GEOLOGICAL SURVEY OF CANADA.

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

CHEMICAL CONTRIBUTIONS

TO THE

GEOLOGY OF CANADA.

FROM THE

LABORATORY OF THE SURVEY.

BY

G. CHRISTIAN HOFFMANN, F. Inst. Chem.

Chemist and Mineralogist to the Survey.

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

Director of the Geological Survey of Canada.

SIR,—I have the honor of herewith submitting to you my Report upon the work carried out in the Laboratory of the Survey during the past year. It was deemed desirable—and this to the exclusion of what represented a very appreciable amount of work—that it should include only such analyses or examinations as were considered likely to prove of general interest.

Desirous that my Assistant, Mr. Frank D. Adams, should receive the merit due to his labors, his name has in all instances been attached to the various analyses and examinations made by him;—those not so particularized having been carried out by myself.

I have the honor to be,

Sir,

Your obedient servant,

G. CHRISTIAN HOFFMANN.

MONTREAL, May 1st, 1881.

CHEMICAL CONTRIBUTIONS

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MISCELLANEOUS MINERALS.

DISSEMINATED GRAPHITE.

Graphitic shale—From French Vale, Cape Breton, Nova Scotia.

"Disseminated graphite" from Nova Scotia.

This deposit is situated about half a mile south of Guthro Lake, and near the French Vale road, and, as Mr. Fletcher informs me, occurs in connection with the George River limestone. It is stated to have a thickness of from two to three feet, and to have been traced for some distance.

Analysis of.

An analysis of what appeared to be a characteristic specimen showed it to have the following composition :—

Graphite	38.387
Silica	22.499
Alumina	14.358
Ferric oxide	5.133
Manganese, nickel, cobalt and copper	Traces.
Lime	1.801
Magnesia	8.001
Disulphide of iron (iron pyrites)	0.409
Water, hygroscopic	1.434
" , combined	3.553
Alkalies	Undet.
	95.575

No other constituents, beyond those here enumerated, were sought for. The graphite was separated, and weighed as such. A small proportion of the sulphur found may be present in the form of a sulphate;

"Disseminated graphite" from Nova Scotia, cont.

the whole of this constituent has, however, been calculated as disulphide of iron, the amount of iron required for such combination having been subtracted from the total iron found, the balance of which latter has been represented as ferric oxide.

The powdered rock is readily attacked by strong hydrochloric acid, whose action, at a boiling heat, during a prolonged digestion, dissolved out—for 100 parts of the air-dried material:—

Silica	0.049
Alumina	11.242
Ferric oxide	5.166
Manganese	Traces.
Lime	1.588
Magnesia	7.776

From this it will be seen that the hydrochloric acid treatment effected the removal of by far the greater part of the alumina, nearly the whole of the lime and magnesia, the whole of the iron assumed to be present as ferric oxide, and, in addition, a portion of the iron (but which has here been calculated as, and included in, the number indicating ferric oxide) represented as in combination with the sulphur. The solution also contained a trifling quantity of sulphuric acid; the amount, however, was not estimated; agreeably with the results of other experiments, it varied according to the length of time occupied in the digestion; unless the latter was very prolonged, it never amounted to more than mere traces.

The proximate analysis of this rock gave:—

Graphite	38.387
Rock matter, soluble in hydrochloric acid	31.096
Rock matter, insoluble in hydrochloric acid	29.083
Hygroscopic water	1.434
	100.

The graphite is very evenly disseminated through the rock, and occurs in the form of minute steel-grey colored scales of bright, metallic lustre. On calcining the powdered mineral, the graphite burns away slowly and with some difficulty, leaving a reddish-brown colored ash.

Adaptability of the graphite for the manufacture of lead-pencils and for electrotyping.

The purified graphite extracted from this rock gives a fairly black lustrous streak, and, so far as quality is concerned, would appear to be well adapted for the manufacture of a very fair grade of lead-pencil, for electrotyping, and most, if not all, of the other numerous applications for which graphite is available. Whether it could be advantageously employed for any of these purposes must necessarily depend upon the cost entailed in the extraction and preparation of the graphite of the requisite degree of purity.

INFUSORIAL EARTH OR EARTHY TRIPOLITE.

From Pollet River Lake, Mechanic Settlement, King's County, New Brunswick. Infusorial earth from New Brunswick.

A detailed statement of the results of the examination of this material appeared in my last report; inasmuch, however, as the analysis possesses an interest in connection with the following experiments, it has also been given here.

The sample had been kept in the dry atmosphere of the laboratory for a lengthened period, and was regarded as perfectly air-dried. It was found that at 100° C., the oxygen of the air exercised a modifying influence upon this material, so that in order to ascertain the correct loss by water at this temperature, it was necessary that, the operation should be conducted in an atmosphere of hydrogen or carbonic acid.

An analysis of the air-dried material gave the following results :— Analysis of.

Silica	80.487
Alumina	3.146
Ferric oxide	0.951
Lime	0.342
Magnesia	0.283
Carbonic acid	0.011
Phosphoric acid	?
Potash and soda	?
Water[1]—combined and hygroscopic—and organic matter	13.321
	98.541

1.—Water and organic matter.

a. Loss on drying over sulphuric acid	6.535
b. Loss (in addition to that of *a.*) on drying at 100° C., in a current of pure and dry hydrogen	3.582
c. Loss (in addition to that of *a.* and *b.*) on ignition (and after correction for carbonic acid)	3.204
	13.321

Some of the many useful purposes to which this material might be applied were alluded to on the former occasion. Since then it has been deemed desirable to ascertain experimentally its suitableness for the manufacture of bricks in imitation of the so-called "light or swimming bricks." These latter, owing to the porous nature of the silica composing the material from which they are made, combine great lightness with infusibility, and are remarkably bad conductors of heat, on which account they constitute, for many purposes of construction, a valuable building material. Its suitableness for the manufacture of bricks.

Manner of conducting the experiments.

Infusorial earth from New Brunswick, cont.

In these experiments the earth was employed alone, as well as in admixture, the addition being in the one case clay (a white pipe-clay), and in the other lime, the material from which the test-bricks were prepared consisting—

In the case of experiment 1. Of the infusorial earth alone.
" " 2. Of a mixture of infusorial earth and clay: 95 parts of the former to 5 of the latter.
" " 3. Of a mixture of infusorial earth and clay: 90 parts of the former to 10 of the latter.
" " 4. Of a mixture of infusorial earth and lime: 99 parts of the former to 1 of the latter.
" " 5. Of a mixture of infusorial earth and lime: 98 parts of the former to 2 of the latter.

The infusorial earth and clay were in an air-dried condition; the lime had been but recently prepared. The amount of dry material and water employed to form the various bricks was in all instances the same. The bricks were all moulded of exactly the same size, and measured 76 mm. in length, 28 mm. in breadth, and 15 mm. in thickness.

A small hand-press was used in the moulding; the pressure employed, however, was not great, and did not very much exceed that which might have been obtained by hand. The freshly moulded bricks having been exposed to a dry atmosphere until they had parted with the greater part of their moisture, were next dried at a temperature of 100° C., after which they were inserted in covered crucibles and placed in an air-furnace, the temperature of which was gradually raised until at the expiration of an hour a white heat had been obtained, at which temperature it was maintained for an additional two hours.

The experiments were carried out in duplicate.

Results.

Refractoriness.—The bricks had in all instances retained their form in perfect tact; they had neither warped nor cracked; their edges remained perfectly sharp, and showed no indication of having undergone even the most incipient fusion. They were all highly absorbent, adhering strongly to the tongue; exceedingly firm, and very tough. Bricks of experiments 1, 4 and 5 appeared to possess this latter property in about an equal degree; they could not be readily broken between the fingers; those of experiment 2 broke only with great difficulty, whilst those of experiment 3 could not be broken in this

wise. The fracture was uneven, in the case of the bricks of experiments 1, 2 and 3, somewhat jagged. The bricks of experiments 1, 2 and 3 presented very smooth surfaces, and possessed a fine and close texture; when suddenly plunged into the flame of a blast-lamp, they decrepitated strongly; this, however, was not the case when the heat was gradually applied. Bricks of experiments 4 and 5 were looser in texture, and when suddenly plunged into the flame of the blast-lamp, stood well; they proved excellent non-conductors of heat: the brick could be held between the fingers, without the slightest inconvenience, whilst the other end was heated to redness in the blast-lamp. Infusorial earth from New Brunswick, cont.

Contraction.—The linear contraction (for the temperature and duartion of firing afore-specified) amounted to—in the case of test-brick

Of experiment 1.....	9.87	per cent. of the original	moulded size.
" 2.....	11.18	"	"
" 3.....	11.18	"	"
" 4.....	9.20	"	"
" 5.....	7.89	"	"

From this it will be seen that the contraction was most marked in those bricks containing an admixture of clay, and least so in those containing an admixture of lime.

Color.—The bricks previous to firing were all perfectly white. After: Those of experiments 1, 2 and 3 were of a uniform cream-color, externally and internally. Those of experiments 4 and 5 were perfectly white; this is in accordance with the fact that the presence of the alkaline earths in ferruginous clays, especially of lime and magnesia, has a singular bleaching power in the kiln, arresting the development of the bright-red color. It has been found that a marl containing six per cent. of ferric oxide and thirty-five per cent. of carbonate of lime, burned of a greyish-buff, instead of the rich red such a proportion of iron would otherwise have produced. Experiment has shown that so small a proportion as five per cent. of caustic magnesia mixed with a red-clay entirely destroys its red-color in the kiln. In the case of the yellow brick, manufactured in the neighborhood of London, England, the colour is dependent on the admixture of ground chalk with the brick-earth, the latter by itself burning of a red color.

Weight—As compared with that of a fire-brick.—The fire-brick measured 9 inches in length, $4\frac{1}{4}$ inches in breadth, and $2\frac{1}{2}$ inches in thickness, and weighed 7 pounds.

From the data obtained in these experiments it was found that a brick of the foregoing dimensions, made under the same conditions and

Infusorial earth from New Brunswick, cont.

from material similar to that employed in the preparation of the test-brick

Of experiment	1	would weigh	3	lbs.	6.2	oz.
"	2	"	3	"	10.9	"
"	3	"	3	"	12.4	"
"	4	"	3	"	1.6	"
"	5	"	3	"	1.9	"

As compared with that of a common brick.—The brick measured 8 inches in length, $3\frac{3}{4}$ inches in breadth, and $2\frac{1}{2}$ inches in thickness, and weighed 4 pounds 15 ounces.

In like manner it was here found that a brick of these dimensions, made under the same conditions, and from material similar to that from which the test brick

Of experiment	1	was prepared, would	weigh	2	lbs.	10.5 oz.
"	2	"	"	2	"	14.2 "
"	3	"	"	2	"	15.4 "
"	4	"	"	2	"	6.9 "
"	5	"	"	2	"	7.1 "

LIGNITE ASH.

Lignite ash from the Souris River

Taken from the outcrop of a seam of lignite occurring on the right bank of the Souris River, six and a half miles east of La Roche Percée, North-West Territory. Collected by Dr. A. R. C. Selwyn, and referred to by him in his accompanying report.

The specimen received was partly in the form of friable lumps and partly in that of powder; it had a light greyish color, and contained intermingled fragments of lignite; the latter in a perfectly unaltered condition.

Analysis of.

This material, when perfectly freed from the associated lignite, was found by Mr. F. D. Adams to have the following composition:—

Silica	16.482
Alumina	1.790
Ferric oxide	0.908
Lime	24.701
Magnesia	0.173
Alkalies (very small quantity)	Undet.
Sulphuric acid	....
Water	20.682

The sulphuric acid was determined, the results however have not been given, inasmuch as they appeared somewhat too high—the amount found was in excess of that required to enter into combination with the bases.

The associated lignite was also examined by Mr. F. D. Adams. He found it to contain 10.971 per cent. of ash, the analysis of which gave him the following results :— Lignite ash from the Souris River, cont.

Silica	15.358
Alumina	18.388
Ferric oxide	7.542
Lime	23.480
Magnesia	19.170
Alkalies	Undet.
Sulphuric acid	13.437
	97.375

This material would therefore appear to consist of the less soluble constituents of the ash of lignite, the more soluble having been removed by the agency of water. From the fact of the associated lignite being in an unaltered condition, it is most reasonable to suppose that this has subsequently become mixed with the other material.

NATURAL WATERS.

A saline water—From MacMaster's Mill, Victoria road, Queensville, Cape Breton, Nova Scotia. Collected by Mr. Hugh Fletcher. Mineral water from Nova Scotia.

The sample received was perfectly clear and colorless, had a slightly alkaline reaction, and was found by Mr. F. D. Adams to contain about 5.859 parts of dissolved solid matter in 1000.

The qualitative analysis made by him showed it to contain the following bases and acids :— Analysis of.

BASES.

Potassa	A trace.
Soda	A very large quantity.
Lime	A small quantity.
Magnesia	A very small quantity.
Ferrous oxide	A small quantity.

ACIDS.

Sulphuric acid	A rather large quantity.
Phosphoric acid	A trace.
Carbonic acid	A rather small quantity.
Chlorine	A large quantity.

Neither bromine nor iodine were detected.

This water belongs—in accordance with the classification of mineral waters adopted by Dr. T. S. Hunt—apparently to the third class.

COALS.

BITUMINOUS COAL.

Bituminous coal.

1.—The following are the results of the examination of a sample of what was supposed to be coal, but which is really little more than a coaly shale. It occurs on the William Dernier estate, bay shore, Upper Salmon River, Albert County, New Brunswick. The seam from which it was taken is stated to have a thickness of about three feet. Examined for Mr. E. B. Chandler.

The specimen had a crumpled shaly structure, and showed traces of slickensides; in parts contained a very appreciable amount of "mother of coal;" color black; powder brownish-black; lustre varied from dull to brilliant.

Analyses of supposed coal from New Brunswick.

Analyses by slow and fast coking gave the following results:—

	Slow coking.	Fast coking.
Hygroscopic water	0.83	0.83
Volatile combustible matter	20.34	24.20
Fixed carbon	30.60	26.74
Ash	48.23	48.23
	100.	100.
Ratio of volatile combustible matter to fixed carbon	1 : 1.50	1 : 1.10

Notwithstanding the very large proportion of inorganic matter, it yields, by fast coking, a moderately firm, coherent, blackish-grey, dull coke. The gases evolved during coking burnt with a yellow, luminous, somewhat smoky flame. Slow coking gave a pulverulent coke. Color of the ash, light brownish-red.

LIGNITE OR BROWN COAL.

NORTH-WEST TERRITORY.

Lignite or Brown coal.

From the Souris River.

2.—From the Souris River, seven miles east of LaRoche Percée. Taken from a boring at a depth of two hundred and seventy eight and a half feet from the surface. The seam was estimated to have a thickness of about six feet. Age, Tertiary. Collected by Dr. A. R. C. Selwyn.

Color black, with a just perceptible brownish tinge; does not soil the fingers; lustre shining resinous; powder black, with a brownish tinge—the same communicated a deep brownish-red color to a boiling solution of caustic potash.

Analyses by slow and fast coking gave the following results:— Lignite or Brown coal, cont.

	Slow coking.	Fast coking.
Hygroscopic water	17.78	17.78
Volatile combustible matter	29.51	32.70
Fixed carbon	44.36	41.17
Ash	8.35	8.35
	100.	100.
Ratio of volatile combustible matter to fixed carbon	1 : 1.50	1 : 1.26

Analyses of, from Souris River.

Both slow and fast coking gave a pulverulent coke. Color of the ash dark brown; it agglutinated slightly at a bright-red heat, and a portion placed on moistened turmeric paper manifested a slight alkaline reaction.

3.—From the Souris River, one mile west of LaRoche Percée, at the junction of Short Creek and Souris River. Seam four feet thick. Age, Tertiary. Collected by Dr. A. R. C. Selwyn. From Souris River.

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

Analyses by slow and fast coking gave as follows:— Analyses of.

	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.	100.
Ratio of volatile combustible matter to fixed carbon	1 : 1.29	1 : 1.10

Both slow and fast coking gave a pulverulent coke. The ash had a brownish-yellow color, agglutinated slightly at a bright-red heat, and when placed on moistened turmeric paper manifested a strong alkaline reaction.

4.—From the Smoky River, five miles below the mouth of Little Smoky River. Seam two and a half inches thick. Collected by Dr. G. M. Dawson. From the Smoky River.

Lignite or Brown coal, cont.

Structure lamellar; made up of alternating layers of a dull and bright lignite and mineral charcoal, of which latter it contained 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—the same communicated a deep brownish-red color to a boiling solution of caustic potash.

Analyses of, from Smoky River.

Analyses by slow and fast coking gave :—

	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.	100.
Ratio of volatile combustible matter to fixed carbon	1 : 1.69	1 : 1.42

By fast coking it yields a slightly coherent, by slow coking a pulverulent coke. The ash had a pale reddish-brown color, agglutinated slightly at a bright-red heat, and manifested a strong alkaline reaction when placed on moistened turmeric paper.

From Athabasca River.

5.—From the Athabasca River, about fifty-five miles above the site of old Fort Assineboine. Upper seam; seam ten feet thick. Collected by Dr. G. M. Dawson.

Structure lamellar; contained an occasional interposed layer of mineral charcoal; some of the layers of lignite were reticulated throughout with delicate laminæ of gypsum; fracture uneven; on exposure to the air splits along the line of bedding; color black; lustre of some of the layers sub-resinous, that of others shining resinous; the powder, which was black with a brownish tinge, communicated a deep brownish-red color to a boiling solution of caustic potash.

Analyses of.

Analyses by slow and fast coking gave as follows :—

	Slow coking.	Fast coking.
Hygroscopic water	11.47	11.47
Volatile combustible matter	28.96	32.09
Fixed carbon	50.92	47.79
Ash	8.65	8.65
	100.	100.
Ratio of volatile combustible matter to fixed carbon	1 : 1.76	1 : 1.49

Both slow and fast coking gave a pulverulent coke. Color of the ash light bluish-grey, it agglutinated but very slightly at a bright-red heat, and manifested but a faint alkaline reaction when placed on moistened turmeric paper. Lignite or Brown coal, cont.

6.—From the Athabasca River, about fifty-five miles above the site of old Fort Assineboine. Lower seam; seam three feet thick. Collected by Dr. G. M. Dawson. From Athabasca River.

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

Analyses by slow and fast coking gave the following results :— Analyses of.

	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.	100.
Ratio of volatile combustible matter to fixed carbon	1 : 1.83	1 : 1.53

Both slow and fast coking yield a pulverulent coke. The ash had a light grey color; it agglutinated but very slightly at a bright-red heat; a portion placed on moistened turmeric paper manifested a slight alkaline reaction.

7.—From Crowfoot Creek, Bow River. Seam six feet thick. Collected by Professor Macoun. From Bow River, (Crowfoot Creek.)

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

Lignite or Brown coal, cont.

Analyses by slow and fast coking gave as follows:—

Analyses of, from Bow River, (Crowfoot Creek.)

	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.	100.
Ratio of volatile combustible matter to fixed carbon	1 : 1.59	1 : 1.33

Both slow and fast coking gave a pulverulent coke. Color of the ash pale brownish-yellow, it agglutinated slightly at a bright-red heat, and manifested a faint alkaline reaction when placed on moistened turmeric paper.

From Bow River, (Blackfoot Crossing.)

8.—From Bow River, Blackfoot Crossing. Collected by Professor Macoun.

Structure lamellar; contained an occasional layer of mineral charcoal; color black; lustre of freshly fractured surface, bright; on exposure to the air shows a slight tendency to split along the line of bedding, some of the layers of lignite were reticulated throughout with films of gypsum, such, on pressure, crumbled somewhat readily into small fragments; color of powder black, with a brownish tinge—it communicated a deep brownish-red color to a boiling solution of caustic potash.

Analyses of.

Analyses by slow and fast coking gave the following results:—

	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.	100.
Ratio of volatile combustible matter to fixed carbon	1 : 1.57	1 : 1.31

Both slow and fast coking gave a pulverulent coke. The ash had a reddish-white color, agglutinated but very slightly at a bright-red heat, and manifested no reaction when placed on moistened turmeric paper.

PROVINCE OF BRITISH COLUMBIA.

9.—From the Pine River, five miles above the lower Forks. Taken from the two-feet seam. Age, Cretaceous. Collected by Dr. A. R. C. Selwyn, and referred to by him in his report. (Report of Progress 1875-76, p. 53.) Lignite or Brown coal, cont. From Pine River.

Structure lamellar, though not always very distinct; does not soil the fingers; hard and firm; lustre of fracture parallel to the bedding dull, that of the fracture across the bedding shining resinous, occasionally brilliant; fracture uneven; contains a brownish-yellow sub-transparent resin, chiefly in small particles, diffused through its substance; resists exposure to the air; color black; powder very dark-brown, inclining to blackish-brown—it communicated only a just perceptible brownish-yellow tinge to a boiling solution of caustic potash. In appearance very closely resembled coal of the Carboniferous system. This may be regarded as a valuable fuel for many purposes. As already stated, it does not—judging from the sample received—disintegrate on exposure to the air, and is sufficiently hard and firm to render it easy of transportation.

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.	100.
Ratio of volatile combustible matter to fixed carbon	1 : 1.96	1 : 1.44

By fast coking it yields a firm, compact and lustrous coke, the caking being doubtless due to the presence of the resin; slow coking gave a pulverulent coke. Color of the ash white, a portion placed on moist turmeric paper manifested no reaction, it did not agglutinate at a bright-red heat, and was very difficultly fusible before the blow-pipe.

10.—From the Pine River, Coal Brook, two and a half miles east of the lower Forks. Seam six inches thick. Age, Cretaceous. Collected by Dr. G. M. Dawson. From Pine River, Coal Brook.

Structure lamellar; lustre sub-resinous to shining resinous, occasionally in parts brilliant; resists exposure to the air; hard

Lignite or Brown coal, cont.

and firm, though perhaps somewhat less so than the preceding specimen; fracture irregular; weathered surfaces in places coated with ferric hydrate; does not soil the fingers; color black; powder brownish-black—the same communicated a deep brownish-red color to a boiling solution of caustic potash. This may be regarded as a lignite of superior quality; in its general appearance it much resembled coal of the Carboniferous system.

Analyses of, from Pine River, Coal Brook.

Analyses by slow and fast coking gave the following results:—

	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.	100.
Ratio of volatile combustible matter to fixed carbon	1 : 1.82	1 : 1.52

Both slow and fast coking gave a pulverulent coke. Color of the ash reddish-white, it manifested no reaction when placed on moist turmeric paper, agglutinated but very slightly at a bright-red heat, and was difficultly fusible before the blow-pipe.

IRON ORES.

PROVINCE OF NOVA SCOTIA.

Iron ores—Analyses of.

Micaceous iron ore. From Middle River, Nova Scotia.

1.—Micaceous iron ore—From Gairloch Mountain, Middle River, Cape Breton. Collected by Mr. Hugh Fletcher, who informs me that it occurs at or near the contact of the Carboniferous conglomerate and pre-Cambrian felsites; that it has been worked to some extent, but probably does not occur in large quantity.

This sample was coated with a thin layer of purplish-red hæmatite, soiling the fingers. It proved to be an exceedingly pure ore. A partial analysis showed it to contain:—

Ferric oxide	97.564
Water, hygroscopic	0.017
Insoluble residue	1.225
Metallic iron	68.295

Micaceous iron ore. From Guysborough County, Nova Scotia.

2.—Micaceous iron ore—Collected by Mr. Hugh Fletcher, by whom I was informed that it occurs as an irregular deposit at the contact of the Devonian (?) and Lower Carboniferous formations, near Stewart Pond, Guysborough County.

This specimen contained numerous fragments of calcareous and other rock matter, notably of the former, the powdered mineral effervescing strongly with acid. It was found to contain :— Iron ores—Analyses of, cont.

Ferric oxide	58.874
Water, hygroscopic	0.019
Insoluble residue	18.580
Metallic iron	41.212

PROVINCE OF QUEBEC.

3.—On Mr. James Richardson's return from a geological reconnaisance of the Magdalen Islands, that gentleman handed me several specimens of rounded nodules, which, as he informed me, occur amongst the *debris* of the fallen cliff immediately under Demoiselle Hill, on Amherst Island. These nodular masses are of very irregular shape and size; they also, judging by the specimens received, differ greatly in composition—some consisting of a compact hæmatite, whilst others were composed almost entirely of manganite. The results of the examination of one of these latter will be found given under Manganese Ores, Analysis No. 3. Mr. F. D. Adams has made a partial analysis of one of the former, determining the more important constituents, and found it to contain :— Hæmatite from Amherst Island, Magdalen Islands.

Ferric oxide	65.201
Manganous oxide	1.559
Phosphoric acid	0.090
Sulphuric acid	0.396
Water, hygroscopic	0.407
Insoluble residue	0.671
Metallic iron	45.641
Phosphorus	0.039
Sulphur	0.158

PROVINCE OF ONTARIO.

4.—Magnetic iron ore—From the east half of the sixth lot of the tenth range of the township of Fitzroy, in the County of Carleton. This and the following specimen were received from Mr. J. A. Gemmill. Magnetite from the County of Carleton, Ontario.

Massive, structure compact. Color greyish-black. Strongly magnetic. In some of the fragments constituting this sample the cleavage was very perfect. This specimen was in parts coated with ferric hydrate; it also contained occasional angular cavities more or less completely filled with the same mineral, and which would, in this instance, appear to have resulted from the decom-

Iron ores—Analyses of, cont.

position of iron pyrites, unaltered fragments of the latter being occasionally found in some of the cavities. It contained :—

Ferric oxide	57.873
Ferrous oxide	31.159
Titanium dioxide	5.290
Water, hygroscopic	0.046
Insoluble residue	2.829
Metallic iron, total amount of	64.746

Magnetite from the County of Carleton, Ontario.

5.—Magnetic iron ore—From the same lot and range of the township of Fitzroy as the preceding.

The specimen consisted of fragments of a fine-granular, dark-grey to greyish-black rock. When pulverized it was separable into a magnetic and non-titaniferous portion and a non-magnetic titaniferous portion. A fragment of the same was submitted to a prolonged digestion with concentrated hydrochloric acid, which effected the removal of the magnetic oxide, leaving behind a more or less friable mass, loosely held together, as it appeared, by a delicate net-work of silica, and consisting for the greater part of a greyish-green colored mineral, apparently pyroxene, some ilmenite, a few grains of colorless, transparent quartz, and here and there a few specks of iron pyrites. A partial analysis gave :—

Ferric oxide	19.841
Ferrous oxide	11.512
Titanium dioxide	present, but not estimated.
Water, hygroscopic	0.207
Insoluble residue	59.757
Metallic iron, total amount of	22.843

NORTH-WEST TERRITORY.

Clay iron-stone from Smoky River, North West Territory.

6.—A specimen of clay iron-stone from the Smoky River, seventeen miles above little Smoky River. Collected by Dr. G. M. Dawson.

Structure, very compact; color, dark brownish-grey, inclining to reddish-brown on weathered surfaces; lustre, dull, earthy; tough; fracture, conchoidal.

A partial analysis of this ore, by Mr. F. D. Adams, gave :—

Ferrous oxide	38.562
Ferric oxide	1.414
Water, hygroscopic	0.840
Insoluble residue	15.948
Metallic iron, total amount of	30.983

COPPER ORES.

1—Supposed copper ore—From the brook, one mile and a half north of Whycocomagh village, Inverness County, Cape Breton, Nova Scotia. Received from Mr. Hugh Fletcher. Copper ores—Analyses of, From Inverness County, Nova Scotia.

It consisted of a mixture, almost in equal proportions, of a very fine granular, almost compact, somewhat bluish-black magnetite, and a dark-green fibrous hornblende, with here and there a slight incrustation of green carbonate of copper, and in parts a little copper pyrites. Weight of sample, five and three-quarter pounds. It was found to contain :

Copper	0.206 per cent.

It was, by request, also assayed for gold and silver. (Gold and Silver Assays, No. 3.)

2.—From the third lot of the seventh range of the township of Ely, County of Shefford, Quebec. This specimen was received from and examined for Mr. J. R. Woodward ; it was not asserted to be an average sample. From the County of Shefford, Que.

It consisted of chalcocite, in a gangue of dolomite and quartz, and contained :

Copper	46.140 per cent.

It was also examined for silver, and the results will be found given under Gold and Silver Assays, No. 5.

MANGANESE ORES.

1.—From the Mira Hills, on the Salmon River road, about two miles east of the head of Loch Lomond, Cape Breton County, Nova Scotia. This and the following specimen were received from the Hon. E. T. Moseley, Esq. Manganese ores—Analyses of.

The specimen consisted of pyrolusite with a little manganite. It was examined by Mr. F. D. Adams, and found—after drying at 100° C.—to contain : Pyrolusite from the Mira Hills, Nova Scotia.

Manganese dioxide	81.52 per cent.

2.—Another specimen from the same locality as the last, and consisting almost exclusively of pyrolusite, also examined by Mr. F. D. Adams, was found—after drying at 100° C.—by him, to contain : Pyrolusite from the Mira Hills, Nova Scotia.

Manganese dioxide	88.98 per cent.
Ferric oxide	0.21 "

Manganese ores—Analyses of, cont.

Assuming this sample to have fairly represented the average character of the deposit, it may be said to be an ore of excellent quality, and, apart from the chief use for which manganese ore is employed, would—owing to its comparative freedom from iron—be especially well adapted for employment as a decolorizing agent in the manufacture of glass.

Manganite from Amherst Island, Magdalen Islands.

3.—Manganite—From Amherst Island, Magdalen Islands. Collected by Mr James Richardson. This specimen has already been referred to under Iron Ores, Analysis No. 3. It consisted of an irregular shaped nodule, which, when broken, exhibited a finely crystalline structure. Mr. F. D. Adams, who examined this sample, found it to contain available

Manganese dioxide	45.61 per cent.
Water, hygroscopic	0.10 "

GOLD AND SILVER ASSAYS.

The following assays were all conducted by Mr. Frank D. Adams.

PROVINCE OF NOVA SCOTIA.

Gold and Silver assays.

Province of Nova Scotia.

1.—From the Meagher Grant settlement, on the Musquodoboit River.

This specimen was forwarded for examination by Mr. W. H. Weeks, of Dartmouth, N.S. It consisted of mispickel in a gangue of quartz. Assay showed it to contain :

Gold	Traces.
Silver	None.

2.—From Musquodoboit.

Examined for Mr. W. H. Weeks, of Dartmouth, N.S. A fine crystalline mispickel associated with a greyish-white, vitreous, sub-translucent quartz. It was found to contain :

Gold	0.146 ounces to the ton of 2,000 lbs.
Silver	0.277 " " " "

3.—From the brook, one mile and a half north of Whycocomagh village, Inverness County, Cape Breton.

This specimen will be found described under Copper Ores, No. 1. Assays showed it to contain :

Neither gold nor silver.

PROVINCE OF NEW BRUNSWICK.

Gold and Silver assays, cont.

4.—From Charley Lake road, parish of Canterbury. Province of New Brunswick.

Collected by Mr. Wallace Broad. A vitreous quartz, stained with ferric hydrate.

It contained neither gold nor silver.

PROVINCE OF QUEBEC.

5.—From the third lot of the seventh range of Ely. Province of Quebec.

This specimen has been described under Copper Ores, No. 2. It was found to contain:

Gold ..... Traces.
Silver ..... 1.094 ounces to the ton of 2,000 lbs.

PROVINCE OF ONTARIO.

6.—From the south-west quarter of the fourteenth lot of the eighth range of the township of Fitzroy, in the County of Carleton. Province of Ontario. Received from Mr. J. A. Gemmill.

The specimen consisted of galena associated with calcite. The galena entirely freed from the gangue, gave on assay:

Silver ..... 2.129 ounces to the ton of 2,000 lbs.

7.—From the Spanish River, about fifty miles up.

Sent for examination by Mr. E. Wright, of Hull, P.Q.

The specimen consisted of a highly weathered schist, containing a little copper pyrites, and in parts stained with green carbonate of copper. It was found on assay to contain:

Silver (with traces of gold) 0.087 ounces to the ton of 2,000 lbs.

8.—From the same locality as the preceding, and received at the same time.

A schist, impregnated with copper pyrites, and with here and there a slight incrustation of green carbonate of copper. Assay showed it to contain:

Silver (with decided traces of gold) 0.219 ounces to ton of 2,000 lbs.

9.—From Marmora?

The specimen consisted of mispickel associated with quartz. It was found to contain:

Gold ..... 4.739 ounces to the ton of 2,000 lbs.
Silver ..... 0.262 " " " "

Gold and Silver assays, cont.

10.—From the ninth lot of the eleventh range of the township of Dalhousie. Forwarded for examination by Mr. J. W. Morris. It consisted of iron pyrites (and which constituted 67.1 per cent. by weight of this specimen) in a gangue of white, somewhat finely crystalline-granular dolomite, in parts much stained with hydrated peroxide of iron.

It contained neither gold nor silver.

PROVINCE OF BRITISH COLUMBIA.

Province of British Columbia.

11.—From the "Sterling Mine," Kokesaila River, Cowichen district, about thirty-five miles by trail from Victoria.

A fine crystalline galena, with a little copper pyrites, in a gangue of dolomitic limestone and quartz. The gangue constituted nearly, if not quite, half the bulk of the specimen. It was found to contain:

Gold ..... Distinct traces.
Silver ..... 9.844 ounces to the ton of 2,000 lbs.

12.—From the same locality as the last.

A fine crystalline galena associated with a little copper pyrites and a small quantity of dolomitic limestone. It was found on assay to contain:

Gold ..... Distinct traces.
Silver ..... 19.323 ounces to the ton of 2,000 lbs.

13.—From the same locality as No. 11.

The specimen consisted of a fine crystalline galena, a little copper pyrites, and a small quantity of dolomitic limestone. This on assay gave:

Gold ..... Distinct traces.
Silver ..... 8.021 ounces to the ton of 2,000 lbs.

14.—From the same locality as No. 11.

A fine crystalline galena, associated with a little copper pyrites, in a gangue of dolomitic limestone. The gangue constituted rather more than half the bulk of the specimen. It was found to contain:

Gold ..... Distinct traces.
Silver ..... 5.104 ounces to the ton of 2,000 lbs.

MISCELLANEOUS EXAMINATIONS.

Miscellaneous examinations.

1.—A specimem of pyrrhotite, labelled, "Nickel ore, from the eleventh range of Sutton, P.Q., was examined for Mr. Alvy Draper, and found by Mr. F. D. Adams to contain :

In addition to traces of copper, a little nickel and traces of cobalt.

2.—Mineral specimen from the ninth range of the township of Madoc, County of Hastings, Ontario. It consisted of iron pyrites, associated with hornblende and chlorite, in a gangue of quartz. Examined at the request of the sender, was found by Mr. F. D. Adams to contain :

A very trifling amount of copper and a trace of cobalt.