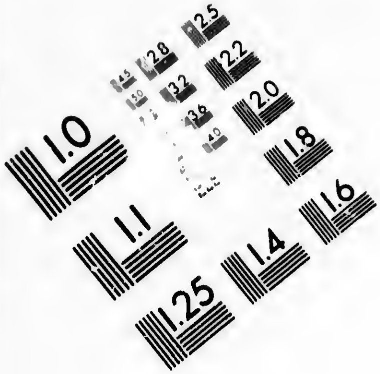
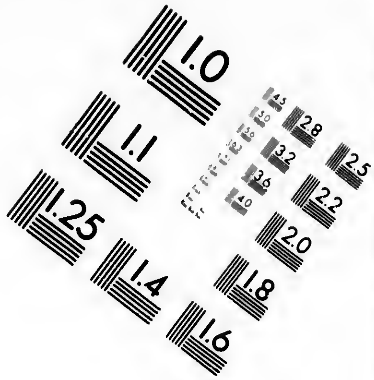

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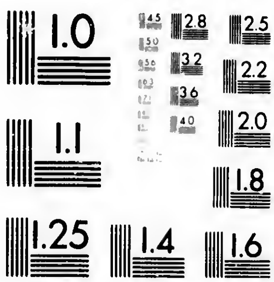

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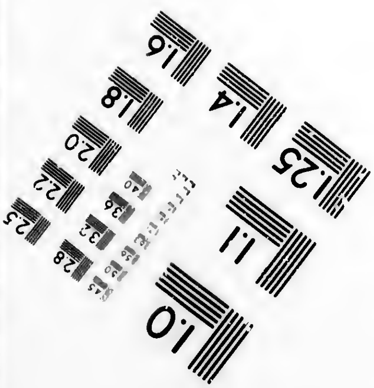
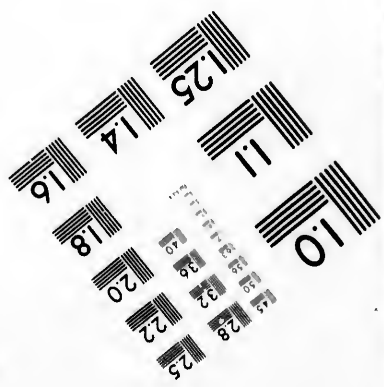

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OLOGICAL AND NATURAL HISTORY SURVEY OF CANADA
ALFRED R. C. SELWYN, LL.D., F.R.S., F.G.S., DIRECTOR.

CHEMICAL CONTRIBUTIONS

TO THE

GEOLOGY OF CANADA.

COALS AND LIGNITES

OF THE

NORTH-WEST TERRITORY.

BY

G. CHRISTIAN HOFFMANN, F. Inst. Chem.,
Chemist and Mineralogist to the Survey.

PUBLISHED BY AUTHORITY OF PARLIAMENT.

MONTREAL:
DAWSON BROTHERS.

1884.

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To

ALFRED R. C. SELWYN, ESQ., LL.D., F.R.S., F.G.S.,

Director of the Geological and Natural History Survey of Canada.

SIR,—I have the honor herewith of laying before you the results of an investigation, carried out by me, with the object of determining the economic value of the Coals and Lignites of the North-West Territory. The specimens were in all instances collected by officers of the Survey—some by yourself, a few by Prof. J. Macoun, one by Mr. R. W. Ells, the remainder and greater number by Dr. G. M. Dawson and Mr. R. G. McConnell. The information in regard to the geological age of the various deposits was kindly furnished by Dr. G. M. Dawson.

I have the honor to be,

Sir,

Your obedient servant,

G. CHRISTIAN HOFFMANN.

OTTAWA, May 31st, 1884.

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Introductory Remarks.

The majority of the fuels under consideration are from the Bow and Belly river districts—a region which may be defined as extending from the 111th meridian westward to the Rocky Mountains, and as being bounded south and north by the 49th and 51st parallels of latitude. A few are from the region immediately east of this, whilst others are from the region north and west of that first mentioned. Two are from the Pine River, British Columbia. Strictly speaking, the analyses of these are out of place in this report, they were however deemed of sufficient interest to justify their insertion here.*

It is very interesting to note the gradual change in the physical and chemical character of the fuels of the Bow and Belly river districts as we proceed from east to west, a change which would appear to have been brought about by the disturbances to which the enclosing strata in and near the vicinity of the Rocky Mountains have been subjected. Assuming this region to be divided into three imaginary belts running parallel to the base of the mountains, we find, as a whole, that whereas

* Analyses of fuels Nos. 1, 14, 15, 17, 18, 19, 21 and 34 were published in one of my former reports, since then, however, further work has been done in connection with most of them, thereby making the analyses more complete.

the fuels of the outer or most eastern belt have all the characters of lignite *, those of the central belt (and consequently somewhat nearer the mountains), the lignitic coals *, have a character intermediate between that of lignite and true coal, whilst those of the innermost belt, and therefore close to the base of the mountains, have all the characters of true coal *—finally we have occurring in the mountains, the anthracitic coal and semi-anthracite.

The coal of the Wellington mine, Vancouver Island, British Columbia, has been selected as a standard of comparison. It is of the same geological age as many of the fuels here referred to—is extensively used, and has the reputation of being an excellent fuel for steam and domestic purposes.—See analysis No. 33.

Brief Outline of Some of the Methods Employed in The Prosecution of this Enquiry.

Methods of analysis, etc.

I. DETERMINATION OF THE SPECIFIC GRAVITY.—The coal or lignite was reduced to the state of a coarse powder by crushing it in an iron mortar, the application of more force than was absolutely necessary to effect this being carefully avoided, so as to obviate, as far as possible, the production of fine particles and dust. The material was subsequently freed from this latter by shaking it upon a sieve of ninety holes to the linear inch. The specimen having been introduced into the specific gravity bottle, and sufficient water added to thoroughly immerse it, the whole was placed under the receiver of an air-pump, and exhaustion very gradually proceeded with: the exhaustion was repeated at intervals and until no more bubbles were seen to come off. The bottle was then removed, and the necessary adjustments having been made, weighed—after which, a portion of the water having been withdrawn, it was again placed under the receiver of the air-pump, etc. Temperature 60° F., the same, I may here remark—having omitted to do so on those occasions—as that observed in determining the specific gravity of the various specimens of graphite and apatite which formed the subject of some former reports.—Reports of Progress, 1876–77, p. 489 and 1877–78, p. 1 H.

II. DETERMINATION OF THE WATER.—The loss by dessication at 110° C. was estimated as hygroscopic water.

III. DETERMINATION OF THE SULPHUR. — This was effected by the method proposed by Mr. Nakamura.† The process is exceedingly simple and affords most accurate results. The details of the method, as given

* See under "Generalizations on the physical and chemical characters, and applications of these fuels." Pages 5 M–10 M.

† Journ. Chem. Soc., xxxv. 785.

Methods of analysis, etc., cont.

by him, are as follows: "Take three or four parts of the mixed alkali carbonates, or of sodium carbonate, to one part of coal in very fine powder. Intimately mix in a large platinum dish or crucible with a dry glass rod, and heat the mixture in the dish or crucible, loosely covered, at first so gently as not to volatilize hydrocarbons, that is, so that no smell or only a very faint aromatic odor is observable, a matter much more easy of execution than might be supposed. Use an argand spirit-lamp instead of a Bunsen's burner, to avoid possible absorbtion of sulphur from the flame of coal gas. Keep at a low temperature for some time; then raise the heat by slow degrees without letting it reach that of visible redness, until the surface, which is at first of a dark-grey color, becomes only faintly grey. No smoke or odorous gases should escape during the whole of the oxidation. When the surface becomes only faintly grey, raise the temperature to a faint red heat, and keep it stationary for about forty to sixty minutes, at the end of which time the mass will become almost perfectly white, or reddish if the coal contains iron, from the complete combustion of the coal. The mass is then treated with water, filtered, and the sulphate is determined in the filtrate as usual after acidification."

It is important that the coal should be very finely pulverized. The mixture should not be stirred during ignition, as this, so far from hastening, retards the operation. The ignition may be conducted in a platinum dish or crucible, the former is to be preferred.

The vessel employed by me was a thin, flat-bottomed, platinum dish, having a diameter, at the base, of four and a half centimetres. Reagent, sodium carbonate. Source of heat, a Berzelius' argand spirit-lamp.

The sulphur existing as sulphate (gypsum) was estimated by boiling the finely pulverized coal with a solution of sodium carbonate, etc., etc.

IV. DETERMINATION OF THE CARBON AND HYDROGEN.—The combustion was effected in a current of oxygen gas, in a tube open at both ends, one of which was placed in connection with the absorbtion-bulbs and tubes, the other with the apparatus for purifying and drying the air and oxygen gas. As prepared for combustion, the tube—commencing with the anterior end—presented the following arrangement:—an asbestos plug, immediately upon which followed a four inch column of a loosely packed mixture of woolly asbestos and lead dioxide, then another asbestos plug, succeeded by a column of granulated cupric oxide kept in place by a loose plug of asbestos, and behind this the platinum boat containing the material to be analyzed. The heating was effected in an Erlenmeyer's furnace, closely attached to the one end of which was a four and a half inch square sheet-iron air-bath, provided with two holes, one on either side, for the passage of the com-

Methods of analysis, etc., cont.

bustion tube, and a tuberlature at the top for the reception of a thermometer—the position of the latter was just a little on one side (forward) of the centre, the bulb being on a level with and almost touching the combustion tube. When the latter was in position, that part containing the column of asbestos and lead dioxide mixture, extended over the furnace proper, passing into the air-bath, which completely enclosed this portion of the tube. The bath which was heated by a separate burner, was maintained throughout the operation at a temperature of 150° to 170° C.

The results of a preliminary analysis of cane sugar were as follows: Employed 0.3083 gram of chemically pure sugar, dried at 100° C., this gave 0.4755 gram carbon dioxide, and 0.1794 gram of water: hence percentage composition of sugar:

	Found.	Calculated.	Difference.
Carbon	42.06	42.10	— 0.04
Hydrogen	6.46	6.43	+ 0.03
Oxygen	51.48	51.47	
	100.00	100.00	

Specimens numbers 2, 26, 28, 30, 31, 32, 33 and 35 all contained more or less calcite. The total amount of carbon dioxide was in each instance determined, as was also the amount remaining in the ash, and corrections made for it in calculating the composition of these fuels.

V. CALORIFIC POWER.—*Experimental.* The determinations were made in a Thompson's calorimeter. The method of procedure recommended in the use of this instrument was closely followed, and every attention was paid to the various details which recent experience has shown to be essential to the obtaining of trustworthy results. These latter are expressed in calories (calorie = one gram of water raised through 1° C. of temperature) and as pounds of water evaporated per pound of fuel: the numbers given in the text, in connection with the analyses are those indicated by the instrument. The corrections to be applied for heat rendered unavailable by reason of the hygroscopic and combined water, are given under Remarks on Tables I. and II.—page 43 M.

V[1]. CALORIFIC POWER.—*Theoretical.* Data employed in the calculation: calorific power of carbon, 8080—calorific power of hydrogen 34,462—calorific power of sulphur, 2221—latent heat of steam, 537° C. In consideration of the amount of sulphur in these fuels being, with one exception, so very small, the heat units due to the combustion of this element have been disregarded.

[In calculating the calorific power of a fuel from its elementary composition, it is assumed that the oxygen is in combination with hydrogen and that only the excess of that element beyond that required for such combination is available as a source of heat; it is further assumed that the calorific power of the carbon and hydrogen as it exists in the fuel is the same as when these elements are in their free or uncombined state: we really have, however, no knowledge as to how the elements are combined nor their state of condensation in the coal, hence the results obtained in calculating the calorific power from its elementary composition can at best be only regarded as an approximation to the truth, sufficiently so, however, to be of value for practical purposes. Methods of analysis, etc., cont.

Dr. Percy, speaking on this subject, remarks*: "The proximate constitution of coal is wholly unknown; we are ignorant whether force is liberated or absorbed during the decomposition—previously to, or at the moment of combustion—of the various compounds of carbon, hydrogen and oxygen, of which the organic part of coal must be composed. Again the hydrogen and oxygen are present in the solid state, and we are unable to determine what amount of force may be absorbed during their conversion into the gaseous state."]

VI. TREATMENT WITH A SOLUTION OF CAUSTIC POTASH.—These experiments were carried out almost simultaneously and under precisely similar conditions, the results therefore admit of a fair comparison. The fuels were all reduced to the same degree of fineness: specific gravity of the potash solution 1.12. The amount of alkaline solution, weight of fuel employed, and length of time occupied in the digestion was in all instances the same.

GENERALIZATIONS ON THE PHYSICAL AND CHEMICAL CHARACTERS, AND APPLICATIONS OF THE FUELS IN QUESTION.

The fuels under consideration may—having regard to their physical characters and chemical composition,—perhaps not inappropriately, be arranged under the three following headings, viz., Lignites, Lignitic Coals, and Coals. Physical and chemical characters.

I. LIGNITES.—Numbers 1 to 21 (inc.).—On exposure to the atmosphere all—with one exception, No. 21—the fuels included in these numbers, have a greater or less tendency to disintegrate and fall to pieces. This property necessarily varies in degree with the different fuels: some resist exposure, especially when well protected, for a tolerably lengthened period, and in the freshly won condition admit of transportation, whilst others break down very speedily and are too friable to bear carriage. If used in their natural state, they should, by reason of their then sounder condition, be employed as freshly

* Percy's Metallurgy; Refractory Materials and Fuel, London, 1875.

Physical and chemical characters, cont.

mined as possible. They all communicate a deep brownish-red color to a boiling solution of caustic potash. The hygroscopic water ranges (No. 21 being disregarded) from, say, 10 to 22 per cent.—in the greater number of cases (excluding Nos. 1, 2, 3, and 21) from 10 to 15 per cent., the average for the seventeen specimens being 12.17 per cent. This high percentage of moisture acts prejudicially in two ways; firstly, it diminishes the relative percentages of the combustible ingredients; and secondly, it (in conjunction with the combined water, of which, the fuels of this class contain a much larger proportion than is found in coals of Carboniferous age) diminishes the heating effect of the fuel by reason of the large amount of caloric which is absorbed in its vaporisation. This defective characteristic of lignites is not, however, exclusively confined to them, it has also been observed in certain American coals of the Carboniferous; some specimens of Iowa coals having been found to contain as much as 12.45, 13.02, and 14.95 per cent. of water. In considering the ash numbers 9, 14 and 20 have been excluded, it being in these instances exceptionally high, number 13 has also been disregarded, as this lignite does not form a separate bed. In the remainder it ranges from, say, 3 to 9 per cent., in five instances only exceeding 7 per cent., the average for the seventeen specimens being 5.83 per cent. The ash, like the moisture, lowers the relative percentages of the combustible ingredients, and hence the heat producing power of the fuel. The value of the latter is influenced not only by the amount but also by the nature of this constituent (when used for household purposes, where the heat of combustion is comparatively moderate, the amount, rather than the character of the ash, is the chief consideration). Combustibles containing a large proportion of ash are prevented from burning completely by reason of the impediment it offers to the draught—when fusible, it forms clinkers upon the bars, impeding the passage of the air and entailing extra labor in stoking and loss of heat from the cooling effects of the rush of cold air through the flues while the grate is being cleared. These fuels are all non-caking—in no instance was a coherent coke obtained either by slow or fast coking, number 17, it is true yields by fast coking a slightly fritted coke, but this is most probably due to the resin which is diffused through its substance.

II. LIGNITIC COALS.—Numbers 22 to 27 (inc.). Of these numbers 22, 23, 24, and 27, may be said to be tolerably firm coals—on exposure to the air they become slightly fissured but do not readily disintegrate; numbers 25 and 26 are hard and firm and well suited for transportation. In appearance they are not unlike some varieties of coal of the Carboniferous—numbers 23, 24 and 25 show slickensides. These fuels all communicate a brownish-red coloration to a boiling solution of caustic potash, which although far less intense than that afforded by any of the fuels considered under I., is nevertheless much deeper than that which would be imparted by any true coal. The percentage of hygroscopic water ranges (omitting No. 24) from, say, 5 to 9 per cent., the average being 6.84 per cent. The amount of ash is very variable. None of these fuels yield, by slow coking, a coherent coke—by fast coking they give, however,—with the exception of No. 22—a slightly fritted coke.

Physical and chemical characters, cont.

III. COALS.—Numbers 28 to 35 (inc.). All these fuels are hard and firm, and would, it may be inferred, bear transportation without serious waste by reduction to fine coal. Numbers 31, 32, 33, 34 and 35, in appearance, closely resemble some varieties of coal of the Carboniferous; numbers 29 and 31 show traces of slickensides. Only one of these coals communicates any very appreciable coloration to a boiling solution of caustic potash, the remainder do not impart a greater depth of tint than that afforded by some coals of Carboniferous age. In common with all the preceding fuels, they yield, by slow coking a non-coherent coke—by fast coking, on the other hand, the result is a coherent coke, that of numbers 28 and 29 being tender, whilst in all other instances the result is a good firm coke. On referring to the ultimate analyses of these coals, as given in the text, it will be seen that the numerical relations between the carbon, hydrogen, and oxygen, inclusive of nitrogen, are the same as exist in some varieties of coal (British non-caking, rich in oxygen) of the Carboniferous system.

From the foregoing statements (and by reference to the various analyses) it will be seen that:

Whereas the fuels enumerated under the heading of Lignite, all have a greater or less tendency to disintegrate on exposure to the air; contain a large amount of hygroscopic water; communicate an intense coloration to a solution of caustic potash; yield a non-coherent coke *, and have a chemical composition very similar to that of many foreign lignites—those referred to under Lignitic coal, show a greater disposition to resist exposure to the air; are, on the whole, tolerably firm, and approximate in appearance to some varieties of coal of the Carboniferous; contain very much less hygroscopic water; do not impart so deep a coloration to a solution of caustic potash; show a slight caking tendency *, and in regard to chemical composition occupy a position between true lignites and true bituminous coals—whilst those designated as Coals, differ from the preceding in that, they resist exposure to the air; are hard and firm; contain but a small proportion of hygroscopic water; communicate but a very slight coloration to a solution of caustic potash; yield, in the majority of instances, a good firm

* Fast coking referred to.

coke *, and in respect to general appearance and chemical composition closely resemble some varieties of coal of the Carboniferous system.

Applications.

All the fuels referred to as coals are well adapted for the manufacture of illuminating gas, as are also, although in a somewhat lesser degree, the lignitic coals—and possibly some of the lignites might be used for the same purpose. The first mentioned being for the most part strongly caking, the coke obtained from them in the process of gas making will constitute a valuable fuel for many purposes; in the case of the lignitic coals and lignites, however, which yield respectively but slightly fritted and non-coherent cokes, the residuary coke, more especially that of the lignites, will most probably be found to be of somewhat limited application. It appeared desirable in the case of those fuels which are only slightly or non-caking, to ascertain what proportion of a caking coal would be required to be added to them in order to ensure the production of a coherent, serviceable coke, and with this object in view the undermentioned experiments were carried out. Number 26 was selected to represent the lignitic coals and number 2 the lignites: the caking coal employed was the well-known Youghiogheny gas coal (Pennsylvania). The materials were reduced to the same state of mechanical division (tolerably fine powder); the weight of mixture employed was in all instances the same, and the cokings were conducted as nearly as possible at the same temperature. The results were as follows:—

Coking experiments.

Number of experiment.	Proportions. Parts by weight, of Number 26. (lignitic coal)	Youghiogheny coal.	Character of the coke.
1.	100	20	Firm, coherent, an excellent coke.
2.	"	15	" " " "
3.	"	10	" " somewhat inferior to the one immediately preceding, but still of good quality.
4.	"	5	Coherent, but tender—fairly good.
	Number 2. (lignite)		
5.	100	20	Firm, coherent — good quality — about equal to that of experiment 3.
6.	"	15	Coherent, somewhat tender, fairly good.
7.	"	10	Coherent, but tender, inferior.

From this it will be seen that—as far as experiments on the small scale are concerned—the addition of fifteen parts of a strongly caking

* Fast coking referred to.

Applications, cont.

coal to one hundred parts of the lignitic coal, ensures the production of a good strong coke: with ten parts of caking coal the product is still a good coke, and even the mixture containing only five parts of caking coal makes a coke which, although somewhat tender, might yet be found useful for some purposes. The lignite, it may be observed, requires a much larger addition of caking coal in order to ensure equally satisfactory results—the mixture containing twenty parts of caking coal does not make a stronger coke than that obtained from the mixture of lignitic coal containing only half that amount of caking coal: with fifteen parts of caking coal, the coke was tender, though possibly still a useful fuel; that made from the mixture containing ten parts of caking coal cannot be regarded as a useful coke.

From the foregoing experiments it may, therefore, be inferred that: —as regards the lignitic coal, the addition of fifteen parts of a strongly caking coal to one hundred parts of that fuel would be found to yield a good firm coke, and that about ten parts of caking coal is the smallest proportion that would be found to give satisfactory results:—in the case of the lignite an addition of not less than twenty parts of caking coal to one hundred parts of lignite would be required in order to ensure the production of a good coherent coke, and that fifteen parts of caking coal is the smallest proportion that can be employed with any probability of obtaining a fairly good coke.*

The lignites constitute a good fuel for the burning of lime and bricks, and very many of them in their sounder condition—that is to say when freshly or comparatively recently mined—will be found suitable for domestic purposes, either for cooking or warming; the better qualities might, step grates being used, be employed for heating steam boilers —there can be little doubt but that they might all be successfully utilized by means of gas producers.

The lignitic coals are good fuels and may be used with advantage for household purposes, for raising steam and in various metallurgical operations. The coals constitute excellent fuels and will be found to serve well for all domestic purposes, to be well adapted for stationary boilers and locomotives, and admirably suited for many metallurgical purposes. The anthracitic coal and semi-anthracite appeared, as regarded their application, to call for a few special remarks, these have been appended to their respective analyses.

With reference to the evaporative power of these fuels, as determined by Thompson's calorimeter—the results obtained are, it need scarcely be

* Experience has shown that, in the preparation of coke from a mixture of non-caking and caking coal, it is very desirable that the latter be reduced to a much finer state of division than the former. The two kinds of fuel should therefore be ground separately and afterwards mixed in the desired proportions.

Applications, cont.

said, higher than could be obtained in practice, where indeed the full capabilities of a fuel are never realized, and this may be ascribed to several causes:—the fuel is scarcely ever fully consumed, a part escapes combustion by passing off in the form of combustible gases and smoke, another portion falls through the grate with the ash; there is loss of heat by radiation and conduction, that by conduction not only occurs through the materials of the furnace, but also from the gaseous products and excess of air, which carry with them a considerable portion of the heat into the chimney and air; heat is also conducted away by the ash which falls through the grate, and a further portion is absorbed in vaporising the hygroscopic and combined water.

In the employment of fuel, its physical and chemical constitution must be taken into account, and the conditions ascertained which are most conducive to the development of its full calorific power:—the furnace should have its details arranged with special reference to the burning of a particular fuel, as may be found after a trial, the best and most economical arrangement for that fuel. With reference to the value to be attached to the experimental results obtained by actually burning a portion of the fuel under the boiler, the information which even this method affords for practical guidance is not always so reliable as might appear at first sight. Touching the evaporative power of coals, Dr. Percy says*—"Numerous costly and very elaborate experiments have been made in this and other countries to determine the relative values of different kinds of coal with reference to steam navigation; and I have no hesitation in expressing my conviction that some of the results may lead to very erroneous conclusions. A particular boiler—it may be an old one—is selected for the purpose of experiment and set over a particular fire-grate, etc. We will suppose two varieties of coal, say A and B, to be tested in this apparatus, and that, weight for weight, A is found to yield more steam than B; whereupon A is pronounced decidedly superior as a steam coal to B. But it is quite possible that this result may be due to the particular boiler and fire-grate being best suited to the manner in which A burns; and that under another boiler, and with another form of fire-grate, etc., B might be found superior to A. Experiments, indeed, have established that such is sometimes actually the case."

* Percy's Metallurgy; Refractory Materials and Fuel, London, 1875.

I. Analyses of Lignites.

Lignite from Souris River.

1.—From the Souris River, one mile west of La Roche Percée, at the junction of Short Creek and Souris River. "Sutherland's" mine. Seam five feet thick. Geological position—Tertiary. Collected by Dr. A. R. C. Selwyn, and referred to by him in the Report of Progress for 1879–80, p. 5 A.

A brownish-black, compact lignite; ligneous texture very marked; lustre for the greater part dull, in more altered parts sub-resinous to resinous; tough; fracture on the whole uneven, occasionally however, verging on the sub-conchoidal; does not soil the fingers, powder black, with a brownish tinge; it communicates a deep brownish-red color to a boiling solution of caustic potash; by exposure to the air becomes more or less fissured.

Specific gravity 1.4168—Weight of one solid cubic foot. 88.55 pounds.

Analyses of.

Analyses by slow and fast coking gave:

	Slow coking.	Fast coking.
Hygroscopic water	21.84	21.84
Volatile combustible matter	32.15	35.12
Fixed carbon	41.61	38.64
Ash	4.40	4.40
	100.00	100.00
Coke, per cent	46.01	43.04
Ratio of volatile combustible matter to fixed carbon	1:1.29	1:1.10

It yields—both by slow and fast coking, a non-coherent coke. The ash has a brownish-yellow color—exposed to a bright red heat it becomes slightly agglutinated.

Lignite from the South Saskatchewan.

2.—From the South Saskatchewan, south side, about ten miles above Medicine Hat. Lower seam. Seam four feet thick. Geological position—Cretaceous. Collected by Mr. R. G. McConnell.

Structure coarse lamellar—the various layers differ somewhat in lustre; contains an occasional interstratified layer of mineral charcoal; color black; lustre along the plane of bedding dull, that of the cross fracture sub-resinous to resinous; fracture uneven, that of some of the layers not unfrequently conchoidal; the brighter portions do not soil the fingers; powder brownish-black; it communicates a deep brownish-red color to a boiling solution of caustic potash; by exposure to the air splits along the plane of bedding and falls to pieces.

Specific gravity 1.3972—Weight of one solid cubic foot 87.32 pounds.

Analyses of.

Analyses by slow and fast coking gave:

	Slow coking.	Fast coking.
Hygroscopic water	16.82	16.82
Volatile combustible matter	29.54	31.90
Fixed carbon	46.34	43.98
Ash	7.30	7.30
	100.00	100.00
Coke, per cent	53.64	51.28
Ratio of volatile combustible matter to fixed carbon	1:1.57	1:1.38

An ultimate analysis gave:

		Exclusive of sulphur, ash, and hygroscopic water.
Carbon	54.35	72.26
Hydrogen	3.34	4.44
Oxygen and Nitrogen	17.52	23.30
Sulphur	0.67	—
Ash	7.30	—
Hygroscopic water	16.82	—
	100.00	100.00

Calorific power of

Calorific power—determined by experiment:

Indicated power of fuel in calories 5144
Indicated evaporative power ....9.57 pounds of water (at 100° C.) per pound of fuel.

It yields—both by slow and fast coking, a non-coherent coke*; the gases evolved during coking burnt with a yellowish, somewhat luminous, slightly smoky flame. The ash has a reddish-brown color—exposed to a bright red heat it becomes slightly agglutinated, at a most intense red heat it forms a more or less vitrified mass.

Lignite from the South Saskatchewan.

3.—From the South Saskatchewan, south side. From the same seam as the preceding specimen, but taken at a point somewhat further up the river, viz., ten and a quarter miles above Medicine Hat. Collected by Mr. R. G. McConnell.

Structure coarse lamellar—the successive layers differ somewhat in color and lustre, the former varying from black, with a brownish tinge, to pure black, and the latter from sub-resinous to shining resinous; some of the layers exhibit a very marked

* With respect to the preparation of a coherent coke from this fuel by admixture of the same with a caking coal, see page 8 M.

ligneous texture; fracture uneven, occasionally somewhat conchoidal; does not soil the fingers; powder brownish-black; it communicates a deep brownish-red color to a boiling solution of caustic potash; by exposure to the air splits along the line of bedding and falls to pieces.

Specific gravity 1.3722—Weight of one solid cubic foot 85.76 pounds.

Analyses by slow and fast coking gave: Analyses of.

	Slow coking.	Fast coking.
Hygroscopic water	17.70	17.70
Volatile combustible matter	28.63	29.90
Fixed carbon	49.83	48.56
Ash	3.84	3.84
	100.00	100.00
Coke, per cent	53.67	52.40
Ratio of volatile combustible matter to fixed carbon	1 : 1.74	1 : 1.62

It yields—both by slow and fast coking, a non-coherent coke; the gases evolved during coking burnt with a yellowish, slightly luminous, almost smokeless flame. The ash has a dark reddish-brown color—exposed to a bright red heat it becomes agglutinated, at a most intense red heat it forms a slaggy mass.

4.—From the North Saskatchewan, right bank, about forty miles below the confluence of the Brazeau River. Seam eighteen to twenty feet thick. Geological position—Laramie (Tertiary ?) or Cretaceous. Collected by Mr. R. W. Ells, 1875. Photographed and described in 1873 by Dr. A. R. C. Selwyn—Report of Progress for 1873–74, p. 49. Lignite from the North Saskatchewan.

Structure, coarse lamellar; made up of alternate layers of more or less dense, bright and dull coal, and numerous interstratified layers of mineral charcoal; the surface of the denser layers parallel to the plane of deposition present a ligneous structure; color black; lustre along the surface of bedding dull, that of the cross fracture sub-resinous to resinous; fracture uneven, that of the brighter layers somewhat conchoidal; the brighter portions do not soil the fingers; powder almost black; it communicates a deep brownish-red color to a boiling solution of caustic potash; by exposure to the air becomes fissured, preferably along the line of bedding, and falls to pieces.

Specific gravity 1.4341—Weight of one solid cubic foot 89.63 pounds.

Analyses of.

Analyses by slow and fast coking gave:

	Slow coking.	Fast coking.
Hygroscopic water	14.78	14.78
Volatile combustible matter	28.46	30.48
Fired carbon	50.69	48.67
Ash	6.07	6.07
	100.00	100.00
Coke, per cent	56.76	54.74
Ratio of volatile combustible matter to fixed carbon	1 : 1.78	1 : 1.59

Calorific power of.

Calorific power—determined by experiment:

Indicated power of fuel in calories 5289
Indicated evaporative power .... 9.84 pounds of water (at 100° C.) per pound of fuel.

It yields—both by slow and fast coking, a non-coherent coke; the gases evolved during coking burnt with a yellowish, slightly luminous, almost smokeless flame. The ash has a pale brownish-yellow color,—exposed to a bright red heat it becomes very slightly agglutinated, at a most intense red heat it becomes slightly fritted.

Lignite from the North Saskatchewan.

5.—From the North Saskatchewan, right bank, a short distance below Fort Edmonton. Seam six feet thick. Geological position—probably Laramie.

Structure very compact and homogeneous; color brownish-black; lustre dull, occasionally sub-resinous; tough; fracture large conchoidal; does not soil the fingers; powder black, with a brownish tinge; it communicates a deep brownish-red color to a boiling solution of caustic potash; by exposure to the air becomes more or less fissured.

Specific gravity 1.4256—Weight of one solid cubic foot 89.10 pounds.

Analyses of.

Analyses by slow and fast coking gave:

	Slow coking.	Fast coking
Hygroscopic water	12.89	12.89
Volatile combustible matter	32.19	33.79
Fixed carbon	52.17	50.57
Ash	2.75	2.75
	100.00	100.00
Coke, per cent	54.92	53.32
Ratio of volatile combustible matter to fixed carbon	1:1.62	1:1.49

Calorific power—determined by experiment: *Calorific power of.*

Indicated power of fuel in calories....................5207

Indicated evaporative power..................9.69 pounds of water (at 100° C.) per pound of fuel.

It yields—both by slow and fast coking, a non-coherent coke; the gases evolved during coking burnt with a yellowish, somewhat luminous, slightly smoky flame. The ash has a dark brownish-yellow color—exposed to a bright red heat it becomes agglutinated, at a most intense red heat it forms a slaggy mass.

6.—From Red Deer River, at the mouth of Arrowwood River. Seam six feet thick. Geological position—Laramie. Collected by Mr. R. G. McConnell. *Lignite from Red Deer River.*

Structure very fine lamellar, the lines of bedding are however not unfrequently very indistinct—tolerably compact; color black; lustre sub-resinous to resinous; fracture uneven, occasionally verging on the conchoidal; does not soil the fingers; powder almost black; it communicates a deep brownish-red color to a boiling solution of caustic potash; by exposure to the air becomes somewhat fissured and in consequence has a tendency to fall to pieces.

Specific gravity 1.4027—Weight of one solid cubic foot 87.67 pounds.

Analyses by slow and fast coking gave: *Analyses of.*

	Slow coking.	Fast coking.
Hygroscopic water	13.08	13.08
Volatile combustible matter	31.49	34.50
Fixed carbon	51.35	48.34
Ash	4.08	4.08
	100.00	100.00
Coke, per cent.	55.43	52.42
Ratio of volatile combustible matter to fixed carbon	1:1.63	1:1.40

Calorific power—determined by experiment: *Calorific power of.*

Indicated power of fuel in calories....................5347

Indicated evaporative power..................9.95 pounds of water (at 100°C.) per pound of fuel.

It yields—both by slow and fast coking, a non-coherent coke; the gases evolved during coking burnt with a yellowish, slightly luminous, almost smokeless flame. The ash has a reddish-brown color—exposed to a bright red heat, it becomes very slightly agglutinated, at a most intense red heat, it forms a slaggy mass.

Lignite from Red Deer River.

7.—From the Red Deer River, two miles below the mouth of Arrowwood River. The seam, which here has a thickness of five feet, is the same as that from which the preceding specimen was taken—it is probably an extension of the seam at Blackfoot Crossing, Bow River (specimen No. 12). Geological position—Laramie. Collected by Mr. R. G. McConnell.

Structure very fine lamellar, the lines of bedding are, however, often almost obliterated—tolerably compact; color black; lustre sub-resinous to resinous; fracture uneven, occasionally approaching the conchoidal; does not soil the fingers; powder almost black; it communicates a deep brownish-red color to a boiling solution of caustic potash; cracks somewhat by exposure to the air and as a result has a tendency to fall to pieces.

Specific gravity 1.3929—Weight of one solid cubic foot 87.06 pounds.

Analyses of.

Analyses by slow and fast coking gave:

	Slow coking.	Fast coking.
Hygroscopic water	14.20	14.20
Volatile combustible matter	30.92	34.22
Fixed carbon	51.21	47.91
Ash	3.67	3.67
	100.00	100.00
Coke, per cent	54.88	51.58
Ratio of volatile combustible matter to fixed carbon	1:1.66	1:1.40

It yields—both by slow and fast coking, a non-coherent coke; the gases evolved during coking burnt with a yellowish, somewhat luminous, slightly smoky flame. The ash has a bright red color—exposed to a bright red heat, it becomes slightly agglutinated, at a most intense red heat it forms a slaggy mass.

Lignite from Red Deer River.

8.—From the Red Deer River, about seven miles above Hunter's Hill. Seam three and a half feet thick. Geological position—Cretaceous, below Pierre. Collected by Mr. R. G. McConnell.

Structure somewhat fine lamellar; contains an occasional interstatified layer of mineral charcoal; reticulated throughout with delicate laminæ of gypsum, those perpendicular to the lamination dividing it into small blocks of irregular shape, consequent upon which the cross fracture, which is very uneven, presents a highly characteristic appearance; lustre in the direction of the bedding dull, that of the cross fracture resinous; apart from the layers of mineral charcoal, does not soil the fingers; powder almost black; it communicates a deep brownish-red color to a boiling solution of caustic potash; after exposure to the air it parts somewhat readily into small fragments, the line of fracture being apparently determined by the films of gypsum.

Specific gravity 1.4257—Weight of one solid cubic foot 89.11 pounds.

Analyses by slow and fast coking gave: Analyses of.

	Slow coking.	Fast coking.
Hygroscopic water	13.06	13.06
Volatile combustible matter	29.41	33.75
Fixed carbon	48.51	44.17
Ash	9.02	9.02
	100.00	100.00
Coke, per cent	57.53	53.19
Ratio of volatile combustible matter to fixed carbon	1:1.65	1:1.30

Calorific power—determined by experiment: Calorific power of.

Indicated power of fuel in calories 5028
Indicated evaporative power ....9.36 pounds of water (at 100° C.) per pound of fuel.

It yields—both by slow and fast coking, a non-coherent coke; the gases evolved during coking burnt with a yellowish, somewhat luminous, slightly smoky flame. The ash has a brownish-yellow color,—exposed to a bright red heat, it becomes slightly agglutinated, at a most intense red heat, it forms a slaggy mass.

9.—From the Red Deer River, nine miles above Hunter's Hill. Seam one and a half foot thick. Geological position—Cretaceous, below Pierre. Collected by Mr. R. G. McConnell. Lignite from Red Deer River.

Structure fine lamellar—tolerably compact; color black; lustre of surface along the plane of bedding dull, that of the cross fracture resinous; fracture uneven, occasionally somewhat conchoidal; does not soil the fingers; in parts coated with a slight deposit of ferric hydrate; powder black, faint brownish tinge; it communicates a deep brownish-red color to a boiling solution of caustic potash; by exposure to the air splits in the direction of the bedding and falls to pieces.

Analyses by slow and fast coking gave: Analyses of.

	Slow coking.	Fast coking.
Hygroscopic water	13.63	13.63
Volatile combustible matter	31.31	34.01
Fixed carbon	41.81	39.11
Ash	13 25	13.25
	100.00	100.00
Coke, per cent	55.06	52.36
Ratio of volatile combustible matter to fixed carbon	1:1.33	1:1.15

It yields—both by slow and fast coking, a non-coherent coke; the gases evolved during coking burnt with a yellowish, slightly luminous, almost smokeless flame. The ash has a pale reddish-yellow color—exposed to a bright red heat it does not become agglutinated, at a most intense red heat it forms a more or less vitrified mass.

Lignite from Red Deer River.

10.—From the Red Deer River, thirteen miles above Hunter's Hill. Seam fifteen inches thick. North-north-east extension of the "Coal Banks" seam (specimen No. 26). Geological position—Cretaceous, base of Pierre. Collected by Mr. R. G. McConnell.

Structure fine lamellar,—tolerably compact; color black; lustre along the plane of bedding dull, that of the cross fracture, resinous; fracture irregular; intersected throughout by numerous thin plates of gypsum; here and there coated with a slight deposit of ferric hydrate; does not soil the fingers; powder black, slight brownish tinge; it communicates a deep brownish-red color to a boiling solution of caustic potash; by exposure to the air splits along the line of bedding and falls to pieces.

Specific gravity 1.4221—Weight of one solid cubic foot 88.88 pounds.

Analyses of.

Analyses by slow and fast coking gave:

	Slow coking.	Fast coking.
Hygroscopic water	12.62	12.62
Volatile combustible matter	32.08	35.99
Fixed carbon	46.72	42.81
Ash	8.58	8.58
	100.00	100.00
Coke, per cent	55.30	51.39
Ratio of volatile combustible matter to fixed carbon	1:1.46	1:1.19

It yields—both by slow and fast coking, a non-coherent coke; the gases evolved during coking burnt with a yellow, luminous, somewhat smoky flame. The ash has a pale dirty reddish-brown color,—exposed to a bright red heat it becomes slightly agglutinated, at a most intense red heat it forms a slaggy mass.

Lignite from the Bow River (Grassy Island).

11.—From Grassy Island, Bow River. Main seam; seam four and a half feet thick. North-north-east extension of "Coal Banks" seam, (specimen No. 26). Geological position—Cretaceous, base of Pierre. Collected by Dr. G. M. Dawson.

Structure fine lamellar, tolerably compact; fracture uneven; lustre of surface parallel to the bedding dull, that across the bedding sub-resinous; color black; contains here and there an interposed patch of mineral charcoal, and is in parts coated with a slight film of ferric hydrate; apart from the patches of mineral charcoal, does not soil the fingers; powder black, slight brownish tinge; it communicates a deep brownish-red color to a boiling solution of caustic potash; by exposure to the air splits in the direction of the bedding and falls to pieces.

Specific gravity 1.4162—Weight of one solid cubic foot 88.51 pounds.

Analyses by slow and fast coking gave: Analyses of.

	Slow coking.	Fast coking.
Hygroscopic water	11.90	11.90
Volatile combustible matter	31.20	35.02
Fixed carbon	50.97	47.15
Ash	5.93	5.93
	100.00	100.00
Coke, per cent	56.90	53.08
Ratio of volatile combustible matter to fixed carbon	1 : 1.63	1 : 1.34

Calorific power—determined by experiment: Calorific power of.

Indicated power of fuel in calories....................5473
Indicated evaporative power.................10.19 pounds of water (at 100° C.) per pound of fuel.

It yields—both by slow and fast coking, a non-coherent coke; the gases evolved during coking burnt with a yellow, luminous, somewhat smoky flame. The ash has a bright red color,—exposed to a bright red heat it becomes slightly agglutinated, at a most intense red heat it forms a more or less vitrified mass.

12.—From Blackfoot Crossing, Bow River; in coulée six and a half miles east of old Blackfoot Agency buildings. The deposit consists of two seams, the upper averaging one foot eight inches in thickness, the lower three feet: they are separated by a foot of carbonaceous shale. This specimen was taken from the lower or three feet seam. Geological position—Laramie. Collected by Dr. G. M. Dawson. Lignite from the Bow River (Blackfoot Crossing.)

Structure fine lamellar, tolerably compact; color black; lustre in the direction of the bedding dull, that of the cross fracture resinous; contains here and there an interposed patch of mineral charcoal; fracture uneven, occasionally somewhat conchoidal; in parts coated with a slight deposit of ferric hydrate; powder black, faint brownish tinge; it communicates a deep brownish-red color to a boiling solution of caustic potash; by exposure to the air splits along the line of bedding and falls to pieces.

Specific gravity 1.3970—Weight of one solid cubic foot 87.31 pounds.

Analyses of. Analyses by slow and fast coking gave:

	Slow coking.	Fast coking.
Hygroscopic water	11.91	11.91
Volatile combustible matter	30.04	33.25
Fixed carbon	54.78	51.57
Ash	3.27	3.27
	100.00	100.00
Coke, per cent	58.05	54.84
Ratio of volatile combustible matter to fixed carbon	1:1.82	1:1.55

Calorific power of. Calorific power—determined by experiment:

Indicated power of fuel in calories 5531
Indicated evaporative power ....10.29 pounds of water (at 100°C.) per pound of fuel.

It yields—both by slow and fast coking, a non-coherent coke; the gases evolved during coking burnt with a yellow, luminous, slightly smoky flame. The ash has a yellowish-brown color,—exposed to a bright red heat it becomes agglutinated, at a most intense red heat it forms a slaggy mass.

"Conchoidal." lignite. 13.—"Conchoidal" lignite found in some parts of the seam from which the preceding specimen was taken. Collected by Dr. G. M. Dawson.

Structure compact; homogenous, like jet—some fragments exhibited, although but faintly, a delicate ligneous texture; color velvet-black; lustre resinous; brittle; fracture conchoidal; feel smooth, does not soil the fingers; powder black, faint brownish tinge; it communicates a deep brownish-red color to a boiling solution of caustic potash.

Specific gravity 1.3850.

Analyses of. Analyses by slow and fast coking gave:

	Slow coking.	Fast coking.
Hygroscopic water	12.31	12.31
Volatile combustible matter	29.82	32.83
Fixed carbon	55.75	52.74
Ash	2.12	2.12
	100.00	100.00
Coke, per cent	57.87	54.86
Ratio of volatile combustible matter to fixed carbon	1:1.87	1:1.60

It yields—both by slow and fast coking, a non-coherent coke. The ash has a dark brownish-yellow color.

This "conchoidal" lignite would appear to consist of fragments of the more solid portions—root, trunk, or branch—of some of the vegetable matter from which the bed of lignite has been derived.

14.—From the south side of Bow River, about four miles below Blackfoot Crossing. Geological position—Laramie. Collected by Prof. J. Macoun. Lignite from the Bow River (Blackfoot Crossing).

Structure somewhat coarse lamellar; contains an occasional layer of mineral charcoal; color black; lustre of freshly fractured surface, bright; some of the layers of lignite are reticulated throughout with films of gypsum, such, on pressure, crumble readily into small fragments; powder black, with a brownish tinge; it communicates a deep brownish-red color to a boiling solution of caustic potash; by exposure to the air has a tendency to split along the line of bedding. This specimen was slightly soiled with clay, which had also permeated some of the fissures.

Analyses by slow and fast coking gave: Analyses of.

	Slow coking.	Fast coking.
Hygroscopic water	10.72	10.72
Volatile combustible matter	29.26	32.63
Fixed carbon	46.09	42.72
Ash	13.93	13.93
	100.00	100.00
Coke, per cent	60.02	56.65
Ratio of volatile combustible matter to fixed carbon	1 : 1.57	1 : 1.31

It yields—both by slow and fast coking, a non-coherent coke. The ash has a reddish-white color,—exposed to a bright red heat it becomes very slightly agglutinated.

15.—From Crowfoot Creek, four miles from its entry into Bow River. Seam six feet thick. Geological position—Laramie. Collected by Prof. J. Macoun. Lignite from the Bow River (Crowfoot Creek).

Structure fine lamellar; reticulated throughout with delicate laminæ of gypsum; fracture uneven: color black; lustre bright; powder black, with a brownish tinge; it communicates a deep brownish-red color to a boiling solution of caustic potash; by simple exposure to the air does not readily fall to pieces—when pressed between the fingers it parts into small fragments, the line of fracture being determined, apparently, by the films of gypsum.

Analyses of.

Analyses by slow and fast coking gave:

	Slow coking.	Fast coking.
Hygroscopic water	11.25	11.25
Volatile combustible matter	31.98	35.59
Fixed carbon	50.85	47.24
Ash	5.92	5.92
	100.00	100.00
Coke, per cent	56.77	53.16
Ratio of volatile combustible matter to fixed carbon	1 : 1.59	1 : 1.33

It yields—both by slow and fast coking, a non-coherent coke. The ash has a brownish-yellow color—exposed to a bright red heat it becomes slightly agglutinated.

Lignite from the Bow River (Horse-shoe Bend).

16.—From Horse-shoe Bend, Bow River. Seam four and a-half feet thick. This specimen was taken from the upper part of the seam. Geological position—Cretaceous, top of Pierre. Collected by Dr. G. M. Dawson.

Structure fine lamellar—tolerably compact; color black; lustre in the direction of the bedding dull, that of the cross fracture, resinous; fracture uneven, occasionally somewhat conchoidal; does not soil the fingers; powder black, with a brownish tinge; it communicates a deep brownish-red color to a boiling solution of caustic potash; by exposure to the air it becomes incrusted with a white efflorescence, resulting from the oxidation of the iron-pyrites, which is disseminated through this lignite in a very finely divided state—splits in the direction of the bedding and falls to pieces.

Analyses of.

Analyses by slow and fast coking gave;

	Slow coking.	Fast coking.
Hygroscopic water	11.13	11.13
Volatile combustible matter	36.52	38.75
Fixed carbon	43.16	40.93
Ash	9.19	9.19
	100.00	100.00
Coke, per cent	52.35	50.12
Ratio of volatile combustible matter to fixed carbon	1 : 1.18	1 : 1.06

It yields—both by slow and fast coking, a non-coherent coke. The ash has a dark brownish-red color,—exposed to a bright red heat it becomes slightly agglutinated, at a most intense red heat it forms a slaggy mass.

17.—From the Smoky River, five miles below the mouth of Little Smoky River. Seam two and a-half inches thick. Geological position—Cretaceous, Dunvegan Group. Collected by Dr. G. M. Dawson, and referred to by him in the Report of Progress for 1879-80, p. 118 B. Lignite from Smoky River.

Structure coarse lamellar; made up of alternating layers of a dull and bright lignite and mineral charcoal, of which latter it contains a good deal; small fragments of a pale yellowish, sub-transparent resin also occur, diffused through certain portions of its substance; color black; powder black, with a brownish tinge; it communicates a deep brownish-red color to a boiling solution of caustic potash.

Analyses by slow and fast coking gave: Analyses of.

	Slow coking.	Fast coking.
Hygroscopic water	11.52	11.52
Volatile combustible matter	31.26	34.83
Fixed carbon	53.04	49.47
Ash	4.18	4.18
	100.00	100.00
Coke, per cent	57.22	53.65
Ratio of volatile combustible matter to fixed carbon	1 : 1.69	1 : 1.42

It yields—by slow coking, a non-coherent coke—by fast coking a slightly fritted coke, the fritting most probably being due to the presence of the resin. The ash has a pale reddish-brown color,—exposed to a bright red heat it becomes slightly agglutinated.

18.—From the Athabasca River, about fifty-five miles above the site of old Fort Assineboine. Upper seam; seam ten feet thick. Geological position—Laramie. Collected by Dr. G. M. Dawson, and referred to by him in the Report of Progress for 1879-80, p. 126 B. Lignite from Arthabasca River.

Structure coarse lamellar; it consists of bright and somewhat dull layers of lignite, and an occasional layer of mineral charcoal interstratified; color black; lustre of some of the layers, sub-resinous, that of others shining resinous; fracture uneven; some of the layers of lignite are reticulated throughout with delicate laminæ of gypsum; powder black, with a brownish tinge; it communicates a deep brownish-red color to a boiling solution of caustic potash; by exposure to the air splits along the line of bedding.

Specific gravity 1.4423—Weight of one solid cubic foot 90.14 pounds.

Analyses of.

Analyses by slow and fast coking gave:

	Slow coking.	Fast coking.
Hygroscopic water	11.47	11.47
Volatile combustible matter	28.96	32.04
Fixed carbon	50.92	47.7
Ash	8.65	8.65
	100.00	100.00
Coke, per cent	59.57	56.44
Ratio of volatile combustible matter to fixed carbon	1:1.76	1:1.49

Calorific power of.

Calorific power—determined by experiment:

Indicated power of fuel in calories..........5424
Indicated evaporative power..........10.10 pounds of water (at 100° C.) per pound of fuel.

It yields—both by slow and fast coking, a non-coherent coke; the gases evolved during coking burnt with a yellow, luminous somewhat smoky flame. The ash has a light bluish-grey color—exposed to a bright red heat it becomes very slightly agglutinated.

Lignite from Arthabasca River.

19.—From the Athabasca River, about fifty-five miles above the site of old Fort Assineboine. Lower seam; seam three feet thick. Geological position—Laramie. Collected by Dr. G. M. Dawson, and referred to by him in the Report of Progress for 1879–80, p. 126B.

Structure somewhat coarse lamellar; made up of successive layers of a bright and dull lignite, with an occasional intervening layer of mineral charcoal; color black; fracture uneven; powder black, with a brownish tinge; it communicates a deep brownish-red color to a boiling solution of caustic potash; by exposure to the air it has a tendency to split in the direction of the bedding.

Specific gravity 1.4387—Weight of one solid cubic foot 89.92 pounds.

Analyses of.

Analyses by slow and fast coking gave:

	Slow coking.	Fast coking.
Hygroscopic water	10.58	10.58
Volatile combustible matter	29.29	32.79
Fixed carbon	53.69	50.19
Ash	6.44	6.44
	100.00	100.00
Coke, per cent	60.13	56.63
Ratio of volatile combustible matter to fixed carbon	1:1.83	1:1.53

It yields—both by slow and fast coking, a non-coherent coke;

The ash has a light grey color—exposed to a bright red heat it becomes very slightly agglutinated.

20.—From the northern side of Milk River Ridge. Seam one and a half foot thick. Southern extension of "Coal Banks" seam (specimen No. 26). Geological position—Cretaceous, base of Pierre. Collected by Mr. R. G. McConnell. Lignite from Milk River Ridge.

Structure fine lamellar, tolerably compact; color black; lustre along the plane of bedding dull, that of the cross fracture, subresinous; fracture uneven; does not soil the fingers; in parts coated with a film of ferric hydrate; powder brownish-black; it communicates a deep brownish-red color to a boiling solution of caustic potash; by exposure to the air splits in the direction of the bedding and falls to pieces.

Specific gravity 1.5140—Weight of one solid cubic foot 94.62 pounds.

Analyses by slow and fast coking gave: Analyses of.

	Slow coking.	Fast coking.
Hygroscopic water	9.84	9.84
Volatile combustible matter	28.66	31.92
Fixed carbon	42.67	39.41
Ash	18.83	18.83
	100.00	100.00
Coke, per cent	61.50	58.24
Ratio of volatile combustible matter to fixed carbon	1:1.49	1:1.23

Calorific power—determined by experiment: Calorific power of.

Indicated power of fuel in calories 4980
Indicated evaporative power .... 9.27 pounds of water (at 100° C.) per pound of fuel.

It yields—both by slow and fast coking, a non-coherent coke; the gases evolved during coking burnt with a yellow, luminous, slightly smoky flame. The ash has a greenish-grey color—exposed to a bright red heat, it becomes very slightly agglutinated, at a most intense red heat it forms a more or less vitrified mass.

21.—From the Pine River, Coal Brook, two and a-half miles east of the Lower Forks. Seam six inches thick. Geological position—Cretaceous, Dunvegan Group. Collected by Dr. G. M. Dawson, and referred to by him in the Report of Progress for 1879-80, p. 117 B. Lignite from Pine River, Coal Brook.

Structure very fine lamellar; the lines of bedding, which are very numerous and close together, are almost obliterated—compact;

color black; lustre sub-resinous to resinous, occasionally in parts brilliant; hard and firm; shows well defined planes of cleat; does not soil the fingers; weathered surfaces in places coated with ferric hydrate; powder brownish-black; it communicates a deep brownish-red color to a boiling solution of caustic potash; resists exposure to the air; in appearance it resembles some varieties of coal of the Carboniferous system.

Specific gravity 1.4217—Weight of one solid cubic foot, 88.86 pounds.

Analyses of. Analyses by slow and fast coking gave:

	Slow coking.	Fast coking.
Hygroscopic water	7.83	7.83
Volatile combustible matter	30.55	34.21
Fixed carbon	55.75	52.09
Ash	5.87	5.87
	100.00	100.00
Coke, per cent	61.62	57.96
Ratio of volatile combustible matter to fixed carbon	1 : 1.82	1 : 1.52

It yields—both by slow and fast coking, a non-coherent coke. The ash has a reddish-white color,—exposed to a bright red heat it becomes very slightly agglutinated, at a most intense red heat it becomes slightly fritted.

II. Analyses of Lignitic Coals.

Lignitic coal from Belly River. 22.—From the Belly River, five miles below the mouth of Little Bow River. Geological position—Cretaceous. Collected by Dr. G. M. Dawson.

Structure very fine lamellar, lines of bedding not unfrequently very indistinct or altogether obliterated—compact; contains an occasional interposed patch of mineral charcoal and here and there a thin plate of gypsum; color black, in parts iridescent; lustre of surface along the plane of bedding dull, that of the cross fracture, resinous, sometimes brilliant; fracture uneven, at times somewhat conchoidal; apart from the patches of mineral charcoal, does not soil the fingers; powder almost black; it communicates a brownish-red color to a boiling solution of caustic potash; by exposure to the air becomes slightly fissured, but is on the whole a tolerably firm coal; in appearance it resembles some varieties of coal of the Carboniferous system.

Specific gravity 1.3976—Weight of one solid cubic foot 87.35 pounds.

Analyses by slow and fast coking gave: Analyses of.

	Slow coking.	Fast coking.
Hygroscopic water	9.18	9.18
Volatile combustible matter	30.66	34.97
Fixed carbon	53.31	49.00
Ash	6.85	6.85
	100.00	100.00
Coke, per cent	60.16	55.85
Ratio of volatile combustible matter to fixed carbon	1 : 1.74	1 : 1.40

An ultimate analysis gave:

		Exclusive of sulphur, ash, and hygroscopic water.
Carbon	62.39	74.99
Hydrogen	3.99	4.79
Oxygen and Nitrogen	16.82	20.22
Sulphur	0.77	—
Ash	6.85	—
Hygroscopic water	9.18	—
	100.00	100.00

The total percentage of sulphur in this coal amounted to 0.816 of this 0.046 was present in the form of gypsum—representing 0.247 of that mineral.

Calorific power—determined by experiment: Calorific power of.

Indicated power of fuel in calories 5821
Indicated evaporative power ....10.84 pounds of water (at 100° C.) per pound of fuel.

It yields—both by slow and fast coking, a non-coherent coke; the gases evolved during coking burnt with a yellow, luminous, slightly smoky flame. The ash has a brownish-yellow color,—exposed to a bright red heat it becomes slightly agglutinated, at a most intense red heat it forms a slaggy mass.

23.—From the Highwood River, North Fork, five miles above Forks. Seam one and a-half foot thick. Geological position—Laramie. Collected by Mr. R. G. McConnell. Lignitic coal from the Highwood River.

Structure compact; shows slickensides; color black, lustre sub-resinous to resinous; hard and firm; fracture uneven; does not soil the fingers; it contains, in parts, a slight deposit of a white amorphous, aluminous mineral which, owing to insufficiency of material, was not identified; powder black, slight brownish tinge; it communicates a brownish-red color to a boiling solution of caustic potash; does not readily fall to pieces when exposed to the air; in appearance it resembles some varieties of coal of the Carboniferous system.

Specific gravity 1.4163—Weight of one solid cubic foot 88.52 pounds.

Analyses of. Analyses by slow and fast coking gave:

	Slow coking.	Fast coking.
Hygroscopic water	6.12	6.12
Volatile combustible matter	26.87	31.92
Fixed carbon	54.93	49.88
Ash	12.08	12.08
	100.00	100.00
Coke, per cent	67.01	61.96
Ratio of volatile combustible matter to fixed carbon	1 : 2.04	1 : 1.56

Calorific power of. Calorific power—determined by experiment:

Indicated power of fuel in calories 5980
Indicated evaporative power .... 11.13 pounds of water (at 100° C.) per pound of fuel.

It yields—by slow coking, a non-coherent coke—by fast coking, a slightly fritted coke; the gases evolved during coking burnt with a yellow, luminous, smoky flame. The ash has a reddish-grey color,—exposed to a bright red heat it does not become agglutinated, at a most intense red heat it becomes slightly fritted.

Lignitic coal from the Highwood River. 24.—From the Highwood River, North Fork. This specimen is from the same seam as the one last under consideration, it was, however, taken at a point about one hundred yards distant from where that was procured.

The description given of the preceding specimen applies also to this one. The specific gravity was not determined.

Analyses of. Analyses by slow and fast coking gave:

	Slow coking.	Fast coking.
Hygroscopic water	4.23	4.23
Volatile combustible matter	26.13	31.06
Fixed carbon	47.97	43.04
Ash	21.67	21.67
	100.00	100.00
Coke, per cent	69.64	64.71
Ratio of volatile combustible matter to fixed carbon	1 : 1.83	1 : 1.38

Calorific power—determined by experiment: Calorific power of.

Indicated power of fuel in calories.................. 5507
Indicated evaporative power............... 10.25 pounds
of water (at 100° C.) per pound of fuel.

It yields—by slow coking, a non-coherent coke—by fast coking, a slightly fritted coke, which crumbles easily between the fingers; the gases evolved during coking burnt with a yellow, luminous, rather smoky flame. The ash has a light bluish-grey color,—exposed to a bright red heat it does not become agglutinated, at a most intense red heat it becomes slightly fritted.

25.—From the Government Indian Farm, south of Pincher Creek, about one mile from the farm buildings, up the valley of the small stream on which they are situated. Seam two feet thick where examined, but reported as considerably thicker where worked into. Geological position—base of Laramie. Collected by Dr. G. M. Dawson. Lignitic coal from Pincher Creek.

Structure foliated, highly contorted; shows slickensides; color black; lustre resinous; firm; fracture uneven; powder black, faint brownish tinge; it communicates a brownish-red color to a boiling solution of caustic potash; slightly soils the fingers; resists exposure to the air; in appearance it much resembles some varieties of coal of the Carboniferous system.

Specific gravity 1.3999—Weight of one solid cubic foot 87.49 pounds.

Analyses by slow and fast coking gave: Analyses of.

	Slow coking.	Fast coking.
Hygroscopic water	5.38	5.38
Volatile combustible matter	27.19	33.19
Fixed carbon	58.34	52.34
Ash	9.09	9.09
	100.00	100.00
Coke, per cent	67.43	61.43
Ratio of volatile combustible matter to fixed carbon	1:2.14	1:1.58

Calorific power—determined by experiment: Calorific power of.

Indicated power of fuel in calories 6241
Indicated evaporative power................11.62 pounds
of water (at 100° C.) per pound of fuel.

It yields—by slow coking, a non-coherent coke—by fast coking, a slightly fritted coke, which crumbles easily between the fingers; the gases evolved during coking burnt with a yellow, luminous, rather smoky flame. The ash has a pale reddish-brown color,—exposed to a bright red heat it does not become agglutinated, at a most intense red heat it becomes slightly fritted.

Lignitic coal "Coal Banks," Belly River.

26.—From the Belly River, main seam at "Coal Banks" (which is at the crossing of the Belly River by the trail to Benton). Seam averages about five and a-half feet thick. Geological position—Cretaceous, base of Pierre. Collected by Dr. G. M. Dawson.

Structure very fine lamellar, the lines of bedding, which are very numerous and close together, are almost obliterated—compact; it contains interstratified, more or less disconnected, lenticular layers of dense, pitch-black, highly lustrous coal, and an occasional patch of mineral charcoal; it is here and there intersected by thin plates of calcite as also by an occasional film of pyrite; it also contains in parts a little reddish-brown, translucent resin; color black; lustre resinous; fracture uneven, occasionally more or less conchoidal; hard and firm; apart from the patches of mineral charcoal, does not soil the fingers; powder black, with a faint brownish tinge; it communicates a brownish-red color to a boiling solution of caustic potash; resists exposure to the air; in appearance it closely resembles some varieties of coal of the Carboniferous system.

Specific gravity 1.3587—Weight of one solid cubic foot 84.92 pounds.

Analyses of.

Analyses by slow and fast coking gave:

	Slow coking.	Fast coking.
Hygroscopic water	6.50	6.50
Volatile combustible matter	31.59	38.04
Fixed carbon	54.36	47.91
Ash	7.55	7.55
	100.00	100.00
Coke, per cent	61.91	55.46
Ratio of volatile combustible matter to fixed carbon	1:1.72	1:1.26

An ultimate analysis gave:

		Exclusive of sulphur, ash, and hygroscopic water.
Carbon	65.30	76.60
Hydrogen	4.30	5.04
Oxygen and Nitrogen	15.65	18.36
Sulphur	0.70	—
Ash	7.55	—
Hygroscopic water	6.50	—
	100.00	100.00

Calorific power of.

Calorific power—determined by experiment:

Indicated power of fuel in calories..................6183
Indicated evaporative power.................11.51 pounds
of water (at 100° C.) per pound of fuel.

It yields—by slow coking, a non-coherent coke—by fast coking, a slightly fritted coke, which crumbles easily between the fingers;* the gases evolved during coking burnt with a yellow, luminous, smoky flame. The ash has a brownish-yellow color,—exposed to a bright red heat it does not become agglutinated, at a most intense red heat it forms a vitrified mass.

Lignitic coal from St. Mary River.

27.—From the St. Mary River, seven miles above its junction with the Belly River. Southern exposure, on St. Mary River, of "Coal Banks" main seam (specimen No. 26). Geological position—Cretaceous, base of Pierre. Collected by Dr. G. M. Dawson.

Structure somewhat coarse lamellar; made up of alternating layers of a greyish-black, dull, and bright black coal, with an occasional interstratified layer of mineral charcoal; it is here and there intersected by thin plates of calcite and also by films of pyrite; fracture uneven,—it occasionally breaks into more or less rhombic fragments; apart from the layers of mineral charcoal, does not soil the fingers; in parts coated with a slight deposit of ferric hydrate; powder black, with a faint brownish tinge; it communicates a brownish-red color to a boiling solution of caustic potash; by exposure to the air becomes slightly fissured, but is on the whole a pretty compact and tolerably firm coal.

Specific gravity 1.3690—Weight of one solid cubic foot 85.56 pounds.

Analyses of.

Analyses by slow and fast coking gave:

	Slow coking.	Fast coking.
Hygroscopic water	7.02	7.02
Volatile combustible matter	29.41	36.47
Fixed carbon	57.28	50.22
Ash	6.29	6.29
	100.00	100.00
Coke, per cent	63.57	56.51
Ratio of volatile combustible matter to fixed carbon	1:1.95	1:1.38

Calorific power of.

Calorific power—determined by experiment:

Indicated power of fuel in calories..................6295
Indicated evaporative power.................11.72 pounds
of water (at 100° C.) per pound of fuel.

* With respect to the preparation of a coherent coke from this fuel by admixture of the same with a caking coal, see page 8 M.

It yields—by slow coking, a non-coherent coke—by fast coking, a slightly fritted coke, which crumbles easily between the fingers; the gases evolved during coking burnt with a yellow, luminous, somewhat smoky flame. The ash has a reddish-brown color,—exposed to a bright red heat it becomes very slightly agglutinated, at a most intense red heat it becomes fritted.

III. Analyses of Coals.

Coal from the Bow River (Coal Creek).

28.—From Coal Creek, Bow River, between Morley and Calgary. Seam four and a-half feet thick. Geological position—base of Laramie. Collected by Mr. R. G. McConnell.

Structure coarse lamellar; contains occasional interposed layers of mineral charcoal; it is intersected by numerous very thin plates of calcite, which are perpendicular to the lamination of the coal; color black; lustre along the line of bedding, dull, that of the cross fracture resinous; fracture uneven, at times somewhat conchoidal; apart from the layers of mineral charcoal, does not soil the fingers; powder black, faint brownish tinge; it communicates a pale brownish-yellow color to a boiling solution of caustic potash; here and there coated with a slight film of ferric hydrate; does not readily become fissured when exposed to the air; a tolerably firm coal.

Specific gravity 1.4002—Weight of one solid cubic foot 87.51 pounds.

Analyses of.

Analyses by slow and fast coking gave:

	Slow coking.	Fast coking.
Hygroscopic water	4.93	4.93
Volatile combustible matter	27.22	33.55
Fixed carbon	52.54	46.21
Ash	15.31	15.31
	100.00	100.00
Coke, per cent	67.85	61.52
Ratio of volatile combustible matter to fixed carbon	1:1.93	1:1.38

An ultimate analysis gave:

		Exclusive of sulphur, ash, and hygroscopic water.
Carbon	62.59	78.91
Hydrogen	4.13	5.21
Oxygen and nitrogen	12.60	15.88
Sulphur	0.44	—
Ash	15.31	—
Hygroscopic water	4.93	—
	100.00	100.00

Calorific power—determined by experiment: Calorific power of.

Indicated power of fuel in calories....................5874
Indicated evaporative power................10.93 pounds
of water (at 100° C.) per pound of fuel.

It yields—by slow coking, a non-coherent coke—by fast coking, a coherent but tender coke, the form of the original particles of coal from which it has been derived may be easily recognized; the gases evolved during coking burnt with a yellow, luminous, smoky flame. The ash has a reddish-brown color,—exposed to a bright red heat it becomes slightly agglutinated, at a most intense red heat it forms a more or less vitrified mass.

29.—From the Old Man River, North Fork, one and a-half mile from the base of the Rocky Mountains. Seam five feet thick. Geological position—Cretaceous, lower than Pierre shales. Collected by Mr. R. G. McConnell. Coal from the Old Man River, North Fork.

Structure compact—lines of bedding somewhat indistinct; it contains a few thin layers of interstratified bright black coal; shows traces of slickensides; hard and firm; fracture uneven, that of the bright layers conchoidal; lustre sub-resinous to resinous; does not soil the fingers; in parts coated with a slight deposit of ferric hydrate; powder almost black; it communicates a brownish-yellow color to a boiling solution of caustic potash; resists exposure to the air.

Specific gravity 1.5299—Weight of one solid cubic foot 95.62 pounds.

Analyses by slow and fast coking gave: Analyses of.

	Slow coking.	Fast coking.
Hygroscopic water	1.75	1.75
Volatile combustible matter	16.85	19.99
Fixed carbon	61.54	58.40
Ash	19.86	19.86
	100.00	100.00
Coke, per cent	81.40	78.26
Ratio of volatile combustible matter to fixed carbon	1:3.65	1:2.92

An ultimate analysis gave:

		Exclusive of sulphur, ash, and hygroscopic water.
Carbon	65.71	84.21
Hydrogen	3.56	4.56
Oxygen and nitrogen	8.76	11.23
Sulphur	0.36	—
Ash	19.86	—
Hygroscopic water	1.75	—
	100.00	100.00

Calorific power of.

Calorific power—determined by experiment:

Indicated power of fuel in calories..................6082

Indicated evaporative power................11.32 pounds of water (at 100° C.) per pound of fuel.

It yields—by slow coking, a non-coherent coke—by fast coking, a coherent but tender coke, the form of the original particles of coal from which it has been derived may be easily recognized; the gases evolved during coking burnt with a yellow, luminous, rather smoky flame. The ash has a reddish-white color,—exposed to a bright red heat or even a most intense red heat it does not become agglutinated.

Coal from the Old Man River, Middle Fork.

30.—From the Old Man River, Middle Fork. Upper seam. Seam three feet thick. Geological position—probably Laramie. Collected by Dr. G. M. Dawson.

Structure very fine lamellar—the successive layers differing somewhat in lustre—compact; color black, but not pure black; lustre sub-resinous to resinous; fracture uneven; here and there intersected by a thin plate of calcite; does not soil the fingers; in parts coated with a slight deposit of ferric hydrate; hard and firm; powder black, slight brownish tinge; it communicates a pale brownish-yellow color to a boiling solution of caustic potash; resists exposure to the air.

Specific gravity 1.4316—Weight of one solid cubic foot 89.47 pounds.

Analyses of.

Analyses by slow and fast coking gave:

	Slow coking.	Fast coking.
Hygroscopic water	3.27	3.27
Volatile combustible matter	26.41	32.53
Fixed carbon	50.50	44.38
Ash	19.82	19.82
	100.00	100.00
Coke, per cent	70.32	64.20
Ratio of volatile combustible matter to fixed carbon	1:1.91	1:1.36

An ultimate analysis gave:

		Exclusive of sulphur, ash, and hygroscopic water.
Carbon	59.84	78.37
Hydrogen	4.17	5.46
Oxygen and nitrogen	12.35	16.17
Sulphur	0.55	—
Ash	19.82	—
Hygroscopic water	3.27	—
	100.00	100.00

Calorific power—determined by experiment: Calorific power of.

Indicated power of fuel in calories 5980
Indicated evaporative power .... 11.13 pounds of water (at 100° C.) per pound of fuel.

It yields—by slow coking, a non-coherent coke—by fast coking, a firm coke, a few particles retaining the form of those of the original coal were discernable in it; the gases evolved during coking burnt with a yellow, luminous, very smoky flame. The ash has a light bluish-grey color—exposed to a bright red heat it becomes but very slightly agglutinated, at a most intense red heat it becomes slightly fritted.

31.—From the Old Man River, Middle Fork. Lower seam. Seam about three feet thick. Geological position—probably Laramie. Collected by Dr. G. M. Dawson. Coal from the Old Man River, Middle Fork.

Structure compact; shows traces of slickensides; hard and firm; color black; lustre sub-resinous to resinous; fracture uneven, occasionally somewhat conchoidal; intersected by numerous thin plates of calcite; does not soil the fingers; powder brownish-black; it communicates only a just perceptible brownish-yellow tinge to a boiling solution of caustic potash; resists exposure to the air; in appearance it resembles some varieties of coal of the Carboniferous system.

Specific gravity 1.3111—Weight of one solid cubic foot 81.94 pounds.

Analyses by slow and fast coking gave: Analyses of.

	Slow coking.	Fast coking.
Hygroscopic water	2.36	2.36
Volatile combustible matter	32.07	40.66
Fixed carbon	56.37	47.78
Ash	9.20	9.20
	100.00	100.00
Coke, per cent	65.57	56.98
Ratio of volatile combustible matter to fixed carbon	1:1.76	1:1.18

An ultimate analysis gave:

		Exclusive of sulphur, ash, and hygroscopic water.
Carbon	71.11	81.01
Hydrogen	5.04	5.74
Oxygen and Nitrogen	11.63	13.25
Sulphur	0.66	—
Ash	9.20	—
Hygroscopic water	2.36	—
	100.00	100.00

Calorific power of.

Calorific power—determined by experiment:

Indicated power of fuel in calories	7020
Indicated evaporative power	13.06 pounds of water (at 100° C.) per pound of fuel.

It yields—by slow coking, a non-coherent coke—by fast coking, a firm compact coke, in concentric layers, in which the form of the particles of coal from which it has been derived is entirely obliterated; the gases evolved during coking burnt with a yellow, luminous, smoky flame. The ash has a pale dirty reddish-brown color,—exposed to a bright red heat it becomes slightly agglutinated, at a most intense red heat it forms a slaggy mass.

Coal from the Upper Belly River.

32.—From the Upper Belly River, twenty-five and a-half miles above the mouth of Kootanie (Waterton) River. Seam one foot thick. Geological position—probably near marine base of Laramie. Collected by Mr. R. G. McConnell.

Structure fine lamellar, the lines of bedding are very close together and occasionally somewhat indistinct—it is interstratified with very thin layers of bright black coal, and contains here and there a patch of mineral charcoal; hard and firm; it is intersected by numerous thin plates of calcite, as also, here and there, by a few films of pyrite; color, greyish-black, almost black; lustre resinous; fracture uneven; shows tolerably well defined planes of cleat; apart from the patches of mineral charcoal, does not soil the fingers; powder brownish-black; it communicates a pale brownish-yellow color to a boiling solution of caustic potash; resists exposure to the air; in appearance it much resembles some varieties of coal of the Carboniferous system.

Specific gravity 1.3802—Weight of one solid cubic foot 86.26 pounds.

Analyses of.

Analyses by slow and fast coking gave:

	Slow coking.	Fast coking.
Hygroscopic water	3.91	3.91
Volatile combustible matter	30.93	38.01
Fixed carbon	53.83	46.75
Ash	11.33	11.33
	100.00	100.00
Coke, per cent	65.16	58.08
Ratio of volatile combustible matter to fixed carbon	1 : 1.74	1 : 1.23

An ultimate analysis gave:

		Exclusive of sulphur, ash, and hygroscopic water.
Carbon	66.19	80.15
Hydrogen	4.43	5.37
Oxygen and nitrogen	11.96	14.48
Sulphur	2.18	—
Ash	11.33	—
Hygroscopic water	3.91	—
	100.00	100.00

Calorific power—determined by experiment: Calorific power of.

Indicated power of fuel in calories 6604
Indicated evaporative power.................12.29 pounds
of water (at 100° C.) per pound of fuel.

It yields—by slow coking, a non-coherent coke—by fast coking, a firm compact coke, in concentric layers, in which the form of the particles of coal from which it has been derived is entirely obliterated; the gases evolved during coking burnt with a yellow, luminous, smoky flame. The ash has a greyish-brown color,—exposed to a bright red heat it becomes slightly agglutinated, at a most intense red heat it forms a slaggy mass.

33.—From the Wellington mine, Vancouver Island, British Columbia. Coal from the "Wellington" mine, Vancouver Island. This mine is situated five and a-half miles north-west of Nanaimo and three miles west of Departure Bay. The seam, which is known as the Newcastle seam, has, in this mine a thickness of from six to ten feet. Geological position—Cretaceous.

Structure very fine lamellar, the lines of bedding, which are very numerous and close together, are almost obliterated—compact; color black; lustre resinous; hard and firm; fracture uneven; it is intersected in many places by thin films of calcite and contains, interstratified with it, an occasional thin calcareous layer consisting of what, at a first glance, appears to be the crushed fragments of somewhat minute shells—a close examination however led to the conclusion that the same was most probably not of organic origin. Powder brownish-black; it communicates only a just perceptible brownish-yellow tinge to a boiling solution of caustic potash; resists the action of the air. In appearance it resembles some varieties of coal of the Carboniferous system.

Specific gravity 1.3222—Weight of one solid cubic foot 82.64 pounds.

The material employed for analysis was regarded as a fair average of a large quantity of the coal.

Analyses of.

Analyses by slow and fast coking gave:

	Slow coking.	Fast coking.
Hygroscopic water	2 75	2.75
Volatile combustible matter	30.95	38.03
Fixed carbon	59.72	52.64
Ash	6.58	6.58
	100.00	100.00
Coke, per cent	66.30	59.22
Ratio of volatile combustible matter to fixed carbon	1:1.93	1:1.38

An ultimate analysis gave:

		Exclusive of sulphur, ash, and hygroscopic water.
Carbon	72.65	80.45
Hydrogen	4.89	5.41
Oxygen and nitrogen	12.77	14.14
Sulphur	0.36	—
Ash	6.58	—
Hygroscopic water	2.75	—
	100.00	100.00

Calorific power of.

Calorific power—determined by experiment:

Indicated power of fuel in calories....................7204
Indicated evaporative power.................13.41 pounds of water (at 100 ° C.) per pound of fuel.

It yields—by slow coking, a non-coherent coke—by fast coking, a firm compact coke, the form of the particles of coal from which it has been derived is perfectly obliterated; the gases evolved during coking burnt with a yellow, luminous, very smoky flame. The ash has a brownish-yellow color—exposed to a bright red heat, it does not become agglutinated, at a most intense red heat it becomes more or less fritted.

This coal is well known on the Pacific coast, and has the reputation of being of good quality both for steam and household purposes. Agreeably with the Report—for the year ending Dec. 31st, 1883—of the Minister of Mines for British Columbia, the output of coal from the Wellington Colliery for the twelve months ending Dec. 31st, 1883, amounted to 171,364 tons, 5 cwt., which with 2,443 tons, 2 cwt. coal in stock Jan. 1st, 1883, makes a total of 173,807 tons, 7 cwt., of this 47,333 tons were sold for home consumption and 124,748 tons, 15 cwt., were sold for exportation, leaving on hand Jan. 1st, 1884, 1,725 tons, 12 cwt.

The coal fields of Nanaimo and Comox, Vancouver Island, have been examined by Mr. J. Richardson and are described by him in his reports—Report of Progress 1876–77, p. 160 (and previous Reports of Progress)—information in regard to the same will also be found in the report of Dr. G. M. Dawson, Report of Progress 1876–77, p. 119.

34.—From the Pine River, five miles above the Lower Forks. Taken from the two-feet seam. Geological position—Cretaceous, Dunvegan Group. Collected by Dr. A. R. C. Selwyn, and referred to by him in the Report of Progress for 1875–76, p. 53, and by Dr. G. M. Dawson in Report of Progress for 1879–80, p. 117 B. Coal from the Pine River.

Structure very fine lamellar, the lines of bedding, which are very numerous and close together, are not unfrequently very indistinct or altogether obliterated—compact; color black; lustre of fracture parallel to the bedding dull, that of the cross fracture resinous, occasionally brilliant; hard and firm; fracture uneven; contains a brownish-yellow sub-transparent resin, chiefly in small particles, diffused through its substance; powder very dark brown, inclining to blackish-brown; it communicates only a just perceptible brownish-yellow tinge to a boiling solution of caustic potash; resists exposure to the air. In appearance it is not unlike some varieties of coal of the Carboniferous system.

Specific gravity 1.4169—Weight of one solid cubic foot 88.56 pounds.

Analyses by slow and fast coking gave: Analyses of.

	Slow coking.	Fast coking.
Hygroscopic water	2.45	2.45
Volatile combustible matter	27.87	33.76
Fixed carbon	54.58	48.69
Ash	15.10	15.10
	100.00	100 00
Coke, per cent	69.68	63.79
Ratio of volatile combustible matter to fixed carbon	1 : 1.96	1 : 1.44

Calorific power—determined by experiment: Calorific power of.

Indicated power of fuel in calories 6295
Indicated evaporative power .... 11.72 pounds of water (at 100° C.) per pound of fuel.

It yields—by slow coking, a non-coherent coke—by fast coking, a firm, compact, and lustrous coke, the coking being doubtless materially influenced by the presence of the resin. Color of the ash, white—exposed to a bright red heat it does not become agglutinated, at a most intense red heat it becomes slightly sintered.

Coal from Mill Creek.

35.—From Mill Creek, about four miles above the mill. Seam eight to nine feet thick, with shaly partings. Geological position—Cretaceous or possibly Laramie. Collected by Dr. G. M. Dawson.

Structure fine lamellar; the specimen examined was made up of layers of a greyish-black, somewhat dull, and jet black coal of brilliant lustre—compact; fracture uneven, that of the brighter layers conchoidal; does not soil the fingers; hard and firm; powder black, with a faint brownish tinge; it communicates only a just perceptible brownish-yellow tinge to a boiling solution of caustic potash; in appearance it closely resembles some varieties of coal of the Carboniferous system.

Another specimen of this coal, had a somewhat coarse lamellar structure, contained an occasional interstratified layer of mineral charcoal, was of a uniform greyish-black color, had a sub-resinous to resinous lustre and showed traces of slickensides.

Specific gravity 1.4226—Weight of one solid cubic foot 88.91 pounds.

Analyses of.

Analyses by slow and fast coking gave:

	Slow coking.	Fast coking.
Hygroscopic water	1.63	1.63
Volatile combustible matter	22.61	28.43
Fixed carbon	63.39	57.57
Ash	12.37	12.37
	100.00	100.00
Coke, per cent	75.76	69.94
Ratio of volatile combustible matter to fixed carbon	1 : 2.80	1 : 2.02

An ultimate analysis gave:

		Exclusive of sulphur, ash, and hygroscopic water.
Carbon	71.57	83.65
Hydrogen	4.05	4.73
Oxygen and nitrogen	9.94	11.62
Sulphur	0.44	—
Ash	12.37	—
Hygroscopic water	1.63	—
	100.00	100.00

Calorific power of.

Calorific power—determined by experiment:

Indicated power of fuel in calories 6604
Indicated evaporative power................12.29 pounds of water (at 100° C.) per pound of fuel.

It yields—by slow coking, a non-coherent coke—by fast coking, a firm coke, a few particles retaining the form of those of the original coal were discernable in it; the gases evolved during coking burnt with a yellow, luminous, smoky flame. The ash has a greyish-white color—exposed to a bright red heat or even a most intense red heat it does not become agglutinated.

36.—Anthracitic coal—from Cascade River—two and three quarter miles from its confluence with the Bow—Bow River Pass, Rocky Mountains. Seam about twenty inches thick. Geological position—Cretaceous. Collected by Mr. E. Coste. *Anthracitic coal, Cascade River, Rocky Mountains.*

The coal in this part of the seam—a point, apparently of exceptional disturbance—was found to be in a pulverulent condition.

An analysis by fast coking gave: *Analysis of.*

Hygroscopic water	2.07
Volatile combustible matter	15.84
Fixed carbon	74.35
Ash	7.74
	100.00

Ratio of volatile combustible matter to fixed carbon .... 1 : 4.69

It yields a non-coherent coke. Color of the ash pale reddish-yellow. As far as chemical composition is concerned this is an excellent fuel, but, owing to its physical condition it could not well be used in its natural state—it might, however, be rendered available by converting it into artificial fuel by adding to it a certain proportion of ground pitch, and moulding the heated mixture, under pressure, into briquettes.

Mr. Coste also collected samples of coal from an outcrop which occurs on the same bank of the river, some four hundred and fifty yards distant—further down the stream—from that whence the succeeding specimen, No. 37, was taken. It has a crumpled flaky structure; shows slickensides; is firm; has a greyish-black to black color and a resinous to vitreous lustre; when fractured it parts into more or less flaky fragments. At present no analysis has been made of this specimen.

37.—Semi-anthracite—from Cascade River, Bow River Pass, Rocky Mountains. *Semi-anthracite, Cascade River, Rocky Mountains.*

The locality in question was examined during the autumn of 1883, by Drs. A. R. C. Selwyn and G. M. Dawson, and was also subsequently visited by Mr. E. Coste, each of whom collected specimens. That brought by Dr. G. M. Dawson was the one selected for analysis, it was collected in such manner as to represent a fair average of the entire face of the seam—which at this point had a thickness of about four feet. Geological position—Cretaceous.

Structure very fine lamellar, the lines of bedding, which are numerous and close together, are almost obliterated, in many specimens entirely so—compact; shows slickensides, some specimens in an eminent degree; it contains interstratified, more or less disconnected, lenticular layers of pitch-black, highly lustrous coal in which no structure is visible, and an occasional patch of mineral charcoal; brittle; fracture, on the whole, uneven, that of the denser and more lustrous layers, imperfectly conchoidal; hard and firm; color greyish-black to black, varying with the layers, in parts iridescent; lustre resinous to vitreous; powder pure black; when heated it decrepitates, falling into small angular fragments.

Specific gravity 1.4272—Weight of one solid cubic foot 89.20 pounds.

Analyses of.

Analyses by slow and fast coking gave:

	Slow coking.	Fast coking.
Hygroscopic water	0.71	0.71
Volatile combustible matter	10.58	10.79
Fixed carbon	81.14	80.93
Ash	7.57	7.57
	100.00	100.00
Ratio of volatile combustible matter to fixed carbon	1:7.67	1:7.50

Calorific power of.

Calorific power—determined by experiment:

Indicated power of fuel in calories 7852
Indicated evaporative power .... 14.62 pounds of water (at 100° C.) per pound of fuel.

It yields, in common with all anthracite,—both by slow and fast coking, a non-coherent coke; when heated in a covered crucible it evolves a small amount of pale yellow smokeless flame of feeble luminosity. It leaves a white ash, which does not agglutinate at a bright red heat, and at a most intense red heat becomes only slightly fritted.

The samples received, represent an excellent fuel—it does not disintegrate on exposure to the air, is sufficiently hard and firm to bear the abrasion incident to transportation, contains but a very small percentage of hygroscopic water, a by no means large amount of inorganic matter, and possesses a high evaporative power.

Prof. H. Darwin Rogers, in speaking of the semi-anthracites of Pennsylvania, says:

"The semi-anthracites crumble up or divide into small angular fragments more readily on the fire than less jointed hard anthracites; and this quality, inconvenient in some cases where the draught is feeble, by causing too dull a fire, is a real excellence wherever the draught can be regulated, and a sufficiently energetic one secured; for if only the additional influx of air is sufficient to overcome the increased friction consequent upon the increase of surface and multiplication of edges arising from the smallness of the lumps, these coals are found to engender almost as high a heat as the anthracites, while they can be made to burn both faster and more steadily. Their absolute efficiency for equal weights is perhaps a little less, proportioned to their smaller total quantity of carbon; but their actual efficiency in equal times is as great, or even greater, than that of the hard anthracites, by virtue of their superior quickness of consumption."

REMARKS ON ACCOMPANYING TABLES.

Remarks on Tables I. and II.

TABLES I. AND II.—The numbers in the column preceding that of the locality, correspond with those employed to particularize the various specimens throughout the text. An asterisk is affixed to the number of those specimens of which ultimate analyses were made—the results of which are embodied in Table III. The calorific power was estimated by Thompson's calorimeter—the results are expressed in calories and as pounds of water evaporated per pound of fuel: the numbers in columns 1 and 2 are those indicated by the instrument: the numbers in columns 3 and 4 are obtained by deducting from the experimental results the heat units required to vaporise the hygroscopic water—the correction is in many instances but very trifling, it has nevertheless, for the sake of uniformity, been made throughout. In order to obtain a yet closer approximation to the truth, a further reduction has to be made for loss of heat incident upon the evaporation of the combined water: as the amount of this latter can only be learnt from an ultimate analysis, this correction can only be applied with exactitude in the case of those fuels of which ultimate analyses are given in Table III. On referring to this latter it will be seen,—under Calorific power II.—that the heat required for the conversion of the hygroscopic and combined water into vapor, results in a diminution of the evaporative power of one pound of the fuel which in the case of specimen

Remarks on Tables I. and II., cont.

Number	2	amounts to	0.35	lb.	Number	30	amounts to	0.16	lb.
"	22	"	0.27	"	"	31	"	0.15	"
"	26	"	0.23	"	"	32	"	0.16	"
"	28	"	0.18	"	"	33	"	0.15	"
"	29	"	0.11	"	"	35	"	0.11	"

By subtracting these amounts from the numbers given in column 2 (Table III.) of Calorific power I., we shall arrive at a very close approximation of the evaporative power of these fuels. Guided by a knowledge of the correction required in these instances it may perhaps be admissable to draw an inference as to the amount of correction to be applied in the case of those fuels of which no ultimate analyses were made, but which, in respect to general character, may be said to be represented by one or the other of those enumerated in Table III; allowing this,—the evaporative power of one pound of the fuel, as given in column 2 of Tables I. and II., of fuels numbers 4, 5, 6 and 8 should be reduced by, say, 0.35 lb.—that of numbers 11, 12 and 18 by 0.30 lb.—that of number 20 by 0.27 lb.—that of numbers 23, 24, 25 and 27 by 0.23 lb., and that of number 34 by 0.15 lb. of water.

Remarks on Table III.

TABLE III.—The specimens referred to in this Table, retain the numbers assigned them in Tables I. and II., and throughout the text.

Calorific power I.—Experimental—the figures given under this heading correspond with those of columns 1 and 2—calorific power—of Tables I. and II.

Calorific power II.—Theoretical—the theoretical calorific power under A is found by multiplying the percentages of carbon and disposable hydrogen (disregarding the sulphur) by their respective calorific powers; the sum of these two products is the number of heat units generated by the complete combustion of one unit of the fuel. Previous to calculating the combined water 1.25 has uniformly been deducted from the number indicating oxygen and nitrogen —upon the assumption that this approximately represents the percentage of nitrogen contained in these fuels. It represents the mean amount of nitrogen contained in some thirty fuels of similar age, embracing twelve lignite coals of Colorado (analyses referred by Prof. W. B. Potter to Mr. G. W. Riggs, Jr.), eight western lignites (U. S.—analyses by H. S. Munroe), eight coals from Vancouver Island (analyses quoted by Robert Brown), and two lignites from the North-west Territory (analyses by C. Tookey). The theoretical calorific power under B. is obtained by deducting from that under A. the heat units required to vaporise the hygroscopic and combined water—the figures under B. give therefore the closest approximation to the available heat.

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TABLE I.—P

Specific Gravity.	Weight of one cubic foot—calculated from the Specific Gravity.	Hygroscopic Water.	LOR OF THE ASH.	CALORIFIC POWER. Experimental. As recorded. 1 Express-ed in calories.	2 Weight of water (at 100° C.) evaporated by 1 lb. of fuel.	After correction for hygroscopic water. 3 Express-ed in calories.	4 Weight of water (at 100° C.) evaporated by 1 lb. of fuel.
168	88.55 lbs.	21.	sh-yellow	undet.	undet.	....	....
972	87.32 "	16.	-brown.............	5144	9.57 lbs.	5054	9.41 lbs.
722	85.76 "	17.	ddish-brown.........	undet.	undet.	....	....
341	89.63 "	14.	wnish-yellow........	5289	9.84 lbs.	5210	9.70 lbs.
256	89.10 "	12.	ownish-yellow.......	5207	9.69 "	5138	9.57 "
027	87.67 "	13.	-brown	5347	9.95 "	5277	9.83 "
929	87.06 "	14.	red..................	undet.	undet.	....	....
257	89.11 "	13.	sh-yellow	5028	9.36 lbs.	4958	9.23 lbs.
let.	....	13.	dish-yellow	undet.	undet.	....	....
221	88.88 "	12.	ty reddish-brown. ...	"	"	....	....
162	88.51 "	11.	red.................	5473	10.19 lbs.	5409	10.07 lbs.
970	87.31 "	11.	sh-brown	5531	10.29 "	5467	10.18 "
850	...	12.	ownish-yellow.......	undet.	undet.	....	....
let.	....	10.	-white	"	"	....	....
let.	....	11.	wnish-yellow........	"	"	....	....
let.	....	11.	ownish-red..........	"	"	....	....
let.	...	11.	dish-brown	"	"	....	....
423	90.14 "	11.	nish-grey	5424	10.10 lbs.	5363	9.99 lbs.
387	89.92 "	10.	ey.................	undet.	undet.	....	....
140	94.62 "	9.	-grey	4980	9.27 lbs.	4927	9.17 lbs.
217	88.86 "	7.	-white	undet.	undet.	....	....

TABLE I.—PROXIMATE ANALYSES OF COALS AND LIGN

Number of Specimen.	LOCALITY.	Specific Gravity.	Weight of one cubic foot—calculated from the Specific Gravity.	ANALYSIS BY SLOW COKING. Composition, per cent. Hygroscopic Water.	Volatile combustible matter.	Fixed Carbon.	Ash.	Ratio of Volatile to fixed combustible.	Percentage of Coke.	Character of the Coke.	Hygroscopic Water.
1	Souris River, one mile west of La Roche Percée, at junction of Short Creek and Souris River.......	1.4168	88.55 lbs.	21.84	32.15	41.61	4.40	1:1.29	46.01	Non-coherent.	21.8
2*	South Saskatchewan, south side, about ten miles above Medicine Hat. Lower seam.............	1.3972	87.32 "	16.82	29.54	46.34	7.30	1:1.57	53.64	do.	16.8
3	South Saskatchewan, south side, about ten and a quarter miles above Medicine Hat. Lower seam.	1.3722	85.76 "	17.70	28.63	49.83	3.84	1:1.74	53.67	do.	17.7
4	North Saskatchewan, right bank, about forty miles below the confluence of the Brazeau River......	1.4341	89.63 "	14.78	28.46	50.69	6.07	1:1.78	56 76	do.	14.7
5	North Saskatchewan, right bank, a short distance below Fort Edmonton	1.4256	89.10 "	12.89	32.19	52.17	2.75	1:1.62	54.92	do.	12.
6	Red Deer River, at the mouth of Arrowwood River.	1.4027	87.67 "	13.08	31.49	51.35	4.08	1:1.63	55.43	do.	1
7	Red Deer River, two miles below the mouth of Arrowwood River	1.3929	87.06 "	14.20	30.92	51.21	3.67	1:1.66	54.88	do.	14.2
8	Red Deer River, about seven miles above Hunter's Hill	1.4257	89.11 "	13.06	29.41	48.51	9.02	1:1.65	57.53	do.	13.0
9	Red Deer River, nine miles above Hunter's Hill...	undet.	....	13.63	31.31	41.81	13.25	1:1.33	55.06	do.	13.6
10	Red Deer River, thirteen miles above Hunter's Hill	1.4221	88.88 "	12.62	32.08	46.72	8.58	1:1.46	55.30	do.	12.6
11	Bow River, Grassy Island.....................	1.4162	88.51 "	11.90	31.20	50.97	5.93	1:1.63	56.90	do.	11.9
12	Bow River, Blackfoot Crossing, six and a half miles east of old Blackfoot Agency buildings	1.3970	87.31 "	11.91	30.04	54.78	3.27	1:1.82	58.05	do.	11.9
13	Found in some parts of the seam from which the preceding specimen was taken	1.3850	...	12.31	29.82	55.75	2.12	1:1.87	57.87	do.	12.3
14	Bow River, south side, about four miles below Blackfoot Crossing	undet.	....	10.72	29.26	46.09	13.93	1:1.57	60.02	do.	10.7
15	Crowfoot Creek, four miles from its entry into Bow River.....................................	undet.	....	11.25	31.98	50.85	5.92	1:1.59	56.77	do.	11.2
16	Bow River, Horse-shoe Bend..................	undet.	....	11.13	36.52	43.16	9.19	1:1.18	52.35	do.	11.1
17	Smoky River, five miles below the mouth of Little Smoky River	undet.	...	11.52	31.26	53.04	4.18	1:1.69	57.22	do.	11.5
18	Athabasca River, about fifty-five miles above the site of old Fort Assineboine. Upper seam......	1.4423	90.14 "	11.47	28.96	50.92	8.65	1:1.76	59.57	do.	11.47
19	Athabasca River, about fifty-five miles above the site of old Fort Assineboine. Lower seam......	1.4387	89.92 "	10.58	29.29	53.69	6.44	1:1.83	60.13	do.	10.5
20	Milk River Ridge, northern side	1.5140	94.62 "	9.84	28.66	42.67	18.83	1:1.49	61.50	do.	9.8
21	Pine River, Coal Brook, two and a half miles east of the Lower Forks	1.4217	88.86 "	7.83	30.55	55.75	5.87	1:1.82	61.62	do.	7.8

OF COALS AND LIGNITES FROM THE NORTH-WEST TERRITORY.

	OKING.		ANALYSIS BY FAST COKING								CALORIFIC POWER. Experimental.			
			Composition, per cent.								As recorded		After correction for hygroscopic water.	
											1	2	3	4
	Percentage of Coke.	Character of the Coke.	Hygroscopic Water.	Volatile combustible matter.	Fixed Carbon.	Ash.	Ratio of Volatile to fixed combustible.	Percentage of Coke.	Character of the Coke.	COLOR OF THE ASH.	Expressed in calories.	Weight of water (at 100° C.) evaporated by 1 lb. of fuel.	Expressed in calories.	Weight of water (at 100° C.) evaporated by 1 lb. of fuel.
29	46.01	Non-coherent.	21.84	35.12	38.64	4.40	1 : 1.10	43.04	Non-coherent.	Brownish-yellow	undet.	undet.	....	....
57	53.64	do.	16.82	31.90	43.98	7.30	1 : 1.38	51.28	do.	Reddish-brown.............	5144	9.57 lbs.	5054	9.41 lbs.
74	53.67	do.	17.70	29.90	48.56	3.84	1 : 1.62	52.40	do.	Dark reddish-brown.........	undet.	undet.	....	....
78	56 76	do.	14.78	30.48	48.67	6.07	1 : 1.59	54.74	do.	Pale brownish-yellow........	5289	9.84 lbs.	5210	9.70 lbs.
32	54.92	do.	12.[illegible]	33.79	50.57	2.75	1 : 1.49	53.32	do.	Dark brownish-yellow.......	5207	9.69 "	5138	9.57 "
33	55.43	do.	1[illegible]	34.50	48.34	4.08	1 : 1.40	52.42	do.	Reddish-brown	5347	9.95 "	5277	9.83 "
36	54.88	do.	14.2[illegible]	34.22	47.91	3.67	1 : 1.40	51.58	do.	Bright red	undet.	undet.	....	....
55	57.53	do.	13.06	33.75	44.17	9.02	1 : 1.30	53.19	do.	Brownish-yellow	5028	9.36 lbs.	4958	9.23 lbs.
33	55.06	do.	13.63	34.01	39.11	13.25	1 : 1.15	52.36	do.	Pale reddish-yellow	undet.	undet.	....	....
6	55.30	do.	12.62	35.99	42.81	8.58	1 : 1.19	51.39	do.	Pale dirty reddish-brown. . .	"	"	....	....
3	56.90	do.	11.90	35.02	47.15	5.93	1 : 1.34	53.08	do.	Bright red................	5473	10.19 lbs.	5409	10.07 lbs.
2	58.05	do.	11.91	33.25	51.57	3.27	1 : 1.55	54.84	do.	Yellowish-brown	5531	10.29 "	5467	10.18 "
7	57.87	do.	12.31	32.83	52.74	2.12	1 : 1.60	54.86	do.	Dark brownish-yellow.......	undet.	undet.	....	....
7	60.02	do.	10.72	32.63	42.72	13.93	1 : 1.31	56.65	do.	Reddish-white	"	"	....	....
9	56.77	do.	11.25	35.59	47.24	5.92	1 : 1.33	53.16	do.	Pale brownish-yellow........	"	"	....	....
8	52.35	do.	11.13	38.75	40.93	9.19	1 : 1.06	50.12	do.	Dark brownish-red..........	"	"	....	....
9	57.22	do.	11.52	34.83	49.47	4.18	1 : 1.42	53.65	{ Slightly fritted }	Pale reddish-brown	"	"	....	....
6	59.57	do.	11.47	32.09	47.79	8.65	1 : 1.49	56.44	Non-coherent.	Light bluish-grey	5424	10.10 lbs.	5363	9.99 lbs.
3	60.13	do.	10.58	32.79	50.19	6.44	1 : 1.53	56.63	do.	Light grey................	undet.	undet.	....	....
9	61.50	do.	9.84	31.92	39.41	18.83	1 : 1.23	58.24	do.	Greenish-grey..............	4980	9.27 lbs.	4927	9.17 lbs.
2	61.62	do.	7.83	34.21	52.09	5.87	1 : 1.52	57.96	do.	Reddish-white.............	undet	undet.	....	....

ABLE I

Specific Gravity.	Weight of one cubic fo
3976	87.
4163	88.
idet.	.
3999	87.4
3587	84.9
3690	85.5
4002	87.5
5299	95.0
4316	89.4
3111	81.9
3802	86.2
3222	82.6
4169	88.5
4226	88.9
idet.	..
4272	89.20

'ABLE II.—PROd.

Specific Gravity.	Weight of one cubic foot—calculated from the Specific Gravity.	OR OF THE ASH.	CALORIFIC POWER. EXPERIMENTAL. As recorded. 1 Expressed in calories.	2 Weight of water (at 100° C.) evaporated by 1 lb. of fuel.	After correction for hygroscopic water. 3 Expressed in calories.	4 Weight of water (at 100° C.) evaporated by 1 lb. of fuel.
3976	87.35 lbs.	9 h-yellow	5821	10.84 lbs.	5772	10.75 lbs.
4163	88.52 "	6 -grey................	5980	11.13 "	5947	11.07 "
idet.	....	4 nish-grey	5507	10.25 "	5485	10.21 "
3999	87.49 "	5 dish-brown..........	6241	11.62 "	6212	11.57 "
3587	84.92 "	6 h-yellow............	6183	11.51 "	6148	11.45 "
3690	85.56 "	7 -brown	6295	11.72 "	6257	11.65 "
4002	87.51 "	4 -brown	5874	10.93 "	5848	10.89 "
5299	95.62 "	1 -white	6082	11.32 "	6073	11.31 "
4316	89.47 "	3 nish-grey	5980	11.13 "	5963	11.10 "
3111	81.94 "	2 ty reddish-brown....	7020	13.06 "	7007	13.05 "
3802	86.26 "	3 -brown..............	6604	12.29 "	6583	12.26 "
3222	82.64 "	2 h-yellow............	7204	13.41 "	7189	13.39 "
4169	88.56 "	2	6295	11.72 "	6282	11.70 "
4226	88.91 "	1 -white	6604	12.29 "	6596	12.28 "
idet.	....	. ldish-yellow.........	undet.	undet.	....	....
4272	89.20 "	0	7852	14.62 lbs.	....	....

TABLE II.—PROXIMATE ANALYSES OF COALS AND LIG

Number of Specimen.	LOCALITY.	Specific Gravity.	Weight of one cubic foot—calculated from the Specific Gravity.	ANALYSIS BY SLOW COKING.						
				Composition, per cent.				Ratio of Volatile to fixed combustible.	Percentage of Coke.	Characte of the Coke
				Hygroscopic Water.	Volatile combustible matter.	Fixed Carbon.	Ash.			
22*	Belly River, five miles below the mouth of Little Bow River....................................	1.3976	87.35 lbs.	9.18	30.66	53.31	6.85	1:1.74	60.16	Non-cohere
23	Highwood River, North Fork, five miles above Forks....................................	1.4163	88.52 "	6.12	26.87	54.93	12.08	1:2.04	67.01	do.
24	Highwood River, North Fork, one hundred yards from site whence preceding specimen was taken.	undet.	....	4.23	26.13	47.97	21.67	1:1.83	69.64	do.
25	Government Indian Farm, south of Pincher Creek, about one mile from farm buildings............	1.3999	87.49 "	5.38	27.19	58.34	9.09	1:2.14	67.43	do.
26*	Belly River, from the main seam at "Coal Banks."	1.3587	84.92 "	6.50	31.59	54.36	7.55	1:1.72	61.91	do.
27	St. Mary River, seven miles above its junction with the Belly River..............................	1.3690	85.56 "	7.02	29.41	57.28	6.29	1:1.95	63.57	do.
28*	Bow River, at Coal Creek, between Morley and Calgary....................................	1.4002	87.51 "	4.93	27.22	52.54	15.31	1:1.93	67.85	Non-cohere
29*	Old Man River, North Fork, one and a half miles from the base of the Rocky Mountains..........	1.5299	95.62 "	1.75	16.85	61.54	19.86	1:3.65	81.40	do.
30*	Old Man River, Middle Fork, upper seam.........	1.4316	89.47 "	3.27	26.41	50.50	19.82	1:1.91	70.32	do.
31*	Old Man River, Middle Fork, lower seam.........	1.3111	81.94 "	2.36	32.07	56.37	9.20	1:1.76	65.57	do.
32*	Upper Belly River, twenty-five and a half miles above the mouth of Kootanie River	1.3802	86.26 "	3.91	30.93	53.83	11.33	1:1.74	65.16	do.
33*	Vancouver Island, British Columbia, "Wellington Mine," Newcastle seam......................	1.3222	82.64 "	2.75	30.95	59.72	6.58	1:1.93	66.30	do.
34	Pine River, five miles above the Lower Forks.....	1.4169	88.56 "	2.45	27.87	54.58	15.10	1:1.96	69.68	do.
35*	Mill Creek, about four miles above the mill........	1.4226	88.91 "	1.63	22.61	63.39	12.37	1.2.80	75.76	do.
36	Cascade River, two and three quarter miles from its confluence with the Bow, Bow River Pass, Rocky Mountains............................	undet.	....	....	....	....	....	....	....	....
37	Cascade River, Bow River Pass, Rocky Mountains.	1.4272	89.20 "	0.71	10.58	81.14	7.57	1:7.67	88.71	Non-cohere

…S OF COALS AND LIGNITES FROM THE NORTH-WEST TERRIORY—*Continued.*

	SLOW COKING.			ANALYSIS BY FAST COKING.							COLOR OF THE ASH.	CALORIFIC POWER. Experimental.			
				Composition, per cent.								As recorded.		After correction for hygroscopic water.	
	Ratio of Volatile to fixed combustible.	Percentage of Coke.	Character of the Coke.	Hygroscopic Water.	Volatile combustible matter.	Fixed Carbon.	Ash.	Ratio of Volatile to fixed combustible.	Percentage of Coke.	Character of the Coke.		1 Expressed in calories.	2 Weight of water (at 100° C.) evaporated by 1 lb. of fuel.	3 Expressed in calories.	4 Weight of water (at 100° C.) evaporated by 1 lb. of fuel.
5	1 : 1.74	60.16	Non-coherent.	9.18	34.97	49.00	6.85	1 : 1.40	55.85	Non-coherent.	Brownish-yellow	5821	10.84 lbs.	5772	10.75 lbs.
3	1 : 2.04	67.01	do.	6.12	31.92	49.88	12.08	1 : 1.56	61.96	Slightly fritted.	Reddish-grey................	5980	11.13 "	5947	11.07 "
7	1 : 1.83	69.64	do.	4.23	31.06	43.04	21.67	1 : 1.38	64.71	do.	Light bluish-grey	5507	10.25 "	5485	10.21 "
)	1 : 2.14	67.43	do.	5.38	33.19	52.[illegible]	9.09	1 : 1.58	61.43	do.	Pale reddish-brown..........	6241	11.62 "	6212	11.57 "
5	1 : 1.72	61.91	do.	6.50	38.04	47.91	7.55	1 : 1.26	55.46	do.	Brownish-yellow............	6183	11.51 "	6148	11.45 "
)	1 : 1.95	63.57	do.	7.02	36.47	50.22	6.29	1 : 1.38	56.51	do.	Reddish-brown	6295	11.72 "	6257	11.65 "
1	1 : 1.93	67.85	Non-coherent.	4.93	33.55	46.21	15.31	1 : 1.38	61.52	Coherent but tender.	Reddish-brown	5874	10.93 "	5848	10.89 "
3	1 : 3.65	81.40	do.	1.75	19.99	58.40	19.86	1 : 2.92	78.26	do.	Reddish-white	6082	11.32 "	6073	11.31 "
2	1 : 1.91	70.32	do.	3.27	32.53	44.38	19.82	1 : 1.36	64.20	Firm.	Light bluish-grey	5980	11.13 "	5963	11.10 "
)	1 : 1.76	65.57	do.	2.36	40.66	47.78	9.20	1 : 1.18	56.98	Firm and compact.	Pale dirty reddish-brown....	7020	13.06 "	7007	13.05 "
3	1 : 1.74	65.16	do.	3.91	38.01	46.75	11.33	1 : 1.23	58.08	do.	Greyish brown..............	6604	12.29 "	6583	12.26 "
3	1 : 1.93	66.30	do.	2.75	38.03	52.64	6.58	1 : 1.38	59.22	do.	Brownish-yellow............	7204	13.41 "	7189	13.39 "
)	1 : 1.96	69.68	do.	2.45	33.76	48.69	15.10	1 : 1.44	63.79	do.	White......................	6295	11.72 "	6282	11.70 "
7	1 . 2.80	75.76	do.	1.63	28.43	57.57	12.37	1 : 2.02	69.94	Firm.	Greyish-white	6604	12.29 "	6596	12.28 "
	....	....	....	2.07	15.84	74.35	7.74	1 : 4.69	82.09	Non-coherent.	Pale reddish-yellow........	undet.	undet.	....	....
7	1 : 7.67	88.71	Non-coherent.	0.71	10.79	80.93	7.57	1 : 7.50	88.50	do.	White......................	7852	14.62 lbs.	....	....

TABLE III.—ULTIMATE ANALYSES OF COALS AND

No. of Specimen.	LOCALITY.	COMPOSITION, PER CENT.				
		Carbon.	Hydrogen.	Oxygen and Nitrogen.	Sulphur.	
2	South Saskatchewan, south side, about ten miles above Medicine Hat—Lower seam......	54.35	3.34	17.52	0.67	7
22	Belly River, five miles below the mouth of Little Bow River...	62.39	3.99	16.82	0.77	6
26	Belly River — from the main seam at "Coal Banks".......	65.30	4.30	15.65	0.70	7
28	Bow River, at Coal Creek, between Morley and Calgary....	62.59	4.13	12.60	0.44	15
29	Old Man River, North Fork, one and a-half miles from the base of the Rocky Mountains. ...	65.71	3.56	8.76	0.36	19
30	Old Man River, Middle Fork, upper seam.................	59.84	4.17	12.35	0.55	19
31	Old Man River, Middle Fork, lower seam.................	71.11	5.04	11.63	0.66	9
32	Upper Belly River, twenty-five and a-half miles above the mouth of Kootanie River....	66.19	4.43	11.96	2.18	11
33	Vancouver Island, British Columbia, "Wellington Mine," Newcastle seam.............	72.65	4.89	12.77	0.36	6
35	Mill Creek, about four miles above the mill..............	71.57	4.05	9.94	0.44	12

COALS AND LIGNITES FROM THE NORTH-WEST TERRITORY.

...ITION, PER CENT.				CALORIFIC POWER I. Experimental.		CALORIFIC POWER II. Theoretical.			
				1	2	A		B	
...xygen and Nitrogen.	Sulphur.	Ash.	Hygroscopic Water.	Expressed in calories.	Weight of Water (at 100° C.) evaporated by 1 lb. of fuel.	Expressed in calories.	Weight of Water (at 100° C.) evaporated by 1 lb. of fuel.	Expressed in calories.	Weight of Water (at 100° C.) evaporated by 1 lb. of fuel.
.52	0.67	7.30	16.82	5144	9.57 lbs.	4842	9.02 lbs.	4654	8.67 lbs.
.82	0.77	6.85	9.18	5821	10.84 "	5744	10.70 "	5600	10.43 "
.65	0.70	7.55	6.50	6183	11.51 "	6137	11.43 "	6015	11.20 "
.60	0.44	15.31	4.93	5874	10.93 "	5991	11.16 "	5896	10.98 "
.76	0.36	19.86	1.75	6082	11.32 "	6212	11.57 "	6157	11.46 "
.35	0.55	19.82	3.27	5980	11.13 "	5793	10.79 "	5708	10.63 "
.63	0.66	9.20	2.36	7020	13.06 "	7038	13.11 "	6962	12.96 "
.96	2.18	11.33	3.91	6604	12.29 "	6413	11.94 "	6327	11.78 "
77	0.36	6.58	2.75	7204	13.41 "	7059	13.14 "	6974	12.99 "
94	0.44	12.37	1.63	6604	12.29 "	6806	12.67 "	6745	12.56 "