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11÷Item 8)	9·77

Efficiency.

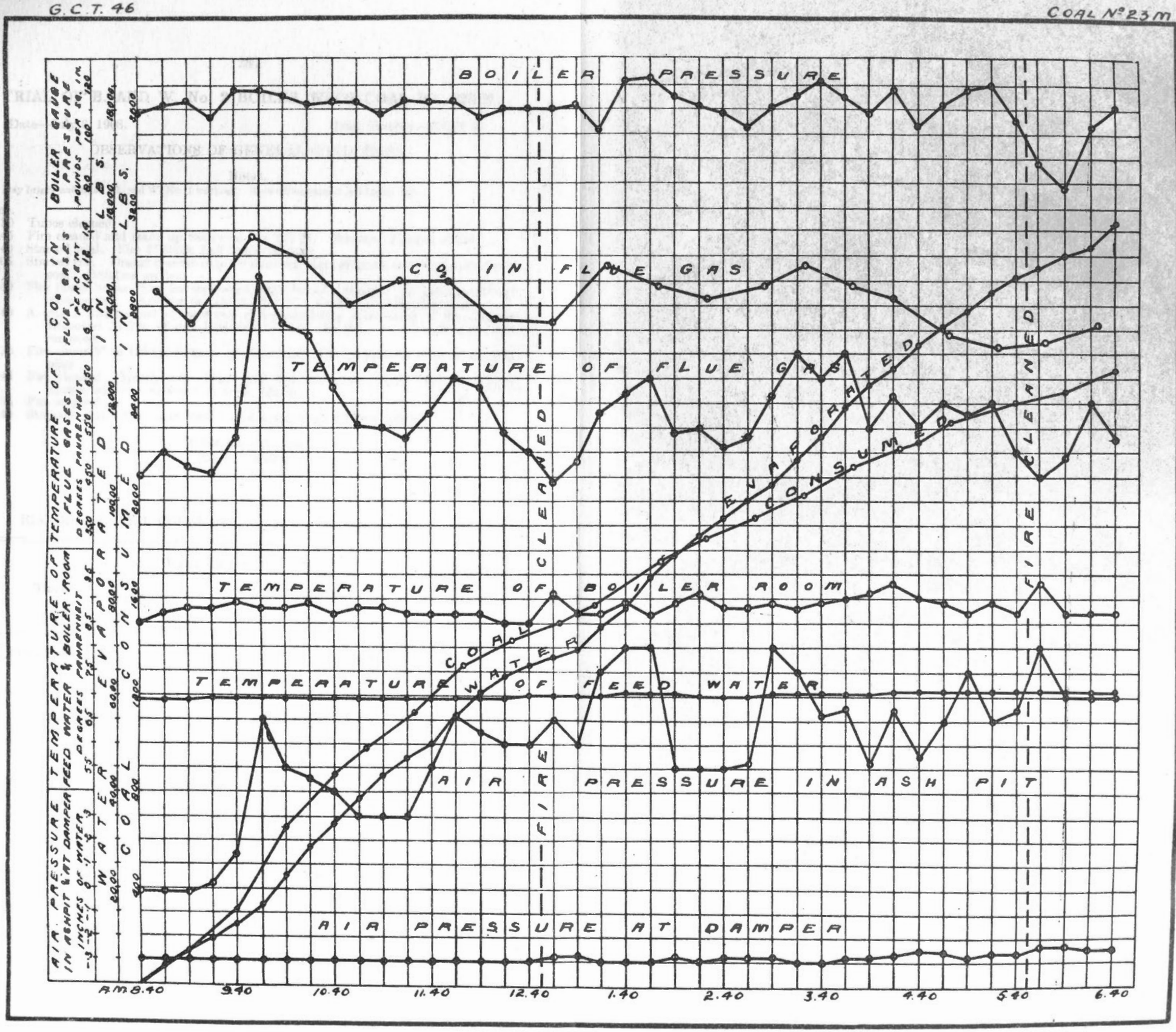
29.	Calorific value of dry coal per lb. (B.T.U.)	13080
30.	Calorific value of the combustible per lb. (B.T.U.)	15230
31.	Efficiency of boiler (based on combustible consumed) (%)	61·9
32.	Efficiency of boiler, including grate (based on dry coal) (%)	54·4

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	28·6
34.	" " of combustible consumed (from gas analyses) (lbs.)	28·9
35.	" " dry coal as fired (from gas analyses) (lbs.)	21·9
36.	Proportion of heat of fuel in escaping dry flue gases (%)	19·6

G.C.T. 46

COAL Nº 23 M



TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 223 M.

Date—July 6, 1908. Trial Number—G.C.T 47.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Day bright and fine. B. and W. No. 1 working. Blow-off examined and found tight.

Time.

7.30 Tubes cleaned.
7.45 Fire cleaned and made up with coal No. 223 M. Pressure, 125 lbs. gauge.
8.40 Started trial. Fire 2″ thick, half burnt through.
9.05 Started fan. Draught seems to penetrate near edges of grate, as with the unwashed coal. Building up fire.
9.40 Fire much better than for unwashed, with forced draught. Air getting through more evenly. Keeping fire about 6″ to 8″. Coal practically smokeless.
2.40 A pile of dirt formed at front end of fire, rendering observation of fire difficult. Removed 56 lbs. of dirt from the front of the fire. It was soft and easily removed.
4.20 Fire about 9″ to 10″ thick; most of coal seems to be burnt on or near to the dead plate.
5.45 Fire cleaned. Mostly soft clinker and dirt which was easily removed. Total clinker and dirt removed at 5.45, 138 lbs.
6.35 Fan stopped.
6.40 Stopped trial. Fire as at start. 42 lbs. ash removed from ash-pit.

CLINKER AND ASH.

194 lbs. clinker.
42 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 47.

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.40 a.m.						
9.15	116	116	8.45	7·7	11·4	0·0
9.40	204	320	9.15	9·7	9·3	0·5
10.00	145	465	9.45	12·8	6·1	0·5
10.30	152	617	10.15	11·8	7·8	0·0
11.00	161	778	10.45	10·1	9·2	0·1
11.20	85	863	11.15	10·1	8·1	1·2
11.50	249	1112	11.45	11·1	6·4	1·0
12.10	114	1226	12.15	11·0	7·6	0·2
12.40	166	1392	12.45	11·0	7·5	0·3
1.10	167	1559	1.15	11·5	8·0	0·0
1.20	35	1594	1.45	9·2	10·4	0·0
1.50	114	1708	2.15	9·0	10·8	0·1
2.20	115	1823	2.45	5·8	14·4	0·1
2.50	83	1906	3.15	10·5	8·6	0·0
3.15	72	1978	3.45	10·5	10·0	0·0
3.45	106	2084	4.15	10·1	10·0	0·3
4.15	133	2217	4.45	6·5	13·9	0·0
4.45	77	2294	5.15	7·9	12·5	0·0
5.20	57	2351	5.55	6·0	14·2	0·0
5.50	104	2455	6.15	6·0	14·0	0·1
6.40	80	2535				
				9·5	10·0	0·1

OBSERVATIONS MADE DURING BOILER TRIAL No. 47.

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.40	118	86	430	68·5	−·01	−·25	.....
8.55	116	85	425	68·5	−·01	−·25	220
9.10	106	87	425	68·5	+·10	−·25	313
9.25	123	88	640	68·5	+·40	−·26	203
9.40	121	88	720	69	+·40	−·28	580
9.55	123	89	680	69	+·40	−·26	480
10.10	123	88	640	69	+·42	−·26	573·5
10.25	102	88	550	69·5	+·30	−·25	516
10.40	118	88	550	69·5	+·32	−·25	293
10.55	123	89	575	69·5	+·52	−·25	413·5
11.10	115	89	570	69·5	+·52	−·25	534
11.25	121	89	640	69·5	+·70	−·26	441
11.40	122	89	690	70	+·75	−·26	550·5
11.55	107	88	640	70	+·72	−·26	474·5
12.10	111	87	650	70	+·72	−·25	544
12.25	110	87	610	70	+·70	−·25	439·5
12.40	121	87	640	70	+·72	−·25	450·5
12.55	113	87	620	70	+·75	−·25	538·5
1.10	113	88	600	69·5	+·72	−·25	562
1.25	113	87	590	69·5	+·72	−·25	393
1.40	113	89	610	70	+·70	−·25	462
1.55	118	88	585	70·5	+·70	−·24	366
2.10	118	88	600	70·5	+·70	−·24	459
2.25	112	88	590	70·5	+·74	−·24	453·5
2.40	104	88	550	71	+·68	−·24	482·5
2.55	103	89	560	71	+·72	−·25	352·5
3.10	110	89	560	71·5	+·68	−·25	331·5
3.25	115	89	670	71·5	+1·00	−·26	470·5
3.40	121	89	675	71·5	+·90	−·28	751
3.55	123	89	690	71·5	+·82	−·28	483
4.10	121	89	650	71·5	+·80	−·27	553
4.25	118	89	590	71·5	+·68	−·27	621·5
4.40	104	89	500	72	+·30	−·24	462
4.55	103	89	540	72	+·55	−·25	302
5.10	123	88	600	72	+·70	−·25	343·5
5.25	123	89	620	72	+·70	−·26	433
5.40	108	88	540	72	+·60	−·26	402
5.55	78	94	460	72	+1·30	−·25	264
6.10	123	89	610	71·5	+·80	−·25	200
6.25	110	89	590	71·5	+·75	−·25	434
6.40	110	89	470	71·5	—·02	−·25	351
	114	88·4	589	70·4	+·60	−·25	17,497 net

SUMMARY OF OBSERVATIONS.

Date—July 6, 1908.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.40 a.m.	Ended—6.40 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Forced
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned May, 1908
4.	Tubes cleaned	7.30 a.m.
5.	Fire cleaned	7.45 a.m., 5.45 p.m.

Fuel.

6.	Kind of coal	No. 223 M—Bankhead Colliery, Alberta
7.	Analysis of dry coal by weight (%).	C = 81·8, H = 3·8, S = 0·6, N_2 = 1·1, O_2 = 3·8, Ash = 8·9
8.	Calorific value of dry coal B.T.U. per lb	13970
9.	Moisture in coal as fired (%)	2·7
10.	Weight of coal fired (lbs.)	2535
11.	Combustible matter in ash and clinker (%)	39·3
12.	Weight of clinker (lbs.)	194
13.	Weight of ash (lbs.)	42

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	+0·60
15.	" above fire " "	−0·18
16.	" at damper " "	−0·25
17.	Amount of damper opening	Full
18.	Temperature of air in boiler house (°F.)	88
19.	Flue temperature (°F.)	589
20.	Analysis of dry flue gas by volume (%)	CO_2 = 9·5, O_2 = 10, CO = 0·1, N = 80·4

Water and Steam.

21.	Temperature of feed water (°F.)	70·4
22.	Total weight of feed water, corrected for difference of level (lbs.)	17497
23.	Water level in gauge at start (inches)	4 15/16
24.	Water level in gauge at finish (inches)	4 11/16
25.	Correction for difference of level, included above (lbs.)	+40
26.	Steam pressure by gauge (lbs. per sq. in.)	114
27.	Barometer reading (inches)	29·8
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	14·9
29.	Temperature in steam calorimeter (°F.)	292·2

Notes.

This coal is more easily burnt than the unwashed: as before, however, would be eminently suitable for a shaking grate. Coal burns practically smokelessly. Clinker very soft and easily removed. Weather bright and fine.

Proximate analysis of dry coal by weight %

Fixed carbon	78·6
Volatile matter	12·5
Ash	8·9

SUMMARY OF RESULTS

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—Coal No. 223 M. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·88. At finish—29·72. Mean—29·80.

Total Quantities.

1.	Date of trial	6/7/08
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	2535
4.	Percentage of moisture in coal as fired (%)	2·7
5.	Total weight of dry coal fired (lbs.)	2467
6.	Total ash and refuse (lbs.)	236
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 14·66; (*b*) weighed	9·5
8.	Total weight of combustible consumed, from analyses (lbs.)	2105
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	17497
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17440
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	20750

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	247
13.	Dry coal per square foot of grate surface per hour (lbs.)	14·7
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1744
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2075
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·2

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	114
18.	Temperature of feed water entering boiler (deg. F.)	70·4
19.	Temperature of escaping gases from boiler (deg. F.)	589
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·85
21.	Percentage of moisture in steam	0·4

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	60·2
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	100·2

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	6·9
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	8·2
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	8·41
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	9·88

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	13970
30.	Calorific value of the combustible per lb. (B.T.U.)	15340
31.	Efficiency of boiler (based on combustible consumed) (%)	62·1
32.	Efficiency of boiler, including grate (based on dry coal) (%)	58·2

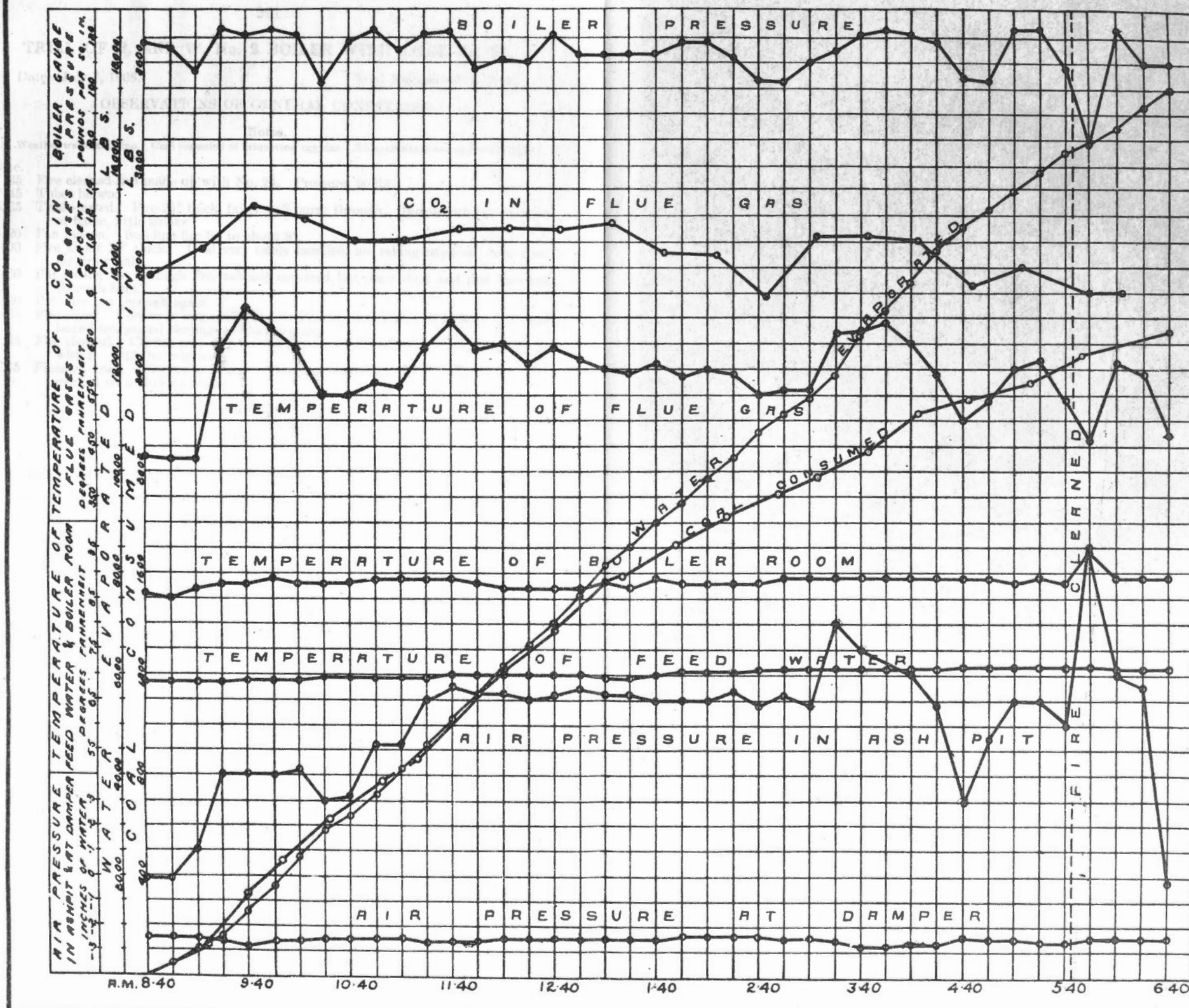
Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	26·0
34.	" " of combustible consumed (from gas analyses) (lbs.)	25·0
35.	" " dry coal (from gas analyses) (lbs.)	21·3
36.	Proportion of heat of fuel in escaping dry flue gases (%)	18·3

GRAPHIC RECORD OF BOILER TRIAL.

G.C.T. 47.

COAL Nº 23 M/00



TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 24.

Date—July 7, 1908. Trial Number—G.C.T. 48.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Weather warm and fine. Coal consisted of briquettes, egg size. Blow-off examined and found tight.

Time.

7.35 Fire cleaned and made up with No. 24. Pressure, 90 lbs.
7.45 Tubes blown.
8.35 Trial started. Fire 2½″ thick, fairly well burnt through. Burns with fair amount of flame, little smoke.
9.20 Fan put on. Building fire up to about 8″.
12.00 Fire about 10″ thick. Coal very easily handled, no raking required, door open for firing only.
2.00 Put slicing bar through fire, nothing removed but some dust and dirt knocked through bars.
3.20 Put slice bar through again.
4.25 Fire sliced. Clinker in large, soft, porous lumps, easily removed 56 lbs. All could have been passed through a shaking grate.
5.35 Fire cleaned. Clinker and dirt very easily removed, being very soft, much dust with it. 245 lbs. removed.
6.35 Finished trial. Fire as at start. This coal would be very much more easily worked on a shaking grate.

CLINKER AND ASH.
301 lbs. clinker.
101 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 48.

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.35 a.m.						
9.05	179	179	8.45	6·0	13·0	0·7
9.25	58	237	9.15	7·3	12·1	0·2
9.55	255	492	9.45	11·5	6·1	1·1
10.15	72	564	10.15	10·5	8·8	0·3
10.45	187	751	10.45	9·9	7·7	1·2
11.15	134	885	11.15	7·4	12·6	0·0
11.45	121	1006	11.45	7·6	11·9	0·0
12.15	96	1102	12.15	10·1	9·2	0·2
12.30	68	1170	12.45	7·2	11·8	0·9
1.00	97	1267	1.15	5·0	15·2	0·0
1.30	85	1352	1.45	7·0	13·1	0·0
2.00	90	1442	2.15	11·4	5·8	1·3
2.10	72	1514	2.45	8·1	12·1	0·2
2.40	178	1692	3.15	9·9	9·6	0·1
3.10	121	1813	4.05	5·7	14·4	0·0
3.40	129	1942	4.15	5·3	14·5	0·1
4.10	81	2023	4.45	6·3	13·0	0·0
4.35	105	2128	5.15	9·3	10·5	0·1
5.05	154	2282	5.40	3·3	17·2	0·0
5.35	159	2341	6.00	8·0	9·5	0·6
5.55	112	2453	6.15	9·9	9·1	0·2
6.15	157	2610				
6.35	56	2666		7·9	11·3	0·4

OBSERVATIONS MADE DURING BOILER TRIAL No. 48.

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.35	116	89	470	71·5	−·01	−·26	.....
8.50	118	92	440	71·5	−·01	−·28	180
9.05	114	92	460	71·5	−·01	−·28	352
9.20	115	92	460	71·5	−·01	−·28	230
9.35	112	93	540	71	+·30	−·30	344
9.50	123	92	700	71	+·30	−·30	505·5
10.05	122	92	740	71	+·30	−·30	599·5
10.20	118	93	640	71	+·25	−·30	485
10.35	111	93	620	71	+·25	−·30	673
10.50	123	93	580	70·5	+·10	−·30	422·5
11.05	95	91	585	71	+·20	−·28	553
11.20	121	94	530	71	+·10	−·28	216
11.35	111	93	540	71	+·12	−·28	354
11.50	123	93	585	71	+·50	−·26	234·5
12.05	119	92	710	71	+·50	−·28	523
12.20	118	91	620	71	+·40	−·22	512
12.35	117	92	560	71	+·40	−·25	430
12.50	110	92	535	71	+·30	−·22	420·5
1.05	115	92	520	71	+·30	−·22	256
1.20	114	92	550	71·5	+·65	−·24	271
1.35	106	92	590	71·5	+·65	−·24	340·5
1.50	113	92	635	71·5	+·90	−·24	425
2.05	121	92	650	71·5	+1·00	−·24	349·5
2.20	123	92	720	71·5	+·80	−·25	631·5
2.35	121	92	630	71·5	+·65	−·22	568
2.50	118	92	600	71·5	+·60	−·23	462·5
3.05	90	92	640	71·5	+·85	−·24	571·5
3.20	118	91	660	71·5	+·80	−·24	434
3.35	120	92	670	72	+·90	−·24	492
3.50	116	93	640	72	+·85	−·20	582
4.05	107	92	600	71·5	+·82	−·20	508·5
4.20	103	92	570	72	+·85	−·20	350·5
4.35	80	93	500	72	+·95	−·20	364
4.50	117	91	560	72·5	+·90	−·20	164
5.05	123	91	620	72·5	+1·05	−·20	344
5.20	123	90	610	72·5	+1·00	−·20	453
5.35	109	89	500	72·5	+1·00	−·20	361
5.50	88	91	450	72·5	+·05	−·20	301
6.05	121	85	575	72·5	+·20	−·22	130
6.20	123	87	850	72·5	+·40	−·30	587
6.35	121	86	540	72·5	0·0	−·25	440
	114	91·5	590	71·5	+·49	−·25	16,421 net

SUMMARY OF OBSERVATIONS.

Date—July 7, 1908.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.35 a.m.	Ended—6.35 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Forced
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned May, 1908
4.	Tubes cleaned	7.45 a.m.
5.	Fire cleaned	7.35 a.m., 5.35 p.m.

Fuel.

6.	Kind of coal	No. 24 coal—Bankhead Colliery, Alberta. Anthracite coal dust briquettes made with over 9% tar
7.	Analysis of dry coal by weight (%)	$C=76\cdot3$, $H=3\cdot7$, $S=0\cdot6$, $N_2=1\cdot0$, $O_2=4\cdot1$, Ash $=14\cdot3$
8.	Calorific value of dry coal B.T.U. per lb	13100
9.	Moisture in coal as fired (%)	0·7
10.	Weight of coal fired (lbs.)	2666
11.	Combustible matter in ash and clinker (%)	30·8
12.	Weight of clinker (lbs.)	301
13.	Weight of ash (lbs.)	101

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	+0·49
15.	" above fire " "	−0·16
16.	" at damper " "	−0·25
17.	Amount of damper opening	Full
18.	Temperature of air in boiler house (°F.)	91·5
19.	Flue temperature (°F.)	590
20.	Analysis of dry flue gas by volume (%)	$CO_2=7\cdot9$, $O_2=11\cdot3$, $CO=0\cdot4$, $N=80\cdot4$

Water and Steam.

21.	Temperature of feed water (°F.)	71·5
22.	Total weight of feed water, corrected for difference of level (lbs.)	16421
23.	Water level in gauge at start (inches)	$4\frac{5}{16}$
24.	Water level in gauge at finish (inches)	$4\frac{1}{4}$
25.	Correction for difference of level, included above (lbs.)	−70
26.	Steam pressure by gauge (lbs. per sq. in.)	114
27.	Barometer reading (inches)	29·65
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	15·2
29.	Temperature in steam calorimeter (°F.)	291

Notes.

(Briquettes).

Clinker is formed in large soft porous lumps which could be passed through a shaking grate. Burns with much flame but little smoke. Fire kept about 8" to 10" and forced draught used. Very easily handled, fire door being opened for firing only and occasionally for slicing. Sliced at 2.00, 3.20, 4.25. Fire cleaned once only during trial. Weather warm and fine.

Proximate analysis of dry coal by weight %

Fixed carbon	68·6
Volatile matter	17·1
Ash	14·3

SUMMARY OF RESULTS.

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 24. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·73. At finish—29·58. Mean—29·65.

Total Quantities.

1.	Date of trial	7/7/08
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	2666
4.	Percentage of moisture in coal as fired (%)	0·7
5.	Total weight of dry coal fired (lbs.)	2648
6.	Total ash and refuse (lbs.)	402
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 20·65; (*b*) weighed	15·2
8.	Total weight of combustible consumed, from analyses (lbs.)	2100
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	16421
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	16360
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	19420

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	265
13.	Dry coal per square foot of grate surface per hour (lbs.)	15·8
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1636
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	1942
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·04

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	114·0
18.	Temperature of feed water entering boiler (deg. F.)	71·5
19.	Temperature of escaping gases from boiler (deg. F.)	590
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·74
21.	Percentage of moisture in steam	0·5

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	56·3
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	93·8

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	6·16
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	7·27
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	7·32
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	9·25

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	13100
30.	Calorific value of the combustible per lb. (B.T.U.)	15290
31.	Efficiency of boiler (based on combustible consumed) (%)	58·4
32.	Efficiency of boiler, including grate (based on dry coal) (%)	53·9

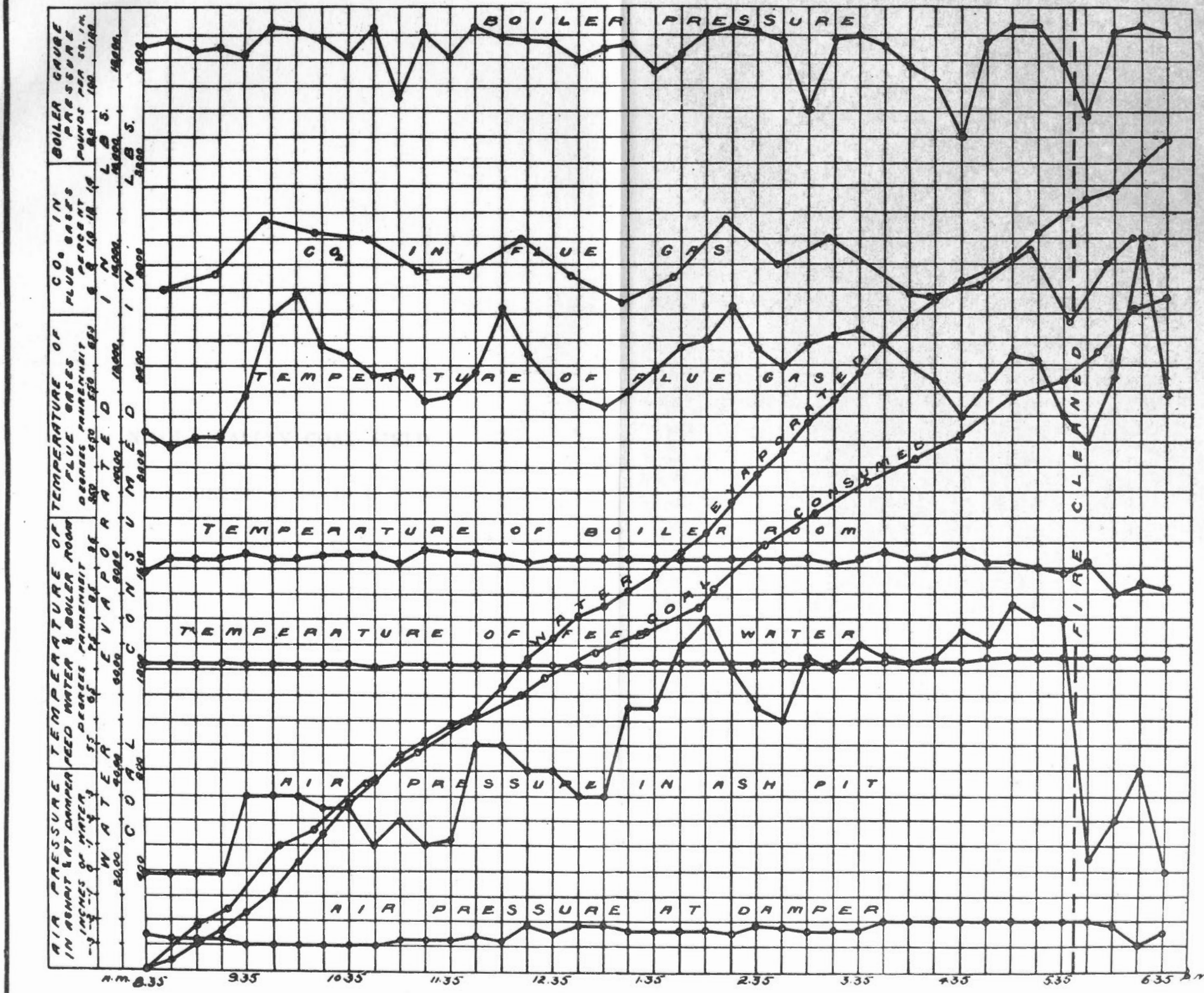
Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	33·0
34.	" " of combustible consumed (from gas analyses) (lbs.)	31·7
35.	" " dry coal (from gas analyses) (lbs.)	25·2
36.	Proportion of heat of fuel in escaping dry flue gases (%)	23·9

GRAPHIC RECORD OF BOILER TRIAL.

G.C.T. 48

COAL No. 24



NICOLA VALLEY COAL FIELD.

BRITISH COLUMBIA.

TRIAL OF B. AND W. No 2 BOILER WITH COAL No. 22 M.

Date—June 19, 1908. Trial Number—G.C.T. 40.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Day fine and clear. B. and W. No. 1 boiler not working. Robb boiler working. Coal very small. Flue gas thermometer changed during trial. Blow-off examined and found tight.

Time.
7.10 Fire cleaned and made up with No. 22 M coal.
8.05 Trial started. 2½" coal, half burnt through.
8.30 Burns very rapidly with much flame, fire kept about 2" thick. Much smoke observed after firing.
9.40 Coal does not cake at all, a thick bed of ash seems to be forming, however.
10.22 Ran rake through fire, knocking much ash through bars.
11.10 " " " "
12.10 Fire cleaned. 168 lbs. clinker removed, consisting largely of ash; clinker soft and easily removed.
3.55 Raked fire (as much ash was on bars.)
5.20 Fire cleaned. 171 lbs. of clinker and ash removed.
6.05 Finish. 115 lbs. of ash raked from ash-pit. A shaking grate would suit this coal.

CLINKER AND ASH.
339 lbs. clinker.
115 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 40.

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.05 a.m.						
8.48	480	480	8.15	7·5	9·1	2·3
9.20	178	658	8.45	8·2	10·3	0·6
9.50	168	826	9.15	10·8	6·7	1·2
10.20	168	994	9.45	9·6	9·2	0·6
10.50	172	1166	10.15	9·8	9·1	0·1
11.20	139	1305	10.45	8·7	8·8	1·9
12.00	200	1505	11.15	9·4	9·3	0·1
12.30	120	1625	11.45	9·8	8·7	0·4
1.00	277	1902	12.15	7·2	11·3	0·3
1.35	146	2048	12.45	10·3	6·2	2·1
2.15	243	2291	1.15	9·5	7·1	1·8
2.30	61	2352	1.45	5·0	14·7	0·0
3.00	242	2594	2.15	8·7	8·1	1·7
3.15	78	2672	2.45	8·9	7·6	2·0
4.00	200	2872	3.15	6·9	12·1	0·0
4.35	122	2994	3.45	7·8	9·9	1·0
5.05	93	3087	4.15	9·0	9·0	0·8
5.40	241	3328	4.45	9·7	9·0	0·1
6.05	90	3418	5.15	8·3	10·3	0·3
			5.45	8·8	7·7	2·4
				8·7	9·2	1·0

OBSERVATIONS MADE DURING BOILER TRIAL No. 40.

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.05	118	77		63	−·02	−·28	.....
8.20	117	79		63	−·02	−·29	420
8.35	120	81		63·5	−·02	−·29	534
8.50	105	83		63·5	−·02	−·29	543
9.05	108	83		63·5	−·02	−·28	552·5
9.20	98	85		64	−·02	−·28	733·5
9.35	99	83		64	−·01	−·24	436
9.50	106	84		64	−·01	−·24	540·5
10.05	120	84		64	−·01	−·24	424
10.20	90	85		64	−·01	−·24	665
10.35	111	85		64	−·01	−·24	294
10.50	113	85		64	−·01	−·25	343
11.05	122	85		64	−·01	−·25	441
11.20	105	85		64	−·01	−·25	413
11.35	123	85		64·5	−·01	−·24	343·5
11.50	121	85		64·5	−·01	−·22	439
12.05	106	84	485	64·5	−·01	−·20	414
12.20	95	89	550	64·5	−·01	−·22	269·5
12.35	120	84	610	64·5	−·01	−·22	343
12.50	122	85	695	64·5	−·01	−·23	453·5
1.05	122	85	625	64·5	−·01	−·23	529·5
1.20	121	85	600	64·5	−·01	−·22	492
1.35	122	85	570	65	−·01	−·22	494·5
1.50	118	85	610	65	−·01	−·22	447
2.05	123	85	600	65	−·01	−·22	449
2.20	122	85	590	65	−·01	−·22	483·5
2.35	122	87	610	65	−·01	−·22	425·5
2.50	120	87	600	65	−·01	−·22	482·5
3.05	120	89	600	65·5	−·01	−·22	461·5
3.20	111	89	.....	65·5	−·01	−·22	443
3.35	123	88	570	66	−·01	−·22	414
3.50	121	88	550	66	−·01	−·22	413
4.05	108	90	550	66	−·01	−·23	341·5
4.20	117	86	640	66	−·01	−·23	361·5
4.35	117	87	620	66·5	−·01	−·23	384
4.50	122	87	610	66·5	−·01	−·23	387
5.05	118	87	550	66·5	−·01	−·23	355·5
5.20	93	90	600	66·5	−·01	−·25	316·5
5.35	122	87	740	66·5	−·01	−·26	384
5.50	122	87	700	67	−·01	−·25	594
6.05	116	87	600	67	−·01	−·25	461
	114·6	85·4	603	64·9	−·01	−·24	17,720 net

SUMMARY OF OBSERVATIONS.

Date—June 19, 1908.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.05 a.m.	Ended—6.05 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned May, 1908
4.	Tubes cleaned	7.35 a.m.
5.	Fire cleaned	7.10 a.m., 12.10 and 5.20 p.m.

Fuel.

6.	Kind of coal	Coal No. 22 M.—Mines 1 and 2, Middlesboro Colliery Nicola Valley Coal and Coke Co., Coutlee, B.C.
7.	Analysis of dry coal by weight (%)	C = 66·1, H = 4·9, S = 0·9 N_2 = 1·4, O_2 = 12·6, Ash = 14·1
8.	Calorific value of dry coal B.T.U. per lb	11720
9.	Moisture in coal as fired (%)	4·8
10.	Weight of coal fired (lbs.)	3418
11.	Combustible matter in ash and clinker (%)	13·8
12.	Weight of clinker (lbs.)	339
13.	Weight of ash (lbs.)	115

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−0·01
15.	" above fire "	−0·21
16.	" at damper "	−0·24
17.	Amount of damper opening	Various
18.	Temperature of air in boiler house (°F.)	85·4
19.	Flue temperature (°F.)	603
20.	Analysis of dry flue gas by volume (%)	CO_2 = 8·7, O_2 = 9·2, CO = 1·0, N = 81·1

Water and Steam.

21.	Temperature of feed water (°F.)	64·9
22.	Total weight of feed water, corrected for difference of level (lbs)	17720
23.	Water level in gauge at start (inches)	$4\frac{9}{16}$
24.	Water level in gauge at finish (inches)	$4\frac{9}{16}$
25.	Correction for difference of level, included above (lbs.)	0
26.	Steam pressure by gauge (lbs. per sq. in.)	114·6
27.	Barometer reading (inches)	29·59
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	15·1
29.	Temperature in steam calorimeter (°F.)	291·0

Notes.

This coal seems to produce very little clinker, much ash is formed on the bars; with a shaking grate this coal should be easily worked. Much smoke, however, is given off. Coal does not coke. Fire raked to remove ash—10.22, 11.10, 3.55. Weather fine and clear.

Proximate analysis of dry coal by weight %

Fixed carbon	46·8
Volatile matter	39·1
Ash	14·1

SUMMARY OF RESULTS.

Made on B. and W. No. 2 Boiler, at McGill University.

To Determine quality of Coal.

Kind of Fuel—Coal No. 22 M. Kind of Furnace—Fixed bars, 30% air space.

Method of Starting and Stopping Test—Alternate (A.S.M.E.)

Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.

Superheating Surface (sq. ft.)—Nil.

Barometer at start—29·75. At finish—29·44. Mean—29·59.

Total Quantities.

1.	Date of trial	19/6/08
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	3418
4.	Percentage of moisture in coal as fired (%)	4·8
5.	Total weight of dry coal fired (lbs.)	3254
6.	Total ash and refuse (lbs.)	454
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 16·38; (*b*) weighed.	14·0
8.	Total weight of combustible consumed, from analyses (lbs.)	2720
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	17720
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17650
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	21110

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	325
13.	Dry coal per square foot of grate surface per hour (lbs.)	19·35
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1765
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2111
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·30

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	114·6
18.	Temperature of feed water entering boiler (deg. F.)	64·9
19.	Temperature of escaping gases from boiler (deg. F.)	603
20.	Pressure of draft between damper and boiler (ins. of water)	0·23
21.	Percentage of moisture in steam	0·50

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	61·1
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	102

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	5·18
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	6·17
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	6·50
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	7·75

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	11720
30.	Calorific value of the combustible per lb. (B.T.U.)	13655
31.	Efficiency of boiler (based on combustible consumed) (%)	54·8
32.	Efficiency of boiler, including grate (based on dry coal) (%)	53·5

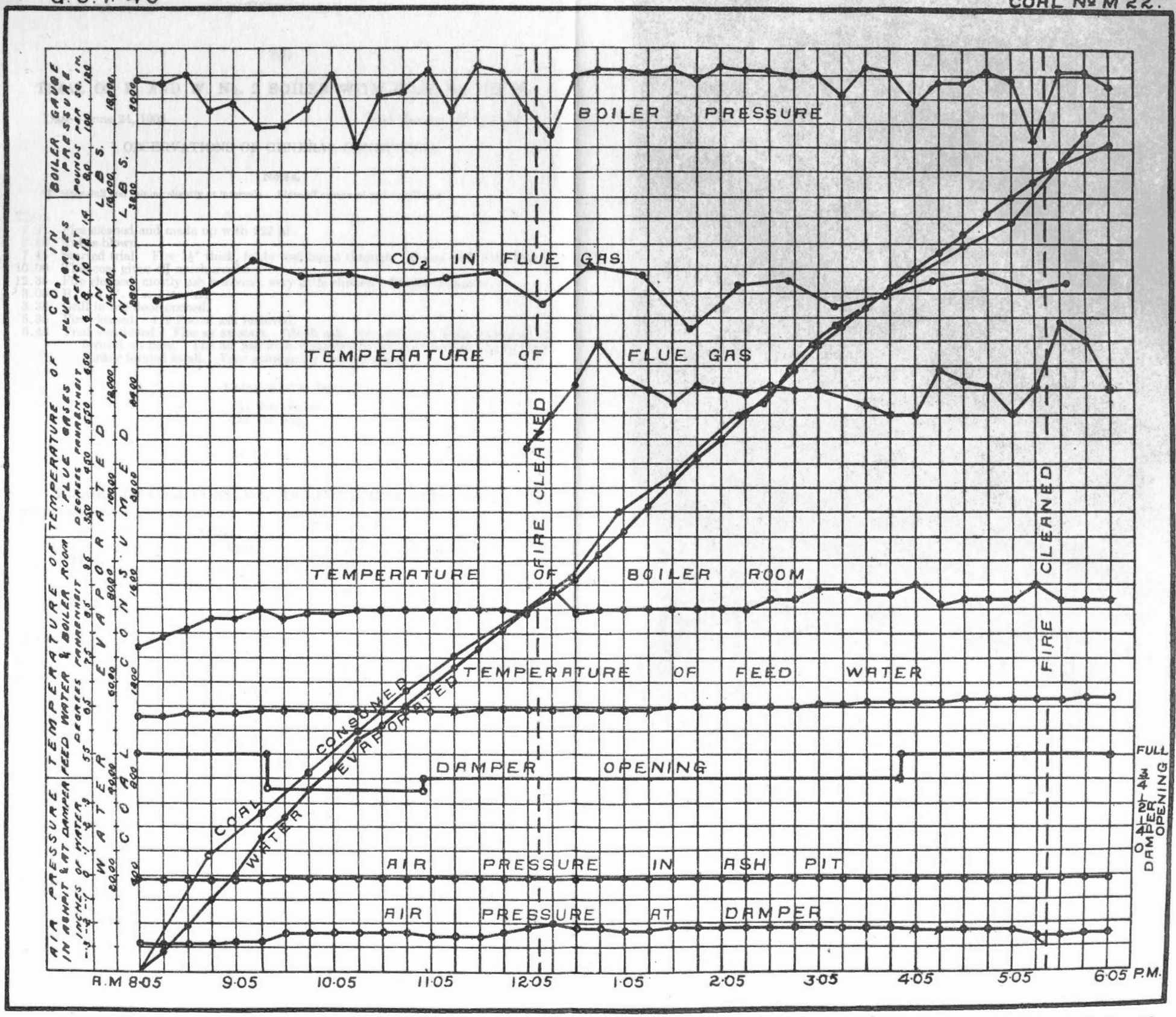
Flue Gases.

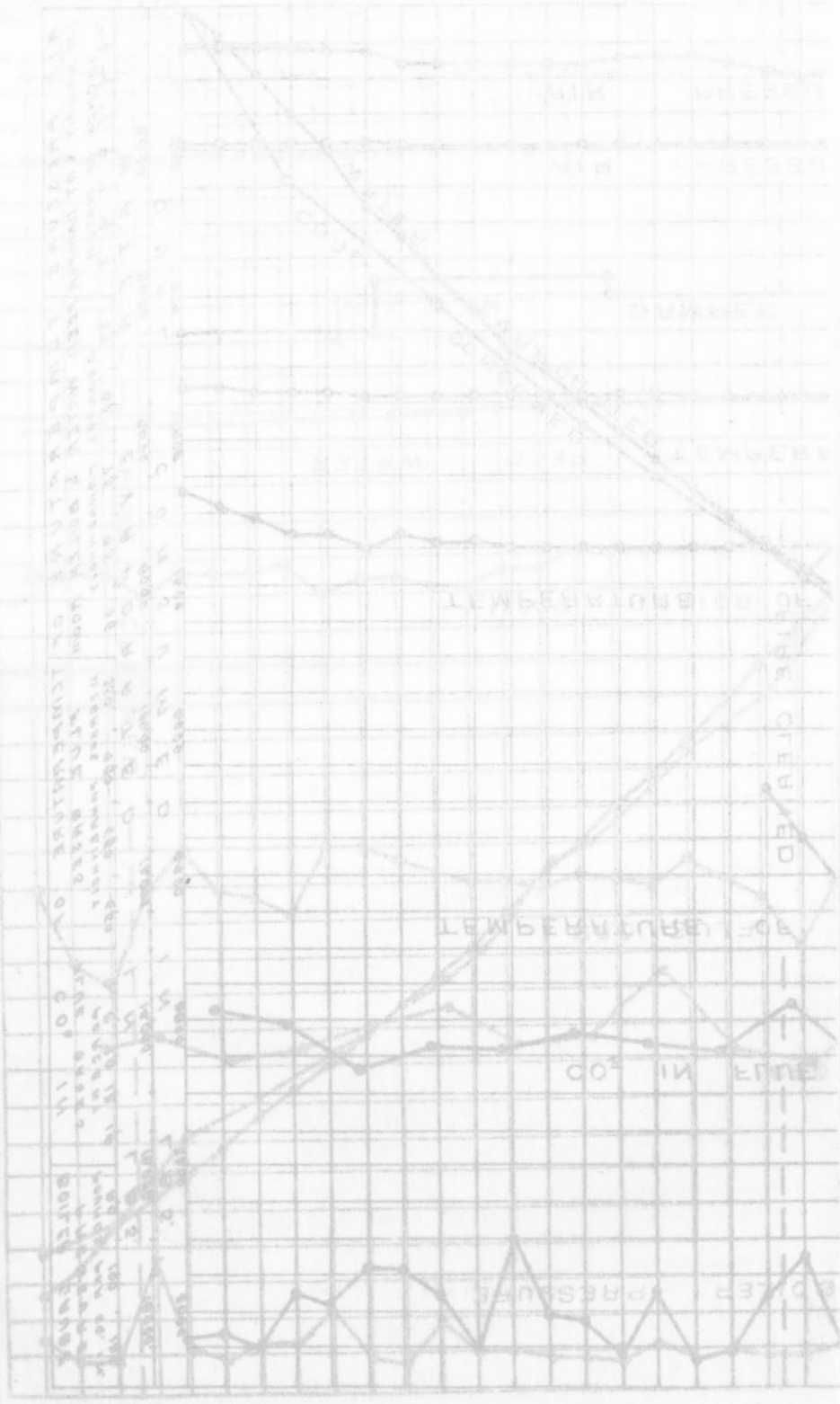
33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	25·6
34.	" " of combustible consumed (from gas analyses) (lbs.)	20·2
35.	" " dry coal (from gas analyses) (lbs.)	16·9
36.	Proportion of heat of fuel in escaping gases (%)	17·9

GRAPHIC RECORD OF BOILER TRIAL.

G.C.T. 40

COAL Nº M 22.





TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 222 M.

Date—June 24, 1908. Trial Number—G.C.T. 42.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Weather dull and raining slightly at intervals. Blow-off examined and found tight.

Time.

7.35 Fire cleaned and made up with 222 M.
7.50 Tubes blown.
7.45 Started trial. Fire 1½" thick, fairly well burnt through. Burns with little flame.
10.00 This coal gives off much smoke.
12.35 Fire cleaned, mostly ash removed, very little clinker. 132 lbs. removed.
3.05 B. and W. No. 1 started.
3.30 Grill in fire door opened.
5.35 Fire cleaned. 119 lbs. of ash removed.
6.45 Trial concluded. Fire as at start. Much ash, very soft and easily removed, is formed on bars. The air has little difficulty in getting through. Very little clinker formed at all. Very suitable for shaking grate.

CLINKER AND ASH.

251 lbs. clinker.
87 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 42.

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval	Total.		CO_2	O_2	CO
Start 8.45 a.m.						
9.15	232	232	8.50	9·8	8·1	1·4
9.30	129	361	9.20	10·9	7·6	1·1
10.00	196	557	9.50	10·8	8·2	0·4
10.20	133	690	10.20	12·5	6·0	0·8
10.50	173	853	10.50..	9·7	9·7	0·5
11.20	136	999	11.20	8·5	10·6	0·8
11.30	62	1061	11·50	8·6	10·4	0·8
12.00	146	1207	12.20	9·1	9·3	1·3
12.30	143	1350	12.50	10·0	9·0	1·1
1.00	245	1595	1.20	11·0	6·4	2·2
1.30	171	1766	1.50	9·8	7·4	2·8
2.00	156	1922	2.20	10·8	7·7	1·2
2.30	147	2069	2.50	10·6	5·8	5·1
2.35	51	2120	3.20	10·2	9·0	0·5
3.05	163	2283	3.50	11·4	4·4	3·5
3.35	184	2467	4.20	10·9	5·4	4·1
4.05	159	2626	4.50	11·0	8·1	1·1
4.35	132	2758	5.20	14·3	2·3	2·4
4.45	58	2816	5.50	11·8	6·9	0·3
5.15	179	2995	6.20	10·7	8·2	0·7
5.30	116	3111				
5.55	204	3315		10·6	7·5	1·6
6.45	142	3457				

OBSERVATIONS MADE DURING BOILER TRIAL No. 42.

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.45	112	85	550	66·5	—·02	—·24	.....
9.00	110	84	580	66·5	—·02	—·24	500
9.15	113	85	660	66·5	—·02	—·26	475·5
9.30	112	85	630	66·5	—·02	—·26	502
9.45	113	85	720	66·5	—·02	—·26	484·5
10.00	115	85	700	67	—·02	—·26	524·5
10.15	108	85	630	67	—·02	—·26	601·5
10.30	107	85	620	66·5	—·02	—·25	464
10.45	108	87	600	66·5	—·02	—·26	483
11.00	102	86	610	66·5	—·02	—·26	434·5
11.15	105	85	610	66·5	—·02	—·26	364
11.30	110	86	590	67	—·02	—·26	392·5
11.45	103	87	560	67	—·02	—·26	485
12.00	112	87	550	67	—·02	—·26	365
12.15	110	87	530	67·5	—·02	—·26	351
12.30	118	84	550	67·5	—·02	—·26	332
12.45	104	87	730	67·5	—·02	—·26	286·5
1.00	123	86	660	67·5	—·02	—·26	344
1.15	112	85	680	67·5	—·02	—·26	603
1.30	113	87	620	67·5	—·02	—·25	465
1.45	108	86	610	67·5	—·02	—·25	511
2.00	106	86	640	67·5	—·02	—·24	467·5
2.15	119	86	670	67·5	—·02	—·24	425·5
2.30	110	86	810	68	—·02	—·25	511·5
2.45	120	85	680	68	—·02	—·25	472·5
3.00	116	85	640	68	—·02	—·20	503
3.15	105	89	570	68	—·02	—·20	397·5
3.30	113	90	640	68	—·02	—·22	444
3.45	123	90	720	68	—·02	—·22	366
4.00	116	92	730	68·5	—·02	—·22	583
4.15	102	91	650	68·5	—·02	—·22	385
4.30	120	94	700	69	—·02	—·22	357
4.45	123	90	770	69	—·02	—·25	446
5.00	123	90	830	69	—·02	—·25	515
5.15	123	89	810	68·5	—·02	—·25	452
5.30	123	87	770	68·5	—·02	—·25	486·5
5.45	111	89	795	68·5	—·02	—·25	414·5
6.00	123	87	1000	68·5	—·02	—·25	364
6.15	122	87	720	68·5	—·02	—·22	556
6.30	121	87	700	68·5	—·02	—·22	448
6.45	122	87	650	68·5	—·02	—·22	468
	113·6	87·0	670	67·6	—·02	—·24	18,131 net

SUMMARY OF OBSERVATIONS.

Date—June 24, 1908.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.45 a.m.	Ended—6.45 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned May, 1908
4.	Tubes cleaned	7.50 a.m.
5.	Fire cleaned	7.35 a.m., 12.35 p.m., 5.35 p.m.

Fuel.

6.	Kind of coal	No. 222 M { Mines 1 and 2, Middlesboro Colliery, Nicola Valley Coal and Coke Co, Coutlee, B.C.
7.	Analysis of dry coal by weight (%)	{ C = 70·8, H = 5·3, S = 0·9, N_2 = 1·5, O_2 = 11·5, Ash = 10·0
8.	Calorific value of dry coal B.T.U. per lb	12020
9.	Moisture in coal as fired (%)	6·2
10.	Weight of coal fired (lbs.)	3457
11.	Combustible matter in ash and clinker (%)	26·5
12.	Weight of clinker (lbs.)	251
13.	Weight of ash (lbs.)	87

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−0·02
15.	" above fire " "	−0·19
16.	" at damper " "	−0·24
17.	Amount of damper opening	Various
18.	Temperature of air in boiler house (°F.)	87
19.	Flue temperature (°F.)	670
20.	Analysis of dry flue gas by volume (%)	CO_2 = 10·6, O_2 = 7·5, CO = 1·6, N = 80·3

Water and Steam.

21.	Temperature of feed water (°F.)	67·6
22.	Total weight of feed water, corrected for difference of level (lbs.)	18131
23.	Water level in gauge at start (inches)	$5\frac{1}{4}$" 600
24.	Water level in gauge at finish (inches)	$5\frac{3}{8}$" 620
25.	Correction for difference of level, included above (lbs.)	−20
26.	Steam pressure by gauge (lbs. per sq. in.)	113·6
27.	Barometer reading (inches)	29·53
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	15·3
29.	Temperature in steam calorimeter (°F.)	291·8

Notes.

Clinker mostly cinders, coal would be suitable for a shaking grate. Air admitted above the fire for a portion of the test. Coal burns with little flame and much smoke. Weather dull and raining slightly at intervals.

Proximate analysis of dry coal by weight %: Fixed carbon 50·2; Volatile matter 39·8; Ash 10·0

SUMMARY OF RESULTS.

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 222 M. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·60. At finish—29·45. Mean—29·53.

Total Quantities.

1.	Date of trial	24/6/08
2.	Duration of trial (hours)	10·0
3.	Weight of coal as fired (lbs.)	3457
4.	Percentage of moisture in coal as fired (%)	6·2
5.	Total weight of dry coal fired (lbs.)	3243
6.	Total ash and refuse (lbs.)	338
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 13·6; (*b*) weighed	10·4
8.	Total weight of combustible consumed, from analyses (lbs.)	2804
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	18131
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	18070
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	21530

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	324
13.	Dry coal per square foot of grate surface per hour (lbs.)	19·3
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1813
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2153
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·36

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	113·6
18.	Temperature of feed water entering boiler (deg. F.)	67·6
19.	Temperature of escaping gases from boiler (deg. F.)	670
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·22
21.	Percentage of moisture in steam	0·5

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	62·4
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	104

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	5·24
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	6·22
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	6·65
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	7·67

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	12620
30.	Calorific value of the combustible per lb. (B.T.U.)	14022
31.	Efficiency of boiler (based on combustible consumed) (%)	52·8
32.	Efficiency of boiler, including grate (based on dry coal) (%)	50·8

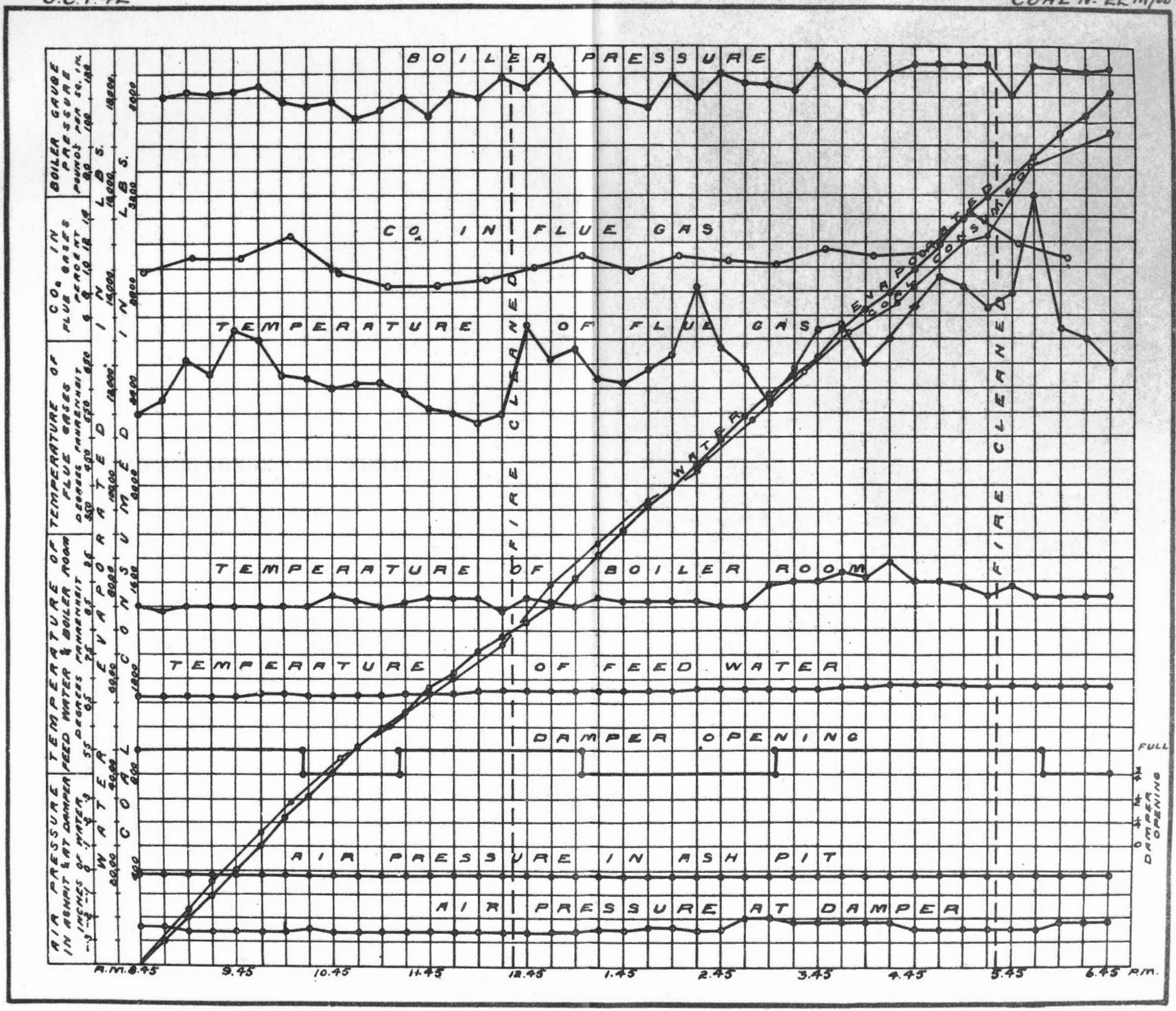
Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	20·5
34.	" " of combustible consumed (from gas analyses) (lbs.)	16·8
35.	" " dry coal (from gas analyses) (lbs.)	14·5
36.	Proportion of heat of fuel in escaping dry flue gases (%)	16·1

GRAPHIC RECORD OF BOILER TRIAL.

G.C.T. 42

COAL Nº 22 M/00



NANAIMO-COMOX COAL FIELD.

VANCOUVER ISLAND, B.C.

TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 20.

Date—June 3, 1908. Trial Number—G.C.T. 33.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Weather cool; cloudy until 10.00 a.m., then fine and bright.

Time.	
a.m.	
6.00	Fire made up with common coal.
7.30	Fire cleaned and made up with No. 20 coal. Pressure, 100 lbs.
7.45	Tubes blown.
8.40	Trial started. Fire 1½″ thick, well burnt through. Pressure, 102 lbs. Two bags of coal burnt before start. Coal in lumps up to 3″ with fair amount of dust. Coal dull in appearance. Burns freely with considerable flame and heavy smoke when fired, giving very hot fire.
12.15	Fire sliced. Very little clinker.
1.25	Calorimeter thermometer discovered to have mercury column broken. Shaken and reset.
2.14	Fire sliced.
2.30	Small quantity of clear vitreous clinker dropped through bars.
3.15	Fire sliced. 20 lbs. of hard, whitish, brittle clinker removed. Clinker somewhat adherent.
3.30	Long thin threads of vitreous slag hanging from bars.
4.56	Fire sliced.
5.30 to 5.38	Fire cleaned. 111 lbs. of clinker and cinders removed. Clinker thin, hard, friable, and somewhat adherent.
6.43	Trial stopped. Fire similar to start. Ash weighed out 66 lbs. Blow-off examined and found tight.

CLINKER AND ASH.

131 lbs. clinker.
66 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 33.

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.40 a.m.						
9.00	280	280	9.00	9·2	9·5	0·0
9.30	237	517	9.30	9·2	9·3	0·1
9.50	111	628	10.00	8·7	6·0	1·6
10.00	86	714	10.30	8·3	7·5	0·7
10.30	106	820	10.55	8·2	8·2	0·4
11.00	108	928	11.25	6·9	12·6	.....
11.10	44	972	11.55	8·5	8·2	0·4
11.30	154	1126	12.25	9·9	5·3	0·5
12.00	136	1262	12.55	8·1	8·5	1·1
12.15	37	1299	1.30	7·7	9·4	0·8
12.30	190	1489	1.55	8·3	9·6	0·4
1.00	127	1616	2.25	10·9	6·4	0·9
1.30	162	1778	2.55	9·7	8·4	.....
2.00	115	1893	3.25	9·9	6·7	1·4
2.18	39	1932	3.55	8·2	9·1	1·1
3.00	282	2214	4.25	9·0	11·1	0·0
3.26	77	2291	4.55	8·5	11·0	0·3
4.00	221	2512	5.25	7·5	12·7	0·3
4.30	89	2601	5.55	9·5	7·5	0·5
5.00	105	2706	6.25	10·1	8·9	0·0
5.45	209	2915				
6.00	73	2988		8·9	8·8	1·5
6.43	175	3163				

OBSERVATIONS MADE DURING BOILER TRIAL No. 33.

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.40	100	68	515	56	—·02	—·25	.....
8.55	122	70	595	56	—·02	—·26	490
9.10	121	76	610	56	—·02	—·25	704·5
9.25	117	75	525	56	—·02	—·17	611
9.40	116	76	520	56	—·02	—·17	702·5
9.55	118	74	515	56·5	—·02	—·17	499
10.10	118	75	500	56·5	—·02	—·17	585
10.25	123	75	460	56·5	—·01	—·13	417
10.40	114	77	470	57	—·01	—·13	474
10.55	96	77	455	57	—·01	—·13	422·5
11.10	106	77	445	57	—·01	—·13	532·5
11.25	121	77	455	57	—·01	—·15	199·5
11.40	120	76	445	57	—·01	—·14	490
11.55	121	77	445	57	—·01	—·14	262
12.10	121	79	455	57	—·01	—·16	325
12.25	123	79	650	57	—·01	—·20	440
12.40	121	81	605	57	—·01	—·18	448·5
12.55	121	81	570	57	—·01	—·18	435
1.10	118	79	465	57·5	—·01	—·17	313
1.25	98	81	465	57·5	—·01	—·17	589
1.40	116	81	460	57·5	—·01	—·17	160·5
1.55	111	79	445	57·5	—·01	—·17	327
2.10	118	79	460	57·5	—·01	—·19	310
2.25	123	77	550	58	—·01	—·18	360·5
2.40	112	77	595	58	—·01	—·22	510
2.55	123	77	580	58	—·01	—·23	377
3.10	120	77	530	58·5	—·01	—·23	447
3.25	123	77	585	58·5	—·01	—·25	425
3.40	119	77	520	59	—·01	—·24	464
3.55	93	77	485	59	—·01	—·24	548
4.10	116	77	495	59	—·01	—·24	367·5
4.25	115	77	475	59	—·01	—·24	434
4.40	116	77	490	59	—·01	—·25	375
4.55	115	77	470	59	—·01	—·24	379·5
5.10	122	79	550	59	—·01	—·24	448
5.25	107	79	470	59	—·01	—·22	431·5
5.40	84	87	710	59	—·01	—·23	313·5
5.55	122	79	550	59	—·01	—·20	444·5
6.10	114	79	560	59	—·01	—·20	552·5
6.25	104	79	565	59	—·01	—·20	571·5
6.43	121	79	600	59	—·01	—·20	639
	117·8	77·3	518	57·7	—·01	—·20	17,825·5 net

SUMMARY OF OBSERVATIONS.

Date—June 3, 1908.	Boiler—B. and W. No. 2.	At McGill University
Commenced—8.40 a.m.	Ended—6.43 p.m.	Duration—603 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned May, 1908
4.	Tubes cleaned	7.45 a.m.
5.	Fire cleaned	7.30 a.m., 5.30 p.m.

Fuel.

6.	Kind of coal	No. 20—Wellington seam, Extension mine, Vancouver island
7.	Analysis of dry coal by weight (%)	$\begin{cases} C=72\cdot9, \quad H=4\cdot7, \quad S=0\cdot4 \\ N_2=1\cdot2, \ O_2=10\cdot7, \ Ash=10\cdot1 \end{cases}$
8.	Calorific value of dry coal B.T.U. per lb	13160
9.	Moisture in coal as fired (%)	1·4
10.	Weight of coal fired (lbs.)	3163
11.	Combustible matter in ash and clinker (%)	15·3
12.	Weight of clinker (lbs.)	131
13.	Weight of ash (lbs.)	66

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−0·01
15.	" above fire " "	−0·15
16.	" at damper " "	−0·20
17.	Amount of damper opening	Various
18.	Temperature of air in boiler house (°F.)	77·3
19.	Flue temperature (°F.)	518
20.	Analysis of dry flue gas by volume (%)	$CO_2=8\cdot9, \ O_2=8\cdot8, \ CO=0\cdot5, \ N=81\cdot8$

Water and Steam.

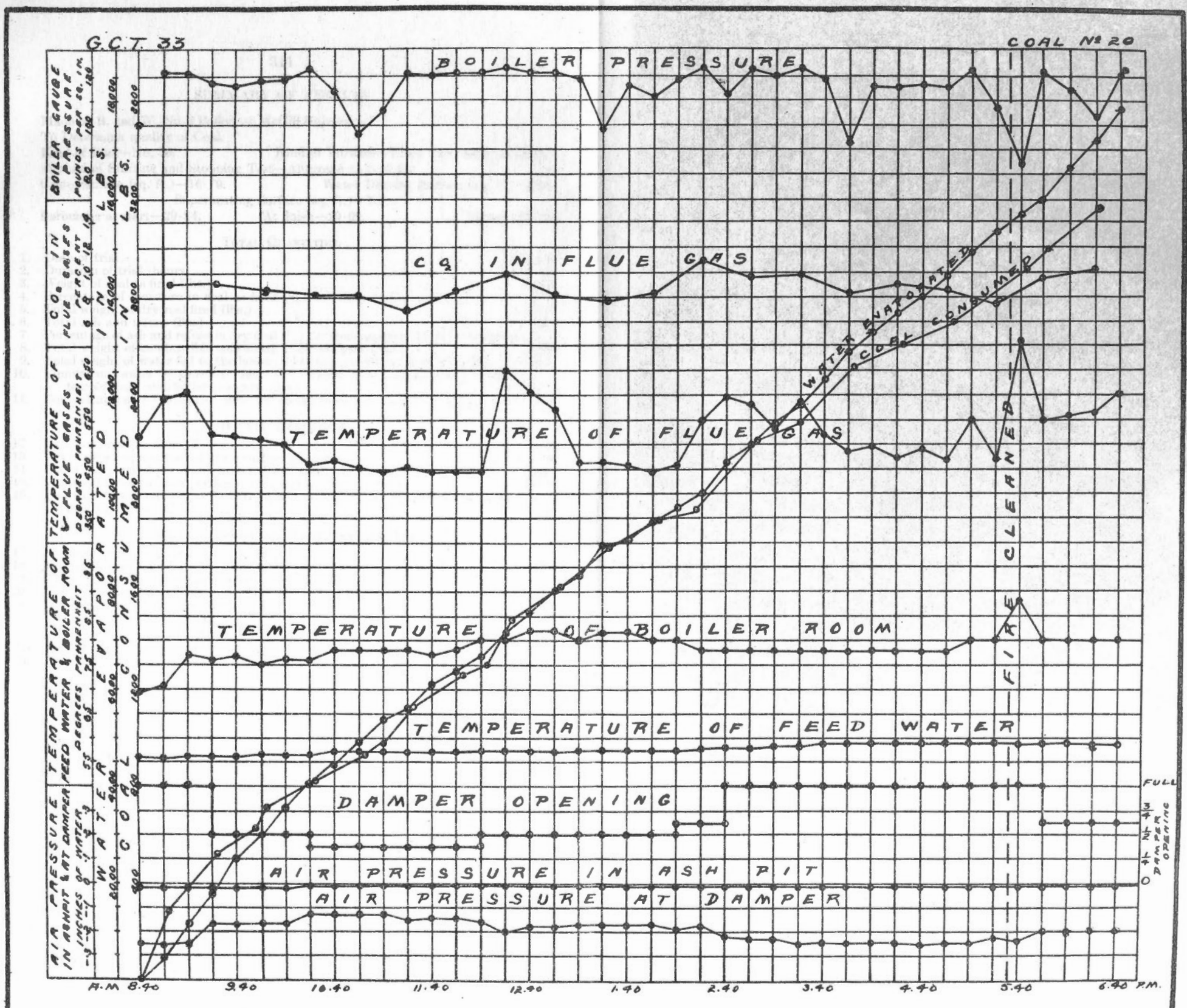
21.	Temperature of feed water (°F.)	57·7
22.	Total weight of feed water, corrected for difference of level (lbs.)	17825
23.	Water level in gauge at start (inches)	3½
24.	Water level in gauge at finish (inches)	3 5/16
25.	Correction for difference of level, included above (lbs.)	+30
26.	Steam pressure by gauge (lbs. per sq. in.)	117·8
27.	Barometer reading (inches)	29·76
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	15·1
29.	Temperature in steam calorimeter (°F.)	292

Notes.

This coal clinkers and the clinker is somewhat adherent. It is doubtful if this coal would be suitable for a shaking grate. Coal burns with considerable flame and heavy smoke. Fire sliced 12.15 p.m., 2.14 p.m. 3.15 p.m., 4.56 p.m. Weather cool, cloudy at first, clearing later.

Proximate analysis of dry coal by weight %

Fixed carbon	49·8
Volatile matter	40·1
Ash	10·1


G.C.T. 33
COAL Nº 20
BOILER PRESSURE
CO₂ IN FLUE GAS
TEMPERATURE OF FLUE GAS
TEMPERATURE OF BOILER ROOM
TEMPERATURE OF FEED WATER
DAMPER OPENING
AIR PRESSURE IN ASH PIT
AIR PRESSURE AT DAMPER
WATER EVAPORATED
COAL CONSUMED
FIRE CLEANED
BOILER GAUGE PRESSURE POUNDS PER SQ. IN.
CO₂ IN FLUE GASES PERCENT
TEMPERATURE OF FLUE GASES DEGREES FAHRENHEIT
TEMPERATURE OF BOILER ROOM DEGREES FAHRENHEIT
AIR PRESSURE IN ASHPIT & DAMPER INCHES OF WATER
WATER EVAPORATED AND COAL CONSUMED
LBS.
FULL
3/4
1/2
1/4
0
DAMPER OPENING
A.M 8.40
9.40
10.40
11.40
12.40
1.40
2.40
3.40
4.40
5.40
6.40 P.M.

SUMMARY OF RESULTS.

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 20. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·84. At finish—29·69. Mean—29·76.

Total Quantities.

1.	Date of trial	3/6/08
2.	Duration of trial (hours)	10·05
3.	Weight of coal as fired (lbs.)	3163
4.	Percentage of moisture in coal as fired (%)	1·4
5.	Total weight of dry coal fired (lbs.)	3119
6.	Total ash and refuse (lbs.)	197
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 11·9; (*b*) weighed	6·3
8.	Total weight of combustible consumed, from analyses (lbs.)	2748
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	17825
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17730
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	21400

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	310
13.	Dry coal per square foot of grate surface per hour (lbs.)	18·4
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1764
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2116
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·33

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	117·8
18.	Temperature of feed water entering boiler (deg. F.)	57·7
19.	Temperature of escaping gases from boiler (deg. F.)	518
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·19
21.	Percentage of moisture in steam	0·5

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	61·6
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	103

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	5·63
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	6·76
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	6·86
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	7·79

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	13160
30.	Calorific value of the combustible per lb. (B.T.U.)	14650
31.	Efficiency of boiler (based on combustible consumed) (%)	51·3
32.	Efficiency of boiler, including grate (based on dry coal) (%)	50·3

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	26·6
34.	" " of combustible consumed (from gas analyses) (lbs.)	22·0
35.	" " dry coal (from gas analyses) (lbs.)	19·4
36.	Proportion of heat of fuel in escaping dry flue gases (%)	15·6

TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 18.

Date—June 17, 1908. Trial Number—G.C.T. 39.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Weather fine and clear. B. and W. No. 1 boiler not working. Robb boiler working. Blow-off examined and found tight.

Time.	
7.35	Fire cleaned and made up with No. 18 coal.
7.45	Tubes cleaned.
8.35	Started trial. About 2½″ of fuel on bars, half burnt through.
8.55	Coal burns briskly at start with a long smoky flame and much smoke is given off. It does not cake.
9.05	Fuel bed about 3″ to 4″ thick.
9.15	Grill half opened, admitting air over the fire.
9.35	Grill fully opened.
9.45	Fire is beginning to clinker, the clinker is hard and clinging to bars.
10.10	Sliced fire, the clinker is thin and hard but easily forced from the bars.
11.30	Sliced fire, clinker hard but easily removed.
12.35	Fire cleaned. 87 lbs. of clinker removed with some difficulty.
3.10	Sliced fire.
3.50	Sliced fire. It was found difficult to force the clinker from the bars. 11 lbs. of clinker were removed.
4.20	Steam jet on under the bars, to prevent clinker sticking to them.
4.45	Fire sliced. Fire clinkering badly, much clinker could not be removed from the bars.
5.35	Fire cleaned. Steam seems to have cooled the bars sufficiently to enable the clinker to be easily removed. 88 lbs. of clinker removed.
6.35	End of trial. Fire as at beginning. 92 lbs. of ash raked from ash-pit. The coal was in large lumps with some small coal. The coal could not be used with a shaking grate.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 39.

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.35 a.m.						
9.10	282	282	8.50	7·4	11·4	0·5
9.35	108	390	9.20	9·0	9·4	1·0
10.15	238	628	9.50	8·0	8·5	1·2
10.45	238	866	10.20	10·2	8·6	0·2
11.06	102	968	10.50	7·1	10·4	1·6
11.36	119	1087	11.20	7·2	11·6	0·4
12.20	186	1273	11.50	7·4	10·4	1·2
12.50	179	1452	12.20	6·0	12·7	0·7
1.20	134	1586	12.50	9·7	6·3	4·0
1.50	203	1789	1.20	8·4	10·8	0·3
2.10	94	1883	1.50	10·6	7·2	1·6
2.40	161	2044	2.20	11·0	7·8	1·4
3.15	195	2239	2.50	7·1	12·3	0·1
3.45	145	2384	3.20	12·6	6·2	0·2
4.30	200	2584	3.50	7·1	11·3	0·4
5.05	139	2723	4.20	9·3	8·8	1·9
5.25	141	2864	4.50	9·1	10·1	0·4
5.50	157	3021	5.20	13·0	4·9	2·0
6.35	245	3266	5.50	15·9	1·5	3·1
			6.20	11·8	7·2	0·0
			6.35	8·2	11·7	0·5
				9·3	9·0	1·1

OBSERVATIONS MADE DURING BOILER TRIAL No. 39.

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.35	108	75	480	61	—·04	—·19	.....
8.50	115	79	500	61	—·03	—·19	530
9.05	103	79	450	61·5	—·02	—·17	565
9.20	116	77	440	62	—·02	—·17	506·5
9.35	113	79	440	62	—·02	—·17	426·5
9.50	117	79	450	62	—·02	—·17	418
10.05	123	79	550	62·5	—·02	—·20	384·5
10.20	121	79	640	62·5	—·02	—·21	544
10.35	113	79	640	62·5	—·02	—·21	512
10.50	103	77	480	62·5	—·02	—·20	592
11.05	123	79	470	62·5	—·02	—·20	244
11.20	108	81	470	62·5	—·02	—·20	476
11.35	123	81	550	63	—·02	—·20	342
11.50	118	81	480	63	—·02	—·20	442·5
12.05	123	81	450	63	—·02	—·20	354
12.20	106	81	430	63	—·02	—·20	364
12.35	101	77	400	63	—·02	—·20	373
12.50	123	79	630	63	—·02	—·22	91·5
1.05	122	77	590	63	—·02	—·18	559
1.20	123	79	550	63	—·02	—·18	505·5
1.35	112	79	650	63·5	—·02	—·18	525
1.50	122	79	650	63·5	—·02	—·19	471·5
2.05	120	79	550	63·5	—·02	—·19	463
2.20	120	79	630	63·5	—·02	—·19	403
2.35	113	79	580	63·5	—·02	—·19	474
2.50	104	79	590	63·5	—·02	—·21	346
3.05	117	81	690	63·5	—·02	—·21	434·5
3.20	118	79	690	64	—·02	—·21	494·5
3.35	117	79	680	64	—·02	—·21	453·5
3.50	107	79	590	64	—·02	—·21	495
4.05	121	81	720	64	—·02	—·21	310·5
4.20	116	81	580	64	—·02	—·21	485·5
4.35	100	79	570	64	—·02	—·21	449
4.50	103	79	530	64·5	—·02	—·20	345
5.05	123	79	650	64·5	—·02	—·24	343
5.20	119	77	750	64	—·02	—·24	503
5.35	113	77	660	64	—·02	—·24	503
5.50	114	79	910	64	—·02	—·25	450·5
6.05	122	77	710	64	—·02	—·20	622·5
6.20	121	77	540	64	—·02	—·20	684
6.35	108	77	440	64	—·02	—·19	574·5
	114·9	78·9	572	63·2	—·02	—·20	18,060·5 net

SUMMARY OF OBSERVATIONS.

Date—June 17, 1908.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.35 a.m.	Ended—6.35 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned May, 1908
4.	Tubes cleaned	7.45 a.m.
5.	Fire cleaned	7.35 a.m., 12.35 and 5.30 p.m.

Fuel.

6.	Kind of coal	No. 18—Upper seam, No. 1 mine, Nanaimo, Vancouver island
7.	Analysis of dry coal by weight (%)	$\begin{cases} C=72\cdot1, & H=4\cdot8, & S=0\cdot9 \\ N_2=1\cdot2, & O_2=10\cdot7, & Ash=10\cdot3 \end{cases}$
8.	Calorific value of dry coal B.T.U. per lb	12830
9.	Moisture in coal as fired (%)	2·3
10.	Weight of coal fired (lbs.)	3266
11.	Combustible matter in ash and clinker (%)	16·9
12.	Weight of clinker (lbs.)	186
13.	Weight of ash (lbs.)	92

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−0·02
15.	" above fire " "	−0·18
16.	" at damper " "	−0·20
17.	Amount of damper opening	Various
18.	Temperature of air in boiler house (°F.)	79·4
19.	Flue temperature (°F.)	572
20.	Analysis of dry flue gas by volume (%)	$CO_2=9\cdot3$, $O_2=9\cdot0$, $CO=1\cdot1$, $N=80\cdot6$

Water and Steam.

21.	Temperature of feed water (°F.)	63·2
22.	Total weight of feed water, corrected for difference of level (lbs.)	18060
23.	Water level in gauge at start (inches)	$4\frac{1}{2}$
24.	Water level in gauge at finish (inches)	$4\frac{3}{8}$
25.	Correction for difference of level, included above (lbs.)	+20
26.	Steam pressure by gauge (lbs. per sq. in.)	114·9
27.	Barometer reading (inches)	30·00
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	14·7
29.	Temperature in steam calorimeter (°F.)	291·0

Notes.

It was found advisable to burn this coal in a thin bed to avoid excessive clinker. For the first three hours a hard clinker was formed which necessitated the fire being sliced from time to time. Later, the clinker adhered to the bars and was difficult to remove; upon turning steam on in the ash-pit, however, difficulty of removal was obviated somewhat.

This coal would not be suitable for a shaking grate. Smoke at first was excessive, but later the smoke abated. Fire sliced 10.10 a.m., 11.30 a.m., 3.10 p.m., 3.50 p.m., 4.45 p.m. Air admitted over bars. Weather fine and clear.

Proximate analysis of dry coal by weight %

Fixed carbon	48·5%
Ash	10·3
Volatile matter	41·2

SUMMARY OF RESULTS.

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 18 Coal. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—30·02. At finish—29·98. Mean—30·00.

Total Quantities.

1.	Date of trial	17/6/08
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	3266
4.	Percentage of moisture in coal as fired (%)	2·3
5.	Total weight of dry coal fired (lbs.)	3191
6.	Total ash and refuse (lbs.)	278
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 12·4; (*b*) weighed	8·72
8.	Total weight of combustible consumed, from analyses (lbs.)	2792
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	18060
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17990
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	21540

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	319
13.	Dry coal per square foot of grate surface per hour (lbs.)	19·0
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1799
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2154
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·37

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	114·9
18.	Temperature of feed water entering boiler (deg. F.)	63·2
19.	Temperature of escaping gases from boiler (deg. F.)	572
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·18
21.	Percentage of moisture in steam	0·5

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	62·4
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	104

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	5·53
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	6·59
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	6·75
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	7·71

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	12830
30.	Calorific value of the combustible per lb. (B.T.U.)	14300
31.	Efficiency of boiler (based on combustible consumed) (%)	52·1
32.	Efficiency of boiler, including grate (based on dry coal) (%)	50·8

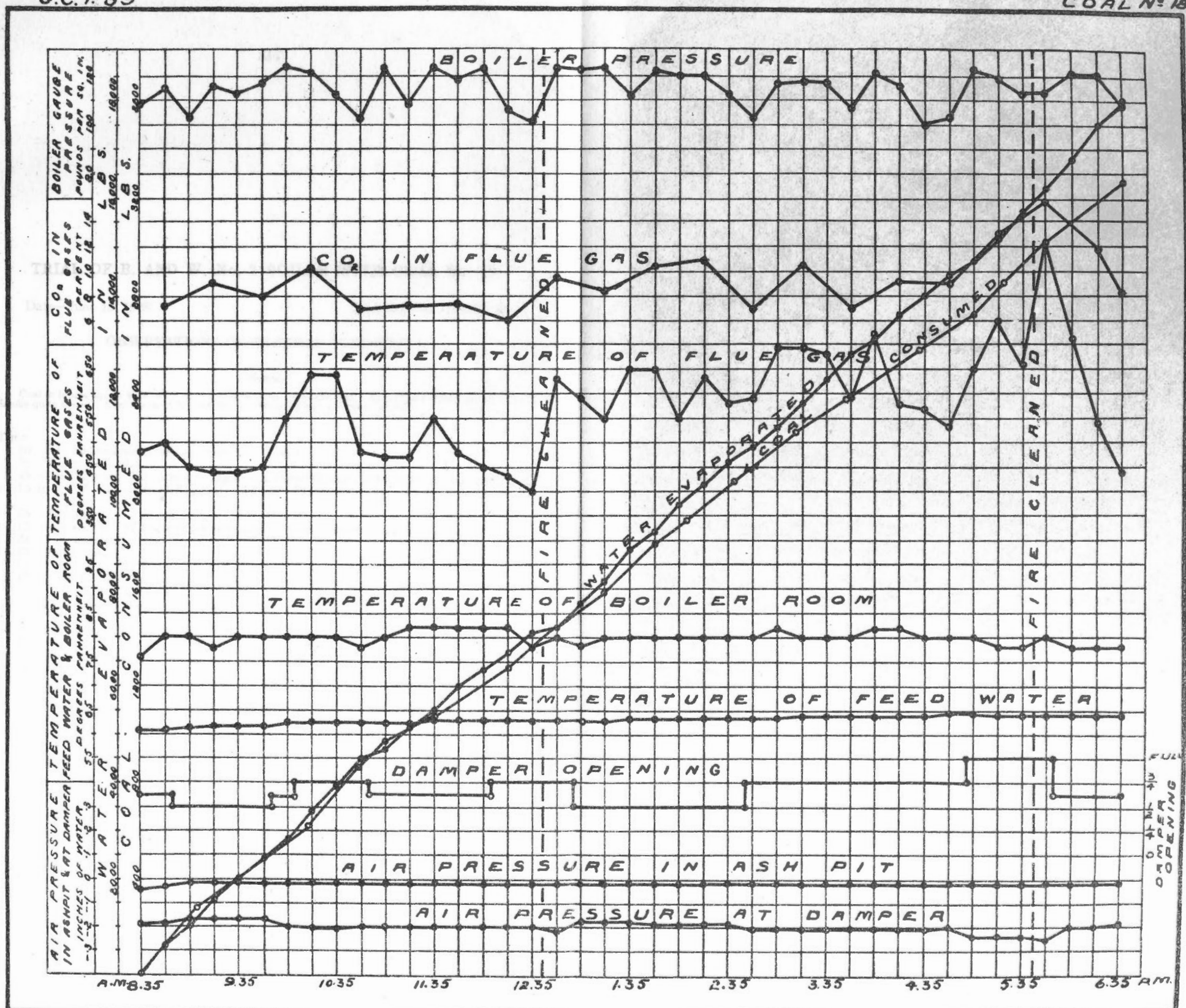
Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	23·9
34.	" " of combustible consumed (from gas analyses) (lbs.)	19·7
35.	" " dry coal (from gas analyses) (lbs.)	17·2
36.	Proportion of heat of fuel in escaping dry flue gases (%)	15·8

GRAPHIC RECORD OF BOILER TRIAL.

G.C.T. 39

COAL Nº 18



TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 17.

Date—June 15, 1908. Trial Number—G.C.T. 38.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Coal in lumps up to 4″ or 5″, with very little dust or small stuff. Appearance much like anthracite Smoke quite heavy. Coal burns with much flame. Weather dull and rainy all day.

Time.
7.40 Fire cleaned and made up with No. 17 coal.
7.50 Tubes cleaned.
8.45 Trial started. Fire about 2″ thick, well burnt through at back, flaming considerably.
10.15 to 10.35 Trouble with pump sticking. Water level dropped to near bottom of glass.
10.58 Fire sliced.
11.10 Fire sliced. 17 lbs. clinker removed. Steam admitted under grate.
11.34 Fan started.
11.49 Fan stopped.
12.04 Fire sliced. 21 lbs clinker removed.
12.40 to 12.46 Fire cleaned. 114 lbs. clinker removed. Clinker hard, heavy, and slightly adherent.
Coal does not coke. Might be used on a shaking grate with steam under bars though not very suitable.
3.50 Fire sliced. 26 lbs. clinker removed.
5.40 to 5.48 Fire cleaned. 118 lbs. clinker removed. Clinker heavy, but more friable than at noon.
6.45 Trial ended. Fire very similar to start. 103 lbs. ashes raked from ash-pit.

CLINKER AND ASH.

296 lbs. clinker.
103 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 38.

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.45 a.m.						
9.00	273	273	8.50	7·3	6·7	0·0
9.30	275	548	9.20	7·7	6·4	0·0
10.15	262	810	9.50	9·6	6·3	0·0
10.30	40	850	10.20	8·9	8·6	0·0
11.00	104	954	10.50	13·6	4·9	0·0
11.30	174	1128	11.20	13·3	4·4	0·0
11.40	32	1160	11.50	11·5	5·6	0·0
12.00	191	1351	12.20	13·8	5·0	0·0
12.30	109	1460	12.50	10·2	6·0	0·0
12.50	190	1650	1.20	13·2	6·5	0·0
1.15	207	1857	1.50	10·4	8·1	0·0
1.35	113	1970	2.20	9·0	9·5	0·0
2.15	232	2202	2.50	9·0	8·2	0·1
2.30	77	2279	3.20	9·4	9·5	0·0
3.00	178	2457	3.50	10·6	8·0	0·0
3.35	163	2620	4.20	6·5	12·4	0·0
4.00	174	2794	4.50	9·5	9·1	0·0
4.25	120	2914	5.20	8·0	10·2	0·0
5.00	212	3126	5.55	10·1	9·3	0·0
5.30	93	3219	6.20	9·1	10·6	0·0
5.55	124	3343	6.35	5·5	14·5	0·0
6.15	140	3483				
6.45	103	3586		9·8	8·1	0·0

OBSERVATIONS MADE DURING BOILER TRIAL No. 38.

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.45	119	79	570	62·5	−·01	−·23	.....
9.00	123	81	690	62·5	−·01	−·24	490
9.15	120	81	550	62·5	−·01	−·20	587
9.30	116	81	670	63	−·01	−·22	500·5
9.45	108	83	750	63	−·01	−·23	429·5
10.00	103	81	570	63	−·01	−·24	532·5
10.15	123	81	490	63	−·01	−·24	253·5
10.30	122	79	470	63	−·01	−·23	450
10.45	102	79	450	63·5	−·01	−·24	333·5
11.00	110	81	610	63·5	−·01	−·27	209
11.15	98	83	680	63·5	−·01	−·27	536
11.30	121	83	770	63·5	−·01	−·30	230
11.45	123	83	1200	63·5	+·15	−·40	623·5
12.00	118	83	670	63·5	−·01	−·34	547·5
12.15	121	81	770	64	−·01	−·32	473
12.30	110	81	650	64	−·01	−·31	710
12.45	98	93	480	64·5	−·01	−·30	475·5
1.00	123	79	620	64·5	−·01	−·34	316·5
1.15	123	79	800	64·5	−·01	−·34	775
1.30	120	79	710	64·5	−·01	−·25	652
1.45	115	79	650	64·5	−·01	−·24	712
2.00	98	79	520	64·5	−·01	−·21	590
2.15	118	79	480	64	−·01	−·25	421·5
2.30	120	79	480	64	−·01	−·25	452
2.45	121	79	470	64·5	−·01	−·25	411
3.00	123	79	510	64·5	−·01	−·25	515
3.15	123	79	490	64·5	−·01	−·24	452·5
3.30	117	79	480	64·5	−·01	−·24	442
3.45	123	79	480	64·5	−·01	−·24	404·5
4.00	123	81	600	64·5	−·01	−·25	400·5
4.15	117	79	540	64·5	−·01	−·25	576
4.30	113	79	480	64·5	−·01	−·23	459·5
4.45	118	79	460	64·5	−·01	−·23	403·5
5.00	100	79	440	64·5	−·01	−·23	486
5.15	102	79	440	64·5	−·01	−·22	362·5
5.30	120	79	440	64·5	−·01	−·23	279
5.45	93	83	410	64·5	−·01	−·20	385
6.00	123	79	560	65	−·01	−·22	334
6.15	122	79	550	65	−·01	−·21	468
6.30	114	79	530	65	−·01	−·21	542
6.45	110	79	520	65	−·01	−·20	414
	115	80·4	578	64	−·01	−·25	18635·0 net

SUMMARY OF OBSERVATIONS.

Date—June 15, 1908.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.45 a.m.	Ended—6.45 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural and forced
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned May, 1908
4.	Tubes cleaned	7.50 a.m.
5.	Fire cleaned	7.40 a.m., 12.40 and 5.40 p.m.

Fuel.

6.	Kind of coal	Coal No. 17—Lower seam, No. 1 mine, Nanaimo, Western Fuel Co., Nanaimo, Vancouver island
7.	Analysis of dry coal by weight (%)	C = 69, H = 4·6, S = 1·3 N = 1·2, O_2 = 12·0, Ash = 11·9
8.	Calorific value of dry coal B.T.U. per lb	12470
9.	Moisture in coal as fired (%)	2·1
10.	Weight of coal fired (lbs.)	3586
11.	Combustible matter in ash and clinker (%)	10·9
12.	Weight of clinker (lbs.)	296
13.	Weight of ash (lbs.)	103

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−0·01
15.	" above fire " "	−0·22
16.	" at damper " "	−0·25
17.	Amount of damper opening	Various
18.	Temperature of air in boiler house (°F.)	80·4
19.	Flue temperature (°F.)	578
20.	Analysis of dry flue gas by volume (%)	CO_2 = 9·8, O_2 = 8·1, CO = 0, N = 82·1

Water and Steam.

21.	Temperature of feed water (°F.)	64
22.	Total weight of feed water, corrected for difference of level (lbs.)	18635
23.	Water level in gauge at start (inches)	$3\frac{15}{16}$
24.	Water level in gauge at finish (inches)	$3\frac{15}{16}$
25.	Correction for difference of level included above (lbs.)	0
26.	Steam pressure by gauge (lbs. per sq. in.)	115·0
27.	Barometer reading (inches)	29·55
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	14·7
29.	Temperature in steam calorimeter (°F.)	291·0

Notes.

This coal clinkers considerably. It might be used on a shaking grate with steam under the bars. Heavy smoke. Burns with much flame. Weather dull and rainy.

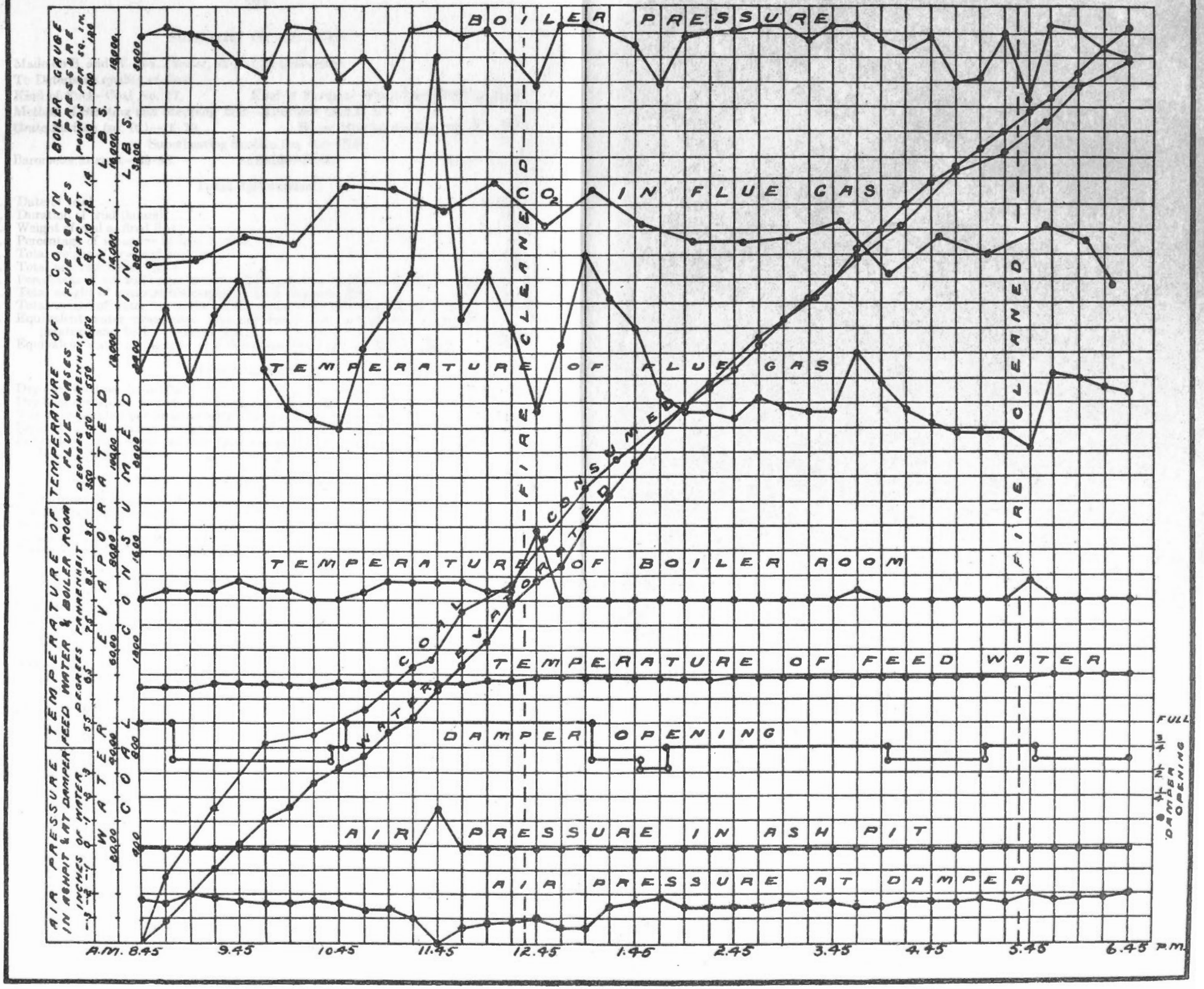
Proximate analysis of dry coal by weight %

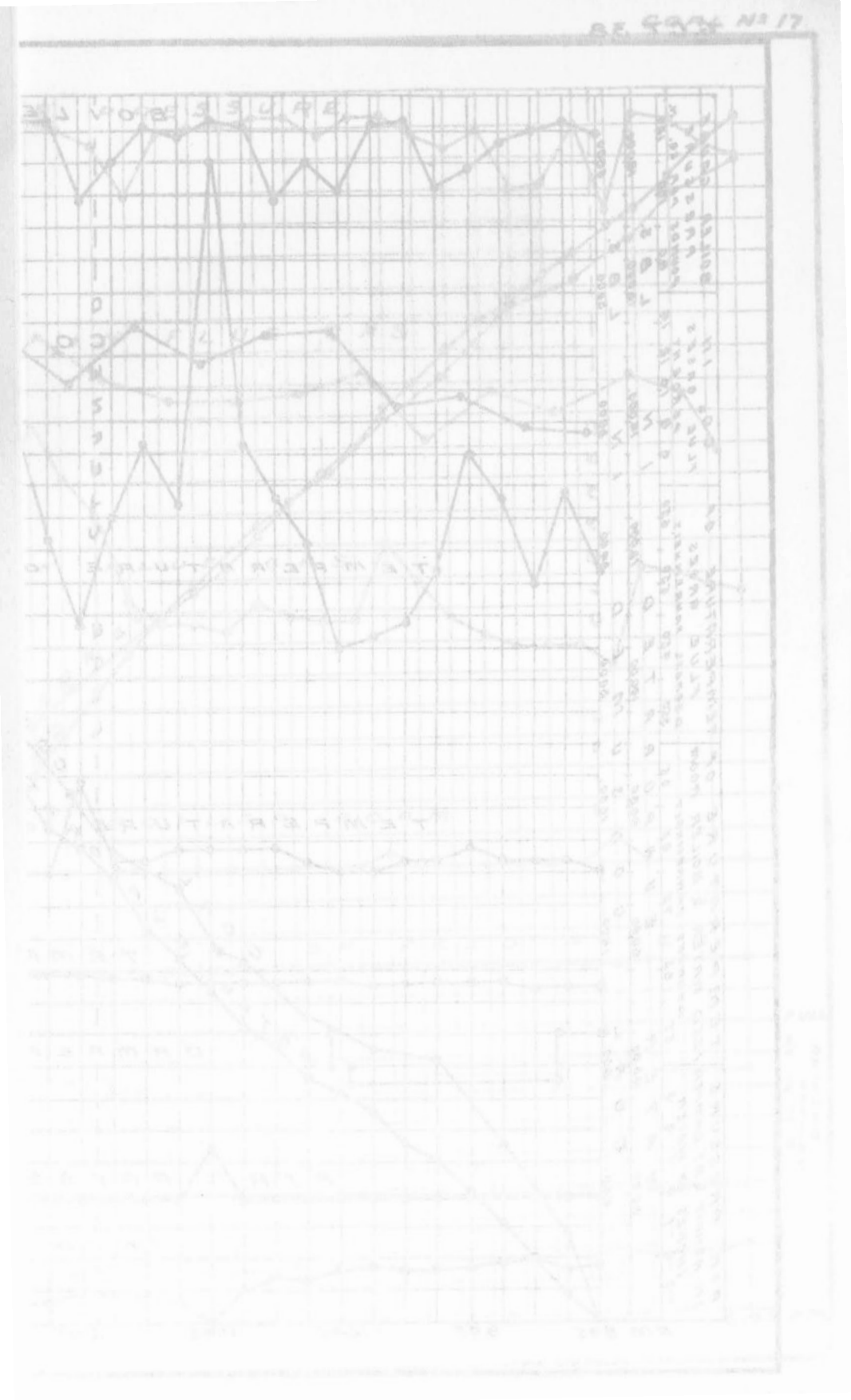
Fixed carbon	46·6
Volatile matter	41·5
Ash	11·9

GRAPHIC RECORD OF BOILER TRIAL.

G.C.T. 38

COAL No 17





SUMMARY OF RESULTS.

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—Coal No. 17. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·48. At finish—29·61. Mean—29·55.

Total Quantities.

1.	Date of trial	15/6/08
2.	Duration of trial (hours)	10·0
3.	Weight of coal as fired (lbs.)	3586
4.	Percentage of moisture in coal as fired (%)	2·1
5.	Total weight of dry coal fired (lbs.)	3511
6.	Total ash and refuse (lbs.)	399
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 13·36; (*b*) weighed	11·4
8.	Total weight of combustible consumed from analyses (lbs.)	3042
9.	Total weight of water fed to the boiler corrected for difference of level (lbs.)	18635
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	18560
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	22190

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	351
13.	Dry coal per square foot of grate surface per hour (lbs.)	20·9
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1856
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2219
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·47

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	115·0
18.	Temperature of feed water entering boiler (deg. F.)	65·0
19.	Temperature of escaping gases from boiler (deg. F.)	578
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·24
21.	Percentage of moisture in steam	60

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	64·2
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	107

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	5·20
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	6·17
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	6·32
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	7·30

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	12470
30.	Calorific value of the combustible per lb. (B.T.U.)	14160
31.	Efficiency of boiler (based on combustible consumed) (%)	49·8
32.	Efficiency of boiler, including grate (based on dry coal) (%)	49·0

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	25·4
34.	Dry flue gas per lb. of combustible consumed (from gas analyses) (lbs.)	20·3
35.	Dry flue gas per lb. dry coal (from gas analyses) (lbs.)	17·5
36.	Proportion of heat of fuel in escaping dry flue gases (%)	16·76

TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 21 M.

Date—June 22, 1908. Trial Number—G.C.T. 41.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

B. and W. No. 1 not working. Robb working. Weather overcast. Coal very dusty and small. Much smoke given off. Blow-off examined and found tight.

Time.

7.40 After cleaning, fire made up with coal 21 M.
8.35 Trial started.
8.50 Coal cokes slightly, necessary to break up with rake from time to time.
12.40 Fire cleaned. About ½″ of clinker formed over fire. 102 lbs. removed.
5.40 Fire cleaned. As before about ½″ clinker formed, very porous, did not stop evaporation very much. 111 lbs. removed.
6.35 Trial finished, 92 lbs. ash.
Fire kept about 4″ thick. Could be used to advantage on a shaking grate. This coal is easily worked, but it is necessary to occasionally rake the fire a little to prevent coking.

Clinker and Ash.

213 lbs. clinker.
92 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 41.

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.35 a.m.						
9.05	290	290	8.50	7·9	10·8	0·6
9.35	144	434	9.20	11·2	7·6	0·7
10.05	170	604	9.50	8·0	11·4	0·5
10.35	154	758	10.20	9·1	10·7	0·5
11.05	107	865	10.50	7·8	11·2	0·4
11.35	136	1001	11.20	8·1	10·3	0·9
12.00	124	1125	11.50	8·6	10·2	1·0
12.30	108	1233	12.20	8·6	11·3	0·0
1.00	136	1369	12.40	9·4	9·9	0·4
1.16	109	1478	1.10	9·3	8·8	1·6
1.45	161	1639	1.40	9·6	9·3	0·4
2.20	198	1837	2.10	9.2	9·4	1·3
2.50	125	1962	2.40	8·3	9·7	1·6
3.20	136	2098	3.10	10·0	8·6	0·5
3.55	133	2231	3.40	10·1	8·9	0·9
4.25	180	2411	4.10	9·7	8·0	2·2
4.55	66	2477	4.40	9·2	9·9	0·9
5.25	134	2611	5.10	8·5	10·8	0·2
5.30	163	2774	5.40	7·9	12·2	0·1
			6.10	7·3	12·4	0·1
6.35	58	2832		8·9	10·1	0·7

OBSERVATIONS MADE DURING BOILER TRIAL No. 41.

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.35	98	79	590	64·5	—·03	—·27	.....
8.50	100	78	625	64·5	—·03	—·27	470
9.05	104	77	670	64·5	—·03	—·27	573
9.20	100	77	725	64·5	—·03	—·27	602
9.35	100	77	605	64·5	—·03	—·23	644·5
9.50	105	79	585	64·5	—·03	—·23	475
10.05	98	80	575	64·5	—·03	—·23	447·5
10.20	123	80	580	64·5	—·03	—·23	372
10.35	112	80	570	64·5	—·03	—·26	474
10.50	114	79	570	64·5	—·03	—·26	397
11.05	108	77	590	64·5	—·03	—·25	486·5
11.20	106	77	590	64·5	—·03	—·25	474·5
11.35	122	77	600	65	—·03	—·25	399·5
11.50	118	78	560	65	—·03	—·25	420
12.05	120	75	550	65	—·03	—·27	414·5
12.20	115	76	535	65·5	—·03	—·27	423
12.35	113	77	530	65·5	—·03	—·27	368·5
12.50	95	81	585	65.5	—·03	—·27	335
1.05	121	77	710	65·5	—·03	—·28	344
1.20	121	77	700	65·5	—·03	—·28	574
1.35	120	78	575	65·5	—·03	—·24	480·5
1.50	120	79	570	65	—·03	—·24	521
2.05	120	79	620	65	—·03	—·24	390·5
2.20	123	81	590	66·5	—·03	—·24	547
2.35	115	81	580	66·5	—·03	—·24	534·5
2.50	122	81	630	66·5	—·03	—·24	424
3.05	120	81	590	66·5	—·03	—·24	526
3.20	111	81	600	66·5	—·03	—·24	464
3.35	116	81	615	67	—·03	—·24	463·5
3.50	116	81	570	67	—·03	—·24	462
4.05	121	82	570	67	—·03	—·24	484·5
4.20	123	81	550	67	—·03	—·24	371
4.35	123	81	560	67	—·03	—·24	396
4.50	123	81	580	67	—·03	—·26	408
5.05	123	81	550	67·5	—·03	—·26	412
5.20	117	81	570	67·5	—·03	—·26	422
5.35	117	79	535	67·5	—·03	—·25	349
5.50	96	93	490	67·5	—·03	—·24	308·5
6.05	120	80	560	67·5	—·03	—·24	115·5
6.20	116	80	630	67·5	—·03	—·26	434
6.35	122	80	725	67·5	—·03	—·27	421
	114·0	79·5	593	65·9	—·03	—·25	17,629 net

SUMMARY OF OBSERVATIONS.

Date—June 22, 1908.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.35 a.m.	Ended—6.35 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned May, 1908
4.	Tubes cleaned	7.30 a.m.
5.	Fire cleaned	7.40 a.m., 12.40 p.m., 5.40 p.m.

Fuel.

6.	Kind of coal	No. 21 M—Wellington Colliery Co., Cumberland, Comox district, Vancouver island.
7.	Analysis of dry coal by weight (%)	C=73·4, H=4·4, S=0·9, N_2=1·0; O_2=8·3, Ash=12·0
8.	Calorific value of dry coal B.T.U. per lb	13010
9.	Moisture in coal as fired (%)	1
10.	Weight of coal fired (lbs.)	2832
11.	Combustible matter in ash and clinker (%)	13·4
12.	Weight of clinker (lbs.)	213
13.	Weight of ash (lbs.)	92

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−0·03
15.	" above fire " "	−0·22
16.	" at damper " "	−0·25
17.	Amount of damper opening	Various
18.	Temperature of air in boiler house (°F.)	79·5
19.	Flue temperature (°F.)	593
20.	Analysis of dry flue gas by volume (%)	CO_2=8·9, O_2=10·1, CO=0·7, N=80·3

Water and Steam.

21.	Temperature of feed water (°F.)	65·9
22.	Total weight of feed water, corrected for difference of level (lbs.)	17629
23.	Water level in gauge at start (inches)	3¼
24.	Water level in gauge at finish (inches)	3¼
25.	Correction for difference of level, included above (lbs.)	0
26.	Steam pressure by gauge (lbs. per sq. in.)	114
27.	Barometer reading (inches)	29·77
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	15·0
29.	Temperature in steam calorimeter (°F.)	290·7

Notes.

This coal is very easily worked, it is necessary to rake fire a little from time time to prevent coking. Clinker porous and easily removed. It would be very suitable for a shaking grate. Much smoke is given off. Weather dull and overcast.

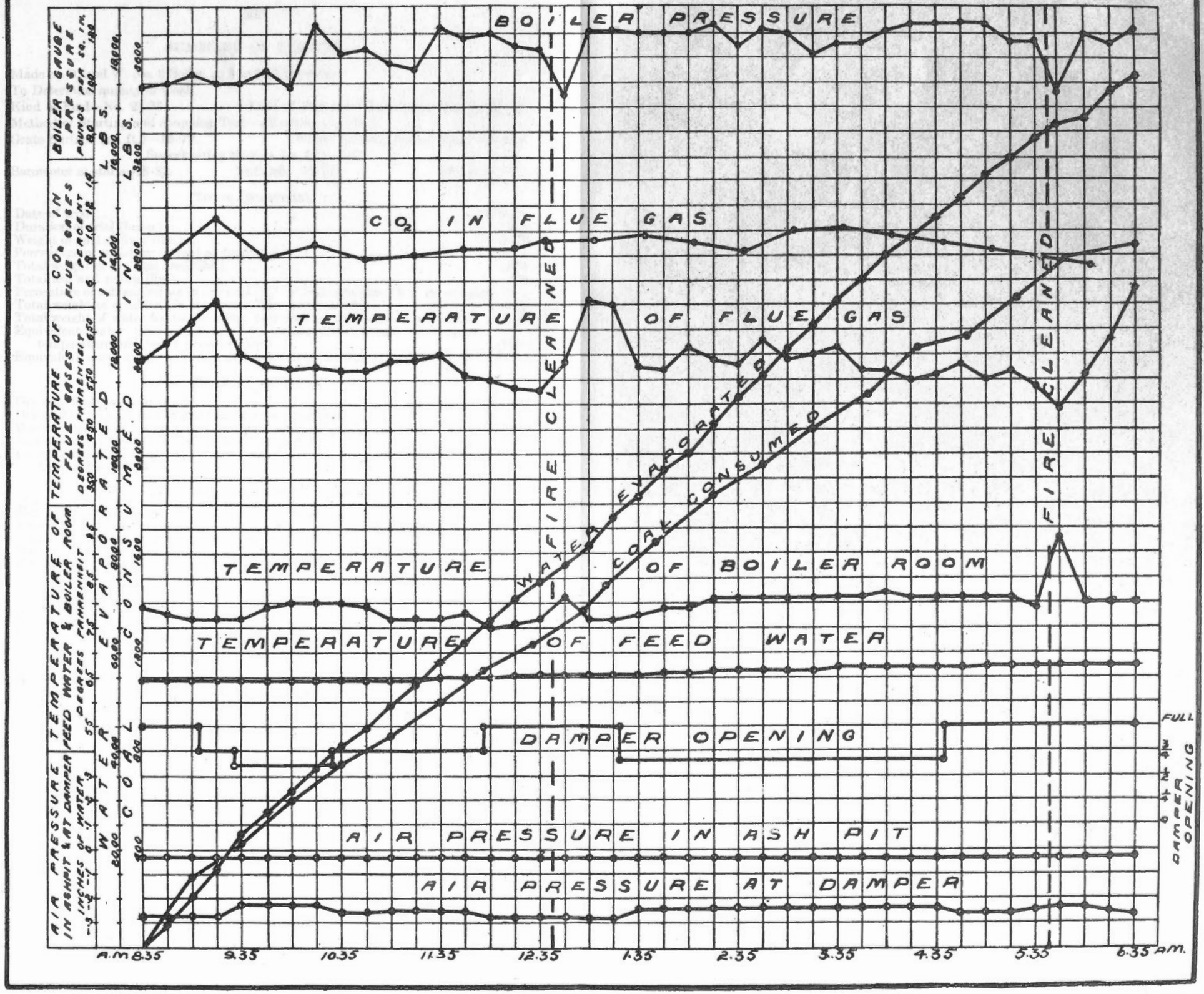
Proximate analysis of dry coal by weight %

Fixed carbon	57·8
Volatile matter	30·2
Ash	12·0

GRAPHIC RECORD OF BOILER TRIAL.

G.C.T. 41

COAL Nº 21 M.



SUMMARY OF RESULTS.

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 21 M. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—28·83. At finish—29·72. Mean—29·77.

Total Quantities.

1.	Date of trial	22/6/08
2.	Duration of trial (hours)	10·0
3.	Weight of coal as fired (lbs.)	2832
4.	Percentage of moisture in coal as fired (%)	1
5.	Total weight of dry coal fired (lbs.)	2804
6.	Total ash and refuse (lbs.)	305
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 13·9; (*b*) weighed	10·8
8.	Total weight of combustible consumed, from analyses (lbs.)	2414
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	17629
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17555
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	20980

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	280
13.	Dry coal per square foot of grate surface per hour (lbs.)	16·7
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1755
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2098
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·28

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	114
18.	Temperature of feed water entering boiler (deg. F.)	65·9
19.	Temperature of escaping gases from boiler (deg. F.)	593
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·22
21.	Percentage of moisture in steam	0·5

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	60·8
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	101

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	6·23
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	7·41
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	7·48
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	8·68

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	13010
30.	Calorific value of the combustible per lb. (B.T.U.)	14800
31.	Efficiency of boiler (based on combustible consumed) (%)	56·7
32.	Efficiency of boiler, including grate (based on dry coal) (%)	55·6

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	25·9
34.	" " of combustible consumed (from gas analyses) (lbs.)	22·1
35.	" " dry coal (from gas analyses) (lbs.)	19·0
36.	Proportion of heat of fuel in escaping dry flue gases (%)	18·0

TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. 221 M.

Date—June 29, 1908. Trial Number—G.C.T. 44.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Weather fine, somwhat cloudy. B. and W. No. 1 boiler in use. Blow-off examined and found tight.

Time.

7.30 Fire cleaned and made up with No. 221 M. coal. Pressure, 95 lbs.
7.45 Tubes blown.
9.20 Coal cakes considerably, it being necessary to break it up every other firing. Not much smoke visible.
9.30 Fire kept about 4″ to 6″ thick.
10.25 Coal caking seems to cause fluctuation in evaporation.
11.00 Keeping a thinner fire, 3″ to 4″ thick.
11.10 Found necessary to slice fire on account of a hard, thin clinker, which was easily removed. Doubtful if this could be used with shaking bars.
12.30 Fire cleaned. Clinker in a thin, hard layer evenly spread over fire, fairly easily removed. Turned steam on under bars after cleaning.
4.00 The use of steam seems to render the clinker more porous, admitting a higher rate of evaporation. Fire kept not more than 4″ thick.
5.30 Cleaned fire. Clinker much softer and more porous than from previous cleaning if steam were used, shaking grate should be advantageous.

CLINKER AND ASH.

139 lbs. clinker.
131 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 44.

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.35 a.m.						
8.50	152	152	8.40	8·6	9·0	1·4
9.20	136	288	9.10	12·4	6·0	1·0
10.00	211	499	9.40	10·1	7·0	1·3
10.30	147	646	10.10	10·0	7·5	1·3
11.00	94	740	10.40	10·9	7·5	0·4
11.35	113	853	11.10	12·6	5·5	2·1
12.05	185	1038	11.40	7·1	13·4	0·0
12.30	76	1114	12.10	11·8	6·4	1·2
12.45	90	1204	12.45	9·8	9·0	1·2
1.15	130	1334	1.10	8·2	10·8	0·9
1.45	130	1464	1.40	9·5	10·1	0·6
2.00	102	1566	2.10	12·2	5·1	1·5
2.30	151	1717	2.40	10·4	8·4	0·5
3.15	227	1944	3.10	9·9	8·5	0·8
3.45	187	2131	3.40	9·0	11·1	0·0
4.15	100	2231	4.10	9·2	10·5	0·0
4.25	42	2273	4.40	10·5	8·2	0·6
4.55	150	2423	5.10	11·0	8·0	0·3
5.20	140	2563	5.40	10·8	7·0	1·0
5.40	78	2641	6.10	7·1	12·5	0·0
6.10	118	2759	6.15	6·0	13·8	0·0
6.35	68	2827				
				9·8	8·8	0·8

OBSERVATIONS MADE DURING BOILER TRIAL No. 44.

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.35	120	85	480	67	−·03	−·26	.....
8.50	110	85	510	67	−·03	−·28	330
9.05	118	85	550	67	−·03	−·28	435
9.20	119	85	550	67	−·03	−·30	506
9.35	123	85	550	67	−·03	−·30	361
9.50	121	87	580	67	−·03	−·30	482·5
10.05	114	87	600	67	−·03	−·30	490·5
10.20	119	86	565	67·5	−·03	−·30	356
10.35	117	86	600	67·5	−·03	−·30	461·5
10.50	123	86	605	67·5	−·03	−·30	382·5
11.05	118	86	605	67·5	−·03	−·30	374·5
11.20	120	87	720	67·5	−·03	−·32	484
11.35	121	85	630	67·5	−·03	−·30	452
11.50	123	85	630	76·5	−·03	−·32	413
12.05	116	85	630	67·5	−·03	−·32	519·5
12.20	118	87	615	67·5	−·03	−·30	512·5
12.35	93	88	500	67·5	−·03	−·25	523
12.50	98	85	620	67·5	−·03	−·30	342
1.05	122	85	680	67·5	−·03	−·30	291·5
1.20	118	85	685	67·5	−·03	−·30	478
1.35	119	85	645	67·5	−·03	−·32	539
1.50	111	85	705	67·5	−·03	−·32	573·5
2.05	123	85	710	67·5	−·03	−·32	493
2.20	121	85	680	68	−·03	−·32	602
2.35	123	85	660	68	−·03	−·32	513
2.50	115	87	710	68	−·03	−·32	531·5
3.05	108	87	615	68	−·03	−·30	537
3.20	112	87	690	68·5	−·03	−·32	483
3.35	123	87	740	68·5	−·03	−·32	449
3.50	118	87	670	68·5	−·03	−·32	582·5
4.05	118	87	630	69	−·03	−·28	413
4.20	123	87	710	69	−·03	−·30	522
4.35	118	85	670	69	−·03	−·30	472
4.50	103	85	625	69·5	−·03	−·28	501
5.05	118	85	600	69·5	−·03	−·28	44·05
5.20	116	85	610	69	−·03	−·30	423
5.35	92	89	580	69	−·03	−·28	390
5.50	110	85	650	69	−·03	−·30	371·5
6.05	114	85	650	69	−·03	−·30	309·5
6.20	115	85	690	69	−·03	−·30	452
6.35	112	85	650	69	−·03	−·30	478·5
	115·7	86·0	629	68·0	−·03	−·30	18,171·5 net

SUMMARY OF OBSERVATIONS.

Date—June 29, 1908.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.35 a.m.	Ended—6.35 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned May, 1908
4.	Tubes cleaned	7.45 a.m.
5.	Fire cleaned	7.30 a.m., 12.30 p.m., 5.30 p.m.

Fuel.

6.	Kind of coal	Coal 221 M—Mines 4 and 7, Wellington Colliery Co., Cumberland, Comox district, Vancouver island.
7.	Analysis of dry coal by weight (%)	C = 77·6, H = 4·6, S = 0·8, N_2 = 1·1, O_2 = 7·0, Ash = 8·9
8.	Calorific value of dry coal B.T.U. per lb	13590
9.	Moisture in coal as fired (%)	3·0
10.	Weight of coal fired (lbs.)	2827
11.	Combustible matter in ash and clinker (%)	25·7
12.	Weight of clinker (lbs.)	139
13.	Weight of ash (lbs.)	131

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−0·03
15.	" above fire " "	−0·18
16.	" at damper " "	−0·30
17.	Amount of damper opening	Full, except when ¾ from 3.50 p.m. to 5.10 p.m.
18.	Temperature of air in boiler house (°F.)	86
19.	Flue temperature (°F.)	629
20.	Analysis of dry flue gas by volume (%)	CO_2 = 9·8, O_2 = 8·8, CO = 0·8, N = 80·6

Water and Steam.

21.	Temperature of feed water (°F.)	68
22.	Total weight of feed water, corrected for difference of level (lbs.)	18171
23.	Water level in gauge at start (inches)	3 11/16
24.	Water level in gauge at finish (inches)	3 11/16
25.	Correction for difference of level, included above (lbs.)	0
26.	Steam pressure by gauge (lbs. per sq. in.)	115·7
27.	Barometer reading (inches)	29·67
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	15·1
29.	Temperature in steam calorimeter (°F.)	293

Notes.

A thin and very hard clinker formed by this coal was very troublesome; this, however, was remedied somewhat by turning steam on under the bars. It is doubtful, however, if this clinker is sufficiently soft to be used with shaking grates. The coal cokes considerably and has to be broken up with a rake periodically. Fire sliced 11.10 a.m. Weather fine, somewhat cloudy.

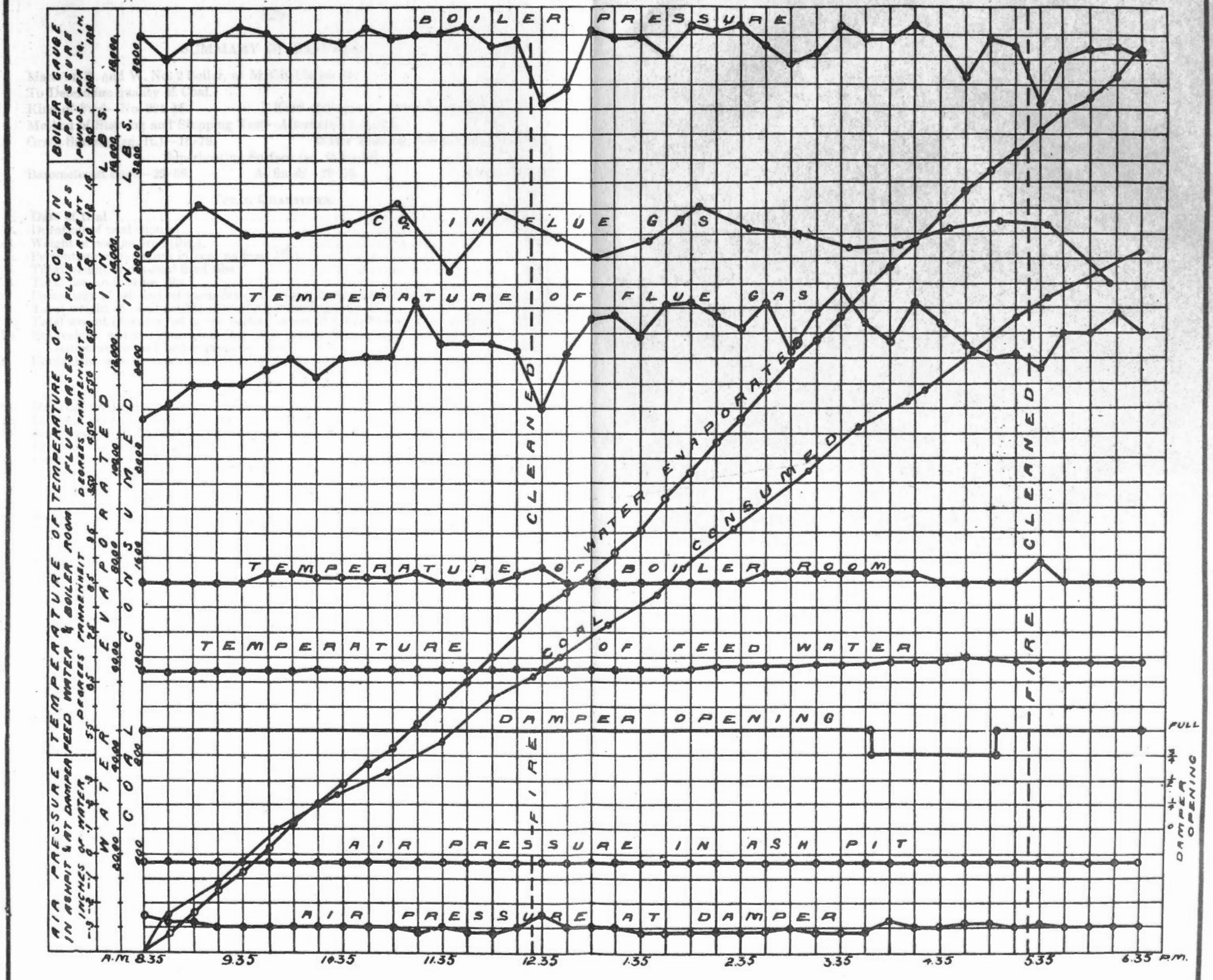
Proximate analysis of dry coal by weight %

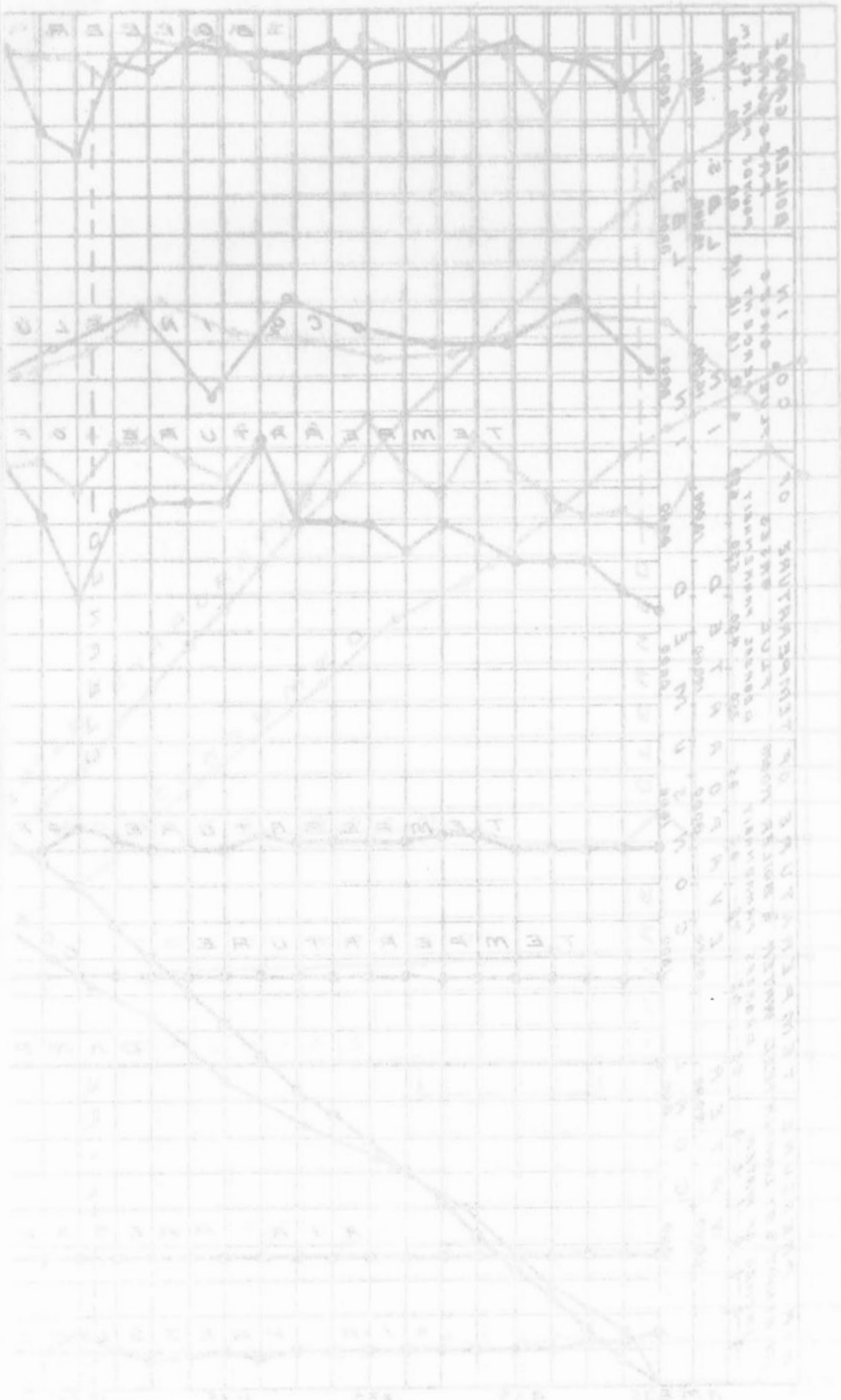
Fixed carbon	60·3
Volatile matter	30·8
Ash	8·9

GRAPHIC RECORD OF BOILER TRIAL.

G.C.T. 44

COAL Nº 21 M/00





SUMMARY OF RESULTS.

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—No. 221 M. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·68. At finish—29·66. Mean—29·67.

Total Quantities.

1.	Date of trial	29/6/08
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	2827
4.	Percentage of moisture in coal as fired (%)	3·0
5.	Total weight of dry coal fired (lbs.)	2742
6.	Total ash and refuse (lbs.)	270
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 11·97; (*b*) weighed	9·86
8.	Total weight of combustible consumed, from analyses (lbs.)	2414
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	18171
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	18110
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	21600

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	274
13.	Dry coal per square foot of grate surface per hour (lbs.)	16·3
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1811
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2160
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·38

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	115·7
18.	Temperature of feed water entering boiler (deg. F.)	68
19.	Temperature of escaping gases from boiler (deg. F.)	629
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·27
21.	Percentage of moisture in steam	0·4

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	62·6
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	104

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	6·42
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	7·68
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	7·89
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	8·95

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	13590
30.	Calorific value of the combustible per lb. (B.T.U.)	14920
31.	Efficiency of boiler (based on combustible consumed) (%)	57·9
32.	Efficiency of boiler, including grate (based on dry coal) (%)	56·1

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	23·5
34.	" " of combustible consumed (from gas analyses) (lbs.)	21·4
35.	" " dry coal as fired (from gas analyses) (lbs.)	18·2
36.	Proportion of heat of fuel in escaping dry flue gases (%)	17·5

ALERT BAY COAL FIELD.

VANCOUVER ISLAND, B.C.

TRIAL OF B. AND W. No. 2 BOILER WITH COAL No. EX. 234.

Date—March 1, 1910. Trial Number—G.C.T. 71.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Coal in fairly small hard pieces, some dust and dirt. The blow-off was examined and found tight. Grate consisted of fixed bars with ¼″ air space.

Time.
a.m.
6.45 A banked fire was broken out.
7.45 Fire cleaned and made up with No. Ex. 234 coal.
The tubes were cleaned previous day and not blown before trial, there being no steam hose.
8.35 Trial started. Fire about 3″ thick, half burnt through, fair amount of flame B. and W. No. 1 boiler is not working. Coal burns with a good flame. It does not coke.
8.50 Fire about 3½″ thick, black smoke emitted.
10.10 Fire about 5″ thick, consisting of about 2″ of dirt and 3″ of fire.
11.10 Fire about 8″ thick, consisting of about 5″ of dirt and 3″ of fire.
11.20 Grill open a little.
12.00 Grill closed.
12.15 Large amount of dirt. Forced draught used.
12.45 to 12.51. Fire cleaned. Clinker removed in large plastic and porous pieces. It adheres to the bars, making fire troublesome to clean. Could not use on shaking grate.
1.40 Put steam on under bars.
2.10 Sliced fire. Clinker not sticking to bars.
2.35 Sliced fire. Removed 11 lbs. of clinker.
3.45 Sliced fire. Removed 16 lbs. of clinker.
4.25 Put fan on.
5.45 Cleaned fire. Clinker removed more easily than before, owing to steam. Fan stopped while cleaning.
6.35 Finished trial. Fire as at start. 84 lbs. of ash were raked from beneath the grate.

CLINKER AND ASH.

427 lbs. clinker.
84 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 71.

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.35 a.m.						
8.55	180	180	8.45	8·1	9·2	3·3
9.14	155	335	9.15	8·1	10·2	0·8
9.25	145	480	9.45	8·1	10·9	1·5
9.55	174	654	10.15	6·3	13·8	0·0
10.25	146	800	10.45	8·5	10·3	0·9
10.45	155	955	11.15	6·2	14·0	0·0
11.10	172	1127	11.45	7·5	12·3	0·0
11.40	168	1295	12.15	7·7	11·5	0·5
12.15	163	1458	12.45	4·8	15·8	0·0
12.45	93	1551	1.15	5·3	14·6	0·2
12.50	73	1624	1.50	8·5	10·9	0·4
1.20	102	1726	2.15	8·1	11·2	0·5
1.50	205	1931	2.45	7·1	12·8	0·4
2.25	166	2097	3.15	8·3	11·5	0·2
2.55	172	2269	3.50	6·4	13·1	0·0
3.20	161	2430	4.15	7·5	11·9	0·2
3.50	165	2595	4.45	6·2	13·3	0·1
4.10	163	2758	5.15	7·7	11·6	0·7
4.45	170	2928	5.40	9·2	10·8	0·3
5.15	164	3092	6.10	9·5	8·8	1·7
5.45	65	3157				
6.00	102	3259		7·5	11·9	0·6
6.20	118	3377				
6.35	25	3402				

OBSERVATIONS MADE DURING BOILER TRIAL No. 71.

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.35	121	66	297	40·6	−·02	−·10	.....
8.50	118	63	306	40	−·02	−·11	360
9.05	121	63	320	40·1	−·03	−·10	500
9.20	122	62	349	40	−·02	−·12	469
9.35	121	62	.....	40	−·02	−·12	433
9.50	123	63	.....	40	−·02	−·12	525
10.05	123	63	348	39·9	−·02	−·12	469
10.20	122	61	323	39·8	−·04	−·11	413
10.35	123	62	330	39·7	−·05	−·11	585
10.50	117	61	365	39·4	−·05	−·10	361
11.05	122	60	330	39·3	−·03	−·10	399
11.20	110	61	328	39·2	−·02	−·09	368
11.35	109	61	334	39·2	−·02	−·12	448
11.50	109	69	362	39·3	−·03	−·12	438
12.05	107	61	328	39·2	−·02	−·11	359
12.20	122	61	363	39·2	+·03	−·16	425
12.35	103	60	335	38·8	−·03	−·15	414
12.50	84	63	305	38·9	−·02	−·15	368
1.05	83	61	303	38·9	−·02	−·10	406
1.20	99	60	330	38·0	−·02	−·10	215
1.35	107	59	320	38·5	−·02	−·18	127
1.50	123	60	380	38·5	−·02	−·18	310
2.05	121	60	410	38·5	−·02	−·13	496
2.20	116	60	410	39·0	−·02	−·13	430
2.35	122	60	460	39·5	−·02	−·15	467
2.50	119	60	390	39	−·02	−·14	360
3.05	121	60	420	39	−·01	−·15	397
3.20	119	60	440	39	−·01	−·15	460
3.35	120	60	460	39	−·02	−·16	509
3.50	115	62	400	38·5	−·02	−·19	469
4.05	124	61	400	37·0	−·02	−·19	430
4.20	121	60	420	38·0	−·02	−·18	315
4.35	111	60	480	38·0	+·09	−·15	685
4.50	115	60	420	38·0	+·08	−·16	410
5.05	106	61	450	39	+·20	−·15	436
5.20	117	61	500	40	+·28	−·15	408
5.35	124	61	440	39	+·23	−·13	556
5.50	111	82	360	44	−·02	−·11	440
6.05	102	65	370	41·5	+·45	−·11	280
6.20	122	62	370	41·0	+·12	−·12	315
6.35	117	62	340	42·0	−·01	−·12	349
	113·7	61·6	374	39·4	+·02	−·13	16,604 net

SUMMARY OF OBSERVATIONS.

Date—March 1, 1901.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.35 a.m.	Ended—6.35 p.m.	Duration—600 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Partly natural and partly forced
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned August, 1909
4.	Tubes cleaned	Previous day
5.	Fire cleaned	7.45 a.m., 12.45 and 5.45 p.m.

Fuel.

6.	Kind of coal	No. Ex. 234
7.	Analysis of dry coal by weight (%)	
8.	Calorific value of dry coal B.T.U. per lb	11560
9.	Moisture in coal as fired (%)	5·3
10.	Weight of coal fired (lbs.)	3402
11.	Combustible matter in ash and clinker (%)	34·3
12.	Weight of clinker (lbs.)	427
13.	Weight of ash (lbs.)	84

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	+0·02
15.	" above fire " "	−0·05
16.	" at damper " "	−0·13
17.	Amount of damper opening	Full
18.	Temperature of air in boiler house (°F.)	61·6
19.	Flue temperature (°F.)	374
20.	Analysis of dry flue gas by volume (%)	CO_2=7·5, O_2=11·9, CO=0·6, N_2=80·0

Water and Steam.

21.	Temperature of feed water (°F.)	39·4
22.	Total weight of feed water, corrected for difference of level (lbs.)	16604
23.	Water level in gauge at start (inches)	$4\frac{3}{16}$
24.	Water level in gauge at finish (inches)	$4\frac{5}{16}$
25.	Correction for difference of level, included above (lbs.)	−20
26.	Steam pressure by gauge (lbs. per sq. in.)	114·7
27.	Barometer reading (inches)	29·65
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	19·3
29.	Temperature in steam calorimeter (°F.)	285·6

Notes.

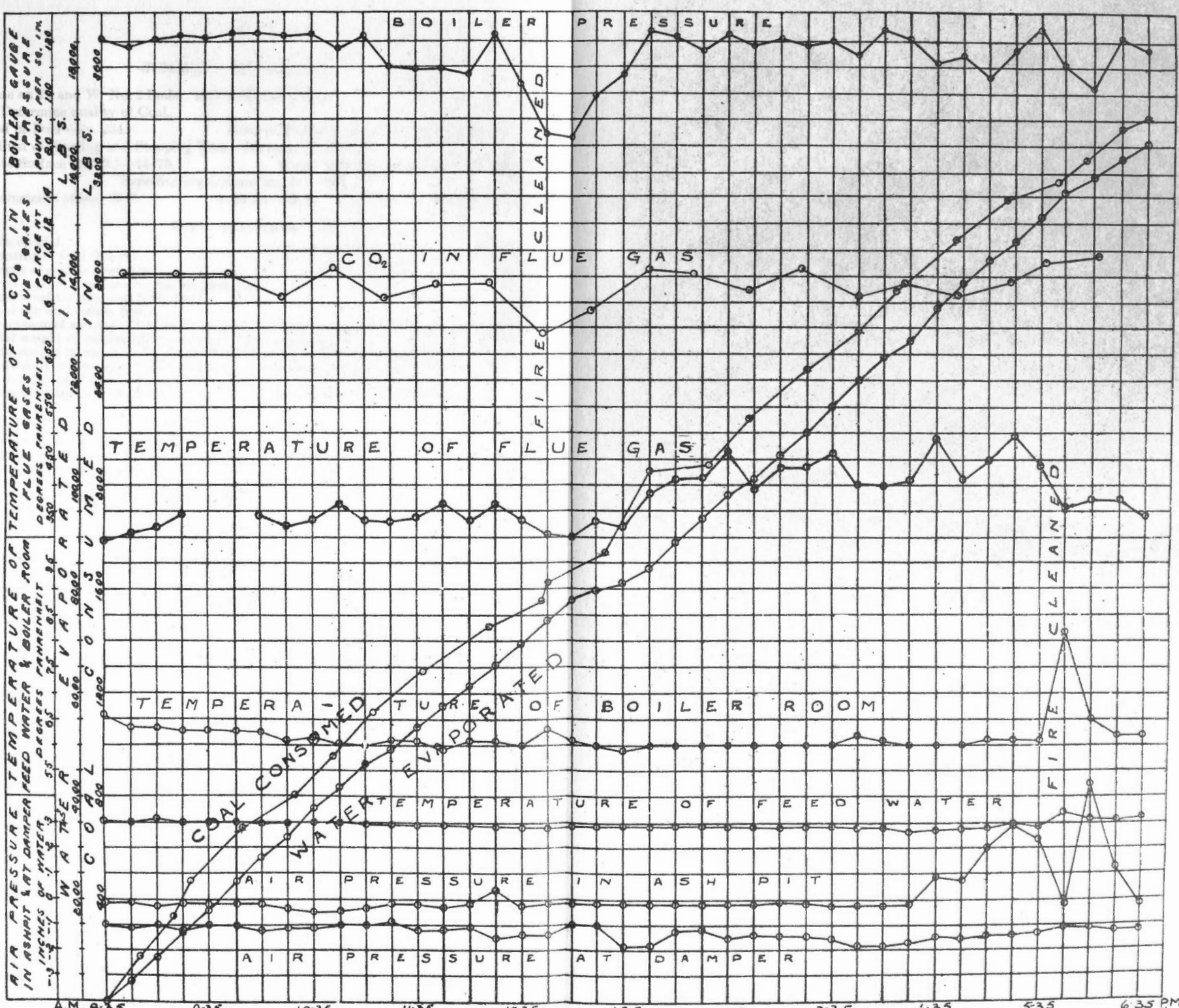
This coal burns with a good flame. It emits a rather dense smoke. It does not coke. The actual fuel bed was kept about 3" thick, but a thick layer of ash and clinker was formed under this. The clinker consisted of large porous pieces which were rather difficult to remove owing to their adhesion to the bars, however, these conditions were improved when steam was admitted underneath the grate. Weather dull and inclined to rain.

Proximate analysis of dry coal by weight %

Fixed carbon	48·2
Volatile matter	36·7
Ash	15·1

GRAPHIC RECORD OF BOILER TRIAL.

COAL Nº Ex 234



SUMMARY OF RESULTS.

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—Ex. 234. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·7. At finish—29·6. Mean—29·65.

Total Quantities.

1.	Date of trial	1/3/10
2.	Duration of trial (hours)	10·00
3.	Weight of coal as fired (lbs.)	3402
4.	Percentage of moisture in coal as fired (%)	5·3
5.	Total weight of dry coal fired (lbs.)	3222
6.	Total ash and refuse (lbs.)	511
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 23·0; (*b*) weighed	15·86
8.	Total weight of combustible consumed, from analyses (lbs.)	2481
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	16604
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	16460
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	20110

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	322
13.	Dry coal per square foot of grate surface per hour (lbs.)	19·2
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1646
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2011
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·15

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	114·7
18.	Temperature of feed water entering boiler (deg. F.)	39·4
19.	Temperature of escaping gases from boiler (deg. F.)	374·0
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·15
21.	Percentage of moisture in steam	1·1

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	58·3
23.	Builders' rated horse-power	60·0
24.	Percentage of builders' rated horse-power developed	97·2

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	4·88
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	5·92
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	6·25
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	8·11

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	11560
30.	Calorific value of the combustible per lb. (B.T.U.)	13620
31.	Efficiency of boiler (based on combustible consumed) (%)	57·5
32.	Efficiency of boiler, including grate (based on dry coal) (%)	52·2

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	31·5
34.	" " of combustible consumed (from gas analyses) (lbs.)	
35.	" " dry coal as fired (from gas analyses) (lbs.)	
36.	Proportion of heat of fuel in escaping dry flue gases (%)	

STANDARDIZATION TRIALS

ON GEORGES CREEK COAL.

TRIAL OF B. AND W. No. 2 BOILER WITH GEORGES CREEK RUN OF MINE COAL.

Date—June 20, 1907. Trial Number—G.C.T. 1.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Weather still and overcast, clearing at noon. B. and W. No. 1 boiler cold. Tubes cleaned before trial.

Time.
18/6/07 Fire lighted and banked 2.00 p.m.
20/6/07 Fire broken out 7.00 a.m.
10.45 Start. Fire thin at front to 12" at back, flaming slightly.
12.34 Fire sliced.
1.25 Fire sliced.
2.15 B. and W. No. 1 boiler fire lighted.
2.25 Fire sliced.
3.21 Fire sliced. 13 lbs. clinker removed.
4.52 Fire sliced. 8 lbs. of clinker removed.
5.52 Fire cleaned. 40 lbs. of clinker removed.
8.30 Fire thoroughly cleaned. 75 lbs. of clinker removed.
8.45 85 lbs. of ashes raked from ash-pit.
8.50 Trial stopped.

Clinker and Ash.

136 lbs. clinker.
85 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 1.

Time.	Weight of coal fired.	
	During interval.	Total.
Start 10.45 a.m.	0	0
11.21	180	180
11.50	158	338
12.45	171	509
1.04	150	659
1.32	116	775
1.54	116	891
2.40	136	1027
3.02	119	1146
3.36	125	1271
4.13	172	1443
5.03	166	1609
5.43	124	1733
6.00	117	1850
6.27	116	1966
7.12	109	2075
7.47	114	2189
8.10	116	2305
8.50	102	2407
Close		

OBSERVATIONS MADE DURING BOILER TRIAL No. 1.

Time.	Steam pressure gauge.	Temperatures °F.			Draft pressures, inches of water.		Water discharged to feed tank in interval.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	lbs.
10.45	108	80·5	365	61·2	0·1	0·3	.....
11.00	103	80·5	355	61·7	0·1	0·35	324
11.15	105	80·5	365	61·7	0·1	0·35	386
11.30	99	81·0	355	61·7	0·1	0·3	453
11.45	108	85·0	370	61·5	0·1	0·35	453·5
12.00	102	86·0	315	61·4	0·1	0·3	526
12.15	104	86·0	320	61·5	0·1	0·3	306
12.30	120	85·0	330	62·5	0·1	0·3	243
1.45	119	86·0	370	63·0	0·1	0·3	504·5
1.00	94	86·0	347	63·5	0·1	0·3	659·5
1.15	115·5	87·0	360	64·0	0·1	0·3	224·5
1.30	122	89·0	420	64·5	0·1	0·3	592·5
1.45	115	87·0	385	64·5	0·1	0·3	647
2.00	114	87·0	365	65·0	0·1	0·3	561
2.15	103	87·0	350	65·0	0·1	0·3	553
2.30	120	88·0	375	65·0	0·1	0·3	507·5
2.45	122	88·0	395	65·0	0·1	0·25	400
3.00	123	87·0	380	64·5	0·1	0·25	462
3.15	99	87·0	385	64·2	0·1	0·25	505·5
3.30	107	88·0	400	64·2	0·1	0·2	433
3.45	97	88·0	400	64·5	0·06	0·2	366
4.00	105	88·0	405	64·5	0·1	0·2	680
4.15	98	87·0	350	64·5	0·1	0·2	350·5
4.30	87	88·0	375	64·5	0·1	0·2	426·5
4.45	99	87·0	360	64·5	0·1	0·2	386·5
5.00	118	88·0	415	64·5	0·1	0·25	315
5.15	119	86·0	405	64·5	0·1	0·2	495
5.30	113	87·0	415	64·5	0·1	0·2	416
5.45	94	87·0	415	64·5	0·1	0·2	591·5
6.00	110	90·0	415	64·5	0·07	0·2	496·5
6.15	103	87·0	400	64·5	0·1	0·2	266
6.30	113	87·0	385	65·0	0·1	0·2	443·5
6.45	112	86·0	402	65·0	0·1	0·2	304
7.00	113	86·0	390	65·5	0·1	0·20	500
7.15	102	86·0	395	64·5	0·1	0·2	443
7.30	113	86·0	375	64·5	0·1	0·2	543
7.45	116	85·0	370	64·2	0·1	0·2	391·5
8.00	118	85·0	405	64·5	0·1	0·2	326·5
8.15	107	85·0	400	64·7	0·1	0·2	452·5
8.30	116	85·0	415	64·7	0·07	0·2	459·5
8.45	102	87·0	355	64·7	0·1	0·2	298·5
8.50	.....	.....	.....	.....	.....	.....	19
Mean	108·7	86·1	379	64·0	0·1	0·25	Total 17,673·5 net

SUMMARY OF OBSERVATIONS.

Date—June 20, 1907.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—10.45 a.m.	Ended—8.50 p.m.	Duration—605 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned June, 1907
4.	Tubes cleaned	Before trial
5.	Fire cleaned	Before trial, 3.21 p.m., 4.52 p.m., 5.52 p.m., 8.30 p.m.

Fuel.

6.	Kind of fuel	Georges Creek, run of mine
7.	Analysis of dry coal by weight (%)— fixed carbon 71·2, volatile matter 19·6, ash 9·2	
8.	Calorific value of dry coal B.T.U. per lb	14080
9.	Moisture in coal as fired (%)	1·9
10.	Weight of coal fired (lbs.)	2407
11.	Combustible matter in ash and clinker (%)	18·5
12.	Weight of clinker (lbs.)	136
13.	Weight of ash (lbs.)	85

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	−0·1
15.	" above fire " "	−0·2
16.	" at damper " "	−0·25
17.	Amount of damper opening	Full
18.	Temperature of air in boiler house (°F.)	86
19.	Flue temperature (°F.)	379
20.	Analysis of dry flue gas by volume (%)	—

Water and Steam.

21.	Temperature of feed water (°F.)	64
22.	Total weight of feed water, corrected for difference of level (lbs.)	17673
23.	Water level in gauge at start (inches)	4·25
24.	Water level in gauge at finish (inches)	4·00
25.	Correction for difference of level, included above (lbs.)	38
26.	Steam pressure by gauge (lbs. per sq. in.)	108·7
27.	Barometer reading (inches)	29·7
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	5·6
29.	Temperature in steam calorimeter (°F.)	222·2

Notes.

Fire broken out 7.00 a.m., sliced 12.34, 1.25, 2.25, 3.21, 4.52, 5.52, and 8.30 A small fire lighted in No. 1 boiler at 2.15 p.m.

SUMMARY OF RESULTS.

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine condition of Boiler. Kind of Fuel—Georges Creek, run of mine.
Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·7. At finish—29·7. Mean—29·7.

Total Quantities.

1.	Date of trial	20/6/07
2.	Duration of trial (hours)	10·08
3.	Weight of coal as fired (lbs.)	2407
4.	Percentage of moisture in coal as fired (%)	1·9
5.	Total weight of dry coal fired (lbs.)	2361
6.	Total ash and refuse (lbs.)	221
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 11·3; (*b*) weighed	9·3
8.	Total weight of combustible consumed, from analyses (lbs.)	2094
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	17673
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17160
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	20500

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	235
13.	Dry coal per square foot of grate surface per hour (lbs.)	14·0
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1701
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2035
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·19

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	108·7
18.	Temperature of feed water entering boiler (deg. F.)	64·0
19.	Temperature of escaping gases from boiler (deg. F.)	379
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·15
21.	Percentage of moisture in steam	4·0

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	59·1
23.	Builders' rated horse-power	60
24.	Percentage of builders' rated horse-power developed	98·5

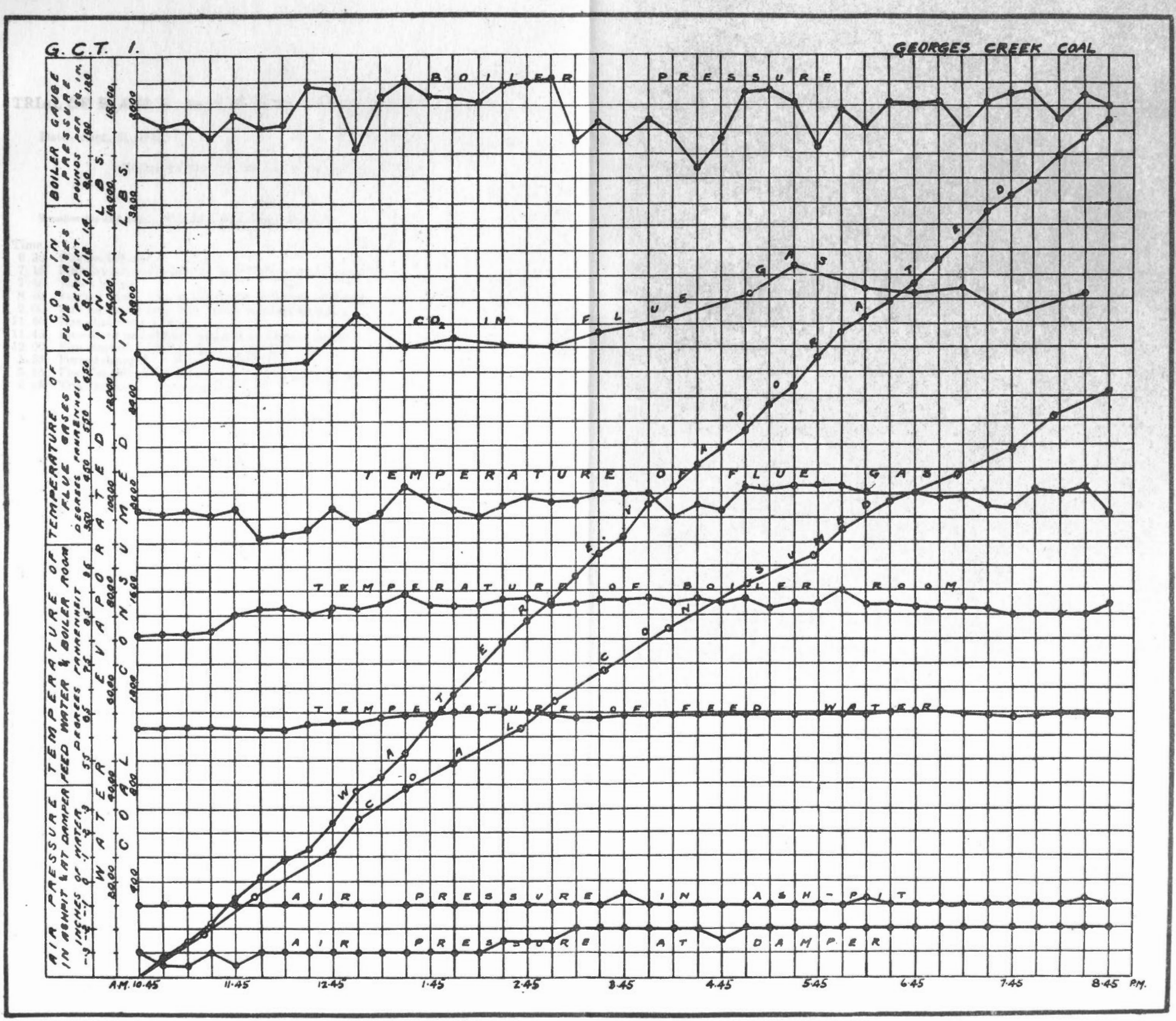
Economic Results.

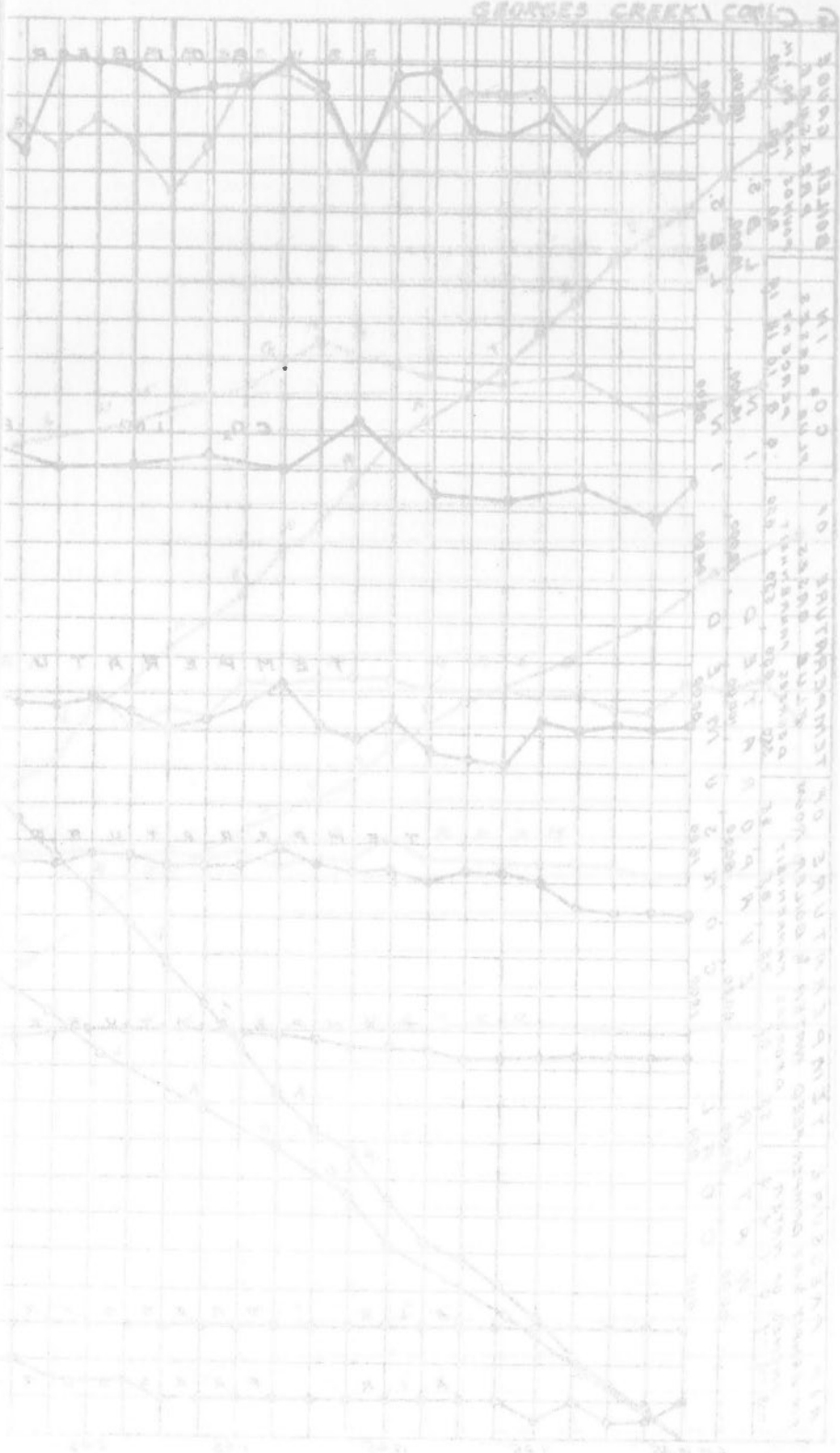
25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 5 ÷ Item 3)	7·35
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	8·53
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	8·69
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	9·8

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	14080
30.	Calorific value of the combustible per lb. (B.T.U.)	15500
31.	Efficiency of boiler (based on combustible consumed) (%)	61·0
32.	Efficiency of boiler, including grate (based on dry coal) (%)	59·6

GRAPHIC RECORD OF BOILER TRIAL.





TRIAL OF B. AND W. No. 2 BOILER WITH GEORGES CREEK COAL.

Date—Sept. 21, 1909. Trial Number—G.C.T. 68.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

Weather fine and clear. Blow-off examined and found tight.

Time.
6.30 Fire broken out.
7.15 Fire cleaned and made up with Georges Creek coal.
7.45 Tubes blown.
8.40 Started trial. Fire 2″ thick and well burnt through.
9.00 Fire has to be kept thin owing to small air space.
11.40 Fire clinkering a little.
11.45 Fire sliced and clinker removed to front of grate.
12.00 Fire cleaned. 89 lbs. clinker removed.
1.35 Forced draught in ash-pit until 5.10.
5.15 Fire cleaned and 186 lbs. hard clinker removed easily.
6.45 Trial finished. Fire as at start.

CLINKER AND ASH.

275 lbs. clinker.
77 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 68.

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.40 a.m.						
9.05	169	169	10.05	8·1	12·1	0·0
9.30	115	284	10.35	7·9	11·7	0·0
10.00	117	401	12.15	8·8	10·3	0·9
10.35	170	571	12.45	10·2	9·2	0·2
11.05	84	655	1.30	9·5	9·7	0·0
11.40	135	791	2.00	8·0	11·9	0·0
12.10	141	932	2.45	7·7	12·5	0·0
12.50	221	1153	3.15	10·1	9·5	0·0
1.25	133	1286	3.45	9·1	10·9	0·0
1.55	290	1576	4.30	8·8	11·3	0·0
2.20	110	1686	5.00	7·0	13·3	0·0
2.50	85	1771	5.30	4·0	15·4	0·5
3.20	140	1911				
3.50	100	2011		8·3	11·5	0·1
4.20	120	2131				
4.55	87	2218				
5.15	35	2253				
5.55	125	2378				
6.25	94	2472				
6.45	80	2552				

OBSERVATIONS MADE DURING BOILER TRIAL No. 68.

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.40	115	71	320	67	−·10	−·13	.....
9.00	111	72	375	63·5	−·10	−·18	378
9.15	108	72	370	63·5	−·10	−·15	460
9.30	114	73	365	64	−·01	−·20	499
9.45	120	73	375	64·5	−·10	−·20	486
10.00	117	73	390	64	−·10	−·17	429
10.15	118	73	360	64	−·10	−·20	455
10.30	115	74	365	64	−·10	−·17	380
10.45	102	74	355	64	−·10	−·20	592
11.00	102	74	355	64	−·10	−·20	355
11.15	112	74	375	64	−·10	−·20	337
11.30	112	74	380	64	−·10	−·20	492
11.45	112	75	375	64	−·10	−·20	302
12.00	112	77	375	64	.....	.....	427
12.15	112	77	370	64	−·10	−·20	295
12.30	117	77	353	64	−·10	−·20	386
12.45	107	76	360	64	−·10	−·20	337
1.00	112	76	400	64	−·10	−·20	430
1.15	111	76	405	64	−·10	−·20	361
1.30	119	76	475	64	+·05	−·20	504
1.45	100	77	460	64	+·10	−·20	412
2.00	105	77	450	64	+·10	−·20	667
2.15	120	78	425	64	+·10	−·20	672
2.30	109	77	455	64	+·05	−·20	711
2.45	93	78	420	64	0·0	−·20	571
3.00	95	78	420	64	0·0	−·20	466
3.15	112	78	455	64	0·0	−·20	465
3.30	122	78	430	64	0·0	−·20	486
3.45	102	78	455	64	0·0	−·20	642
4.00	112	78	415	64	0·0	−·20	442
4.15	117	80	440	64	−·05	−·20	346
4.30	112	79	400	64	−·10	−·20	576
4.45	112	79	405	64	−·05	−·20	366
5.00	117	78	385	64	−·10	−·20	458
5.15	107	78	285	64	−·05	−·20	344
5.30	109	78	370	64	−·05	−·20	262
5.45	119	80	420	64	−·05	−·20	225
6.00	117	80	435	64·5	.....	.....	562
6.15	.....	.....	.....	.....	.....	.....	230
6.30	117	76	425	64	−·05	−·20	290
6.45	117	.....	.....	.....	.....	.....	690
	111·5	76·2	396·	64·1	−·01	−·20	17,778 net

SUMMARY OF OBSERVATIONS.

Date—Sept. 21, 1909.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.40 a.m.	Ended—6.45 p.m.	Duration—605 mins.

General.

1.	Method of stoking	Hand-spreading on alternate sides
2.	Kind of draft	Natural
3.	Condition of boiler and date of last cleaning	Thoroughly cleaned August, 1909
4.	Tubes cleaned	7.45 a.m.
5.	Fire cleaned	7.15 a.m., 12.00 noon, 5.15 p.m.

Fuel.

6.	Kind of coal	Georges Creek
7.	Analysis of dry coal by weight (%)	
8.	Calorific value of dry coal B.T.U. per lb	13450
9.	Moisture in coal as fired (%)	2·9
10.	Weight of coal fired (lbs.)	2552
11.	Combustible matter in ash and clinker (%)	8·4
12.	Weight of clinker (lbs.)	275
13.	Weight of ash (lbs.)	77

Air and Flue Gas.

14.	Air pressure under fire (inches of water)	+0·01
15.	" above fire " "	−0·01
16.	" at damper " "	−0·20
17.	Amount of damper opening	Full open
18.	Temperature of air in boiler house (°F.)	76·2
19.	Flue temperature (°F.)	396·1
20.	Analysis of dry flue gas by volume (%)	CO_2=8·3, CO=0·1, N=80·1, O=11·5

Water and Steam.

21.	Temperature of feed water (°F.)	64·1
22.	Total weight of feed water, corrected for difference of level (lbs.)	17778
23.	Water level in gauge at start (inches)	5½
24.	Water level in gauge at finish (inches)	5½
25.	Correction for difference of level, included above (lbs.)	+40
26.	Steam pressure by gauge (lbs. per sq. in.)	111·5
27.	Barometer reading (inches)	30·0
28.	Pressure in steam calorimeter by gauge (lbs. per sq. in.)	6·9
29.	Temperature in steam calorimeter (°F.)	279·3

Notes.

Necessary to keep fire thin owing to small air space. Cleaned fire out twice.

Proximate analysis of dry coal by weight %: Fixed carbon, Volatile matter — Undetermined. Ash 12·6

SUMMARY OF RESULTS.

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Fuel.
Kind of Fuel—Georges Creek. Kind of Furnace—Fixed bars, 15% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—30. At finish—30. Mean—30.

Total Quantities.

1.	Date of trial	21/9/09
2.	Duration of trial (hours)	10·5
3.	Weight of coal as fired (lbs.)	2552
4.	Percentage of moisture in coal as fired (%)	2·9
5.	Total weight of dry coal fired (lbs.)	2478
6.	Total ash and refuse (lbs.)	352
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 13·76; (*b*) weighed.	14·2
8.	Total weight of combustible consumed, from analyses (lbs.)	2137
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	17778
10.	Equivalent water evaporated into dry steam from actual feed water temperature and boiler pressure (lbs.)	17680
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	21140

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	245·7
13.	Dry coal per square foot of grate surface per hour (lbs.)	14·62
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1753
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2096
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·28

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	111·5
18.	Temperature of feed water entering boiler (deg. F.)	64·1
19.	Temperature of escaping gases from boiler (deg. F.)	396·1
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·21
21.	Percentage of moisture in steam or number of degrees of superheating	0·6

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	60·8
23.	Builders' rated horse-power	60·0
24.	Percentage of builders' rated horse-power developed	101·3

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	6·97
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	8·28
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	8·54
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	9·90

Efficiency.

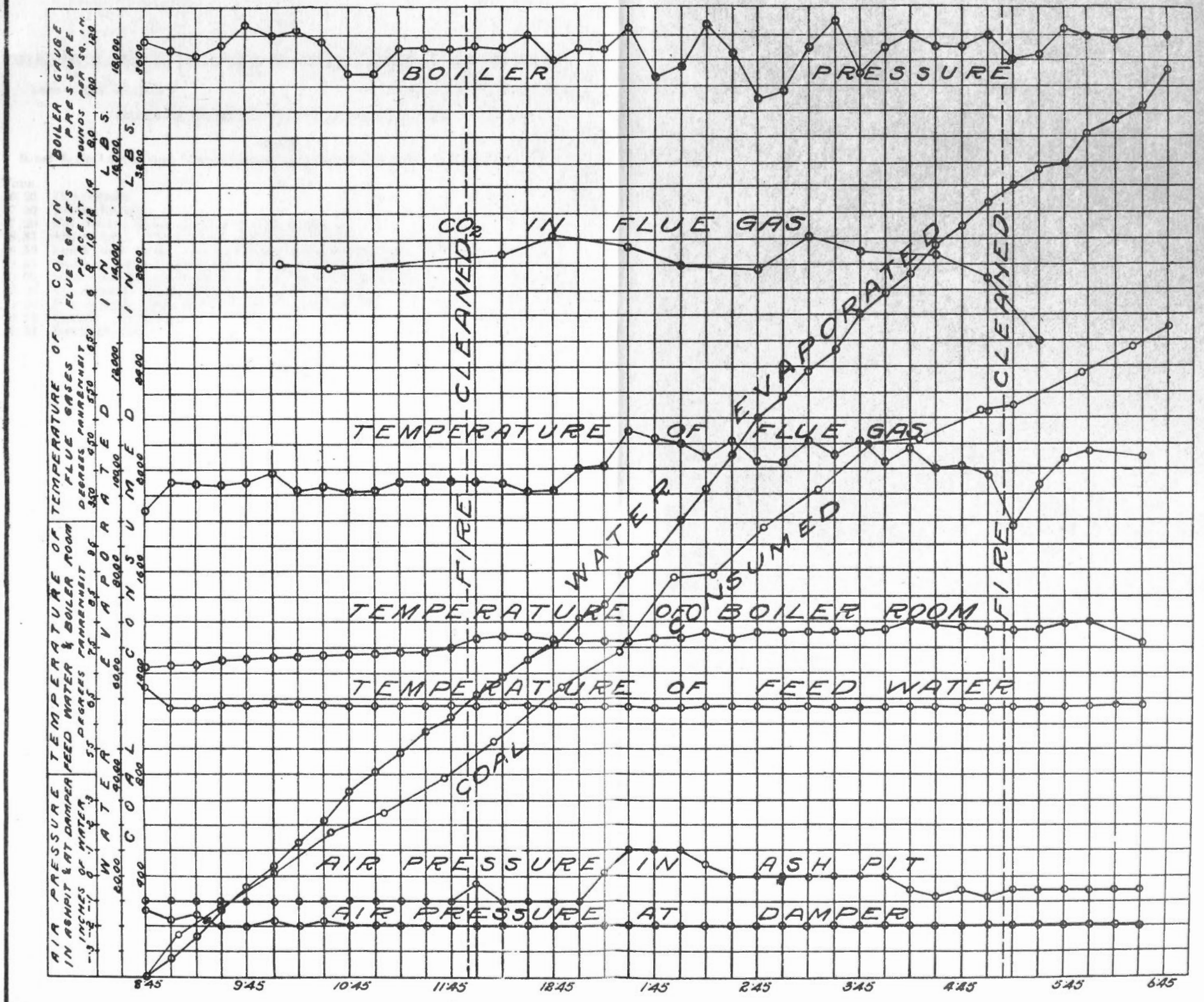
29.	Calorific value of dry coal per lb. (B.T.U.)	13450
30.	Calorific value of the combustible per lb. (B.T.U.)	15390
31.	Efficiency of boiler (based on combustible consumed) (%)	62·1
32.	Efficiency of boiler, including grate (based on dry coal) (%)	61·3

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	29·5
34.	" " of combustible consumed (from gas analyses) (lbs.)	
35.	" " coal as fired (from anemometer) (lbs.)	
36.	Proportion of heat of fuel in escaping dry flue gases (%)	

G.C.T. 68

COAL - GEORGE'S CREEK



TRIAL OF B. AND W. No. 2 BOILER WITH GEORGES CREEK COAL.

Date—April 14, 1910. Trial Number—G.C.T. 72.

OBSERVATIONS OF GENERAL CONDITIONS.

Notes.

B. and W. No. 1 not working. Blow-off examined and found tight. Fixed bars, ½" air space.

Time.
6.20 Fire remade.
7.40 Tubes cleaned.
7.20 Fire cleaned. Boiler pressure, 100 lbs. square in.
8.33 Started trial. Fire 3" thick, well burnt through.
8.50 Fire 3" to 4" thick. Coking a little, broke up with rake.
9.35 Broke up fire with rake—and at 9.45, 10.00, and 10.20.
10.00 Forced draught under ash-pit. Fairly heavy brown smoke.
12.20 Fire cleaned. Hard cinders easily removed—83 lbs.
5.20 Fire cleaned. Hard cinders easily removed—94 lbs.
6.15 Fan off. No draught.
6.33 Fire as at start.

CLINKER AND ASH.
177 lbs. clinker.
104 lbs. ash.

RECORD OF COAL CONSUMED DURING BOILER TRIAL No. 72.

Time.	Weight of coal fired.		Time of sampling flue gases.	Composition of flue gases by volume, per cent.		
	During interval.	Total.		CO_2	O_2	CO
Start 8.33 a.m.						
8.56	114	114	8.45	5·8	12·0	0·3
9.25	95	209	9.10	8·0	11·4	0·4
9.43	72	281	9.40	6·0	12·2	0·3
10.15	101	382	10.00	8·0	11·6	0·4
10.27	62	444	10.20	8·6	10·6	0·3
11.00	174	618	10.40	8·8	10·1	0·2
11.30	103	721	11.00	9·4	8·6	0·2
12.05	70	791	11.30	8·8	10·2	0·1
12.45	200	991	11.50	8·2	10·0	0·2
1.20	136	1127	12.15	7·2	12·8	0·1
1.50	163	1290	12.40	8·4	10·1	0·3
2.25	175	1465	1.10	8·9	10·0	0·1
2.50	100	1626	1.30	9·0	9·4	0·8
3.10	136	1762	1.50	8·1	9·9	0·5
3.55	61	1823	2.15	9·5	9·3	0·2
4.25	126	1949	2.40	9·4	10·2	0·1
4.45	91	2040	3.00	8·0	11·0	0·5
5.10	52	2092	3.25	8·8	10·6	0·2
5.40	147	2239	3.50	7·0	12·4	0·0
6.00	119	2358	4.10	7·0	11·7	0·3
6.33	68	2426	4.35	9·0	9·6	0·6
			4.55	8·1	10·6	0·3
			5.20	6·2	12·2	0·4
			5.40	7·4	10·8	0·3
			6.00	9·4	9·5	0·1
				8·0	10·7	0·3

OBSERVATIONS MADE DURING BOILER TRIAL No. 72.

Time.	Steam pressure gauge.	Temperatures ° F.			Draft pressures, inches of water.		Water apparently evaporated in interval. lbs.
	lbs. per sq. in.	Boiler room.	Flue gases at entrance to flue.	Feed Water.	In ash-pit.	At entrance to flue.	
8.33	121	60	.....	54	−·01	.....	.....
8.48	122	59	.....	54	−·01	.....	460
9.03	92	59	.....	52	−·01	.....	249
9.18	93	60	.....	50	−·01	.....	452
9.33	91	60	350	48	−·01	.....	351
9.48	87	60	345	48	−·01	.....	348
10.03	105	59	420	47	−·02	.....	201
10.18	119	61	415	47	−·02	−·12	420
10.33	118	62	425	46	−·02	−·11	391
10.48	121	62	475	46	+·06	−·13	389
11.03	116	62	500	45	+·07	−·12	571
11.18	109	63	435	45	+·03	−·12	478
11.33	103	62	405	45	+·02	−·09	402
11.48	121	64	490	44	+·03	−·11	408
12.03	121	64	510	44	+·04	−·13	517
12.18	111	64	415	44	+·04	−·13	448
12.33	103	67	480	45	+·12	−·13	399
12.48	110	66	460	45	+·05	−·13	271
1.03	123	66	470	45	+·05	−·12	490
1.18	104	67	430	44	+·02	−·12	396
1.33	106	67	550	44	+·12	−·12	498
1.48	124	67	555	44	+·06	−·13	530
2.03	122	65	510	44	+·05	−·13	510
2.18	109	65	545	44	+·06	−·13	558
2.33	81	66	530	44	+·03	−·14	599
2.48	105	65	560	44	+·05	−·13	601
3.03	77	63	490	44	+·03	−·13	562
3.18	94	63	455	44	+·06	−·13	490
3.33	121	64	550	44	+·08	−·13	402
3.48	99	64	525	44	+·10	−·12	540
4.03	98	64	495	44	+·03	−·12	550
4.18	100	64	500	44	+·05	−·12	505
4.33	102	64	475	44	+·04	−·12	409
4.48	124	64	470	44	+·03	−·12	378
5.03	122	64	500	44	+·03	−·12	505
5.18	121	64	475	44	+·03	−·12	418
5.33	81	76	420	44	+·04	−·12	480
5.48	122	71	465	45	+·04	−·13	143
6.03	122	67	550	44	+·03	−·13	509
6.18	124	67	500	46	−·02	−·13	490
6.33	123	66	483	46	−·02	−·12	476
	109	64	430	45·5	+·03	−·12	17,794 net

SUMMARY OF OBSERVATIONS.

Date—April 14, 1910.	Boiler—B. and W. No. 2.	At McGill University.
Commenced—8.33 a.m.	Ended—6.33 p.m.	Duration—600 mins.

General.

1. Method of stoking.....Hand-spreading on alternate sides
2. Kind of draft..... Natural, 8.33 to 10 a.m.; forced, 10 a.m. to 6.15 p.m.; natural 6.15 p.m. to 6.33 p.m.
3. Condition of boiler and date of last cleaning.....Thoroughly cleaned August, 1909
4. Tubes cleaned.....7.40 a.m.
5. Fire cleaned.....7.20 a.m., 12.20 p.m., 5.20 p.m.

Fuel.

6. Kind of coal.....Georges Creek
7. Analysis of dry coal by weight (%).....
8. Calorific value of dry coal B.T.U. per lb.....13790
9. Moisture in coal as fired (%).....2·0
10. Weight of coal fired (lbs.).....2426
11. Combustible matter in ash and clinker (%).....19·1
12. Weight of clinker (lbs.).....177
13. Weight of ash (lbs.).....104

Air and Flue Gas.

14. Air pressure under fire (inches of water).....+0·03
15. " above fire " " .....−0·06
16. " at damper " " .....−0·12
17. Amount of damper opening.....Full
18. Temperature of air in boiler house (°F.).....64
19. Flue temperature (°F.).....382
20. Analysis of dry flue gas by volume (%)...$CO_2 = 8·0$, $O_2 = 10·7$, $CO = 0·3$, $N_2 = 81·0$

Water and Steam.

21. Temperature of feed water (°F.).....45·5
22. Total weight of feed water, corrected for difference of level (lbs.).....17794
23. Water level in gauge at start (inches).....$3\frac{7}{8}$
24. Water level in gauge at finish (inches).....$3\frac{7}{8}$
25. Correction for difference of level (lbs.).....0
26. Steam pressure by gauge (lbs. per sq. in.).....109
27. Barometer reading (inches).....29·64
28. Pressure in steam calorimeter by gauge (lbs. per sq. in.).....10·2
29. Temperature in steam calorimeter (°F.).....289

Notes.

Forced draught was used owing to natural draught being poor, on account of no other boiler being in use. Fire kept from 3″ to 4″ thick. Coal caked considerably necessitating the fire being continually broken up with a rake. There was no difficulty in removing some hard cinders upon cleaning. The smoke was fairly heavy and brown.

Proximate analysis of dry coal by weight %: Fixed carbon..... / Volatile matter..... } undetermined. Ash..... 11·2

SUMMARY OF RESULTS.

Made on B. and W. No. 2 Boiler, at McGill University.
To Determine quality of Coal.
Kind of Fuel—Georges Creek. Kind of Furnace—Fixed bars, 30% air space.
Method of Starting and Stopping Test—Alternate (A.S.M.E.)
Grate Surface (sq. ft.)—16·79. Water Heating Surface (sq. ft.)—639.
Superheating Surface (sq. ft.)—Nil.
Barometer at start—29·66. At finish—29·62. Mean—29·64.

Total Quantities.

1.	Date of trial	14/4/10
2.	Duration of trial (hours)	10·0
3.	Weight of coal as fired (lbs.)	2426
4.	Percentage of moisture in coal (%)	2·0
5.	Total weight of dry coal consumed (lbs.)	2378
6.	Total ash and refuse (lbs.)	281
7.	Percentage of ash and refuse in dry coal (%) (*a*) from analyses 13·85; (*b*) weighed 11.82	
8.	Total weight of combustible consumed, from analyses (lbs.)	2049
9.	Total weight of water fed to the boiler, corrected for difference of level (lbs.)	17794
10.	Equivalent water evaporated from actual feed water temperature and boiler pressure (lbs.)	17767
11.	Equivalent water evaporated into dry steam from and at 212° F. (lbs.)	21570

Hourly Quantities.

12.	Dry coal fired per hour (lbs.)	237·8
13.	Dry coal per square foot of grate surface per hour (lbs.)	14·15
14.	Water evaporated per hour corrected for quality of steam (lbs.)	1777
15.	Equivalent evaporation per hour from and at 212° F. (lbs.)	2157
16.	Equivalent evaporation per hour from and at 212° F. per square foot of water heating surface (lbs.)	3·37

Average Pressures, Temperatures, Etc.

17.	Steam pressure by gauge (lbs. / sq. in.)	109
18.	Temperature of feed water entering boiler (deg. F.)	45·5
19.	Temperature of escaping gases from boiler (deg. F.)	382
20.	Pressure of draft between damper and ash-pit (ins. of water)	0·15
21.	Percentage of moisture in steam or number of degrees superheating	0·3

Horse-Power.

22.	Horse-power developed (Item 15 ÷ 34½)	59·4
23.	Builders' rated horse-power	60·0
24.	Percentage of builders' rated horse-power developed	99·0

Economic Results.

25.	Water apparently evaporated under actual conditions per lb. coal as fired (Item 9 ÷ Item 3)	7·33
26.	Equivalent evaporation from and at 212° F. per lb. coal as fired (Item 11 ÷ Item 3)	8·90
27.	Equivalent evaporation from and at 212° F. per lb. of dry coal (Item 11 ÷ Item 5)	9·07
28.	Equivalent evaporation from and at 212° F. per lb. of combustible consumed (Item 11 ÷ Item 8)	10·51

Efficiency.

29.	Calorific value of dry coal per lb. (B.T.U.)	13790
30.	Calorific value of the combustible per lb. (B.T.U.)	15500
31.	Efficiency of boiler (based on combustible) (%)	65·5
32.	Efficiency of boiler, including grate (based on dry coal) (%)	63·6

Flue Gases.

33.	Dry flue gas per lb. carbon (from gas analyses) (lbs.)	29·7
34.	" " of combustible consumed (from gas analyses) (lbs.)	
35.	" " dry coal (from gas analyses) (lbs.)	
36.	Proportion of heat of fuel in escaping dry flue gases (%)	

GRAPHIC RECORD OF BOILER TRIAL.