PRESIDENTIAL ADDRESS

THE

CRETACEOUS SYSTEM IN CANADA.

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I.—*Presidential Address: the Cretaceous System in Canada.*

By J. F. WHITEAVES.

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At the last meeting of the Society, my predecessor in this chair selected as the subject of his address the "diffusion and sequence of the faunæ" of the oldest division of the palæozoic rocks, as developed in the maritime provinces. On the present occasion it may not be inappropriate for me to select as my theme some aspects of the present state of our knowledge of the newest division of the mesozoic rocks, or, in other words, of the Cretaceous System, of the western and north-western portions of the Dominion.

Although it has long been known that the coal-fields of Nanaimo and Comox, on Vancouver Island, are of Cretaceous age, and that Cretaceous rocks occur over large areas of country in Manitoba and the North West Territories, it is not quite clear by whom or at what date the existence of these rocks in any part of Canada was first recorded. The literature of the subject, prior to the confederation of the provinces, may thus be briefly epitomized. Isbister, who published a summary of the geology of the northern portion of this continent in the Quarterly Journal of the Geological Society of London for May, 1855, makes no mention of any Cretaceous rocks.

1857. In the fourth volume of the Transactions of the Albany Institute, Mr. F. B. Meek published a paper entitled "Descriptions of new organic remains from the Cretaceous rocks of Vancouver's Island." The date of this paper is given on the authority of Mr. Meek himself, in two subsequent papers descriptive of additional species from the same series of rocks, now known as the Nanaimo group, but the title page of the volume is dated 1858–64. The specimens referred to are stated by Mr. Meek to have been forwarded to him by Dr. J. S. Newberry, then geologist of Lieutenant Williamson's northern Californian and Oregon exploring expedition, to whom they were sent by the Smithsonian Institute from Nanaimo.[1] The collection, Mr. Meek says, is "one of much interest, since it furnishes the first evidence we have had of the occurrence of Cretaceous rocks along the western coast of North America." One of the fossils is referred with doubt to the *Baculites ovatus* of Say, and the following twelve are described as new :—

Nucula Traskana.
Arca (Cucullæa) equilateralis.
Arca Vaucouverensis.
Cardium scitulum.
Pholadomya (Goniomya) borealis.
Pholadomya subelongata.
Trigonia Evansana.
Thracia (?) occidentalis.
Thracia (?) subtruncata.
Dentalium Nanaimoensis.
Ammonites (Scaphites) ramosus.
Ammonites Newberryanus.

[1] Dr Newberry, in his "Notes on the Later Extinct Floras of North America," &c., published in the Ann. Lyc. Nat. Hist. N. York, vol. ix, April, 1868, says that these fossils were collected by Dr. Turner.

1857. In the sixth volume of "Explorations and Surveys for a Railroad Route from the Mississippi River to the Pacific Ocean," Dr. J. S. Newberry discusses the age of the rocks associated with the coal on Vancouver Island, especially at Nanaimo, and concludes that they are Cretaceous on purely palæontological evidence.

1858. (April 19.) Dr. B. F. Shumard, in a paper in the first volume of Transactions of the Academy of Sciences at St. Louis (pp. 120-125), describes three species of fossils collected by Dr. John Evans from the Cretaceous rocks on the Nanaimo river, under the names *Inoceramus Vancouverensis*, *Pinna calamitoides*, and *Pyrula glabra*.

1859. (May.) Professor Leo Lesquereux, in the 27th volume (pp. 359-363) of the American Journal of Science and Arts, describes five new species of fossil plants, viz., *Populus rhomboidea*, *Quercus Benzoin*, *Q. multinervis*, *Q. platinervis* and *Cinnamomum Heerii*, collected by Dr. John Evans (then United States geologist for the Territory of Oregon) at Nanaimo, but claims that the rocks from which they were obtained are of Miocene age. He also doubtfully refers one of the fossil plants from Nanaimo to the genus *Ficus*.

1859. (June.) The "Papers relative to Captain Palliser's Explorations in British North America" contain a first general report by Dr. (now Sir) James Hector, dated Fort Carlton, December 12, 1857, on the geology of the country examined by the expedition. In this report Dr. Hector states that he had found rocks containing such Cretaceous fossils "as *Inoceramus*, *Baculites* and others," near the elbow of the South Saskatchewan, and that the same shale was observed near Fort Ellice.

1859. (November 2.) Mr. Hilary Bauerman, in a paper "on the Geology of the South-eastern part of Vancouver Island,"[1] publishes a few notes on the Cretaceous rocks at Nanaimo and Comox, and gives the generic names only of a few fossils from these localities.

1859. (Month not stated). An "Appendix to the seventeenth volume of the Journals of the Legislative Assembly of the Province of Canada," published in Toronto, contains Mr. S. J. Dawson's "Report on the exploration of the country between Lake Superior and the Red River Settlement, and between that place and the Assiniboine and Saskatchewan," and Professor H. Y. Hind's "Report on the Assiniboine and Saskatchewan Exploring Expedition." In the former Mr. Dawson states that in June, 1858, he collected several species of fossils from the valley of the Assiniboine, below Fort Ellice, and transmitted them to E. Billings, then palæontologist to the Geological Survey of Canada, who, in a letter bearing date February 1st, 1859, says that this "collection furnishes us with almost indisputable evidence that a considerable part of the territory belongs to the Cretaceous period, or the great chalk formation so largely developed in the old world." In the latter, Professor Hind states that he collected Cretaceous fossils in 1858 in the valleys of the Assiniboine and its tributaries, and devotes half a chapter to a comparison of the Cretaceous rocks examined with those of the upper Missouri country, and the whole of another to a report on the fossils by Mr. Meek, to whom they were submitted by Mr. Billings. The rocks are considered to be the equivalents of Nos. 2, 4 and 5, or, in other words, of the Benton, Pierre and Fox Hills groups of Meek and Hayden's Upper Missouri section, and thirteen species of fossils are enumerated as occurring in divisions Nos. 4 and 5. Of these, ten are identified with the following previously described species, viz.:

[1] Quart. Journ. Geol. Soc. Lond., vol. xvi, pp. 198-202.

Avicula linguæformis, Evans & Shumard.	Avellana concinna, Hall & Meek.
Avicula Nebrascana, Evans & Shumard.	Ammonites placenta, Dekay.
Leda Evansi, Meek & Hayden.	Scaphites nodosus, Owen. Var.
Rostellaria Americana, Evans & Shumard.	Scaphites Conradi, Morton.
Natica obliquata, Hall & Meek.	Nautilus Dekayi, Morton.

The three remaining, viz., *Anomia Flemingi*, *Inoceramus Canadensis*, and *Leda Hindi*, are described as new and figured.

1859. (Month not stated). Professor Oswald Heer, in his "Fossil Flora of Vancouver Island and British Columbia," describes *Sequoia Langsdorfii* from rocks which are now known to be of Cretaceous age, at Nanaimo, V. I., besides six species of fossil plants from the Tertiary deposits at Burrard Inlet. The specimens of the *Sequoia* were collected by Dr. C. B. Wood, and sent to Professor Heer for examination, by Dr. Hooker.

1861. In a paper "on the Geology of the country between Lake Superior and the Pacific Ocean (between the 48th and 54th parallels of latitude) visited by the Government Exploring Expedition under the command of Captain J. Palliser (1857-60)"[1] Dr. Hector instituted a comparison between the Cretaceous rocks east of the Rocky Mountains, with those of Vancouver Island. He published therein an ideal vertical section of the Cretaceous System in British North America, which he divides into six groups. Group B of this section is said to correspond with No. 1, and Groups D, E, and F, to Nos. 3, 4 and 5 of Meek & Hayden's Upper Missouri section, while the rocks at Nanaimo and other localities in Vancouver Island are placed at the base of the section, in group A. The paper contains several lists of Cretaceous fossils, contributed by Mr Etheridge, but most of the fossils in these lists are only determined generically. Still, as many as nineteen species altogether are recorded, all of which are marine mollusca. Eleven of these are from various localities in what we now call Manitoba and the districts of Assiniboia, Saskatchewan and Alberta. These are:

Ostrea anomiæformis.	Astarte Texana, Conrad.
" lugubris, Conrad.	Cardium multistriatum, Shumard.
" cortex, Conrad.	Cytherea Texana, Conrad.
" vellicata, Conrad.	Pholadomya occidentalis, Morton.
Inoceramus Crippsii, of Rœmer & Conrad.	Baculites compressus, Say.
Leda Hindi, Meek.	

Eight additional species are enumerated as having been collected at Nanaimo, Comox or Valdez Inlet. These are:

Inoceramus Texanus, Conrad.	Inoceramus mytiloides, Conrad.
" Nebrascensis, Owen.	Trigonia Emoryi, Conrad.
" undulatoplicatus, Rœmer.	Cytherea Leonensis, Conrad.
" confertim annulatus, Rœmer.	Ammonites geniculatus, Conrad.

Inoceramus Crippsii (Rœmer) and *Baculites compressus* are stated to be common to the Cretaceous rocks of the plains and Vancouver Island, while, of the whole eighteen, no less than thirteen are identified with Texan or Mexican species.

1861. Mr. Meek, in a paper entitled "Description of New Cretaceous Fossils, collected by the North-West Boundary Commission on Vancouver and Sucia Islands,"[2]

[1] Quart. Journ. Geol. [illegible]d., vol. xvii, pp. 388-445.

[2] Proc. Ac. Nat. Sc. Phila[illegible]ol. xiii, pp. 314-318.

described *Dosinia tenuis* from Nanaimo; *Inoceramus subundatus*, *Baculites occidentalis*, *Ammonites Vancouverensis* and *Nautilus Campbelli*, from Comox; *Ammonites complexus*, var. *Suciensis*, from Comox and the Sucia Islands; and *Baculites inornatus* from the Sucia Islands.

1863. Dr. J. S. Newberry, in the seventh volume of the 'Boston Journal of Natural History,' describes two new species of fossil plants, viz.: *Aspidium Kennerlyi* and *Taxodium cuneatum*, collected by Mr. George Gibb at Nanaimo. He identifies one of the species obtained by Mr. Gibb with the *Populus rhomboidea* of Lesquereux, and refers some small fragments to the genus *Sabal*. More perfect specimens of the latter plant, collected by Mr. James Richardson at Nanaimo, in 1875, were described by Sir J. W. Dawson in the first volume of the Transactions of this Society,[1] under the name *Sabal imperialis*.

1864. The first volume of the Palæontology of California contains descriptions and figures of two new species of fossil shells, *Hamites Vancouverensis* and *Pecten Traskii*, from Nanaimo, by Mr. W. Gabb.

Previous to the confederation of the provinces in 1867, the Cretaceous rocks of what we now call Manitoba, the North-West Territories and British Columbia were entirely outside of the sphere of operations of the Geological Survey of Canada. With the birth of the new Dominion, however, the conditions were changed, and the seventeen annual reports published since 1867, with many special publications not included therein, will abundantly show how far the new obligations imposed upon its staff have been met. The Cretaceous rocks, in particular, of Manitoba and the North-West Territories (including the district of Athabasca and part of the Mackenzie River district) and those of the Rocky Mountains and British Columbia have been examined systematically and reported upon by Drs. Selwyn, G. M. Dawson, R. Bell and J. W. Spencer, and by Messrs. James Richardson, R. G. McConnell, and J. B. Tyrrell. These explorations have added largely to our knowledge of the distribution of the Cretaceous rocks in Canada, of their economic products, and of their relations to each other and to the strata by which they are underlaid or succeeded. Our knowledge, also, of the flora and fauna of these rocks has been largely increased, their plant remains having been examined and reported upon by Sir J. W. Dawson, in the Transactions of this Society and elsewhere; their foraminifera by Dr. G. M. Dawson and Mr. Tyrrell, their radiolaria by Dr. Rüst (of Hanover, Germany), the remainder of their invertebrate remains and a few (four) of their fossil fishes by the present writer, in special publications of the Survey or elsewhere; while their other vertebrate remains have been entrusted, for examination, to Professor E. D. Cope. It is now practicable to subdivide these deposits in accordance with their fossil remains, and to institute an intelligible comparison between the Cretaceous rocks at widely separated localities in Canada. In endeavoring to summarize the latest results of our attempts in these directions and the present state of our knowledge of the flora and fauna of the Cretaceous rocks of Canada, it will be convenient to consider these rocks in a direction from east to west geographically, unless otherwise stated, and in a descending order geologically. These rocks, accordingly, will be considered in the following order: (1) Those of Manitoba and the North-West Territories; (2) those of the Rocky Mountain region; (3) those of British Columbia, inclusive of the islands off the Pacific Coast; after which it will be convenient to consider (4) those of the Yukon district.

[1] Sect. IV, 1882, p. 26.

The Cretaceous system of Europe is divided by some writers into the Upper, Middle and Lower Cretaceous, and by others into merely the Upper and Lower Cretaceous, the dividing line being drawn immediately above the Gault by those who adopt the latter view. In Canada, as in the United States, it is at present found most convenient to adopt a single division of the system and to draw the line between the Upper or Later and the Lower or Earlier North American Cretaceous, as nearly as practicable at the base of the Dakota group or of that of its local representative.

Manitoba and the North West Territories.

In this region all the Cretaceous rocks that have yet been examined, would appear to be referable to the Upper or Later North American Cretaceous, as here defined.

It is still doubtful whether the Laramie formation of Canada should be regarded as forming the summit of the Cretaceous or the base of the Tertiary System, though, at present, the consensus of opinion among geologists would seem to favour the former view. In mapping the northern part of the district of Alberta Mr. Tyrrell found that the Laramie there is divided into two series, and has expressed the opinion that its upper portion, which he proposes to call the Pascapoo series, is of Eocene age, and that its lower portion, which he calls the Edmonton series, and which is equivalent to Dr. Dawson's "St. Mary River series," of Southern Alberta, is Cretaceous. This division is based mainly upon palæontological evidence, and more especially upon the circumstance that the Edmonton series is now known to contain numerous remains of Dinosaurs (*Lælaps*, &c.), and that it is the highest horizon in Canada at which Dinosaurs are known to occur.

In Manitoba and the North-West Territories, as in the adjacent portions of the United States, it is found to be no longer practicable to separate the Fox Hills group from the Fort Pierre group, nor the Niobrara from the Benton In this region, therefore, the Upper or Later North American Cretaceous may be subdivided into five formations, viz.: (1) The Laramie, in whole or in part; (2) The Pierre-Fox Hills or Montana formation; (3) the Belly River series; (4) the Niobrara-Benton or Colorado formation; and (5) the Dakota.

The Laramie formation.—From the Laramie formation in Canada, no less than seventy-one species of fossil plants have been identified or described by Sir William Dawson[1] since 1867, about twenty-five of which are from the Mackenzie River district. Most of these plant remains are leaves of angiospermous trees, indicative of a terrestrial flora, but there are a few aquatic species. Thirty-five species of invertebrata from the Laramie of Alberta and the Souris River district have been recorded or described by the writer in the first part of the first volume (pp. 2-28) of "Contributions to Canadian Palæontology," published by the Geological Survey in 1885. Four of these are land shells and the remainder shells of mollusca, for the most part of fresh water or estuarine genera. The fine series of Dinosaurian remains collected by Mr. Tyrrell in 1885 and by Mr. T. C. Weston in 1889, from the Laramie of the Red Deer River in Alberta, has been partially reported upon by Professor Cope, who published preliminary descriptions of two crania of *Lælaps incrassatus*, in the Proceedings of the American Philosophical Society for April,

[1] In Dr. G. M. Dawson's Brit. N. Am. Bound Rep., pp. 327-331; in Geol. Surv. Can., Rep. Progr. 1879-80, pp, 51-51A; and in the Trans. of this Soc., vol i, sect. 4, pp. 32-33; vol. iii, sect. 4, pp. 15-18; vol. iv, sect. 4, pp. 19-34; and vol. vii, sect. 41, pp. 69-74.

1892. Other Dinosaurian remains, which are not yet reported upon, had previously been collected by Dr. Dawson and Mr. McConnell, in the Laramie at Scabby Butte, Spring Ridge, and the Bow River.

The Pierre-Fox Hills or Montana formation.—Up to 1889, sixty-eight species of fossils have been recorded or described as occurring in this formation in Canada,[1] which has been found by Dr. Dawson and Mr. McConnell to extend as far to the north-westward as Coal Brook on the Peace River, the Smoky River at the mouth of the Little Smoky, Lesser Slave Lake, and the Athabasca River ten miles below the mouth of the Pelican. With the exception of an echinoderm (*Hemiaster*), a brachiopod (*Lingula*), and a long tailed decapod (*Palæastacus*), all these fossils are shells of marine mollusca, most of which are identical with species described by Meek and Hayden and others, from rocks of the same age in the Upper Missouri country, though a few were previously undescribed. In the third part of the "Contributions to Canadian Micro-Palæontology," published by the Geological Survey in 1892, Dr. Rüst identified three and described thirteen species of Radiolaria collected by Messrs Tyrrell and Dowling from the lower portion of the Pierre shales of north-western Manitoba. In the same year Professor S. H. Scudder described a new fossil beetle, *Hylobiites cretaceus*, collected by Mr. Tyrrell from the Pierre shales at Millwood, Manitoba.[2]

The Belly River series.—In 1882 Dr. G. M. Dawson made the discovery that a series of estuarine deposits in northern Alberta, which he had originally supposed to form part of the Lignite Tertiary or Laramie formation, and described under the former of these two names in his British North American Boundary Report, really occupy a position "below the Pierre shales, or at least below a portion of these shales." For these deposits, which have since been found to extend into western Assiniboia, and to contain a fossil flora and fauna remarkably like those of the Laramie, the name of the Belly River series has been proposed.[3] The fossil plants of this formation have been examined and reported upon by Sir William Dawson, in the Transactions of this society for 1885 (vol. iii, sect 4, pp. 15-16), their invertebrate remains by the writer, in "Contributions to Canadian Palæontology," volume one, part one (pp. 55-77), and their vertebrate remains have been forwarded to Professor Cope for examination. Sir William Dawson finds that the fossil flora of the Belly River series or formation, so far as known, consists of leaves of three species of deciduous trees (angiosperms) and of remains of one species each of the fresh-water genera *Brasenia*, *Pistia* and *Lemna*. Of these six species, two, viz., *Platanus nobilis* and *Lemna scutata*, or one-third of the whole, are known to occur also in the Canadian Laramie. The invertebrata represented in the collections made so far from the Belly River formation, which were studied quite independently of the plant remains, give remarkably similar results. They were found to consist of thirty-one species of brackish or fresh-water shells (mollusca), and of these, ten or eleven, or about one-third of the whole, are known to occur also in the Canadian Laramie. The vertebrata of this formation have not yet been fully reported upon by Professor Cope, but he at once recognized the close resemblance between its fish teeth and scales, its portions of scutes of turtles and bones of reptilia, and those of the Laramie. The three species of turtles, viz., *Compsemys ogmius*, *Plastomenus coalescens* and *P. costatus*,

[1] In Geol. Surv. Canada, Rep. Progr. 1879-80, p. 124B; and in Contr. to Can. Palæont., vol. i, pt. 1 pp. 29-54, and 78-81; also vol. i., pt. 2, pp. 174-184.

[2] In Contr. to Can. Pal., vol. ii, Fossil Insects, pp. 30-31.

[3] In Geol. Surv. Canada, Rep. Progr. 1882, 83, 84, p. 119c.

and the Dinosaur, *Cionodon stenopsis*, from six miles west of the first branch of the Milk River, which were described by Professor Cope in an appendix to Dr. Dawson's Boundary Report, are, however, now known to be from the Belly River series.

The Niobrara-Benton, or Colorado formation.[1]—Five species of foraminifera from the Niobrara shales of the Boyne River, Manitoba, were identified by Dr. Dawson in 1875, in his British North American Boundary Report, (p. 79), and nine additional species, determined by Mr. C. Davies Sherborne, have since been recorded by Mr. Tyrrell[1] as occurring in the same formation at other localities in southern Manitoba. In a paper published in 1890, in the eighth volume of Transactions of this society,[2] Mr. Tyrrell points out that the different horizons in the Cretaceous may readily be determined by the minute tests of the radiolaria or foraminifera, in borings in which the larger fossils are either absent or too much broken to be identified.

Six species of marine invertebrata belonging to other groups than the foraminifera, viz., one tubicolous annelid (*Serpula*), four mollusca proper, one cirripede (*Loricula*), and four of fishes from the Niobrara-Benton of Manitoba were recorded or described in 1889, in the second part of the first volume (pp. 185-196) of "Contributions to Canadian Palæontology."

The Niobrara-Benton of the district of Athabasca has yielded to Dr. Bell an interesting series of fossils, in 1882, and large and important collections of the fossils of these rocks were made by Mr. McConnell in 1889 and 1890. These collections have not yet been fully reported upon, but the Ammonites in them were identified or described by the writer and illustrated in a paper published in the last volume of Transactions of this society. They consist of from fifteen to twenty species of marine mollusca, besides the five Ammonites that have been reported upon.

In the Report of Progress of the Geological Survey of Canada for 1879-80 (published in 1881) Dr. Dawson proposed the local name of the "Dunvegan group" for a series of sandstones and shales, the "Lower Sandstones" of his Peace River section, which hold shells of brackish and fresh-water mollusca and numerous remains of land plants. These sandstones and shales, however, probably form part of the Niobrara-Benton formation. The fauna of the sandstones of the Dunvegan group is very similar to that of the so-called Bear River Laramie of Wyoming, which is now known to be much older than the true Laramie, and consists of such brackish water genera as *Ostrea*, *Brachydontes* and *Corbula*, and of such purely fresh-water mollusca as *Corbicula*, *Unio* (or *Margaritana*) and *Goniobasis*. Most of the genera are similar to those of the Canadian Laramie and Belly River formation, but the species are all different, the most characteristic of the latter and the only ones that have been specifically identified being *Corbula pyriformis* and *Corbicula Durkeei*. The plant remains of the shales of the Dunvegan group, as described by Sir William Dawson in a "Note on the Fossil Plants" in Dr. Dawson's Report, and in the first volume of Transactions of this society,[3] are said to resemble those of the Dakota group of the western United States and consist of the leaves or fruits of twenty species of angiosperms, among the more noticeable of which are two cycads, *Dioonites borealis* and *Cycadites Unjiga*,

[1] In Geol. Surv. Canada, Ann. Rep. vol. v (1892), p. 211E.

[2] Sect. 4, pp. 111-115.

[3] Vol. i (1883), sect. 4, pp. 20-23.

and the fronds or portions of fronds of one species of fern. Sir William Dawson regards the plant-bearing beds of the Dunvegan group as "near the horizon of the Niobrara," but it is by no means certain whether the entire series represents estuarine and terrestrial conditions at the commencement of the Niobrara, or a north western development of the Belly River formation. Stratigraphically the Dunvegan group or series appears to be immediately underlaid by the Fort St. John shales of Dr. Dawson's Peace River section (which are probably the local representatives of the Benton), and overlaid, at least in Pine River Cañon, by "at least 1700 feet of strata the uppermost beds of which hold an *Inoceramus*," which is apparently *I. altus*.

The only fossils that have as yet been collected from the Fort St. John shales are a small *Pecten*, species not determinable; a *Pteria* not unlike *P. Nebrascana*; an *Inoceramus*, which may possibly be *I. problematicus*; and crushed specimens of an Ammonite resembling *Acanthoceras Woolgari*, but which has been provisionally described under the name *Buchiceras cornutum*.[1]

The Dakota formation.—This formation has been recently recognized by Mr. Tyrrell[2] in Manitoba, and is supposed by Mr. McConnell to occur in the District of Athabasca, in both cases resting unconformably upon Devonian limestones. According to Mr. Tyrrell,[3] very few fossils have been found in the Dakota sandstone of Manitoba, which was previously regarded as the basal portion of the Benton, and those that have been found are confined to the upper beds. "They consist chiefly of carbonized fragments of wood and coniferous leaves, but the following animal remains have also been collected, viz., *Lingula subspatulata*, Hall & Meek; *Ostrea congesta*, Conrad; *Modiola tenuisculpta*, Whiteaves, and scales of cycloid fishes."[4] No fossils have yet been collected from the Dakota sandstone (the "tar sands") of the Athabasca district.

The Rocky Mountain Region (inclusive of the Foot Hills.)

On the eastern and central portions of the plains the Cretaceous rocks are almost horizontal, but on the eastern flanks of the mountains they are considerably folded and much disturbed. In the Foot-Hills and in the Rocky Mountains they occupy or form the bases of narrow troughs in the palæozoic rocks. As the sections of the Cretaceous rocks in this region have not yet been completely worked out, there is at present no satisfactory evidence as to the relative position which the different beds occupy in the series, but some attempts have been made to correlate them on the evidence of the fossils which they contain. The fossils which have been collected from these deposits consists of remains of plants or of marine invertebrata. By their plant remains Sir William Dawson recognizes three horizons in the Cretaceous rocks of this region, viz. 1, the Mill Creek series; 2, the Intermediate series; and 3, the Kootanie series.[5]

The Mill Creek series.—From this series Sir William has identified or described twenty species of land plants.[6] Four of these are fronds or portions of fronds of ferns, one is the

[1] In the Trans. of this Soc. for 1884, vol. ii, sec. 4, pp. 239-40.
[2] Geol. Surv. Canada, Ann. Rep., vol. v, (1892), p. 209E.
[3] Ibid.
[4] Ibid.
[5] In the Trans. of this Society for 1885, vol. iii, sec. 4, p. 2.
[6] Ibid., pp. 11-15.

strobile or fruit of a cycad (*Williamsonia*), and the remainder dicotyledons, the broad leaves of angiospermous trees or shrubs. Sir William thinks that this series is not improbably older than the Dunvegan group of the Peace River district, "and that it has important points of agreement" . . . . "with the Dakota group of the western United States."

The Intermediate series.—This series, which has been found only at the north branch of the north fork of the Old Man River, in Alberta, has yielded, so far, five species of plants, viz., a fern (*Asplenium Dicksonianum*, Heer), branchlets of two conifers (*Glyptostrobus Groenlandicus*, Heer, and *Taxodium cuneatum*, Newberry), and leaves of two species of dicotyledons which Sir William Dawson has described under the names *Sterculia vetustula* and *Laurus crassinervis*.[1] Of these five species, the fern and the two conifers occur in the Kootenay series, and one of the latter (*Taxodium cuneatum*) was originally described from the Cretaceous rocks at Nanaimo, V.I.

The Kootanie series.—Twenty-seven species of fossil plants, which have been either determined or described by Sir William Dawson in the third and tenth volumes of Transactions of this society, are there recorded as having been collected from the Kootanie series of the Crow's Nest and Kootenay passes. Eight of these are ferns, one is an *Equisetum*, six are cycads and twelve coniferæ, besides one doubtful organism (*Taonurus*) which is regarded as possibly allied to the algæ. In the flora of the Kootanie series no remains of angiosperms have yet been detected, though it should not be forgotten that three species of plants are now known to be common to the Kootanie and Intermediate series, and that two species of angiosperms have been found in the latter. No remains of angiosperms have as yet been collected from the Lower or Earlier Cretaceous at any locality in Canada.

The invertebrata of the distorted Cretaceous rocks of this region have been studied quite independently of the plant remains, and as a result of these studies the following estuarine or purely marine divisions of the system have been recognized.

The Laramie formation.—The lower portion of this formation has been recognized near the head waters of Oyster Creek, a tributary of the north-west branch of the Old Man River. The fossils recognized from the Laramie at this locality are *Ostrea glabra*, var. *Wyomingensis* and *Corbicula occidentalis*.[2] The Laramie is also represented in the folded rocks of the Foot-Hills, as at Pincher Creek, for example.[3]

The Pierre-Fox Hills or Montana formation.—On the Ghost River and on the Bow River near the mouth of the Ghost River, a few specimens of *Baculites compressus*, Say., were collected by Mr. McConnell in 1891. This is one of the most characteristic fossils of the Pierre-Fox Hills or Montana formation, and as such may be regarded as satisfactory evidence of the existence of that formation in this region.

The Niobrara-Benton or Colorado formation.—The fissile shales at Mill Creek hold shells of *Inoceramus problematicus*, Schlotheim, which in England is said to be characteristic of the Lower Chalk, and in the upper Missouri country of the Niobrara. These shales, however, probably belong to a different horizon to the plant-bearing Mill Creek series.

In the first part of the first volume of "Contributions to Canadian Palæontology," published in 1885 (pp. 83-89), under the heading "Exact Geological Horizon Uncertain," eight

[1] In the Trans. of this Society for 1885, vol. iii, sect. 4, pp. 10 and 11.
[2] See Geol. Surv. Canada, Ann. Rep., vol. i, N.S., p. 92a.
[3] " " " " Rep. Progr. 1882-84, p. 97c.

species of fossils different to those of the Niobrara-Benton of Manitoba, were identified or described from the Cretaceous rocks at several localities in this region. Seven of these species are shells of marine mollusca, five of which are elsewhere characteristic of the Benton, and one is a previously undescribed decapod crustacean for which the name *Hoploparia? Canadensis* was proposed, but which is now believed to be a *Podocrates*, very closely related to *P. Dulmenensis*, Schluter. In 1886 a small collection of fossils obtained by Mr. McConnell from the Cretaceous shales "faulted under the Cambrian limestones at the gap of the south fork of Ghost River, includes, among others, such Benton species as *Scaphites ventricosus*, and perhaps *S. Warreni*, and an *Inoceramus* like *I. undabundus*."[1]

The Devil's Lake deposits.—In 1887 Mr. McConnell collected a remarkable series of fossils from near the base of a small Cretaceous outlier, in the Rocky Mountains, three miles north of the east end of Devil's Lake, Alberta. These fossils have been reported upon by the writer in the second part of the first volume of "Contributions to Canadian Palæontology." They consist of one species of brachiopoda and nine of marine mollusca. The brachiopod and one of the pelecypoda were previously undescribed, but eight of the mollusca were found to be identical with species from the Lower Shales or coal bearing deposits of the Queen Charlotte Islands.

From the combined evidence afforded by the fossil flora and fauna of the Cretaceous rocks of this region, it would appear that the Laramie, the Pierre-Fox Hills, the Niobrara-Benton formation, and perhaps also the Dakota, are there represented. The Kootanie series, and the Devil's Lake deposits, which at that locality form the base of the Kootanie, are, on the other hand, almost certainly older than the Dakota formation, and hence referable to the Lower or Earlier North American Cretaceous.

British Columbia and the Islands off the Pacific Coast.

It will be most convenient to consider the Cretaceous rocks of this region in the following order, viz., (1) the Nanaimo group of Vancouver and the adjacent islands; (2) the Queen Charlotte Island series; and (3) the Cretaceous at other localities in the province.

The Nanaimo group.—The Cretaceous rocks of the coal-fields at Nanaimo, Comox and Cowitchen of Vancouver and the adjacent islands were systematically examined by the late Mr. James Richardson in the summer seasons of 1871-77 (both years inclusive) and reported upon by him in the Reports of Progress of the Geological Survey of Canada for those years. Large collections of fossils were made by Mr. Richardson from the lower and central subdivisions of these rocks, but very few fossils and none that could be determined, were obtained from the upper part of the series. Hence it was and is still quite uncertain whether the Upper Shales and Sandstones of his Comox section and the Upper Sandstones of his Nanaimo section should be regarded as Upper Cretaceous or Lower Tertiary. Dr. Dawson thinks that they probably represent the Puget group of Dr. C. A. White.[2]

From the basal and middle or definitely Cretaceous subdivisions of these two sections at Nanaimo, Baynes Sound (Comox) and Beaver Harbour, Vancouver Island, and on Protection and Newcastle islands, twenty-seven species of fossil plants were identified or

[1] Geol. and Nat. Hist. Canada, Ann. Rep., N.S., vol. ii, (1887), p. 17D.

[2] Am. Journ. Sc. and Arts, Series 3, vol. xxxix, p. 182.

described by Sir William Dawson in the Transactions of this society for 1883.[1] A large number of these plants are leaves of angiosperms, such as extinct species of poplar, beech, elm, oak and willow, also portions of the fan-shaped leaves of a true palm, *Sabal imperialis*, allied to the Palmetto of the southern United States and West Indies.

The other fossils from the lower and middle subdivisions of this group of rocks (for which Dr. G. M. Dawson, in 1890, suggested the local name of the Nanaimo group)[2] are remains of marine invertebrata, and of these, 106 species were identified or described in the second part of the first volume of "Mesozoic Fossils," published by the Geological Survey of Canada in 1879. One of these is a coral, two are referable to the brachiopoda, and the remainder are shells of marine mollusca. To correspond with the palm leaves, which are suggestive of warmer climatic conditions than those which now obtain at the Vancouver group of islands, there are two species of *Nautilus*, and a large volute formerly designated as *Fulgoraria Navarroensis*, but which it would be more correct to call *Rostellites Gabbi*.

The lower and middle or most fossiliferous subdivisions of the Nanaimo group are still regarded by Canadian geologists as probably referable to the Upper or Later rather than to the Lower or Earlier North American Cretaceous, and the reasons for this view may be thus briefly summarized. 1. Their fossil flora, so far as known, consists largely of numerous species of angiosperms, and no traces of these have yet been detected in the Lower or Earlier Cretaceous. 2. Their invertebrate fauna is essentially similar to that of the Chico group of the Californian geologists, and bears a considerable resemblance to that of the Pierre-Fox Hills or Montana formation, both of which are very generally believed to belong to the Upper North American Cretaceous. 3, Not one of the numerous species of ammonites or ammonitoid shells that have been found in the fossiliferous portion of the Nanaimo group, is known to occur also in the Lower Shales of the Queen Charlotte Islands, which are presumed to represent part of the Lower North American Cretaceous. Thus, portions of the shells of two species of *Baculites* are not at all infrequent in the lower subdivision of the Nanaimo group, but not a trace of a Baculite has yet been detected in the Cretaceous of the Queen Charlotte Islands.

But, on the other hand, at least one species of mollusc (*Nucula truncata* of Gabb, a well marked and easily identified shell) and perhaps two others (*Nautilus Suciensis* ? and *Teredo Suciensis* ?) are known to occur both in the lower part of the Nanaimo group and in the Lower Shales of the Queen Charlotte Islands. There seems to be also but little if any difference between certain specimens of *Inoceramus* from these two formations. Moreover, Mr. J. S. Diller, of the U. S. Geological Survey, who has made considerable collections of the fossils of the Cretaceous rocks of northern California and southern Oregon in 1888 and 1889, suggests[3] that the fauna of the Chico and Shasta groups of these states are more closely related than had hitherto been supposed." This view of the relations of the faunæ of these formations was advocated by Mr. T. W. Stanton in a paper read before the Geological Society of America, at its meeting in Ottawa in December last, (1892), and since published by the Society.[4]

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[1] Vol. I, sect. 4, pp. 24-29.

[2] Amer. Journ. Sc. and Arts, Series 3, vol. xxxix (March, 1890), pp. 180-83.

[3] Bull. Geol. Soc. America, vol. iv, pp. 208-213. The quotation is from Mr. Stanton's paper, ib., p. 250.

[4] Ib., pp. 245-256.

The Queen Charlotte Island Cretaceous.—In 1872 Mr. Richardson examined the coal-bearing deposits of Skidegate Inlet, in the Queen Charlotte Islands. In his report upon these islands, published in the Report of Progress of the Geological Survey of Canada for 1872–73, Mr Richardson divides these rocks into three groups, viz., 1, the Lower Shales, with coal and iron; 2, Coarse Conglomerates; and 3, the Upper Shales and Sandstones."

With the exception of some fragments of fossil plants and a few crushed and distorted specimens of a single species of *Inoceramus*, whose specific relations were then doubtful, which were obtained from the Upper Shales and Sandstones, all the fossils collected by Mr. Richardson are from the Lower Shales. The plant remains from the Lower Shales, which are not numerous, are stated by Sir William Dawson, in an appendix to Mr. Richardson's Report, to consist of portions of the woods of two coniferous trees (*Cupressoxylon* and *Dadoxylon*), allied to the modern cypresses and yews, together with fruits and fragments of leaves of a previously undescribed species of Cycad allied to the recent *Dioon edule* of Mexico, for which the name *Cycadeocarpus* (*Dioonites*) *Columbianus* was proposed. Some preliminary notes on the other fossils collected by Mr. Richardson, nearly all of which are remains of marine invertebrata, were published by Mr. E. Billings, who was then palæontologist to the Geological Survey, in another appendix to the same Report, but none of the specimens were determined specifically. On the evidence of the fossil plants Sir William Dawson thought that these Lower Shales are either lower Cretaceous or Jurassic, and Mr. Billings, on the evidence of the invertebrate fossils, thought that they are "partly Cretaceous and partly Jurassic."

The invertebrata of these shales were more fully reported upon by the present writer in the first part of the first volume of "Mesozoic Fossils," published by the Geological Survey in 1876. Of the twenty-five species therein identified or described, eleven belong to the Ammonitidæ, three to the gasteropoda, and eleven to the pelecypoda, one of the latter being a *Unio*.

In 1878 Dr. Dawson made a careful examination of the coal-bearing deposits at Skidegate and Cumshewa Inlets, in the Queen Charlotte Islands, and of the Cretaceous rocks at Quatsino Sound, on the north west coast of Vancouver Island. He found that the coal-bearing series of the Queen Charlotte Islands is overlaid unconformably by Tertiary deposits, and underlaid, also unconformably, by fossiliferous rocks of Triassic age. In his report on these islands, published in the Report of Progress of the Geological Survey of Canada for 1878–79, Dr. Dawson adopts the three sub-divisions of Mr. Richardson's section, though he treats the section in descending order, calling the Upper Shales A, the coarse conglomerates B, and the Lower Shales C, and adds thereto two more sub-divisions, viz., D, Agglomerates, and E, Lower Sandstones.

The fossils collected by Dr. Dawson in the Cretaceous rocks of the Queen Charlotte Islands form the subject of the third part of the first volume of "Mesozoic Fossils," published in 1884. From the Upper Shales and Sandstones of Mr. Richardson and Dr. Dawson's section, the only species recognized so far is *Inoceramus problematicus*, and these shales etc., are therefore supposed to represent the Niobrara of the plains. The only fossil obtained from the "Coarse Conglomerates" is a worn fragment of the guard of a Belemnite, but, from their stratigraphical position, these conglomerates are assumed to be the local representatives of the Benton and Dakota. As many as sixty-five species of marine invertebrata are enumerated or described as having been collected by Dr. Dawson in the

Lower Shales, or coal-bearing deposits proper, but fourteen of these are identical with species previously collected from these shales by Mr. Richardson. Of the sixty-five species, one is a coral and one a brachiopod, thirty-seven are pelecypoda, seven gasteropoda, and nineteen cephalopoda. The fauna of these shales was found to be remarkably similar to that of the Gault of Europe, and to include such characteristic species of that formation as *Schloenbachia inflata*, *Desmoceras Beudanti*, *D. planulatum*, *Lytoceras Timotheanum*, *Inoceramus concentricus*, and *Actinoceramus sulcatus*. In Mr. Richardson's collections from these shales there are five species of Ammonites, viz., *Stephanoceras Richardsonii*, *S. cepoides*, and *S. oblatum* (these last two being distinctly referable to the genus *Spharoceras*), *Perisphinctes Skidegatensis* and *P. Carlottensis*, which have such a Jurassic aspect that it was naturally supposed that there might have been some mistake about the exact geological horizon at which they were alleged to have been collected. But, in the collections made by Dr. Dawson there is a typical example of *Spharoceras cepoides* from the Lower Shales at South Island, in Skidegate Inlet, where it was found associated with such distinctively Cretaceous species as *Lytoceras Timotheanum* and *Inoceramus concentricus*; and a characteristic fragment of *Perisphinctus Skidegatensis*, obtained also *in situ*, from the base of the same shales at the east end of Maud Island, in Skidegate Inlet.

The only fossils obtained from the Agglomerates, or sub-division D, of Dr. Dawson's section, are three fragments of shells, apparently of pelecypoda, but these are so badly preserved that even their generic relations could not be ascertained.

From the Lower Sandstones, or sub-division E, of Dr. Dawson's section, eleven species of fossils were identified or described, but five of these are identical with species from the Lower Shales. Hence it is inferred that the Lower Shales (C), the Agglomerates (D), and the Lower Sandstones (E) are most likely mere subordinate members of one sub-division, which represents locally the whole of the lower or earlier North American Cretaceous. Altogether, eighty-three species of fossils, exclusive of the few plant remains, have now been recorded as having been collected by Mr. Richardson and Dr. Dawson from the Cretaceous rocks of the Queen Charlotte Islands. One of these is from the "Upper Shales" and presumably upper Cretaceous, seventy-six are from the "Lower Shales," and six additional species from the "Lower Sandstones."

The name "Queen Charlotte Island group" was proposed by the writer in 1882[1] for the three lower sub-divisions (C, D and E) of the Queen Charlotte Island Cretaceous, and that of the "Queen Charlotte Island formation" by Dr. Dawson in 1889.[2]

The Cretaceous at other localities in the province. In 1875, deposits, apparently of Cretaceous age, were discovered by Dr. Dawson at Tatlayoco Lake, which empties into Bute Inlet through the Homathco River. From these deposits, numerous specimens of a variety of *Aucella Mosquensis*, and a few imperfect guards of *Belemnites impressus* were collected.

It was subsequently found that the Jackass Mountain beds of Dr Selwyn, on the Fraser River, contained similar fossils, which were also found on the Skagit River and in other places in the western part of the southern interior of British Columbia. The fossils of these rocks and those from Tatlayoco Lake form the subject of a paper in the first volume of Transactions of this society, in which they were regarded as possibly of nearly the same age as the Upper Neocomian of Europe, partly because of the abundance among them of

[1] Trans. Royal Soc. Canada, vol. i, sect. 4, p. 85.
[2] Am. Journ. Sc. and Arts, vol. xxxviii, p. 121.

one of the varieties of *Aucella Mosquensis*, which is stated by Eichwald to be peculiar to that formation in Russia, and partly because of their resemblance to, or identity with, the fossils of the Shasta group of California.

Certain rocks described by Dr. Dawson in the Report of Progress of the Geological Survey of Canada for 1876-77, and there referred to as the "Porphyrite series," occur on Sigutlat Lake and the Iltasyouco River, which flows from Sigutlat Lake into the Dean or Salmon River. The fossils collected from these porphyrites were reported upon provisionally by the writer in an appendix to Dr. Dawson's Report. They were then regarded as possibly of Jurassic age, on account of their resemblance to the fossils of the so-called Jurassic rocks of the Black Hills of Dakota, but are now believed to be Cretaceous.

The collections of fossils that have been made from the Cretaceous rocks at Quatsino Sound, Vancouver Island, in 1878 and 1885, and at various localities off the coast or on the mainland of British Columbia between 1875 and 1888, have led to the conclusion that the *Aucella* bearing rocks and Jackass Mountain series of that province are not older than, but of about the same age as the Queen Charlotte Island formation, and that the porphyritic rocks of Sigutlat Lake and the Iltasysuco River are of the same age and not altered jurassic sediments.

The Yukon District.

Although included in the North West Territories, the orographical and geological features of this district are so much more nearly related to those of British Columbia that it will be convenient, for the sake of comparison, to consider the Cretaceous rocks of the Yukon district immediately after those of British Columbia.

In Dr. Dawson's Report upon the Yukon exploring expedition of 1887 and 1888, published by the Geological Survey of Canada in 1889,[1] it is stated that deposits holding fossil plants and probably of the age of the Laramie were discovered in 1887 on the south side of the Upper Pelly River, twenty-seven miles and a half west of the mouth of Ross River, and on the Lewes River, between Rink Rapids and the Salmon River. Sir William Dawson reports as follows upon the fossils collected at the first of these localities. "The few specimens examined are full of impressions of dicotyledonous leaves, much crushed and imperfect. One has the venation of *Corylus Mac Quarri* (Forbes). Another seems to be a *Juglans*, near to *J. acuminata* (Braun). Both of these species are said by Heer to occur at English Bay, Alaska, and also on Mackenzie River. The determinations cannot, however, be considered as certain."[2] According to Sir William Dawson, also, the species represented in the collections made on the Lewes River are *Taxodium tinajorum*, Heer, *Glyptostrobus Europæus*, Heer, and *Sequoia Langsdorffi*, Heer (doubtful)."[3] *Glyptostrobus Europæus*, it may be mentioned, had previously been collected in the Laramie at Porcupine Creek, N.W.T., and *Sequoia Langsdorffi* in the Laramie of Porcupine Creek and the Mackenzie River.

At Rink Rapids, on the Lewes River, and at Lake Labarge, farther up on the same river, Dr. Dawson found fossiliferous Cretaceous rocks which are probably of about the

[1] Ann. Rep., new series, vol. iii, pt. 1, pp. 1-277B.
[2] Ib., p. 126B.
[3] Ib., p. 149B.

same age as the Queen Charlotte Island formation. The fossils from the Rink Rapids, which were described and figured in the second part of the first volume of "Contributions to Canadian Palæontology," are all new species of marine invertebrata, for which the names *Discina pileolus*, *Cyprina Yukonensis*, *Schloenbachia borealis*, and *Estheria bellula* were proposed. The name *Discina pileolus* is unfortunately preoccupied (by Hicks, in 1866, for a Menevian fossil from St. Davids') and may be changed to *D. Dawsoni*. The *Schloenbachia* seems to be rather nearly related to the *S. propinqua*, of the Lower Sandstones or subdivision E, of the Queen Charlotte Island Cretaceous. The fossils from Lake Labarge consist of a small sponge, several badly preserved corals, two or three small species of pelecypoda, fragments of casts of an elongated spiral gasteropod, and a piece of the phragmocone of a small belemnite, but all so imperfectly preserved that even their generic relations are doubtful.

In 1888, Mr. McConnell discovered rocks holding specimens of a *Scaphites* very like one of the Benton species, on the Porcupine River, fourteen miles below the mouth of Bell River. A little farther down the Porcupine he found sandstones full of one of the varieties of *Aucella Mosquensis*, and collected numerous examples of the same fossil in rocks of Lower or Earlier Cretaceous age on the main Pelly or Yukon River, eight miles below the Antoine River.

Prior to the confederation of the provinces in 1867, not more than eight species of fossil plants had been identified or described from the Cretaceous rocks of any part of the country now included in the Dominion, and all of these are from the south eastern portion of Vancouver Island. To-day, 108 species of fossil plants have been recorded or described from the Canadian Cretaceous, exclusive of the Laramie, or 179 species inclusive of the Laramie, as follows:

From Manitoba and the North West Territories.		
Laramie	71 species.	
Belly River series, not also in Laramie	6 "	
Dunvegan series	21 "	
	98	98
From the Rocky Mountain region.		
Mill Creek series	20 "	
Intermediate series	5 "	
Kootanie series	27 "	
	52	52
From British Columbia.		
Nanaimo group	27 "	
Queen Charlotte Islands series	1 "	
	28	28
From the Yukon District.		
Laramie and not yet found elsewhere in Canada	1	1
Total		179 species.

Before confederation, only fifty-five species of fossils other than plant remains, had been recognized or described from the Cretaceous rocks of what we now call Canada, and, of this number, thirty-two are from Vancouver Island and twenty-three from the North West Territories. Now, we know of 358 species of animal remains from the undoubted Cretaceous rocks of the Dominion, and of 394 if we include the Laramie. These numbers are made up as follows :

From Manitoba and the North West Territories.		
Laramie		
Mollusca, 35 : dinosauria, 1	36 species.	
Pierre-Fox Hills.		
Radiolaria, 16 : other marine invertebrata, 68 : coleoptera, 1 :	85 "	
Belly River series.		
Mollusca, additional to those found also in the Laramie, 21 ; turtles, 3 : dinosauria 1 :	25 "	
Niobrara-Benton.		
Foraminifera, 14: other marine invertebrata (6) and fishes (1) from Manitoba, 10 : Ammonites from the district of Athabaska, 5 : from Dunvegan series, mollusca determined, 2 :	31 "	
Dakota.		
One brachiopod and one mollusc, not known to occur also in the Benton :	2 "	
	179	179
From the Rocky Mountain region.		
Niobrara-Benton.		
Additional species of marine invertebrata :	9 "	
Devils Lake deposits.		
Four species additional to those found also and previously in the Queen Charlotte Islands :	4 "	
	13	13
From British Columbia.		
Nanaimo group.		
Marine invertebrata :	106 "	
Queen Charlotte Island Cretaceous.		
Marine invertebrata, 82 species, and one Unio :	83 "	
Cretaceous at other localities in the province.		
Additional species of marine invertebrata :	9 "	
	198	198
From the Yukon District.		
Four marine invertebrata from the Rink Rapids of the Lewes River :	4 "	4
Total :		394 species.

West of Lake Winnipeg and north of the forty-ninth parallel, all the most important and workable beds of coal, as geologists are aware, are found either in the Cretaceous or in the Laramie. Who has not heard of the coal-fields of the Souris region and Turtle Mountain, of the North and South Saskatchewan (at Edmonton and Medicine Hat) and Queen Charlotte Islands, or of the mines now in operation at Lethbridge, Canmore, Anthracite, Nanaimo and Comox ? The economic products and lithological characters of the subdivisions of the Cretaceous and Laramie at the various localities examined by Drs.

Selwyn, Dawson and Bell and by Messrs. McConnell and Tyrrell, have been fully described in their respective reports. These descriptions have been supplemented by published analyses showing the chemical composition of a series of coals and lignites specially selected to cover the range of their distribution and to illustrate the connection between the variation in their composition and the conditions under which they were deposited.

The Cretaceous rocks of the United States had been studied and described by several eminent geologists[1] fully thirty years before the existence of these rocks in Canada had been recognized or recorded. Yet only two years ago,[2] Dr. C. A. White expressed the opinion that much more extensive studies of the subdivisions of the Cretaceous of North America were necessary, before these formations could be satisfactorily correlated with the subdivisions of the European Cretaceous. Canadian Cretaceous geology is no more a continental unit than that of the United States, and we are not yet able to correlate satisfactorily the subdivisions of the British Columbia Cretaceous with those of Manitoba and the North-West Territories, nor of either with those of Europe. A comparatively small portion of the Cretaceous rocks of Canada has been examined in any detail, and more or less isolated areas of these rocks are known to exist in parts of the Canadian North-West, about which scarcely any other information has been obtained. Still, the facts as summarized in this address, are sufficient to show that substantial additions to our knowledge of the geographical distribution, of the economic products and of the fossil flora and fauna of the Cretaceous rocks of Canada, have been made within the quarter of a century that has elapsed since the confederation of the provinces.

[1] For a list of the names of these and the titles of their papers, see pages 61-67 of Dr. C. A. White's "Correlation Papers—Cretaceous"; Bull. U. S. Geol. Surv., No. 82.

[2] Ibid., pp. 11 and 208.