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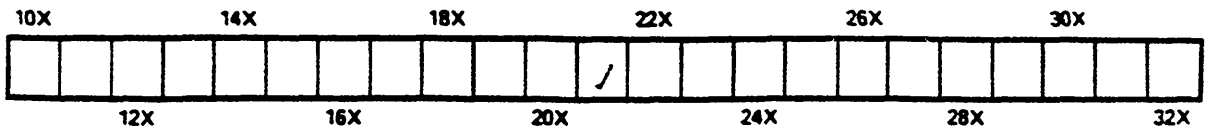

THE CANADIAN

RECORD OF SCIENCE,

INCLUDING THE PROCEEDINGS OF

THE NATURAL HISTORY SOCIETY OF MONTREAL,

AND REPLACING

THE CANADIAN NATURALIST.

VOL. I. (1884-1885.)

MONTREAL:
PUBLISHED BY THE NATURAL HISTORY SOCIETY,
AND FOR SALE BY DAWSON BROTHERS.
1885.

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THE

CANADIAN RECORD OF SCIENCE.

MONTREAL.

VOLUME I. ... ... NUMBER 1.

I. INTRODUCTION.

THE CANADIAN NATURALIST, of which the present journal is a continuation, first appeared in February, 1856, under the title of *The Canadian Naturalist and Geologist*, with the name of E. Billings as editor, and was published at Montreal, bi-monthly. After the first year there was added to its title the words, "*and Proceedings of the Natural History Society of Montreal*," it being at the same time announced that it was conducted by a committee of this Society, Mr. Billings remaining one of the editors.

Of this, the first series of the journal, eight volumes appeared, the last in 1863. In 1864 began a new series with the same title as before, still published bi-monthly and conducted by a committee of the Natural History Society, Mr. D. A. P. Watt being the general editor. In 1866 only two numbers of volume III. were published, and but one in 1867, the remaining three numbers appearing in 1868; so that this volume extends over the three years 1866-1868, though the journal still purported to be bi-monthly. With volume IV. the title was changed to that of *The Canadian Naturalist and Quarterly Journal of Science*. This volume was

published in 1869, and volume V. in 1870, the journal being edited, as before, by a committee of the Natural History Society. Of volume VI. two numbers appeared in 1871, and two in 1872. In 1873 the journal resumed its quarterly publication, but with half the number of pages, so that volume VII. was made to consist of eight numbers, and covered the two years, 1873-1874; Dr. B. J. Harrington becoming sole editor. Volume VIII. was again irregular in its publication, and its eight numbers extended over the four years, 1875-78. Volume IX. began in 1879, and the last number of it was not published till March, 1881. With volume X. Mr. J. T. Donald who, for the previous volume had been assistant editor, took charge of the journal, and of this volume the concluding number was published in July, 1883. The second series of ten volumes of the *Canadian Naturalist* thus extends over a period of more than eighteen years.

The present journal, which, under the title of THE CANADIAN RECORD OF SCIENCE, is to take its place, will be conducted as before, by a committee of the Natural History Society of Montreal, which will moreover publish the journal. It will, as far as possible, appear quarterly, and will make a volume of about five hundred pages once in two years, beginning May, 1884. Original and selected articles, more particularly those of especial interest to the country, will appear in its pages, and it is hoped that by the hearty co-operation of scientific workers throughout the Dominion THE CANADIAN RECORD OF SCIENCE may be made a worthy successor of *The Canadian Naturalist.*

Montreal, May, 1884.

II. The Royal Society of Canada.

This Society, which was founded in May, 1882, by His Excellency the Marquis of Lorne, held its second annual meeting in 1883, at Ottawa on the 22nd to 25th of May, inclusive, under the presidency of Principal Dawson of McGill College, Montreal.

The objects of the Society are: first, to encourage studies and investigations in literature and science; secondly, to publish transactions, annually or semi-annually, containing the minutes of proceedings at meetings, records of the work performed, original papers and memoirs of merit, and such other documents as may be deemed worthy of publication; thirdly, to offer prizes or inducements for valuable papers on subjects relating to Canada, and to aid researches already begun and carried so far as to render their ultimate value probable; fourthly, to assist in the collection of specimens, with a view to the formation of a Canadian Museum of archives, ethnology, archæology and natural history.

The members are entitled "Fellows of the Royal Society of Canada," and His Excellency the Governor-General is the Honorary President and Patron of the Society. The Society consists of the four following sections:—1. French literature, with history, archæology and allied subjects; 2. English literature, with history, archæology and allied subjects; 3. Mathematical, chemical and physical sciences. 4. Geological and biological sciences.

The officers of the Society are a president and vice-president, with an honorary secretary and treasurer, to be elected by the whole Society; besides a president, vice-president and secretary of each section, to be elected by the section. These elections are annual, and the officers so elected constitute the council of the Society. The members of the Society shall be persons residing in the Dominion of Canada or Newfoundland who have published original works or memoirs of merit, or have rendered eminent services to literature or science. The number of members in each section is limited to twenty. The Society may elect by ballot on proposal by three members, or on recommendation of the council, persons not resident in Canada as corresponding members. Such persons must be eminent in literature or science, and evidence to that effect must be presented to the Society at the time of their

proposal or recommendation. The number of corresponding members is limited to sixteen, and shall represent each section of the Society. The Society will meet annually in such city of the Dominion as it may determine from time to time, and may at any annual meeting appoint other meetings to be held in the course of the year. Every scientific or literary society in the Dominion which may be selected by vote of the Society will be invited by circular of the honorary secretary to elect annually one of its members as a delegate to the meetings of the Society; such delegate to have during his term of office the privilege of taking part in all general or sectional meetings for reading and discussion of papers, and to be empowered to communicate a short statement of original work done and papers published during the year by his society, and to report on any matters which the Royal Society may usefully aid, in publication or otherwise.

In addition to the Fellows of the Society, there were present delegates from the various scientific and literary societies of the Dominion, as well as from several societies of Britain and the United States.

THE REPORT OF THE COUNCIL

referred to the fact that a favorable answer had been received, through His Excellency the Governor-General, to the memorial to Her Majesty the Queen, asking her gracious permission to name the society the Royal Society of Canada, and to the fact that the act to incorporate the Royal Society of Canada had been passed by the Dominion Parliament (a draft of the bill being embodied in the report), and went on to state that a grant of $5,000 had been voted by the Dominion Parliament, and had been placed at the disposal of the Society. A circular to the officers of the Hudson's Bay Company, in relation to the collection of specimens in geology, natural history, ethnology, &c., had been forwarded to all the posts of the Company, but the practical effect of this circular would greatly depend on the ability of the Society to contribute to the expense of making collections and of transmitting them to Ottawa. Invitations to send delegates to the meeting had been sent to all the local societies in the Dominion and also to several English and foreign societies. A memorial had been addressed to the Government on the subject of the admission of

certain classes of scientific books and periodicals free of duty, and it was believed the action of Parliament in its last session would change some portions at least of the law complained of. The matter of uniform time had been committed to Mr. Sanford Fleming, to represent their views to the International Congress on the subject. At the meeting of the council, in December, 1882, the subject of regulations was taken up, and a draft prepared, which was printed and circulated to the members. The report recommended that, as it seemed likely that the British Association for the Advancement of Science would meet in Montreal in 1884, the Society should take measures to extend a welcome to the Association, and to be represented by as many as possible of its members on the occasion.

On motion of Mr. Faucher de St. Maurice, it was resolved to ask the Government, through the Minister of Marine and Fisheries, that such specimens of the Canadian fishery exhibit now at the International Fishery Exhibition, in London, England, as are of scientific value, should be offered to the National Museum.

His Excellency the Governor-General then delivered the following address to the Society :

When we met last year, and formally inaugurated a society for the encouragement of literature and science in Canada, an experiment was tried. As with all experiments, its possible success was questioned by some, who feared that the elements necessary for such an organization were lacking. Our meetion of this year assumes a character which an inaugural assembly could not possess. The position we took in asserting that the time had come for the institution of such a union of the scientific and literary men of this country has been established as good, not only by the honorable name accorded to us by Her Majesty—a designation never lightly granted—but also by that without which we could not stand, namely, the public favors extended to our efforts.

Parliament has recognized the earnest purpose and happy co-operation with which you have met, and worked in unison. Knowing that the talents exhibited are not those of gold and silver only, it has stamped with its approbation your designs by voting a sum of money, which in part will defray the expense of the printing of your transactions. And here, in speaking of this as a business-meeting, I would venture to remind you, and all

friends of this Society throughout the country, that the $5,000 annually voted by the House of Commons will go but a very short way in preparing a publication which shall fully represent Canada to the foreign scientific bodies of the world. We have only to look to the Federal and State Legislatures of America to see what vast sums are annually expended by the State for scientific research. We see there also how the proceeds of noble endowments are annually utilized for the free dissemination of knowledge. It is therefore not to be supposed that the comparatively small pecuniary assistance provided by any government-grant can absolve wealthy individuals from the patriotic duty of bequeathing or of giving to such a national society the funds without which it cannot usefully exist.

You will forgive me, as one who may be supposed to have a certain amount of the traditional economical prudence of his countrymen, for mentioning one other matter, on which at all events, in the meantime, a saving can be effected. While it is necessary to have accurate and finely executed engravings of beautiful drawings for the illustration of scientific papers, it is necessary that the printing of the transactions should occasion as little cost as possible, and I believe you will find it advisable for the present that each paper shall be printed only in that language in which its author has communicated it to the Society. Your position is rather a peculiar one, for although you work for the benefit of the public, it is not to be expected that the public can understand all you say when your speech is of science in consultation with each other. The public will, therefore, I trust, be in the position of those who are willing to pay their physicians when they meet in consultation, without insisting that every word the doctors say to each other shall be repeated in the hearing of all men. When funds increase it seems to me that the economy it will probably now be necessary to exercise in regard to this may be discarded.

In the sections dealing with literature, it is proposed to establish a reading-committee, whose duty it shall be to report on the publications of the year, that our thanks may be given to the authors who advance the cause of literature among us. To assist in that most necessary enterprise, the formation of a National Museum, circulars have been addressed by the Society to men likely to have opportunities for the collection of objects of interest,

and the Hudson's Bay Company's officers have been foremost in promoting our wishes. The Government is now prepared to house all objects sent to the Secretary of the Royal Society at Ottawa, and contributions for collections of archives, of antiquities and of zoology, and of all things of interest, are requested. I rejoice, gentlemen, that I have been able to be with you now that a year has elapsed since our inauguration, as this period allows us in some measure to judge of our future prospects. These are most encouraging, and the only possible difficulty that I can see ahead of you is this: that men may be apt to take exception to your membership because it is not geographically representative. I would earnestly counsel you to hold to your course in this matter. A scientific and literary society must remain one representing individual eminence, and that individual eminence must be recognized if, as it may happen accidentally, personal distinction in authorship may at any particular moment, be the happy possession of only one part of the country. A complete work, and one recognized for its merit, should remain the essential qualification for election to the literary sections, and the same test should be applied, as far as possible, to the scientific branches. If men be elected simply because they came from such and such a college, or if they be elected simply because they came from the east, from the west, from the north, or from the south, you will get a heterogenous body together, quite unworthy to be compared with the foreign societies on whose intellectual level Canada, as represented by her scientific men and authors, must in future endeavor to stand.

One word more as to the kindly recognition already given to you. In America, in France, and in Britain, the birth of the new institution has been hailed with joy, and our distinguished president is at this moment also a nominated delegate of Britain. An illness we deplore has alone prevented the absence of an illustrious member of the Academy of France; and the French Government, with an enlightened generosity which does it honor, had expressed its wish to defray the expenses of the most welcome of ambassadors. We have the satisfaction of cordially greeting an eminent representative of the United States, and we express the desire, which is shared by all in this hall, that our meeting may never want the presence of delegates of the great people who are dear as they are near to us.

It is, gentlemen, greatly owing to your organization that the British Association for the Advancement of Science will next year meet at Montreal, following in this a precedent happily established by the visit last year of the American Association. These meetings at Montreal are not without their significance. They show that it is not only among statesmen and politicians abroad that Canada is valued and respected, but that throughout all classes, and wherever intellect, culture and scientific attainments are revered, her position is acknowledged, and her aspiration to take her place among the nations is seen and welcomed.

I am sure that your British brethren have chosen wisely in selecting Montreal, for I know the hearty greeting which awaits them from its hospitable citizens. The facilities placed at the disposal of our British guests will enable them to visit a large portion of our immense territory, where in every part new and interesting matters will arrest their attention, and give delight to men who in many cases have but lately realized our resources. Their words, biased by no interests other than the desire for knowledge, and founded on personal observation, will find no contradiction when they assert that in the lifetime of babes now born the vast fertile regions of Canada will be the home of a people more numerous than that which at the present time inhabits the United Kingdom.

I must not now further occupy your time, but would once more ask you to accept my heartfelt thanks for the determination shown by all to make the Royal Society a worthy embodiment of the literary activity and scientific labor of our widely-scattered countrymen throughout this great land.

PRINCIPAL DAWSON, in replying, referred to the kind and generous manner in which the last meeting of the Society had been treated by the people and press of Canada, and to the faith apparently entertained by the people that Canada is capable of sustaining such a Society. He then noticed the various points of progress during the recess—the gracious permission of Her Majesty to assume the title of the Royal Society of Canada, and the obligations thereby imposed; the incorporation of the Society by Act of Parliament and the grant in aid of its publications; the movement toward the beginning of a national museum, the new feature in the meeting arising from the presence of delegates from local societies, and the advantage accruing therefrom:

the courteous replies given by societies abroad, and the presence of delegates from some of them, and the probable influence of the contemplated visit of the British Association on Canadian science. He also referred to the care which would be taken with regard to expenditures on publications. He next noticed the removal by death of one of the members of the Society, Mr. George Barnston, and paid a tribute of respect to his personal worth and valuable services to Canadian science.

The remainder of the address was occupied with remarks on the progress of Canadian science, considered as embracing the two great branches of experimental and observative investigation. In chemistry and meteorology Canada had made greater progress, and was better provided with means of research than in physics and astronomy; but appliances were increasing, and the educational activity in these branches gave the prospect of greater progress in the future. In geological and biological science the most important public provision was that furnished by the Geological Survey, which had the great advantage of being general rather than provincial, but was not as yet adequately provided for, either in buildings or means, and should have a greater amount of independence. Private research in geology and natural history had naturally made more progress than in most other departments, but there was a boundless field for exploration and study which had as yet been merely touched, and as there were educational facilities in abundance it was hoped that the number of scientific collectors and investigators would increase. In all these departments it was the function of the Society to aid, stimulate and encourage, and to afford scope for discussion and for publication.

In conclusion, he referred to the connection of science with literature. The two departments were in this Society intimately associated, the literary sections being in some sense scientific as well. Science has a literature of its own, great and increasing, and which competes with history and fiction for the popular eye and ear. Nature, rather than art, is the foundation of the best literature. It is on this, rather than in the graces of composition, or the tricks of style, or the flowers of imagination, that enduring literary fame must be built. This is especially the case in this country where history has been and will be marked out by its physical features and resources, and where our real poetry is that of our great rivers and vast lakes, our boundless plains, our

solitudes and changeful climate. These are unwritten poems which have impressed themselves on the minds of our people more than anything man has yet said or done, and he who most truly interprets these great unwritten histories and poems will build up the most lasting fame. For this reason he rejoiced that the Society embraced both literature and science, and he was profoundly convinced that it was for the highest interest of Canada that, while its scientific men should be men of culture, its literary men should be men of scientific knowledge and scientific habits of thought.

Hon. Dr. Chauveau, Vice-President of the Society, followed in French. He said that this was almost the second inauguration of the Royal Society, which had been already founded and inaugurated by His Excellency the Governor-General, but which had since obtained permission from Her Majesty to assume the name of the Royal Society, which it was doing most auspiciously now under the joint presidency of His Excellency and Her Royal Highness. He said that the very excellent remarks of His Excellency and the most exhaustive address of the President, Principal Dawson, did not leave him much to say; still he would point out two great and most desirable results of the establishment of this Society. One was to make our literature and our scientific exertions more widely known in other countries, and the other, which was perhaps more difficult to obtain, was to make the two great elements of this country, French and English, better known to each other.

Several comparisons had been resorted to in order to illustrate the estrangement which had so long existed between these two sections in many respects, as well as in those of literature and science. Not unfrequently the two races had been compared to the waters of the Ottawa and the St Lawrence, which ran for a long time side by side without mixing together—but still they mixed. He himself had alluded elsewhere to the famous staircase of the historical château of Chambord, which was so constructed that two persons could ascend at the same time without seeing each other, it being a kind of double staircase, and in the progress which these two races made towards their common destiny they also seemed in many respects to ignore each other, meeting occasionally on the political platform.

This Society would have the effect of bringing together men from all parts of the country, who have followed various pursuits in the world of science and literature. He noticed with pleasure in the list of papers to be read in the section of English Literature, one on French Canadian literature, by Mr. John Lesperance, an Anglo-Canadian writer with a French name. He was almost ashamed that the French section had allowed itself to be distanced in that courteous move, and could only account for it perhaps by the fact that as a good deal of criticism was always mixed up with any literary review his section had perhaps acted in accordance with the famous word at Fontenoy, "*Messieurs les Anglais, tirez les premiers.*" He hoped, however, that Mr. Lesperance's action would meet with reciprocity, and no one could do better in the French section than Mr. Oscar Dunn, a French *littérateur* with an English name.

In anticipation of this he would say a few words on Anglo-Canadian literature. He then alluded to the poems of Adam Kidd, the Huron chief, and to the subsequent poems of Heavysege, Sangster, Reade, Murray, and the works of Mrs. Leprohon, another English writer with a French name. He also referred to the works of Kirby, Lesperance, and Mrs. Moody, as well as to the works in prose of Dr. Ryerson, Mr. Dent and others. He concluded by alluding to the reception which the invitations of the Society had received abroad, and especially to the response made by the Académie Française, and praised the conduct of the French government in offering to defray the expenses of a delegate. He spoke in warm terms of M. Marmier as an old friend of Canada, who had accepted the choice made of him by the Academy, and regretted that a gentleman who had been in Canada nearly forty years ago, and who had ever since shown a strong interest in Canada and Canadians, could not, on account of sudden illness, be present. M. Marmier had done much in making Canada known, and especially in recommending to the French Academy the works of Mr. Fréchette, the poet laureate of Canada.

The proceedings of the sections devoted to the sciences will naturally be of interest to our readers, and therefore we give a *resumé* of them.

SECTION III—MATHEMATICAL, PHYSICAL AND CHEMICAL SCIENCES.

Mr. Sanford Fleming made some remarks on the adoption of a universal meridian for the regulation of time, and pointed out that the memorial of the Society at its last meeting, requesting that Canada should be represented at the International Conference to be held on this subject, at the invitation of the President of the United States, had not been responded to.

A motion was adopted, recommending to the Council the appointment of a committee for the purpose of co-operating with other societies and carrying out this system, and the adoption of a memorial to His Excellency, asking that the Imperial government may be moved to have Canada represented at the conference in question.

Prof. Johnson, of Montreal, gave an account of the preparations which were made at McGill University for the observation of the late transit of Venus, and read a report from Prof. McLeod of the observations which were successfully made at Winnipeg.

The secretary, Prof. Cherriman, read a report from Mr. Carpmael of Toronto, to the Minister of Marine and Fisheries on the same subject, recording the preparations made in Canada and including the reports of the observations at Cobourg, Ottawa, Kingston and Winnipeg, which were the only stations where the observations were wholly or partially successful.

Prof. Williamson gave a verbal account of the observations which were made by him at Kingston.

Dr. Ellis, of Toronto, gave an account of a remarkable sulphur-spring near Port Stanley, and also an explanation of the method by which the tannin-determination of Lowenthal might be made valuable for the detection of impurities or adulterations in spices.

Mr. F. N. Gisborne read a paper on recent improvements in practical telegraphy.

Mr. T. Macfarlane read a paper on the decomposition of zinc-sulphate by common salt.

Dr. T. Sterry Hunt discussed the mechanical transfer of matter in the process of segregation, on which an interesting discussion arose, Mr. Macfarlane illustrating the subject by reference to the kernel-roasting of copper-bearing iron-pyrites as seen in the ore-heaps at Lennoxville.

Prof. McGregor, of Halifax, Nova Scotia, read a paper on the variation of the polarization of electrodes with their difference of potential.

Prof. Harrington, of McGill University, Montreal, described two species of minerals new to Canada—meneghinite from Ontario, and tennantite from the Eastern Townships.

Dr. Ellis presented a specimen of tellurium found in the gold ores of Lake Superior, the first discovery of tellurium in Canada.

Mr. Baillargé, read a paper entitled "Hints to Geometers for a new edition of Euclid."

Dr. Haanel, of Victoria College, Cobourg, communicated a paper on the application of hydriodic acid as a blow-pipe reagent. A new process was described in which this acid is used with a blow-pipe flame on tablets of plaster-of-Paris for determining the character of minerals. A number of water-color drawings were exhibited, showing a beautiful series of characteristic colored sublimates on these plaster tablets, proving that a large number of elements and even of compound minerals can thus be determined by their action with hydriodic acid.

Prof. Dupuis, of Kingston, described a mode of construction by which a sidereal clock could be made to show mean time also.

Capt. Deville read a paper on the measurement of terrestrial distances by astronomical observations, which proposed to substitute the difference of azimuths instead of, as usual, the difference of latitudes.

Mr. Macfarlane read a paper on the reduction of sulphate of soda by carbon.

Mr. Baillargé contributed papers on the following subjects: On simplified solutions of two of the more difficult cases in hydrographic surveying; and The measurement of surveys by spherical triangles and polygons on a sphere of any radius; the latter in the French language.

SECTION IIII—GEOLOGICAL AND BIOLOGICAL SCIENCES.

Dr. Selwyn read a paper, entitled "Notes on the Geology of Lake Superior." The points insisted on by Dr. Selwyn were: the conformity of the Laurentian and Huronian divisions of the older crystalline rocks, the Lower Cambrian age of the upper copper-bearing rocks of Logan, called Animikie, Nepigon and Keweenian by Dr. Hunt, and the unconformity of the Animikie divisions

to the underlying Huronian, by some geologists in the United States supposed to be of the same age.

Mr. W. Saunders, of London, Ont., read a paper "On the influence of Sex on Hybrids among Fruits." This paper gave some of the results of Mr. Saunders' experience in hybridizing fruits. The facts cited confirmed the view that the influence of the female is more strongly expressed in the habit, character of growth and constitution of the plant, while the influence of the male is more distinctly seen in the form, color and quality of the fruit, and, in the case of hybrid grapes, in the size and form of the seeds also.

A paper by Mr. G. F. Matthew, of St. John, N. B., on "The Method of distinguishing Lacustrine from Marine Deposits," was read by Prof. Bailey, of Fredericton.

Dr. Grant, of Ottawa, read a communication on "The Inferior Maxilla of the Phoca Grœnlandica, from Green's Creek near Ottawa."

Principal Dawson, of Montreal, read a note on "Spores and spore-cases, from the Erian formation," giving results which are set forth more at length in a paper in this number, on "Rhizocarps in the Palæzoic Period."

Professor Bailey read a paper on the folding of the carboniferous strata in the Maritime Provinces by Mr. E. Gilpin, jr. After a preliminary sketch of the carboniferous measures of the Lower Provinces, the writer described each of its great subdivisions as exposed at various points. The lower coal-measures are met in southern New Brunswick as fine sediments and grits, and resemble the same measures as found at Horton and elsewhere. They are represented in Cape Breton county and in Newfoundland by great beds of conglomerate. Sections show a line of minimum deposition along the Cobequids to Cape George, and thence through Bras d'Or to Cape Ray. The carboniferous limestones are described as passing into the succeeding measures, except at places in Cape Breton and southern New Brunswick, where they were folded before the millstone-grit period. The greatest depression of this period would appear to have been in the Richmond district, and to have gradually diminished to the north-west and north-east. The points of maximum accumulation appear to have been at the Joggins and in Richmond county. These measures in Newfoundland and Cape Breton pass regularly into the succeeding coal-measures. In Pictou County they were extensively folded before the later measures were

formed. The folding of the coal-measures and of the succeeding measures were referred to, and the opinion was advanced that comparatively little folding of the carboniferous had taken place in the Lower Provinces since the close of the trias. During the carboniferous period, in addition to the continental changes of level giving rise to conditions of deposition characterizing the carboniferous limestone, millstone-grit, etc., there were extensive foldings of a more local character, apparently in some cases marking the closing of these oscillations. These foldings and their subsequent denudations have played an important part, hitherto but little studied in modifying the conditions arising from the larger and more extended movements which have hitherto principally received attention, and show the district to have been far from quiet during the carboniferous age.

Professor R. Bell's paper on the causes of the fertility of the land in the Canadian Northwest territories was of great interest. The author, after referring to the various processes by which soils in general are formed, pointed out the reason for the fertility or otherwise of great districts in the older provinces. In the Canadian Northwest a vast fertile tract stretches, with certain exceptions, from the Red River Valley to the Liard River, a distance of some fourteen hundred miles. The soil of this tract was characterized as a dark loam, of varying depth, and of a nearly homogeneous consistency. The primary cause of the fertility of this region was the abundance of the underlying crude material out of which a finished soil could be made. This was derived partly from the wide-spreading cretaceous marls, which were nearly co-extensive with the fertile tract, and partly from the drift during the glacial period. Dr. Bell next considered the process by which the black loamy soil was formed out of this subsoil, and he considered that the main agency was the work of moles and other burrowing animals. Darwin had proved that in England and some other countries earth-worms played the chief part in the formation of the vegetable mould. These worms appeared to be absent in the Northwest, owing principally to the frost penetrating into the ground beyond the depth to which worms can burrow, but the moles and the ground-squirrels or gophers more than make up for their absence. In the fertilized tracts the old and new mole-hills cover the whole surface, rendering it hummocky, which may be easily observed after the prairie has been swept by

a fire. The badgers often did what was compared to subsoil ploughing. All the animals referred to were very active in the autumn, digging many more burrows than appeared to be of any use to themselves. Each hummock thrown up by the moles covered about a square foot, and buried all the grass, etc., on this space. In this manner large quantities of vegetable matter were ultimately incorporated with the soil. The work of the moles also acted in another way, in refining the soil, for they left behind the stones and coarse gravel, so that these in time became sunk beneath the layer of mould produced. By a fortunate coincidence, at the season when the burrowing animals are most active, the prairie-vegetation is mature, and contains the largest amount of useful substances. The coldness of the soil during the most of the year tended to preserve the organic matter in it, while the circumstances given were the direct cause of the fertility. The ultimate reason was perhaps to be looked for in the climate of the Northwest, for to this were due the growth of the vegetation which formed the manure and the food of the little workers which mingled it with the soil. Thus we could trace a mutual dependence of the circumstances which together have given to our Northwest Territories that surpassing fertility of soil which cannot fail to attract to it a vast population.

The reading of this paper was followed by a very interesting discussion. Dr. Selwyn corroborated what the author had said as to the phenomena and their vast importance in an economic point of view.

Prof. Macoun considered that the chief cause of the fertility of the soil was owing to the action of the frost on its rocky constituents, to which Dr. Bell replied that this did not account for the introduction of the organic matter, and that on this the fertility mainly depended. If the fertility were in proportion to the frost, then the Arctic regions should have the richest soil, which was not the case.

Dr. Dawson mentioned that stratified superficial deposits were found in various parts of the Northwest. The author said he had referred to these in his paper as due to the transient action of water during a submergence of the land, but that this was not a material part of the question.

In reply to a request, Professors Bell and Macoun described the various burrowing animals which had been mentioned.

Dr. G. M. Dawson then read a paper entitled "Notes on Triassic Rocks of the West," after which Prof. Bailey gave an interesting address on the occurrence of Indian relics in New Brunswick.

Dr. T. Sterry Hunt read a paper entitled "Studies on Serpentine Rocks," and by title one on the Taconic Question in Geology, and Prof. Macoun one entitled "Notes on Canadian Polypetalæ."

LIST OF PAPERS PRESENTED IN SECTIONS III. AND IV. AT THE MEETING OF THE ROYAL SOCIETY OF CANADA, MAY, 1883.

Section III. Mathematical, Physical and Chemical Sciences.

1. Prof. McGregor:—On the independence of the Electromotive Force of Polarization of the difference of Potential of the Electrodes.

2. Prof. Harrington:—On some Minerals new to Canada.

3. Mr. Baillargé:—(I.) Hints to Geometers for a New Edition of Euclid;

4. (II.) Simplified Solution of two of the more difficult cases in the parting off or dividing up of land; also a case in Hydrographical Surveying;

5. (III.) Le toisé des surfaces des triangles et polygones sphériques sous un rayon ou diamètre quelconque.

6. Prof. Haanel:—On the Application of Hydriodic Acid as a Blow-pipe Reagent.

7. Prof. Dupuis:—A Mechanical Arrangement for making a Sidereal Clock show also mean time.

8. Capt. Deville:—The Measurement of Terrestrial Distances by Astronomical Observations.

9. Mr. T. Macfarlane:—(I.) On the Reduction of Sulphate of Soda by Carbon;

10. (II.) On the Decomposition of Zinc-Sulphate by Common Salt.

11. Prof. Johnson:—An Account of the Preparations at McGill College for Observing the late Transit of Venus.

12. Mr. Gisborne:—Recent Improvements in Practical Telegraphy

13. Mr. Sanford Fleming:—On the Regulation of Time and the Adoption of a Universal Prime Meridian.

14. Dr. T. Sterry Hunt:—On the Mechanical Transfer of Matters in the Process of Segregation.

15. Prof. Chapman:—(I.) On Cryptomorphism in its relations to Classification and Mineral Types;

16. (II.) A suggestion respecting Spectroscopic Scales.

In addition to the sixteen papers above mentioned by members of the section, the following were also read:—

1. Dr. Ellis:—(I.) Analysis of the Water of a Sulphur Spring near Port Stanley, Ont.

2. (II.) Some Applications of Lowenthal's Method of Tannin Estimation.

3. Prof. Coleman (read by Prof. Haanel):—Spectroscopic examination of the coatings obtained by the treatment of certain substances with Hydriodic Acid in blow-pipe analysis.

4. Prof. McLeod (read by Dr. Johnson):—Report of Observations of the Transit of Venus at Winnipeg.

Section IV. Geological and Biological Sciences.

1. Dr. Selwyn:—On the Geology of Lake Superior.

2. Wm. Saunders:—On the Influence of Sex on Hybrids among Fruits.

3. Prof. Macoun:—Notes on the Flora of the Gaspé Peninsula.

4. Edwin Gilpin, jr.:—The Folding of the Carboniferous in the Maritime Provinces.

5. Dr. G. M. Dawson:—Note on the Triassic of the Rocky Mountains and British Columbia.

6. G. F. Matthews:—(I.) On the Method of Distinguishing Lacustrine from Marine Deposits;

7. (II.) Illustrations of the Fauna of the St. John group; part 2.

8. The Abbé Laflamme:—Note sur la Géologie du lac Saint Jean.

9. R. Chalmers (communicated by Principal Dawson):—On Erosion from Coast and Floating Ice in the Baie des Chaleurs District.

10. Dr. J. A. Grant:—On the Superior Maxilla of *Phoca Grœnlandica*, from Green's Creek, Gloucester, County Russell, Ont.

11. Prof. Macoun :—Notes on Canadian Polypetalæ.

12. Principal Dawson :—On Spores and Spore-cases from the Erian Formation.

13. Dr. R. Bell :—On the Causes of Fertility of the Land in the Canadian North-West.

14. Prof. Chapman :—A new classification of Crinoids.

15. (I.) Dr. T. Sterry Hunt :—Studies of Serpentine Rocks ;

16. (II.) The Taconic Question in Geology.

17. Rev. Dr. Honeyman :—On the Triassic and later Geological formations of the Eastern United States and British America.

18. Prof. L. W. Bailey :—On the occurrence of Indian remains in New Brunswick

19. J. F. Whiteaves :—Some recent additions to the fauna of the Hamilton group in Ontario.

III. On Rhizocarps in the Palæozoic Period

By J. W. Dawson of Montreal.

(*Read before the American Association at Minneapolis, Aug.* 16, 1883.)

Some years ago my attention was directed by the late Sir W. E. Logan to a shale from the Erian formation of Kettle Point, Lake Huron, supposed to be on the horizon of the Marcellus shale of New York, and which was filled with minute brownish discs, scarcely more than an hundredth of an inch in diameter, and which I recognized as probably spore-cases of macrospores of some acrogenous plant. They were described in some detail in a paper on "Spore-cases in Coal," published in the *American Journal of Science*, for April, 1871, and reprinted in the *Canadian Naturalist*, new series, Vol. V.

They were described as "flattened disc-like bodies, slightly papillate externally, and with a minute point of attachment at one side and sometimes a slit more or less gaping at the other. Viewed under the microscope as transparent objects, they appear yellow like amber, and show little structure, except that the walls can be distinguished from the internal cavity, and the latter is seen in places to contain patches of granular or flocculent matter."

They occur in a brown bituminous shale, which burns with much flame. This bed is stated in the report of the Geological Survey of Canada to be twelve to fourteen feet in thickness, but whether the fossils are equally abundant throughout its thickness is uncertain. The shale also contains vast numbers of rounded transparent granules, which may be escaped spores or microspores.

The only other fossils found in this bed are stems of a species of *Calamites* (*C. inornatus*), and a *Lepidodendron* obscurely preserved, but not improbably the *S. primaevum* of Rogers. My impression at the time when these spore-cases were first examined was that they might have been produced by a *Lepidodendron* or other lycopodiaceous plant.

In July, 1882, my attention was again directed to the subject by Prof. Orton, of Columbus, Ohio, who mentioned to me the occurrence of similar bodies in vast numbers in the Erian and Lower Carboniferous shale of Ohio, known as the Huron, Cleveland and Berea shales. Prof. Orton regarded these bodies as spore-cases, and was disposed to consider them as a main source of the bituminous matter so abundant in these formations in Ohio. He subsequently detailed his observations at the meeting of the American Association at Montreal, and referred to certain thread-like branching stems found with these bodies as possibly connected with them. Though this observation did not seem to be absolutely certain, yet in connection with the very wide distribution of the organisms in marine beds it served to shake the belief which I had formerly entertained as to the lycopodiaceous affinities of the *Sporangites Huronensis*, which on comparison I found some of Prof. Orton's specimens precisely resembled

For the geological facts relating to the mode of occurrence of the Ohio specimens, I may refer to Prof. Orton's paper, which appears in the proceedings of the American Association; merely stating that he describes the *Sporangites* as occurring throughout the thickness of the Ohio black shale, amounting to 250 to 300 feet, and which extends over a very wide area in Ohio and the neighbouring states.

At the meeting of the American Association, in the discussion of Prof. Orton's paper, Prof. Williams of Cornell University,

mentioned that he had found similar bodies in the Hamilton shales of New York, and that they were associated with the curious pinnately leaved plant, *Ptilophyton Vanuxemi*, an observation to which I subsequently referred in discussing the affinities of this plant, in a report to the Geological Survey on the Erian plants of Canada, published in 1882.* Prof. Williams was kind enough to send me specimens, in which, however, the round spore-case like bodies were much less distinct than in the specimens from Ohio and Lake Huron. In the report above referred to I have also noticed the occurrence of rounded spore-like bodies in association with the stems of *Trochophyllum* of Lesquereux from the Lower Carboniferous of Pennsylvania, and of which specimens were submitted to me by Mr. Lacoe of Pittston, and Prof. Lesquereux. *Trochophyllum* I regard as closely allied to or perhaps congeneric with *Ptilophyton*, and in the report already referred to have argued that these plants were probably aquatic.

Still more recently Prof. J. M. Clarke, of Northampton, Massachusetts, was so kind as to send me two fragments of rock containing *Sporangites* similar to those above mentioned—one from the Genessee shale of Canandaigua, N.Y., and another from the Corniferous limestone. In the latter these bodies retain their globular form, though some are partially crushed in such a way as to show their membranous character. In slices prepared by Prof. Clarke the wall is seen to be thin and carbonaceous, with indications of a dense cellular structure, and some of the specimens show a projecting aperture or point of attachment at one side, giving them a somewhat pear-shaped appearance. The size of all these macrospores from the Erian of New York is nearly the same with that of Lake Huron specimens. Those found with *Trochophyllum* in the Lower Carboniferous are much larger.

No certain clue seemed to be afforded by all these observations as to the precise affinities of these widely-distributed bodies; but in March last Mr. Orville Derby, of the Geological Survey of Brazil sent me specimens found along with fronds of *Spirophyton* in the Erian of that country, which seemed to throw a new light on the whole subject. Mr. Derby's specimens recalled to remembrance certain fossils which had been sent to me several years

* Report on Erian Plants of Canada. Part II.

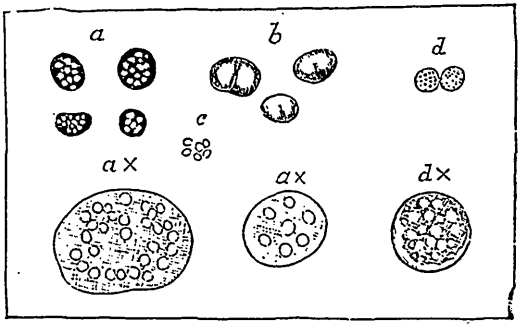
ag› by the late Prof. Hartt, and which, like Mr. Derby's specimens, occurred in beds holding *Spirophyton*, though these were at that time regarded as Carboniferous. In a note prepared for Prof. Hartt, but not, so far as I am aware, published, I had noticed these fossils as follows :—

" *Sporangites*—Specimens from a shale at Rio Tapagos, above Haituba. These are spore-cases, probably of a Lepidodendroid plant, and appear similar to those described by Carruthers as found in cones from Brazil, referred by him to his genus *Flemingites*.* Carruthers' specimens were from Rio Grande du Sul, and were found in shales associated with beds of coal, and believed to be of Carboniferous age, though the fossils leaves found with them and attributed to the genera *Noeggerathia* and *Odontopteris* would, if interpreted by North American analogies, be supposed to be older than the true coal-formation. The present specimens are labelled as Carboniferous, but the occurrence in them of abundant fronds of *Spirophyton* rather points to a Devonian date."

Mr. Derby's specimens contain *Spirophyton*, and also minute rounded *Sporangites* like those obtained by Prof. Hartt. But they differ in showing the remarkable fact that these rounded bodies are enclosed in considerable numbers in spherical and oval sacs, the walls of which are composed of a tissue of hexagonal cells, and which resemble in every respect the involucres or spore-sacs of the little group of modern acrogens, known as Rhizocarps, and living in shallow water. More especially they resemble the sporocarps of the genus *Salvinia*. This fact opens up an entirely new field of investigation, and I would now proceed to describe these interesting specimens, to inquire as to their probable affinities with modern plants and their probable relations to other palæozoic forms of vegetation found with them.

Mr. Derby's specimens are labelled as from Rio Trombetas and Rio Curuà. They occur in two kinds of matrix. One is a thinly laminated sandy shale, tinged red with peroxide of iron, and with occasional ferruginous laminæ. In this the spore-sacs are flattened and black, and show the structure of the walls under the microscope. The contained macrospores, when visible, appear as minute tubercles or sometimes as depressions on the wall of the envelope, or more frequently as round light-coloured spots, according to their state of preservation (fig. 1 *a*). The other kind of

matrix is a gray dense shale in which the spore-sacs appear less flattened and destitute of carbonaceous matter.



(*a*) *Sporangites Braziliensis*, nat. size; (*a* ×) same, magnified.
(*b*) *Sp. bilobatus*, nat. size.
(*c*) Detached macrospores.
(*d*) Spore-cases of *Salvinia natans*; (*d* ×) the same magnified.

The very numerous spore-sacs contained in these shales are extremely variable in size and form, and may have belonged to several species of plants. They resolve themselves, however, into two leading types, which may be provisionally named *Sporangites Braziliensis* and *S. bilobatus*; though I would suggest for them, in prospect of the discovery of their vegetative parts, the name *Protosalvinia*. They may be described as follows:—

Sporangites (*Protosalvinia*) *Braziliensis*, S. N. (fig. 1 *a*), Sporocarps thin, carbonaceous, having a structure of dense hexagonal cells and enclosing macrospores which vary in number from three or four to as many as twenty-five; form circular, oval or reniform. Longest diameter from three millimetres to six millimetres. Some of the sacs which do not show included round bodies may have held microspores.

S. (*P.*) *bilobatus*, S. N. (fig. 1 *b*) Sporocarps oval or reniform, three millimetres to six millimetres in diameter, each showing two rounded prominences at the ends, with a depression in the middle, and sometimes a raised neck or isthmus at one side connecting the prominences. Some of the specimens indicate that each prominence or tubercle contained several macrospores. At first sight it would be easy to mistake these bodies for valves of *Beyrichia*.

The geological relations of the beds containing these interesting remains are thus stated by Mr. Derby:*

* Proceedings of the American Philosophical Society, Feb. 21, 1879.

"The third or Curuà group consists almost exclusively of black and red shales, passing at times into shaly sandstone. These beds form low cliffs along the rivers Maecurù and Curuà for a considerable distance, lying almost horizontal, except where disturbed by eruptions of diorite. On the Trombetas the black shale forms two short cliffs on the river-bank and the red shale is badly exposed on a lake near by. At Ereré these rocks are exposed in the eastern part of the plain, and in the base of the serras, particularly that of Tajuri, the front of which is composed entirely of these shales. The black shale forms the lowest bed, the thickness of which, on the Curuà, is estimated by Mr. Smith at 300 feet. It is well laminated, almost slaty in structure, and in the lower part contains numerous large calcareous and arenaceous concretions. The first are bluish black in colour, have well-developed cone-in-cone structure, and emit, when struck with a hammer, a strong odour of petroleum."

"The reddish shale lies above the black, having, more or less, the same thickness. It is generally chocolate-coloured, mottled with spots of a darker hue, and banded, parallel with the stratification, with white, yellow or black. The rock consists of clay, mixed with a considerable proportion of fine-divided mica and sand, the last often forming independent layers a few inches thick. The only fossils found in these shales were fucoids, of the genus *Spirophyton*, and small fruit-like bodies, resembling very much a flattened currant, consisting, apparently, of a thin pellicle enclosing two to six small grains. The *Spirophyton* is apparently identical with one of those described by Prof. Hall, from the Hamilton group of New York. It occurs abundantly in all the localities, in both the black and red shale, near the junction of the two."

"On the Curuà and Maecurù the red shale, which is undoubtedly Devonian, is followed by beds of coarse sandstone which, according to Mr. Smith, are at least fifty feet thick on the Curuà. This is followed by fossiliferous carboniferous beds. The red shale is also overlaid by coarse sandstone, in the mountains of Ereré, but it is not certain that this sandstone is of the same formation as that of the Curuà."

"As regards the extension of the Devonian series, it has been recognized as far west as the river Uatumâ, a small river between the Trombetas and the Rio Negro. On the southern side

of the valley, there are, on the Tapajos, shales containing *Spirophyton* and calcareous concretions, which were referred provisionally to the Carboniferous by Prof. Hartt, but which seem to me to be Devonian, and I refer to the same age the black shale found by Sūr Penna on the Xingû."

I have not seen specimens of the black shales referred to in this description, but should think it likely that on careful examination they might be found to owe their carbonaceous or bituminous matter to the partial decay of *Sporangites*. They also deserve careful examination, with the view to the discovery of the vegetation appertaining to the sporocarps. The similarity of these Brazilian beds to those holding similar fossils in Ohio and Ontario is very striking.

There can be no question of the close resemblance of the Brazilian species of *Sporangites* with the spore-envelopes of modern Rhizocarps. Some individuals of the *S. Braziliensis* are scarcely distinguishable in form or contained macrospores from the sporocarps of *Salvinia natans* of the rivers of Europe (fig. 1 *d*). It is true that the analogy of *Salvinia* would lead us to expect other sacs containing microspores; but in ordinary circumstances the latter could not be preserved in a visible state, and in the Brazilian shales there are many specimens not showing macrospores, and which might have been filled with microspores which had been flattened into an undistinguishable mass.

If we compare the separate microspores of the Brazilian sporocarps, and especially those which are found detached from their envelopes, with *Sporangites Huronensis*, we see a remarkable similarity in size, form and texture, sufficient to justify us in supposing that the latter may be of the same nature with the former, but deprived of their outer cases either by dehiscence or by decay, and this is the view which I am now disposed to take of their nature, and which better accords with their wide distribution in aqueous deposits and with their accompaniments than any other supposition. I may add that Prof. Orton and Prof. Clarke, in letters to the author, refer to grouping of the little-rounded bodies and traces of enveloping membrane. In this connection I would also mention the sacs containing rounded bodies known as *Parka*, and which have been met with in the Erian beds both in Scotland and in Gaspé, and have been supposed to be ova of crustaceans.

It is true that these are much larger than the sporocarps above referred to, but on examination of Gaspé specimens in my collection, I am disposed to suspect that they also may prove to be the fructification of Rhizocarps.

It remains to enquire, Are there any Erian plants known to us in their stems and foliage, to which such organs of fructification as those above described might have belonged?

A preliminary question would naturally be as to the vegetative organs of modern Rhizocarps. On reference to the descriptions, and to a somewhat extensive collection of specimens placed at my disposal by Mr. D. A. P. Watt, of Montreal, I find that these may be referred to three leading types. Some, like *Pilularia*, have simple linear leaves; others, like *Marsilea*, have leaves in verticils and cuneate in form; while others, like *Azolla* and *Salvinia*, have frondose leaves more or less pinnate in their arrangement. The first types present little that is characteristic, but there are in the Erian sandstones and shales great quantities of filamentous and linear objects which it has been impossible to refer to any genus, and which might have belonged to plants of the type of *Pilularia*.

It is possible also that such plants as *Psilophyton glabrum* and *Cordaites angustifolia*, of which the fructification is quite unknown, may have been allied to Rhizocarps. With regard to the verticillate type, we are at once reminded of *Sphenophyllum*, which many palæo-botanists have referred to the *Marsiliacæ*, though, like other palæozoic acrogens, it presents complexities not seen in its modern representatives. *S. primaevum* of Lesquereux is found in the Hudson River group, and my *S. antiquum* in the middle Erian. Besides these there are in the Silurian and Erian beds, plants with verticillate leaves which have been placed with the *Annulariæ*, but which may have differed from them in fructification. *Annularia laxa* of the Erian and *Protannularia Harknessii* of the Silurian may be given as examples. As to pinnate leaves, I have already referred to the remarkable plants of the genus *Ptilophyton*, found both in the Erian and Carboniferous, and which seem to have been aquatic in their habit like Rhizocarps. It is deserving of notice, also, that the two best known species of *Ptilophyton* (*P. princeps*, and *P. robustius*), while allied to lycopods by the structure of the stem and such rudimentary

foliage as they possess, are also allied, by the form of their fructification, to the Rhizocarps, and not to ferns, as some palæo-botanists have incorrectly supposed.*

I do not suppose that the facts above stated furnish any positive proof that the abundant *Sporangites* of the Erian period were the fructification of Rhizocarps, but they establish a certain probability of this, and invite to farther researches. If it should prove that these humble plants, now so insignificant, culminated in the palæozoic age, and occupied the extensive submerged flats of that period with an abundant vegetation, producing a great quantity of the bituminous matter found in the resulting beds, this early culmination of the Rhizocarps would be strictly in accordance with other facts in the development of the vegetable kingdom. We may even be permitted to speculate on the existence in the early palæozoic and eozoic ages of a rich Rhizocarpean vegetation, anticipating the great development of the acrogens in the later palæozoic.

I have not referred above to the well-known fact that in certain beds of coal and shale of the Carboniferous period there are multitudes of globular spore-cases or microspores not dissimilar from those above described. These may have been derived from plants of higher organization than the Rhizocarps, yet it is quite possible that this group of plants may have contributed to them. It is, however, only in the Erian that these *Sporangites* are so widely and abundantly distributed in aquatic beds, and that we have direct evidence as to their origin.

IV. On the Athabasca District of the Canadian North-West Territory. †

By the Rev. Émile Petitot.

Some nine years ago, I wrote a short paper on the Fur District of Athabasca, which was inserted in the Bulletin of the French Geographical Society, for July–September, 1875, and was also twice published separately. My subsequent journeys on the Upper Athabasca river, and a stay of some months on the lake of

* See Report on Erian Plants of Canada, 1882.

† From the Proceedings of the Royal Geographical Society for November, 1883.

the same name, have enabled me to collect fresh topographical, statistical, and historical material on this great district of the Canadian North-west; so that I have had to recast my former account in order to interpolate these recent acquisitions as well as my personal observations.

It will be needless to refer to the works of the first explorers of the region, such as Hearne, Mackenzie, Franklin, Back, Richardson, and others, or even to the more recent 'Wild North Land' of Captain Butler, as the commercial district of Athabasca, which takes its name from the river and lake, has undergone so many modifications during the last decade. In 1879, the Hudson's Bay Company joined a considerable portion of the Lesser Slave Lake and Mackenzie districts to the old Athabasca district, and its boundaries were defined by the dismembered and modified Mackenzie district on the north, the Churchill district on the east, the English River on the south, the Upper Saskatchewan on the south west, and British Columbia on the west.* From the Buffalo river, a sout[illegible]uent of the Great Slave Lake, the entire shore of that inland [illegible]n-water sea up to and including the two Fonds-du-Lac on the east, belongs to this district; and Forts Resolution and Reliance, which are contained in it, are subordinate to Fort Chipewyan, the headquarters.

If a straight line be drawn from Fort Reliance (situated at the outlet of Artillery Lake, the mouth of the great river "Tpatchégé-tchôp," whose current is as perceptible across Slave Lake as that of the Slave River) to the 105th meridian, and the latter

* It should be observed that since M. Petitot's return to France, Athabasca has been re-defined as one of the four districts of the Prairie section of the North-West Territories, by order of the Privy Council of Canada dated the 8th May, 1883, in the following words:—"4th. Athabasca. The district of Athabasca, about 122,000 square miles in extent, to be bounded on the south by the district of Alberta; on the east by the line between the 10th and 11th ranges of Dominion Lands townships before mentioned [*i. e.*, the line dividing the 10th and 11th ranges of townships numbered from the fourth initial meridian of the Dominion Lands system of survey, or about 111° 30′ W. long.] until, in proceeding northward, that line intersects the Athabasca River; then by that river and the Athabasca Lake and Slave River to the intersection of the last with the northern boundary of the district, which is to be the 32nd correction line of the Dominion Lands township system, and is very nearly on the 60th parallel of north latitude; westward by the Province of British Columbia." This district is of larger area than Great Britain and Ireland.

followed to its intersection with the 61st parallel, the most easterly limit of the district is then defined. This imaginary line here meets a chain of crystalline rocks, belonging to the Laurentian system, which divides the basin of Hudson's Bay from that of the great interior lakes; and as this chain is the highest land in this region it serves as a natural boundary between the Athabasca district and the districts of the English River and Upper Saskatchewan. The Athabascan frontier leaves this chain a little to the east of La Biche (or Red-deer) Lake, and follows the 55th parallel to the Rocky Mountains, thus cutting the old district of the Lesser Slave Lake, in which Forts Assiniboine and Jasper are subordinate to Edmonton House, the headquarters of the Upper Saskatchewan. Then following northwards the great Cordillera, which is the natural western limit of the district, the frontier reaches beyond the Mountain River Portage, and comes again to the Great Slave Lake by a line passing between the nearly parallel courses of the Peace and Hay rivers.

The Athabasca district comprises two great rivers and two great fresh-water basins. The rivers are the Athabasca (better known locally by the Canadian name of La Biche, meaning Red-deer or Elk River) and the Peace River (also called "Des Castors" or Beaver River). The junction of these two forms the noble stream which, after connecting the Athabasca and Great Slave Lakes, takes the name of the Mackenzie. Its Indian names, which it preserves throughout its whole course, are "Dèsnézé" or Great River, and "Na-otcha-Kotchô" or River with giant banks. The lakes are the Athabasca (the "Lake of the Hills" of Hearne) and the Great Slave Lake (in Chipewyan, "Lake of the Crees").

To the chief topographical features of this district I propose to add my own observations on the nature of the soil and its products, statistics of the population, and some historical speculations, and I shall follow in these the natural direction of the waters, from south-west to north-east.

I.

The most southern source of the Athabasca river is in the Rocky Mountains in a little lake at the foot of Mount Brown, 16,000 feet high, not far from the sources of the Saskatchewan, Fraser, and Columbia rivers, and a little south of the Yellow

Head Pass. I do not know the exact length of the Athabasca from its source, but it cannot be less than 500 or 600 miles. There are 240 miles of its Slave River course from Fort Chipewyan to Fort Resolution on the Great Slave Lake, and the Mackenzie is reckoned as 1045 miles; this would give nearly 2000 miles for the entire river-system.

From its source to the confluence of the Clear-water ("Washé-Kamaw" in the Cree dialect, but more commonly called "Sipisis" or Little River) the general direction of the Athabasca is from south-west to north-east; from that point, after two very abrupt angles to the east and south-east, it goes almost straight north to the Athabasca Lake.

For my purpose, we are only interested in the river after its receiving the drainage of the Lesser Slave Lake, at which point it enters the district of Athabasca. Before that point it receives five small rivers, the Miette, Bonhomme, Baptiste, Macleod, and Pembina. This last name, or rather "Nipi-mina," is a Cree word for elk-berries (the fruit of a guelder rose, *Viburnum edule*, which grows there).

I should observe that the name Elk River, applied to the Athabasca, is not only unknown in the north-west, even to British settlers, but is incorrect, since it refers to the elk (moose) or "orignal" (*Alces americanus*), whilst the Athabasca bears the name of the "cerf bossu" of Canada (the wapiti),* called "biche" by the Canadians (the name of the female). The Crees call the wapiti "Wawaskisieu" and the Chipewyans "Thé-zil," or Reindeer of the Rocks, both tribes also applying these names to the great water-system of which I am treating, and which should therefore be called the Great Red-deer River.

A little below the outlet of the drainage of the Lesser Slave Lake, the Athabasca receives the waters of another river, also called La Biche, which drains the pretty lake of the same name. Still lower, on the right bank, are the confluences of the Crying River ("Kitou Sipi") and Wide River ("Kaministi Kwéya"), and on the left bank the Pelican River ("Tsatsakin Sipi"), and Lake Wabasca. The right bank also receives the House's River ("Waskaigan Sipi"); then, before reaching the turbulent

* It is a common error in North America to call the wapiti by the name of elk.

cascades and foaming sheets called the Great Rapid, the right bank is again broken by the "Miyotinaw," and the left by the "Nistaukam" (Mustuch or Bison River), whilst another (Red-deer or La Biche River), at least the sixth of the name in the district, also enters the Rapid on the left bank.

The large Clear-water river affluent is called "Otthap-dès," or River of the Groves, by the Chipewyans, and "Little Athabasca" by the Canadians. Inclosed between sandy banks 400 feet high, which it washes and eats away, revealing bare rocks of the most picturesque character conceivable, this fresh and limpid stream is literally buried under the natural bowers of vegetation following its shores and climbing the walls of its cañon. Nowhere have I seen more pleasing views, more crystal like yet impetuous waters more turbulent rapids and cascades, or more shady and varied woods. Its bed is covered with fresh-water mussels (*Unio*) which, however, the Indians do not eat, and its forests contain moose and bear. A pretty spring of sulphurous and saline waters rises from five different sources in the prairie near the river, and could be made the site of an excellent sanitary bathing establishment.

A trading-post called The Forks is situated at the junction of the Clear-water with the Athabasca. Beyond the Clear-water the latter receives on its right bank the Saline and Pierre-à-Calumets rivers, and on its left bank the Beaver, Red and Cypress rivers. The sandy banks of the Athabasca vary from 200 to 400 feet in elevation, and present many formations, all apparently belonging to the transition period.

Below the drainage of Lake La Biche and Wide River, on the left bank, a red-coloured exposure of the schistose and oblique stratifications which dip into the muddy current suggests the action of ancient subterranean fires, called "boucanes" by the Canadians. Here are found sulphates of iron and magnesia, nitrous deposits, and native carbonate of soda. In one place along the miry bank, a number of jets of hot steam find a vent through the mud, and make the waters of the river bubble. These traces of plutonic action are then transferred to the right bank, both above and below the confluence of the Clear-water, where there is a chain of volcanoes on a small scale, in the form of

little cones of whitened and scorified earth. Beyond these places, indications of active and extinct igneous action are only found on the right bank of the Athabasca and Mackenzie system, reappearing all along this immense fluvial artery with an intermittent activity and inaction difficult to explain. In some places these "boucanes," after having vented fire and smoke for decades, entirely disappear, only to show themselves without apparent cause elsewhere.

Traces of the subterranean bituminous veins that keep up these fires can be followed to the shores of the Arctic Ocean, in the cliffs of Franklin Bay and Cape Bathurst, where Sir John Richardson took them to be active volcanoes.

These "boucanes" are usually found on the line of imperfect coal, *i.e.*, of deposits of lignite incompletely carbonised, and consequently unfit for the forge or fuel. They are so along the Boucanes River, one of the affluents of the Peace River, as well as above Fort Norman on the Lower Mackenzie; but here there is no outer trace of coal or lignite, though it is probable that there are subterranean veins of those substances, and that the phenomena mentioned are owing to the protocarbonated hydrogen of the coal deposits. Nevertheless (although fire-damp explodes on contact with oxygen, as is often found at the beginning of winter in some of the lakes of the north-west), the capability of spontaneous illumination which Richardson attributes to the identical exhalations of Fort Norman, has not been found to exist in this gas. It is impossible to attribute to the Indians the extinction of the fires of bituminous schists in the Athabasca-Mackenzie system. Their ignition is intermittent, without apparent cause, and unstable. It is, moreover, accompanied by a strong smell of petroleum, whilst hydrogen is inodorous. But the carburets of hydrogen, of which petroleum is composed, do not make it, any more than they do fire-damp, spontaneously inflammable, even on contact with air,—in spite of received popular opinion. We must, therefore, consider them as one of the effects of igneous action, materially connected with the fire of the volcanoes; for the Boucanes occur under similar conditions to the vents of these subterranean fires, being found on the river banks, on intermediary strata inclosing schist, bitumen, lignites, thermal sulphurous or saline waters, rock-salt, &c.

I have observed a saline spring near the mouth of the Clear-water; a little below this point the Athabasca receives a saline feeder, which rises in a natural salt-spring of considerable size; and below Lake Athabasca, on the left bank, is a second saline feeder, rising in the Caribou Mountains, which contain vast deposits of rock-salt, and a cavern remarkable for its crystalline concretions.

Still further, between Forts Simpson and Norman, two other saline streams, unfit for drink, are fed by the mines of rock-salt contained in Clarke's Rock, a mountain of volcanic aspect. Lastly, there is a fifth saline river not far from the Arctic Ocean.

About 56° 30′ N. lat., the Athabasca meets Birch or Bark Mountain, a continuation of the heights forming Portage la Loche or Methy Portage (named after the loche or fresh-water cod-fish) and leaves its former course in order to open a way across the ravines of the mountain, thus making a right-angled elbow at the east. This wonderful cañon is called the Great Rapid. For some twenty-five or twenty-eight leagues it impedes and much endangers the navigation of the Athabasca. Besides the Great Rapid, properly so called, the traveller must pass as best he may the Brûlé, Noyé, Pas-de-bout, Croche (or Sinuous), Stony, Cascade, and Mountain Rapids. In short, the whole make one continuous rapid, twice as long as that of the Bear River, for the current sometimes reaches a rate of twelve to fifteen miles an hour.

There is nevertheless, strictly speaking, no cataract in the Athabasca canon, only a very strong declivity, in the form of a rapid flat sheet of water, obstructed by enormous boulders. At its commencement the river finds itself checked by the vast natural dam of Bark Mountain, the base of which is sandstone or madre-poriferous limestone. The raging flood dashes against this obstacle, in which it has striven to batter a breach for centuries, washing away and carrying off the quartzose particles and exposing the madreporic conglomerate, shelly limestone, or bituminous sandstone forming the base of this vast deposit, and detaching and isolating a multitude of globular masses of solid or hollow sandstone contained in the quartzose sand, which now obstruct the bed of the river and are the cause of its foaming rapids. These concretions are found at every elevation of the cliffs, from the size of a coat-button to that of a Dutch fishing-vessel; they are of all degrees of

measurement and bulk, and of elegant or grotesque shapes, from buttons and turnips to the planet Saturn with its rings.

I have never seen in any geological text-book an explanation of the formation of these lenticular concretions, geodes, or pisolites, which I cannot believe to be merely concretions of sandstone rolled and rounded by the action of water. I am inclined to the opinion that they are masses thrown up in a globular form by some subterranean igneous force, and falling into the water holding much mud in solution, in which they have passed from a pasty condition to a solid consistency, crystallising as it were in it by the action of cold. I adopt this view, because these pisolites (whether geodes or not) are only met with in this district near rapids and waterfalls, in localities exhibiting numerous traces of subterranean fires, formerly much more active and powerful than now; and because I have found some of these concretions composed of iron pyrites, crystallising from the centre outwards, and also others of bog iron. Whatever may be the method of formation of such singular freaks of nature, the Athabasca in eroding a tortuous and deep channel through the sandstone of Bark Mountain, finds its bed obstructed by these gigantic concretions, which are the sole cause of its rapids, and render its navigation so perilous as to be well-nigh impossible. Besides this danger, great numbers of them are exposed on the sandy surface at all heights of the cliffs, forming immense caps constantly threatening the heads of the unsuspecting travellers beneath.

Remarkable vegetable fossils are often found in the sandstone of this part of the Athabasca, imbedded in the rock, but capable of detachment with the hammer. I have noticed whole trunks of *Cupressoxylon* (probably a *Sequoia*), characteristic of the tertiaries, and have sent specimens of it to Montreal and to Paris.

Near the Clear-water a pudding-stone begins to appear in horizontal layers from the level of the water, probably also reaching below it. This conglomerate is here overlaid by oblique stratifications of bituminous schist, which transude asphalt from top to bottom. The savannas and swamps covering the surface of these rocks conceal rich mines of bitumen under their thin coat of turf; and from Point Colbert to the Pierre-à-Calumets river they have given rise to the Chipewyan name of "Ellel Dèssé," or "River of the moving grounds."

The proximity of pisolites and considerable deposits of quartzose sand leads me to the belief that the bituminous matter exuding from the black cliffs of the Athabasca is *Pisasphaltum areniferum*, characteristic of the tertiaries. It flows in summer in wide sheets from the schistose flanks of the cliffs down into the river, mixing with the sands and solidifying so as to form a conglomerate, sometimes softened by the sun's rays and at others hard and brittle, of which fragments detached by the waters are carried down and deposited on the shores of the Athabasca-Mackenzie system, where they could be mistaken for nodules of basalt. They acquire an astonishing degree of hardness, and it is only by accident that their true origin is eventually discovered.

The bituminous schists are replaced at intervals by a shell-bearing limestone of dolomitic character, sometimes milky white. From this I have extracted various fossils, including *Terebratulæ*, very small Belemnites, *Atrypa reticularis*, *Cyrtina hamiltonesis* and *C. umbraculosa*. These limestone strata are undulating, and occur both above and below the water-level.

The shores of the Athabasca present an attractive sight. Far from injuring plant-life, the presence of naphtha and the subterranean fires seem to have imparted new vigour to it, so that the lofty banks have their steep slopes covered with vigorous and varied vegetation. Besides white pine, larch, aspen, and birch (which gives its name to the Bark Mountain), the forest trees here include, Virginian pine, cypress, Banks's pine, Weymouth pine, balsam-poplar, alder, and many kinds of willow.

Along its waters, discoloured by muddy matter and loaded with deposits to such an extent as to be prejudicial to fish-life, I have collected a large number of medicinal plants: *Geum strictum* and *rivale*, *Verbascum*, *Elæagnus argentea* (a very sweet-smelling shrub whose berries are a great delicacy to bears), *Lonicera parviflora*, *Cypripedium* with its large golden lips, saxifrages, *Polygala*, *Erythronium dens-canis*, and beautiful scarlet lilies like the Martagon, which would be an ornament to any garden. The Indians are very fond of the bulbs of this latter plant, which the Tinneys* call "Télé-nuié" (or Crane bread) and the Crees

* Also variously written as Tinneh, 'Tinnè, 'Dtinnè, Dinnè, Dinè, Dinneh, Dènè,' &c. (meaning "men" or "people")—the great northern or Athabascan family of Indians.

"Okitsanak." The eatable *Hedysarum* with blue flowers, and the poisonous one with yellow (known as the Travelling Vetch) are found there also. The male fern adorns the woods with its large fronds, and others, such as *Polypodium*, Capillary, and *Scolopendrium*, carpet the mossy rocks with their elegant plumes. But the most abundant plant all along the river is sarsaparilla. The Tinney of the Beaver tribe know this smilaceous plant as a febrifuge and sudorific, and collect its roots; but they are not aware of the anti-syphilitic properties of smilacine, a tannic base contained in it, and which I have more than once pointed out to them.

It is a curious fact that I have never heard a *Cicada* in the Northwest, though on two occasions (in 1876 and 1879) I satisfied myself of the occurrence of those insects at the junction of the Clear-water and the Athabasca, though I only found them on that spot.

The wapiti has become rather uncommon in the forests of the Athabasca, but the moose is frequently met with there. I have never travelled along this noble river (and I have done so six times) without seeing it, sometimes as many as three individuals together. The frugivorous black bear, lynx, beaver, and otter are common. On June 23rd, 1879, I met two Cree hunters who declared that since the spring (*i. e.*, in less than three months) they had between them killed along the river two hundred beavers, twenty-five moose, twenty bears and five wapiti; and I may add that from experience of the Redskins I know they are more given to diminish than to exaggerate the results of their hunting. This shows that life could still be maintained on the river if there existed inhabitants able to hunt and provision the trading-posts. But from the drainage of the Lesser Slave Lake to Lake Athabasca there are but thirty-one Crees and twenty-two Chipewyans, women and children all told.

The original mouth of the Athabasca is now distant a good day's navigation from the lake. It is shown by the simultaneous receding of both the high strands forming the bed of the river, which from this point keep widening away from each other until they disappear in the interior. A flat uniform plain follows, composed of accumulations of soil, with no admixture of rock, and covered by dense forest growth. The river has thus actually

filled up its own ancient estuary with the material it has carried along, for no other in the world is more loaded with muddy deposits, vegetable detritus, and floating trees.

Almost immediately after this the river divides into two arms, of which only the right-hand one retains the name of Athabasca, the left taking that of Embarras, because of the frequent bars made across it by the timber borne on its waters. Further on, the Athabasca channel is subdivided into three other branches, of which the central was the principal channel in 1879, whilst the left one, known as the Brochets (or Pike) River, rejoined the Embarras branch. But all these channels are interconnected by a multitude of creeks, not reckoned by the natives, as they are only navigable by bark canoes.

Some maps make the river Athabasca communicate with Lake Mamawi (or Mamawa), which is also represented as an expansion of one of the mouths of the Peace River; but this is a double error. Lake Mamawi (meaning in Cree, Reunion or Assemblage) receives its waters from Clear Lake, with which it communicates by a very short arm called the Hay River ("Klopè-djiéthé"); and Clear Lake itself is fed from Bark Mountain, having no connection with the Peace River. But before entering Mamawi, the waters of Clear Lake bifurcate, the left channel discharging under the name of the "Des Enfants" or Children River, into the most eastern mouth of the Peace River, called "Aux Œufs" or Egg River which flows into Lake Athabasca.

The waters of Mamawi are also drained into the latter basin by four channels, of which the right-hand one passes direct into it, the other three eventually uniting and emptying into the eastern mouth of the Peace River, which, before reaching Lake Athabasca, sends out an arm towards Lake Mamawi. This quadruple channel bears the name of the Four Forks, and is the cause of the Cree name for Mamawi. Very curious tidal fluctuations result from this arrangement. In ordinary weather, with things in their normal condition, the above description is correct. But as the level of Lake Athabasca is materially heightened at the period of flood, the waters of its basin, or more correctly the currents of the Athabasca which cross it, flow back in the direction of the Four Forks, reaching Lake Mamawi and even Clear Lake itself, so that they connect the first with the eastern or Embarras chan-

nel of the Athabasca, and inundate all the prairies between the different mouths of that great river, forcing the Egg River to flow back to the main branch of the Peace River which joins the Great Slave River.

Such was the condition of the estuary of the Athabasca and its mouths in Franklin's time (and also in 1876); and if there are errors in the maps of that time, they are either owing to incorrect information or to misunderstanding; for I can scarcely believe that the first explorers were able to visit all of these localities, considering the short time they spent in the country.

The vast marshy savanna of this delta—an ocean of tall grass, mare's-tail, *Cyperus*, reeds, and willows, intersected by numberless miry creeks always covered with water-fowl—is well called in Cree "The Herbaceous Network," which is practically the meaning of Athabasca, Ayabasca, Arabasca, and Wabasca, in the Algonquin dialects,—a name applied to the entire lake and also to the river by Europeans.

There are often not more than two or three feet of water in these creeks of the Athabasca; but sometimes the whole estuary is submerged and becomes part of the lake, still bearing on its muddy surface a flotilla of huge trees which have got locked together and materially heightened its level. I saw such a state of things in 1871 and 1876; but how different was the estuary three years after! At that time, the channels of the Athabasca were almost dry; the main current had left the central one and gone wholly to the east, and the savanna of the estuary, elevated many feet above it, was changed into the immense and perfectly firm prairie, covered with young willow copses and dotted with water-holes.* But the most remarkable thing was that the estuary of the Athabasca had entirely left this high and dry prairie, and betaken itself to a point between its old mouth and that of the Peace River, into the Rocky (or Stony) River, the drainer of the great lake. The expanse of waters between these two points had therefore vanished, and the once great bay of Lake Athabasca, so picturesque with its chains of granitic pine-clad isles, like a fleet of war-ships preparing for nautical evolutions, had wholly disappeared. Perhaps I should more correctly say that this basin of five to six leagues still existed with its rocky rim, but instead of

* See Macoun, in Rep. Geol. Survey of Canada, 1875-76, p. 91.

water it contained grass; instead of resembling a vast turquoise set in a jasper border, it seemed an emerald, silver-veined. This part of the lake was also transformed into a prairie, from Bustard Island to the Rocky River, and its former islands, now surrounded by fertile land, only lacking the plough to produce splendid crops, were mere isolated elevations—landmarks destined in future ages to show that once the white-fish, the carp, and the pike disported in places destined, I hope, to be improved ere long by high cultivation.

This condition of the waters endured till I left the North-west; for in 1881 Mr. R. McFarlane wrote to me that this drying-up had proved a severe calamity to the Redskins of the lake, who had hitherto derived plentiful supplies of food from the well-known fisheries of the Four Forks and Bustard Island, now of course entirely destroyed.

It seems that the four mouths of the Athabasca, the embouchure of Lake Mamawi, and the eastern (or Egg River) channel of the Peace River, retained their respective currents beneath the waters of the lake, before filling it up; and when the level of the lake had become considerably heightened by their numerous interconnections, their beds remained like so many narrow rivers, which now run through the dried-up mud, far from the ancient isles, to reunite in the great outlet of the Rocky River.

Unless some extraordinary flood remodifies this newly formed estuary, the Athabasca district will thus have gained an immense space of land, excellent for cultivation, and not requiring artificial fertilisation for very many years; and it should be noted that the climate of the lake is far from being an obstacle to the ripening of cereals and vegetables, for at the Philadelphia Centennial Exhibition in 1876, the Catholic Mission near Fort Chipewyan obtained a silver medal and honourable mention for cereals of the first quality and remarkable size. In fact, the chief want of the lake-district as regards colonization is vegetable mould. With the exception of the estuary above mentioned, and of the still more extensive and no less extraordinary one of the Peace River, only rocks are found in it; and it may be said with truth that the entire north from the Slave Lake and River to Hudson's Bay is only a gigantic bed of crystalline rocks, where the planetary nucleus is exposed under the form of various granites, feldspar,

syenite, porphyry, serpentine, &c. Vegetation is only to be seen in the inequalities of the stony surface or depressions in these products of fusion, where the action of water has not entirely cleared away their sandy surface, or where it has deposited a slight layer of sedimentary earth, as at the Chipewyan Mission. Conifers, black alder, heather, *Cistus*, *Absinthium*, and some other aromatic plants root in the meagre soil, and diminish the melancholy aspect of this vast exposed portion of the frame of nature.

I firmly believe that all the land reclaimed from the Peace and Athabasca rivers is of the best quality, if the present conditions are maintained. But there is always the fear of some exceptional rise in the waters causing a sudden flood, of such a nature that the vast plains recently uncovered might be once more overrun by devastating currents washing away their soil and entirely re-modifying their surface.

I have travelled over the whole of the estuary of the Peace River,* above referred to, and found it no less curious than that of the Athabasca. As before mentioned, its first or most eastern channel enters Lake Athabasca at the Four Forks, under the name of Egg River; and the maps are quite wrong in representing the Clear Lake River as another mouth of the Peace River. But between the Egg River and the Canard or Duck Portage, where there are unmistakable traces of an old western channel, this river has four other openings into the Slave River, without counting six creeks originating in the same number of lakes formed by the overflow of the Peace River, but with no currents of their own, directly its waters retire. Between the two last-named points, therefore there is an immense plain, comparable in fertility with the delta of the Camargue in Provence, intersected by rivulets and dotted with lakes and ponds. Forest-trees have sprung up in it, and pine-crowned hillocks rising in a hundred different places show the position of former islands. Crops of the highest quality could be raised on this gigantic and well-watered delta, which contains prodigious quantities of timber deposited by the waters during past ages. I am firmly of opinion that the colonization and cultivation of this portion of the Athabasca district deserve serious attention, and I have therefore done my best to prepare a

* On the Peace River District, see also Dawson, in Rep. Geol. Survey Canada, 1879-80, (B) p. 66 *et seq.*

map of those two great estuaries as accurately as possible, preserving the local names of the lakes and water-ways. This map is, indeed, the chief result of my labors.

Besides these vast deltas there are other lands, on the left bank of the Slave River, perfectly fit for cultivation; this is indeed proved by the old settlement of the Beaulieu family on the banks of the Salt River; but the settlers there would have to struggle against inextricable forests, and an entire want of roads or other communications, without mentioning other serious inconveniences.

But there is in the Athabasca district a belt not overrun by forest, and which has nothing to fear from periodical inundations; where timber only grows sufficiently for the needs of colonists, and is rarely a mechanical obstacle; well covered with undergrowth and grass, capable of cultivation, crossed by a waggon-track, watered by streams, stocked with fish-bearing lakes, and offering every facility and advantage for the construction of a railroad. I refer to the zone of natural prairie along the Rocky Mountains, from the mountains of the Upper Saskatchewan to the banks of the Hay River, one of the feeders of the Great Slave Lake. I have been told by very many persons who have travelled over the Great Prairie, by which name this fertile belt is known, that it comprises every condition requisite for settlement, as well as being rich in lumber requisites and minerals of all kinds. Sulphur, bitumen, and coal crop up in many places, with rock-salt, iron, native copper, and even gold (according to report). Against these advantages, must be set the fact that the means of subsistence have become more and more rare, from the rapid diminution and imminent extinction of the animals which supplied the daily food of the Indians, such as the moose, caribou, wapiti, bison of the woods (a distinct species from the musk-ox and prairie bison), beaver, porcupine, &c. The musk-rat alone seems not to have failed as yet, and continues, as before, to swarm on the lakes, ponds, and smallest streams. I can only regret that I have no personal knowledge of this fertile region.

II.

Lake Athabasca is the smallest of the fresh-water seas which stretch like a chain from the Gulf of St. Lawrence to the Arctic Ocean, east of the Mississippi, the Red River of the North, and the Athabasca-Mackenzie system.

It is 230 miles long by twenty miles broad, and about 600 feet above the level of the Arctic Ocean, according to the observations of General Sir J. H. Lefroy. The position of Fort Chipewyan, the headquarters of the district, is 58° 43′ N. lat., and 111° 18′ 32″ W. long.; that of Fort Fond-du-Lac is 59° 20′ N. lat. and 107° 25′ W. long.

Like a number of other lakes in this region, it is a crystal sheet of water lying in a deep bed, granitic at the north end, and with sandy and muddy deposits at the south. Three of its sides are granite, and a great number of granite islands thickly set with pines dot its surface. But there are no mountains there, and Hearne, the first explorer in 1771, would have been more correct in naming it Lake of the Isles than Lake of the Hills, as the abundance of islands strikes the traveller at the first glance.

I have already explained the Cree meaning of Athabasca. The present inhabitants, the Chipewyan Tinneys, call it "Yétapè-t'ué" (Lake Superior), or more habitually "Kkpay-t'èlè-kkè," or Willow bed, alluding, doubtless, to the deltas. This was also the name of an old trading-fort at the mouth of the Athabasca river, where willows were the dominant feature of the vegetation, only conifers and aspens being visible elsewhere.

The nature of the soil of the lake is therefore identical with that of the great lakes tributary to Hudson's Bay, such as Lakes Wollaston, Caribou, Beaver, and Bear, the Lake of the Woods, and Lake Winnipeg, and of those which drain to the Atlantic, as the Canadian lakes proper.

The fishes of the lake are *Coregonus lucidus* or white-fish, salmon-trout (which there, as in more northern waters, reaches thirty-five lbs. and over), Canadian trout, *Catastomus reticulatus*, maskinongé (*Esox estor*), grey and red sucking-carps, sandre (*Lucioperca Americana*, called doré by the Canadians), the golden-eyed lakêche, lamprey, methy (*Lota maculosa*), &c. I only refer here to the larger species, for the very sufficient reason that the smaller ones are entirely unknown.

The north of the lake, which is wholly sterile and rocky, only affords support for caribou, which find a palatable food in various lichens growing there. The animals and plants of the forests and prairies to the south have already been referred to.

It is obviously impossible that very exact cartographic representations should exist of so vast a lake, which has only once or twice been visited by scientific observers, and then only partially, having never been explored as a whole. I have therefore here also to make some alterations in the maps now current.

The lake receives eleven watercourses, of which eight (the Peace, Mamawi, Athabasca, Little Fork, William's, Unknown, Beaver, and Other-side rivers) are on its south. The Grease and Carp rivers enter into it from the Barren Ground; and the Great Fond-du-Lac river flows in on the east. The latter drains into the lake the waters of the Great Black Lake and the Lake of the Isles, a basin dotted with granitic blocks and fed by two streams which are practically a chain of small lakes. The most southerly of these rises at the foot of Beast's Mountain, not far from Wollaston or Great Hatchet Lake; the northern one rises near Lake Caribou, but without having any kind of communication with it.

It was doubtless the proximity of these two great lakes to the most eastern sources of Lake Athabasca that caused Hearne to believe that Lake Wollaston was connected with Hudson's Bay by the Churchill river, and with the Arctic Ocean by Lake Athabasca. Nothing, however, could be more incorrect. The most northern source of Lake Wollaston is the glacial river springing from the elongated granitic water-parting before mentioned. This lake drains into Lake Caribou by the Canoe River, a simple connecting arm, and communicates with the Churchill River by the Deer River. But there is absolutely no communication between the lakes occupying the two slopes of the water-parting.

I have therefore corrected four geographical mistakes about these Canadian lakes, to which various drainages have hitherto been attributed. The first mistake refers to Lake La Ronge, which empties into the Churchill, and which was also said to open into the Beaver River; but I showed in 1873 that the Beaver receives the La Plonge River, which rises near Lake La Ronge, though not taking the actual waters of the latter lake. The second concerns Lakes Wollaston and Athabasca, as above stated.

The third refers to the Great Bear Lake, to which Sir John Richardson attributed three outlets, viz., the Bear Lake River and the Hareskin River, entering the Mackenzie, and the Beghula River, entering the Arctic Ocean. In ascending these three rivers to their respective sources, I proved in 1869–70 that the Bear Lake has only one outlet, viz., the river of the same name; that the Hareskin River flows out of the Wind Lake near Smith Bay in Bear Lake; and that the Anderson (the "Beghula" of Richardson) rises in a little lake at the foot of Mount "Ti-dépay" quite to the north of and some distance from Bear Lake. Lastly, the fourth error is regarding the famous great lake of the Eskimo, to which various openings into the Arctic Ocean were attributed, besides one outlet in the mouths of the Mackenzie and another in the Anderson River. It is now known that this lake (the size of which has been considerably diminished) has but one outlet, the river "Natowdja," a direct tributary of the Arctic Ocean.

I also made, in 1879, a complete survey of the course of the Slave River from the great lake of the same name to that of Athabasca, in order to complete my former work on the Mackenzie; and it is remarkable that, although I had no map to refer to, and no other instrument than a compass, the result agreed almost exactly with Franklin's route-map of 1820, except as regards some islands, which either escaped his observation or have been exposed since his journey, some winter-portages that he never crossed, and a few bends in the river which he probably passed at night-time.

Above the rapids formed by the Caribou range, where that range leaves the left bank and turns off towards the east, along the course of the great Des Seins River, or "Thou-bau-dessé," * the Slave River crosses a flat plain covered with inextricable forests, apparently reclaimed by degrees by the sedimentary deposits of its muddy waters. This river has no sandy shores. Its muddy banks are constantly washed off on one side to be deposited on the other. At times they give way, and the current,

* This river, a southern affluent of the Great Slave Lake, is apparently represented on M. Petitot's map by the "T'al'tsan-Dessé" or Yellow Knives River. The name used in the above text seems to agree with the "Thuwu-desseh" of the map of Back's "Narrative" (1836), which enters the Slave Lake to the east of the mouth of the Slave River.

precipitated with violence into the forests, opens fresh channels, whilst the old ones, obstructed by the mire and sand brought down, are filled up and transformed into a marshy savanna. The Duck Portage was formed in this way. Entering it from the north (the direction facing the current), the idea is suggested that it is a channel of the river or one of its affluents; but the traveller soon finds himself in an immense dried-up marsh, quite level, and entirely composed of black viscous mud, cracked by desiccation and covered with timber formerly deposited by the waters. Its Chipewyan name, "Tédh dédh-héli t'ué" (Float-wood Lake) points to its origin. There is however, no trace of any lake; but a chain of wooded and elevated isles shows that this is the ancient bed of the Slave River, which, after filling in with muddy deposits, has been obstructed in its course by imbedded timber and forced to break a passage to the right by an abrupt eastern elbow. I think this alteration of course has been effected recently. It may perhaps be the outlet which I saw in course of formation in 1862, though I had then no opportunity of accurately fixing its position.

During extraordinary floods the surplus waters of the Slave River spread over this great marsh and scour the Duck Portage; but at an epoch before the formation of the present bed, when the Duck Portage was the ordinary channel, the overflow passed to the left by another natural channel, now dry. This shows a gradual tendency of the Slave River towards the east in this district. The conditions above referred to as existing at the mouth of the Athabasca, are also shown at the mouth of this river, for the current has so clogged its bed and filled up its estuary as to be compelled to divide and make its way across the sedimentary deposits of its delta, which it cuts up into a great number of mud islands.

The first and oldest of its branches contained large and lofty islands, identical as to soil with the mainland, and wooded, like it, with white pines, *Populus balsamifera*, aspens, and birches, whose venerable trunks show an existence of at least six or eight centuries. If a line be drawn on the right from this point to the mouth of the Des Seins River, and on the left to that of the Oxen River, a triangle or delta will be described wholly occupied by the ancient and recent mouths of the river. The latter, after divid-

ing into three channels, is subdivided into two great median arms, of which the eastern one is called Jean's River, a corruption of the Chipewyan name "Dzan-des-tché," literally Mud-river end, or Muddy mouth. Up to this point standing trees are found in the delta, but they are no longer coniferous, thus showing that the islands are of later formation. As the channels subdivide vegetation decreases with them; aspens, poplars, and alders have disappeared, and only small willows, six to eight feet high, are found. Still lower down, nothing is found but reeds, bulrushes and at last only mare's-tail (*Equisetum*), an exclusively aquatic growth, entirely covered during floods.

Such are the products of the last sedimentary formations, which are not yet consolidated. Between them and the lake extends a moving bog, fluctuating with the waters, which cover it for a few inches. Any unfortunate boat running into this mud will infallibly become as firmly imbedded as the innumerable tree-trunks whose roots are horizontally exposed above its surface. Some years hence these unsolid and unfathomable banks will, become firm, and, aided by the accumulations and drying effects of frosts in winter, will form new islands, more and more encroaching on the Slave Lake.

During the 240 miles of the course of the Slave River, it only receives two affluents, one on each bank, viz., the Dogs and the Salt rivers, the first of which is above and the second below the Rapids, interrupting its navigation.

The maps of Lake Athabasca give indeed its southern affluents, but two of these, the Unknown and Beaver rivers, are not represented to be of large dimensions, nor are the lakes from which they spring shown as being within so comparatively short a distance of the lacustrine enlargement of the Churchill known as Lake Lacrosse, that passage from the latter to the tributaries of Lake Athabasca could be made by the head-waters of the Caribou river. I have thought it right to rename these two great rivers and the lakes from which they spring after Messrs. C. P. Gaudet and R. McFarlane, as a mark of my respect and gratitude.

III.

The first person entitled to honour as the explorer of Lake Athabasca, was Samuel Hearne. He discovered it in 1771, and named it "Lake of the Hills." Seven years afterwards, the

North-west Company sent hither a Canadian, Joseph Frobisher, who founded the first trading-post. The Hudson's Bay Company soon followed the example of its rival, so that here, as in many other places, these two commercial bodies found themselves in competition at an early date. Nevertheless, the discoveries of Hearne, of Peter Pond in 1779, and even of Sir Alexander Mackenzie in 1789, however authentic and scientific, were apparently anticipated by the far-reaching tracks of the *coureurs de bois;* for when Pond reached the Great Slave Lake, the half-breed Canadian family of Beaulieu had already settled on the Salt River—one of them, named Jacques, indeed acted as interpreter for this trading-officer, just as, at a later date, his nephew François was Sir John Franklin's hunter and interpreter.

In 1820, and again in 1829, Sir John Franklin, accompanied by Lieutenant Back and Dr. Richardson, visited Athabasca on their way to the Arctic Ocean, when commencing their explorations for the famous North-West passage. The portrait drawn by these travellers of the Chipewyan Tinneys (whom they also call, though wrongly, Athabascans) is anything but a flattering one, and shows the recent change for the better in the character and disposition of these Indians. I can myself speak of as great an alteration in the Beaver Indians, who are now as gentle and inoffensive as they were thievish, shifty, and faithless twenty-five years ago. This is the natural effect of the commercial relations and religious habits acquired since that date by these child-like tribes.

The Chipewyans, without being as timid as their northern brethren, who deserved the uncomplimentary epithet of "Slaves" bestowed on them by the first explorers, are now a gentle, peaceful, and honest people, comparatively chaste and religious, though they may perhaps be accused of being a little too morose in disposition and fond of solitude. The Catholic Missionaries first visited them in 1847, and two years later settled among them. In 1866 or 1868, if I remember rightly, a clergyman of the church of England was domiciled at Fort Chipewyan; and lastly, in 1875, the Montreal sisters of charity founded a school with an orphanage and hospital there. This fort has for some years been the seat of an Anglican bishop.

From the time of the historian Charlevoix a vague acquaint-

ance with Lake Athabasca must have existed in Canada, for he speaks of the Dog-rib Indians and the "Savanois" (now called "Mashkégous" [Maskigos] or swamp-dwellers), the former of whom lived at the north-east of the lake, while the hunting-grounds of the latter were to the east and south-east.

At this date, the Ayis-iyiniwok or Iyiniwok (Men), called by Duponceau "Killistini," by the Ojibbeways "Kinistinuwok," and by the French "Cristineaux" (also called "Klistinos" and "Knistineaux"), from which have finally been derived the names Cris, Crees, Kree, and Krî, lived on the banks of the Beaver-Churchill river, which they called Great Water (Missi-Nipi), as well as on the shores of Cross-isle Lake, Moor-hen Lake, Cold Lake, &c. In short, they occupied the country between the Savanois Indians on the east and the Grandspagnes (also called Prairie-Crees), on the west. The Chipewyans at that time lived along the course of the Peace River, after crossing the Rocky Mountains, not having yet ventured down into the country now occupied by them between the Great Slave Lake and Frog Portage on the English River. It was in fact their primitive home in the Rocky Mountains that originated the Canadian name "Montagnais" or Highlanders for these Tinneys, who now live in a flat country.

Lake Athabasca, the Slave River, and the shores of the Great Slave Lake were the exclusive territory of another tribe of Tinneys, to whom the epithet of Slaves was given, from their natural timidity and cowardice. They themselves recognized two divisions, people living among the hares (or northern Tinneys), and among the rabbits (meaning the Chipewyans). The latter name is applied by the Crees to the entire Tinney nation, and means "Tailed men," *i.e.*, men clothed in tailed skins. This arose from the fact that all the Tinneys, like the modern Dindjiés of Alaska, used to wear a fringed robe of moose or reindeer skin, ending in a long point in front and behind.

The Indians using the Algonquin tongue, such as the Crees, Savanois, Grandspagnes, and Ojibbeways, carried on a pitiless war against the Athabascan Tinneys or Slaves, who from natural timidity gave up their territory to their enemies, and fell back on the Great Slave Lake, pursued by the Crees, who made a great slaughter among them. Various islands and archipelagos retain

the name and the memory of these dreaded Ennas (strangers, enemies), including Dead Men's Isle, which keeps alive to this day the recollection of the defeat of the Katchô-Ottiné, subsequently called Slaves. From that time, this portion of the Tinney family never ventured south, but remained in the cold lands and swampy forests of the north, where they became split up and settled under the names of Dog-ribs, Hareskins, Highlanders, Slaves, &c. Their different tribal dialects vary but slightly *inter se*, differing much more widely from the Chipewyan.

The Kilistino or Crees, established on Lake Athabasca and its tributaries and discharges, found themselves exposed to the attacks of the Chipewyan Tinneys arriving from the west by the Peace River (called Amisko-Sipi or Beaver River by the Crees), thus proving that the Tinney family, or at least its northern tribes, are of later origin on the American continent than the Killini or Hillini Lléni. But, being as brave as, if not braver than, the invaders, they offered such a resistance that prisoners and slaves were made on both sides. Meanwhile the English appeared in Hudson's Bay at the mouth of the Missi-Nipi (called English River from them), and founded a factory there named Churchill, after the then prime minister of England. This became the medium of commerce between the coast Eskimo, the Savanois, and the Crees of the interior.

Before the Hudson's Bay Company sent Hearne to explore the interior, a Chipewyan woman named Tha-narelther (Falling Sable) was carried off by a Savanois war-party, and taken in captivity to the shore-region of Hudson's Bay. She saw with astonishment in the tents of her captors domestic utensils and arms entirely new to her, and as she at first believed them to be of native manufacture she admired the intellectual superiority of the Killini, and determined to remain with a people so superior to herself in intelligence and cleverness. But she did not live among them long before detecting from their ways and ceaseless wanderings that they obtained these things from strangers, in exchange for peltry and provisions. This traffic puzzled the captive, but, as she imagined that the original possessors of the riches bestowed upon the Savanois must be their relations or allies, she never thought of taking refuge with them and begging their protection.

Only after some years of harsh captivity, did she discover that the "Agayasieu" (the Cree name for the English), who supplied the Crees and Savanois, belonged to an entirely strange race, good-natured and generous, friendly with all the aborigines, and coming from the far east to trade with them. Her mind was then soon made up. She succeeded in reaching Fort Churchill alone, and as she had learned enough of the Algonquin dialect to make herself understood by the interpreters of the fort, she was enabled to let the Hudson's Bay Company's officers know that she belonged to the great nation of "Men" (Tin ·ys), living far off in the west, and professing honesty and fair behavior like the English. She expressed her determination of returning to her own people and begged for assistance on the way home, promising to establish friendly relations between her countrymen and the officers of the company, who, glad of the opportunity of extending the sphere of their commercial transactions, gave her a sledge and dogs, with various presents, and a safe conduct through the land of the Killini. Attracted by these presents, the Chipewyans at once undertook the long voyage from the Peace River to the mouth of the Churchill, calling the fort "Thé-yé" (stone house), and its inhabitants "Thé-yé Ottiné" (men of the stone house), a name by which the English are still known among the Tinneys.

These relations continued to the time when Joseph Frobisher established Fort Chipewyan, on the shores of Lake Athabasca, in 1778, for the North-west Company, at which date there were as many as 1200 Redskins settled on the Lake. But the white man brought with him the horrible disease of small-pox, till then unknown to the Americans, which made great ravages among the Tinneys, and more than decimated the Crees, driven to the southern part of the lake by the warlike attitude of the Chipewyans. Influenza, an epidemic catarrhal affection, attacking the tribes at regular intervals of about seven years, completed the work of the small-pox. Reduced to a very small number, the Crees ceased all hostile action against the Chipewyans, who had become their superiors, both in number and in strength; so that the possession of the lake, and indeed of the territory of Athabasca, remained with the Tinneys, who permitted a few Crees and Savanois to remain among them.

From Athabasca the Chipewyans spread north by degrees towards the shores of the Great Slave Lake, and east and north-east towards Hudson's Bay, where, having met with vast herds of wild reindeer, they settled on the Barren Grounds, living from that time in common under the names of Yellow-knives ("T'altsan Ottiné"), and Caribou-eaters ("Ethen eldéli"). Such of these as remained attached to the Churchill traders took the name of the latter, and are still known to their western fellow-tribesmen as "Thé-yé Ottiné." Finally, many of them even ventured south to Lake La Biche, Cold Lake, Lake La Ronge, Cross Island, Heart Island, &c., where they bear the name of "Thi-lan Ottiné" (Men of the end of the head).

When leaving the fertile plain watered by the Peace River and its affluents, the Chipewyan Tinneys were hard pressed by a tribe still more warlike than themselves, namely the Sécanais or "Thé-kké Ottiné" (Men who live on the mountains) who in their turn had come from the western slope of the Rockies, where they left tribes identical with themselves as to language and customs.

As to the Beaver Tinneys, they crossed the mountains to the south and reached the plains of the Saskatchewan, where still lives a remnant of this people, the Sarcis (in Cree "Sarséwi") whose Black-foot name means bad (from "Sa-arsey," not good).

Hearne permitted the association of some Chipewyans on his expedition to the Copper-mine River, a tributary of the Arctic Ocean, with a result that is well known, as is also the massacre committed by his followers among the Eskimo.

The Hudson's Bay Company was not long in founding a trading-post on Lake Athabasca, establishing one under the name of Wedderburne on an islet near Fort Chipewyan. This remained till 1821, when the rival companies united their interests and put an end to their regrettable hostilities.

Commerce and religion have materially civilized the manners and character of the Cree, Chipewyan, and Beaver Indians inhabiting the Athabasca district. They are at present quiet, peaceable, inoffensive, and friendly to the white man, but very much diminished in numbers, the failure of animal life, and the extraordinary decrease for many years in the waters of the rivers and lakes, which has destroyed the fish to an immense extent, and driven

away wild fowl, having caused such a famine that many died of hunger and misery between 1879 and 1881. There were 900 Chipewyans and 300 Crees at Fort Chipewyan in 1862, but in 1879 I could only find 537 Chipewyans and 86 Crees, even including those living on the river Athabasca. Now there is but one single family of Crees at the lake, and the remnants of the tribe have gone away to join their fellows of the Peace River.

The same fate has befallen the Chipewyans. In their total of 500 must be reckoned those of Fort Smith, at the foot of the rapids of the Slave River, as well as those of Salt River, and many families of the Great Slave Lake and Ox River.

In short, the Athabasca district, comprising the Peace River and parts of both the Lesser and Great Slave Lakes, now contain no more than 2268 souls, including 150 half-castes and fifty-seven white men of various origin—English, Scotch, Irish, and French-Canadians.

The following are the exact statistics in 1879, for which I am indebted to Mr. R. McFarlane, the chief of the district:—

Forts.	Tinney	Crees.	Half Castes.	Whites
Chipewyan, Smith, and Small Red River together	537	86	50	28
Fond-du-Lac	318	...	15	2
Resolution (Slave Lake)	300	...	25	15
Vermillion (Peace River)	234	6	15	2
MacMurray (Clear-Water River)	31	22	10	4
Dunvegan (Peace River) and Battle, together	195	137	20	6
St. John or D'Epinette (Peace River) and Slave Lake, together	195	...	15	
	1810	251	150	57

Grand total of the Athabasca district, 2268

The following statistics of the whole Athabasca and Mackenzie Redskin population (including women and children), were collected with great care by myself in various localities in which I have visited or stayed in at different times. I have before me synoptical tables by tribes and families, including even the names of the individuals.

Great Slave Lake.

Fort Resolution, 1863—64 ...	Chippewyans	245	
	Yellow Knives	332	
			577
Fort Rae, 1864	Dog Ribs		788

Mackenzie.

Providence, 1871	Slaves, or Etcha-ottiné...		300
Black Lake River, 1878	Etcha-ottiné		115
Hay River, 1874	" "		100
Fort Simpson, 1873	" "		300
Forts Norman and Franklin (Bear Lake), 1869, together...	Slaves or Etcha-ottiné	97	
	Dog Ribs	47	
	Mountain Indians ...	43	
	Hareskins	85	
			272
Fort Good Hope, 1867	Hareskins		422
Fort Macpherson (Peel River), 1866 including La Pierre's House ...	Dindjié or Louchéaux, Quarrelers, Kutchin ...		290
	Eskimo of the Anderson	250	
	" " Mackenzie	300	
			550
Forts Liard and Nelson, Liard River	(Not collected by myself) Slaves		500
	Population of the Mackenzie		4214

Athabaska.

Forts Chipewyan and Smith, 1879	Chipewyans... ...	537	
	Crees	86	
			623
Fond-du-Lac, 1879	Caribou eaters ...	..	318
Vermillion, Peace River, 1879 ...	Beavers	234	
	Crees	6	
			240
Fort MacMurray, Athabaska River, 1879	Chipewyans ...	81	
	Crees	22	
			53
Fort Dovegan, Peace River, 1879	Beavers and Sécanais	195	
	Crees	137	
			332
Fort St. John, Peace River, 1879 Lesser Slave River	Sécanais		195
	Population of the Athabaska		1761
	Maximum total*		5975

* These figures may be compared with similar but less detailed statistics collected by Captain (now Sir Henry) Lefroy in 1844, and published in the Proceedings of the Canadian Institute. 1853. They were also based on the books of the Hudson's Bay Company's trading posts and the personal knowledge of its officers. The enumeration of the Tinney under various subdivisions comes to 1592 men, estimated to represent 7575 souls. To these were added, at Fort Chipewyan, Lesser Slave Lake, and Isle à la Cross, 209 families of the Crees, estimated at 1081 souls. The Indians have apparently, therefore, decreased in numbers since 1844.

V. Meteorological Observations for 1883.

The following is an abstract of the observations made in 1883 at the McGill College Observatory, at Montreal, situated 187 feet above sea-level: C. H. McLeod, superintendent.

Month.	Thermometer.				*Barometer.				† Mean pressure of vapor.	‡ Mean relative humidity
	Mean.	Max.	Min.	Mean daily average.	Mean.	Max.	Min.	Mean daily range.		
January	5.67	39.0	-20.4	18.52	30.1917	30.649	29.272	.3473	.0545	83.01
February	13.61	44.1	-12.1	16.78	30.1716	30.755	29 527	.3638	.0710	77.90
March	16.68	43.0	- 9.8	19.65	29.9123	30.439	29.038	.3215	.0762	72.64
April	37.22	62.8	11.1	14.82	29.9555	30 449	29.602	.1992	.1453	64.40
May	50.13	81.5	32.8	16.72	29.9277	30.301	29.494	.2008	.2428	70.85
June	65.82	84.0	46.0	16.85	29.8705	30.448	29.326	.1512	.4640	72.89
July	67.33	82 8	47.8	16.43	29.8798	30.161	29.594	.1121	.4860	72.35
August	66.37	85.8	45.5	16.68	29.9610	30.343	29.596	.1263	.4564	70.30
September	56.30	78.9	35.8	17.40	30.2977	30.461	28.971	.2186	.3448	72.70
October	43.78	68.8	24.3	13.43	30.1221	30.730	29 013	.1974	.2233	74.21
November	33.91	66.9	4.9	12.96	29.9978	30.566	29.349	.2995	.1608	75.88
December	16.61	48.1	-19.4	17 24	30.0308	30.789	29.232	.2961	.0910	83.32
Means for 1883	39.452	.....	.. ....	16.498	30.0265	.....	.....	.....	.23384	74.162
Means for nine years ending with December, 31st, 1883	42.162	.....	.....	.....	29.9757	.....	.....	.....	.25244	73.991

Month.	Wind.		Sky clouded p. ct.	Percentage of possible sunshine.	Inches of rain	Number of days on which rain fell	Inches of snow	Number of days on which snow fell	Inches of rain and snow melted	Number of days on which rain and snow fell	Number of days on which rain or snow fell
	Mean direction.	Mean velocity in miles per hour.									
January	S.W. by S.	11.63	54.7	42.5	0.34	3	20.0	16	2.31	2	17
February	W. by S.	12.61	54.4	48.0	0 51	4	17.2	16	2.80	2	18
March	W.S.W.	12.72	49.6	52.0	0.04	2	35.5	15	3.30	2	15
April	W.	11.18	60.9	60.6	0.84	10	6.7	7	1.48	2	15
May	W.N.W.	12.02	73.3	45.0	6 94	20	Inapp.	2	6.94	0	22
June	S.W. by W.	9.82	52.3	54.0	3.45	19	0.0	0	3.45	0	19
July	W.S.W.	7.91	46.9	62 2	4.72	18	0.0	0	4.72	0	18
August	S.W. by W.	9.45	44.7	61.4	1.60	13	0.0	0	1.60	0	13
September	W.S.W.	8.34	48.6		3.57	15	0.0	0	3.57	0	15
October	N.W. by N.	8.53	61.0	41.5	2.49	14	0.0	0	2.49	0	14
November	S.W. by W.	11.90	71.6	24.7	2.05	14	12.1	8	3.17	1	21
December	S.W.	12.69	68.0	27.3	1.03	6	25.5	17	3.64	3	20
Means for 1883	W.S.W.	10.733	57.17	48 31							
Totals	.....	.....	.....	.....	27.58	138	117.0	81	39.47	12	270
Means for nine years ending with Dec. 31st, 1883	W. by S.	11.01$_{00}$	60.94	....	27.10	137.1	114.1	84.8	38.59	15.6	205. 7

*Barometer readings reduced to 32° F. and to sea level. † Inches of mercury. ‡ Relative, saturation being 100. The monthly means are derived from observations taken every four hours, beginning with 3.13 a.m.

The greatest heat was 85° 8 on August 22nd; the greatest cold —20° .4 on January 6th°; the extreme range of temperature for the year was therefore 106° .2. The greatest range of the thermometer in one day was 45° on January 13th; the least range in one day was 2° .8 May 22nd. The warmest day was July 5th, the mean temperature (from max. and min.) being 70° .15; the coldest day was January 5th, the mean temperature being 15° .65 below zero. The highest barometer-reading was 30.789 on December 23rd; the lowest 28.971 on September 25th, giving a range of 1.818 inches for the year. The lowest relative humidity was 28 on May 18th and 19th. The greatest mileage of wind recorded in one hour was 45 on January 21st; its greatest velocity was at the rate of 60 miles per hour on January 18th.

The sleighing of the winter closed on April 6th. The first snow of the autumn fell on November 12th, but was inappreciable; the first noticeable snow was on November 13th. The first river-craft arrived in port on April 27th. Ferries began running on April 28th. Navigation was open on May 4th. Auroras were observed on 39 nights. Lunar coronas were observed on 3 nights; lunar halos on 14 nights; solar halos on 3 days; hoar-frost on 24 days; fogs on 10 days; thunder-storms on 16 days, and lightning without thunder on 2 days; brilliant clear red sky on 6 days.

VI. Notes on some Antiferments.*

By J. T. Donald, M.A.

The liability of many of our articles of food to change, especially in warm weather, has from very early times, incited men to seek for some substances that will prevent this change. Such substances receive the general name of antiseptics or antiferments, and many of them are well known. New compounds, or at least mixtures of well-known antiferments with new names, are at intervals presented to the public, who are assured that each new one in turn is far superior to any hitherto employed.

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* Read before the Natural History Society, Montreal, January, 1884.

During the past two years several so-called new antiseptics have been sent to me for examination. I have thought that a knowledge of their constituents, and what they really effect as antiferments, might be of interest to this Society; hence these notes.

In the autumn of 1881, I received from a gentleman interested in packing fish a sample of a substance called *Glacialine*, accompanied by a sheet describing its mode of use, and a certificate as to its value. In the words of this sheet, a pinch of glacialine will prevent a pint of milk, beer, wine or soup from turning sour, and a nine-ounce packet will enable hundreds of eggs to be kept fresh from June to Christmas; for nine ounces is sufficient to prepare a gallon of antiseptic fluid. Examination showed that the glacialine was simply boracic acid finely ground. A number of experiments made with it proved conclusively that it had antiseptic powers of a high order, yet it did not give the results that were claimed for it. Its action was not as long continued as its vendors claimed; eggs, kept in a solution of the boracic acid, however, retained their flavor, and were as good after several months as when fresh-laid; oysters remained sweet when treated with it, but the flavor was said to be impaired. At the time this substance was sent me, boracic acid was by no means a new food-preservative; it had been used for many years (as far back as 1865), both alone and mixed with alum. In London, England, it had been sold to milkmen for years under the names of *Aseptin* and *Double Aseptin*.

The next antiseptic I received, bore the name of *Ozone*, although it was a black powder. Directions for use were somewhat as follows:—"Place water in which the articles are to be preserved in a suitable vessel, put a quantity of the ozone in a dish, which is to be floated on the water; then set fire to the ozone, covering the vessel and admitting only a small quantity of air. After the ozone has ceased to burn, the liquid is to be stirred and is ready for use." An examination of this so called ozone showed it to be a mixture of sulphur and carbonaceous matter. When the mixture was ignited sulphurous anhydride was produced and, this dissolving in water, rendered it more or less antiseptic. The antiseptic properties of sulphurous anhydride (the gas obtained by burning sulphur) have been known for a very long time. The gas

acts by destroying the germs whose growth causes fermentations, disease and decay, and for this reason it is used for fumigating apartments. The curious thing about this ozone is its name, for, to the chemist, ozone is the name of an allotropic form of oxygen.

The third sample of food-preservative received bore simply the name of *Antiferment* and is intended for preserving wine, beer, and cider. It is composed chiefly of common salt and sodic carbonate, with a very small quantity of salicylic acid. The gentleman who sent the sample informed me that, so far as he had been able to test the material, it did satisfactorily what was claimed for it. Through what length of time it acts, I cannot say. Two of its ingredients, viz: salt and salicylicacid, are both well known as food-preservers, and it is quite credible that the two, acting in conjunction, may very powerfully oppose fermentation. The manufacturers of Antiferment advertise that they prepare several brands of food-preservatives, each for a specific purpose; that for the keeping of meat is called *Viandine*. *Science* for Sept. 14, 1883, contains a note on viandine, in which the composition is said to consist of sixty-seven parts of a mixture bora boracic acid, and fifteen parts of chloride of potassium and eighteen parts of water.

The same journal further states that numerous trials had been made with viandine, and that, whilst it to a certain extent prevented putrefaction, it by no means accomplished what was claimed it, and could not be recommended for preserving meat.

The last antiferment to which I have had my attention called is name *Boroglyceride*. It was first prepared, I believe, by Prof. Barff, the original inventor of the well-known Bower-Barff process for rendering iron rustless. Boroglyceride, as its name indicates, is composed of boracic acid and glycerine, and is a hard, brittle solid, somewhat resembling ice in appearance. Since boracic acid and glycerine are both well-known antiseptics, we should naturally expect that a compound of the two would be very useful for preventing fermentation. There are many who are loud in their praises of boroglyceride, and not without cause, if the substance acts as effectually as Prof. Barff, who is worthy of credence, assures us it does.

With this preparation the inventor sent cream from England to Zanzibar, passing through the hot climate of the Red Sea, and

on being eaten in Africa it had not at all deteriorated. By means of it he has kept cream perfectly sweet and good for eighteen months. Pigeons treated with boroglyceride were sent from Bermuda to England, and kept there for several months without change, while sardines, by means of the preparation, were brought from Spain without any loss of flavor. Prof. Barff claims that his antiferment is not in any way injurious to health. In proof of this claim, he states he has for a year and a half given a member of his family daily the greater part of a quart of cream treated with one ounce of the boroglyceride, and no injurious effects were noticed. During a whole summer the pupils of a college, to the number of two hundred, used milk treated with boroglyceride; its presence was not detected by any of them, nor was there the slightest sign of ill-health arising from its use. It would seem that this last mentioned antiferment is the best yet introduced, and it may be expected to prove a boon to the public.

VII. Notes on Eozoon Canadense.

By J. W. Dawson, C.M.G., F.R.S.

(Abstract of a paper read before the British Association at Southport, 1883).

The oldest known formation in Canada is the Ottawa gneiss, or fundamental gneiss, a mass of great but unknown thickness, and of vast area, consisting entirely of orthoclase gneiss, imperfectly bedded and destitute of limestones, quartzite or other rocks which might be supposed to indicate the presence of land-surfaces and ordinary aqueous deposition. It constitutes the lower part of the Lower Laurentian of Logan, and may be regarded either as a portion of the earth's original crust, or as a deposit thereon by aqueo-igneous agency and without any evidence of derivative deposits.

Succeeding this is a formation of very different character, though still included in the Lower Laurentian of Logan. It has been named the Grenville series, and includes beds of limestone, quartzite, iron ore, and graphitic and hornblendic schists, with evidence locally of [illegible]le-beds. It is in this, and especially is one of its great limeston[illegible], the Grenville limestone, that *Eozoon Canadense* occurs. It has been shown that these limestones are regu-

larly bedded and of great horizontal extent. The Grenville formation presents lithological evidences of ordinary atmospheric erosion of the older rocks, and of ordinary aqueous as well as organic deposition.

Above this is the Norian series of Hunt, or Upper Laurentian of Logan, in which lime-feldspar rocks become dominant, and show that the calcareous rocks accumulated in the preceding period were already contributing to the material of new deposits. No evidence of Eozoon has been found in this series, which is, thus far, entirely unfossiliferous. The Huronian and other series, also of Eozoic or pre-Cambrian rocks, succeed to the Norian, and in one of these, the Hastings group, belonging probably to the Taconian of Hunt, specimens of Eozoon and indications of worm-burrows and other obscure fossils have been found.

With reference to the mode of preservation of Eozoon, it was stated that in its ordinary condition, as mineralised by serpentine, it presents the simplest kind of mineralisation of a calcareous fossil; that in which the orignal calcite walls still exist, with no change except a crystallisation of the calcite, common in the fossils of newer formations, and with the cavities filled with a hydrous silicate, which was evidently in process of deposition on the sea-bottom on which Eozoon is supposed to have lived. Commencing with this fact, the author proceeded to show that the various imperfections and accidents of preservation observed in Eozoon are precisely parallel to those observed in palæozoic and mesozoic fossils.

In conclusion, it was stated that many new observations had been made by Dr. Carpenter and the author, and would appear in a memoir now in course of preparation by the former, and that the author hoped, on the occasion of the visit of the British Association to Canada next year, to exhibit to those interested in the subject the large series of specimens of Eozoon now in the museum of McGill University.

VIII. Botanical Notes.

Six-leaved Clover.—A specimen of six-leaved clover, possessing some features of interest, was found in Mount Royal Park by Miss Van Horne, on June the 6th. Upon examination, the leaflets appeared to be united to the petiole in two distinct groups of three each. The petiole was also flattened and had a width about twice that of its thickness, while a strongly defined median furrow gave unmistakable evidence that the monstrosity was developed by union of the two leaves in the bud throughout the entire length of their petioles. Furthermore, it was found that there was only one pair of stipules instead of two, or their rudiments, as might have been expected; but this pair, instead of being lateral to the base, as in a normal petiole, were median along the central furrow, or in other words, they represented the survival of the two interior stipules along the line of union, and the suppression of the external stipule in each petiole.

D. P. P.

Tension.—An interesting case of tension developed through conjunctive growth, was observed during the month of May in a large elm tree at Abbotsford, P.Q., on the land of Mr. Chas. Gibb. It appears that, originally, the tree forked a short distance above ground, and the main limbs thus formed continued to grow at a slightly diverging angle. As the two structures mutually approached through co ntinued growth in diameter, the bark of their inner faces came in contact, and caused a compression which finally arrested further increase in that direction, but forced the new growth out laterally. Thus, in time, the two trunks came to present a plano-convex section, separated at their plane surfaces by the persistent bark. Through excessive lateral growth, and the added influence of strong internal tension, the now closely approximated lateral edges of the two limbs ruptured their bark and affected a complete union, thereby enclosing the original bark of the two, in a firm and constantly thickening case of wood. The compression increased with growth, and finally brought the two layers of bark into a high state of tension, which was made quite conspicuous at the time the tree was cut. When the first section was made the compound trunk was found to be nearly square in outline, with the extreme length of the diagonals 98 c. m. and 85 c. m., while the line of internal fissure, which

coincided with the longer diagonal, was found to be 87 c. m. long and 1.9 c. m. at its greatest width. The included bark was so strongly compressed as to be very solid. With the second cut, the tension was largely released, and the crack almost immediately opened to 5.5. c. m. at its greatest width.

D. P. P.

Sisyrinchium bermudiana.—On first seeing the specimens of Sisyrinchium collected in the Bermudas by Sir J. H. Lefroy and Mr. Moseley, I suspected that they were specifically different from the plant commonly known as *Sisyrinchium bermudiana*, and after comparing them with numerous specimens of the plant so called from eastern North America, I was convinced that such was the case. Referring to the literature of the subject, I found this view supported by all the early writers who had actually seen the Bermudan plant. The history of the two species concerned is soon told. Towards the end of the seventeenth century Plukenet figured and briefly described what he termed the Bermudan and the Virginian Sisyrinchii, the types of which are still preserved in the Sloane Herbarium at the British Museum. Dillenius, who had opportunities of seeing living plants at Eltham, followed Plukenet in distinguishing these two species, and published better figures and more complete descriptions of them in the 'Hortus Elthamensis.' Linnaeus, who we assume did not see the Bermudan plant, as there is no specimen in his herbarium, united the two, as varieties of one, under the name of *S. bermudiana*. Miller, who seems to have been the most accomplished English botanist of his day, was the first to restore the two forms to specific rank. This was in 1771. In 1789 Curtis figured the true Bermudan plant, and insisted upon its specific rank, remarking that he had living plants before him of both the species figured by Dillenius. Unfortunately he gave it a new specific name, for which he afterwards expressed his regret. The first De Cand[illegible]rote the text to the excellent figure of the Bermudian plant, which was published in Redouté's Liliacées, at the beginning of the present century, and he particularly points out its distinctive characters. I have not taken the trouble to turn up every book in which the two species are likely to be mentioned, and I have not ascertained who was the first botanist to re-unite them; but the North American botanists seem to be agreed

that there is only one species of Sisyrinchium in the Eastern States, and this they designate *S. bermudiana.* The error probably arose in consequence of the Bermudian plant disappearing from European gardens, though the name was retained. *S. bermudiana* requires the shelter of a greenhouse in this country, not merely to protect it from frost, but also to enable it to attain its full development, while *S. angustifolium*, the other species, is perfectly hardy and grows like grass. Curtis, having been deceived by its behavior during a very mild winter, at first stated that the Bermudian plant was hardy, an assertion that he recalled in the letter-press accompanying the figure cited below of his S. *gramineum.*

The synonymy of the Bermudian plant follows.—

SISYRINCHIUM BERMUDIANA Linn. Sp. Pl., ed. i. p. 954 (quoad β tantum); Miller, Dict., ed. 6; Lamarck Encycl. Method. Bot. i., p. 408; Redouté Lill. t. 149. Sisyrinchium *bermudense* floribus parvis, ex cæruleo & aureo mixtis; Iris Phalangoides quorundam; Plukenet, Almagestum, p 348 et Phytogr., t. 61, fig. 2. Bermudiana Iridus folio, fibrosa radice, Tournefort Inst. Rei Herb., p. 388, t. 108; Dillenius, Hort. Elth., p. 48, t. 41, fig. 48.

Sisyrinchium iridioides, Curtis, Bot Mag., t. 94.

Sisyrinchium bermudianum, var. 1, Baker in Journ. Linn. Soc, Lond., xvi, p. 117.

Endemic in the Bermudas.

Besides the Bermudian specimens alluded to above, there are cultivated specimens at Kew from the herbarium of Bishop Goodenough, presented by the corporation of Carlisle.

Sisyrinchium bermudiana differs from *S. angustifolium* in being much larger in all its parts, and strikingly so in its broad leaves, which are equitant at the base; hence Curtis's name *iridioides.* It grows eighteen to twenty-four inches high, and is stout in proportion. The flowers are large, and the broad segments of the perianth are obovate-mucronate; but I have not been able to compare the flowers, as there are none of the Bermudian specimens in a satisfactory state. However, a comparison of the figures cited should be sufficient to convince any one of their specific diversity.

With regard to the forms of Sisyrinchium from eastern North America, if they are all to be regarded as belonging to one species, (and we have the authority of the leading botanists in the States for considering them as such,) Miller's name, being the earliest, is the one to adopt.

SISYRINCHIUM ANGUSTIFOLIUM Miller, Dict., ed. 6 (1771).
Sisyrinchium anceps Cavanilles, Dissert. vi, p. 345, t. 190, fig. 2 (1788).
Sisyrinchium gramineum Curtis, Bot. Mag., t. 464(1799).
Sisyrinchium mucronatum Michaux, Fl. Bor-Am. ii, p. 33 (1803).
Sisyrinchium bermudiana Linn., Sp. Pl., ed. i, p. 954 excl. *β. bermudense.*
Sisyrinchium bermudiana, A. Gray, Man. Bot. Northern U. S., ed. 5, p. 517; Chapman, Fl. Southern U. S., p. 474; Baker in Journ. Linn. Soc. Lond., xvi, p. 117, excel. var.1.
Sisyrinchium cæruleum parvum gladiato caule *Virginianum*: Plukenet, Almagestum, p. 348, et Phytogr., t. 61. fig. 1.
Bermudiana graminea, flore minore cæruleo: Dillenius, Hort. Elth., p. 49, t. 41, fig. 49.

Common in the Eastern States of North America from Massachusetts to Florida, and naturalized in the Mauritius, New Zealand, and Australia. It also occurs in Ireland, where it is reported to be spreading; and as it so readily colonizes, it has been considered as an introduced plant, though, on the other hand, the North American *Eriocaulon septangulare* is generally admitted to be indigenous in Ireland. Since the above has been in type, Dr. Asa Gray has directed my attention to the fact that Mr. Sereno Watson pointed out, as long ago as 1877 (Proc. Am. Acad. Sc. xii, p. 277), that the Bermudian Sisyrinchium is a distinct species; but as he neither elaborated the synonymy of the species nor explained that the Linnean *S. bermudiana* was a composite one, he has only so far anticipated me that he recognized the Bermudian plant as different from the North American.— *W. B. Hemsley*, in American Naturalist for June, 1884.

IX. PROCEEDINGS OF THE NATURAL HISTORY SOCIETY.

The first ordinary meeting of the Natural History Society of Montreal for the session 1883-84 was held on the evening of Monday, 29th October; the president, Dr. T. Sterry Hunt, in the chair. After routine business, Mr. G. L. Marler exhibited specimens of the osprey, wood-duck and blue-bird, presented to the museum by Mr. W. L. Marler, St. Johns, Que. The thanks of the society were given Mr. Marler for his donation.

Messrs. W. H. Rintoul, and W. P. J. Bond were elected ordinary members, and Messrs. J. H. R. Molson, J. O. Robert, J. Jack and Prof. D. P. Penhallow were proposed for membership.

Dr. T. Sterry Hunt then gave an account of "Igneous and Aqueous Theories in Geology," after which a general discussion on this topic followed.

The second meeting was held on Nov. 26th; the president in the chair. Four birds were presented to the museum, viz.: A velvet duck from Mr. J. L. Macdonald of St. Johns, and three specimens of the Napoleon gull by Mr. G. L. Marler,

Messrs. J. H. R. Molson, J. A. Robert, J. Jack and D. P. Penhallow were elected ordinary members of the society; and Messrs. J. H. R. Molson and J. H. Burland life-members.

Dr. Osler then made a communication on "The Brain of the Seal," illustrated by many prepared specimens of the brains of this and other animals.

The third meeting was held on January 28th. In the absence of the president, Major Latour occupied the chair. Messrs. Marler, Molson and Latour were appointed a committee to ascertain on what conditions Messrs. Dawson Bros. would permit the use of the title of "The Canadian Naturalist" for the society's journal.

Dr. Harrington presented to the library a copy of his "Life of Sir W. E. Logan," and Mr. W. L. Marler, of St. Johns, Que., presented the museum with a specimen of the saw-whet owl, for both of which gifts the thanks of the society were voted.

Dr. Harrington, Mr. Beaudry, Dr. Hingston and Mr. Marler were appointed a committee to prepare an address to the Governor-General, asking him to become the patron of the society.

Messrs. F. B. Caulfield, J. J. Robson, E. A. Robert and G. Young were proposed as ordinary members.

Mr. J. T. Donald read a paper in "Some Antiferments" which is published in this number of The Record, and also presented notes on a clay found at Côte St. Luc, and on the occurence of the mineral samarskite in the county of Berthier, Que.

(The continuation of the Proceedings will appear in the next number.)