MÉMOIRES

ET

COMPTES RENDUS

DE LA

SOCIÉTÉ ROYALE

DU

CANADA

POUR L'ANNÉE 1889.

TOME VII.

MONTRÉAL:
DAWSON FRÈRES, LIBRAIRES-ÉDITEURS.
1890.

PROCEEDINGS

AND

TRANSACTIONS

OF THE

ROYAL SOCIETY

OF

CANADA

FOR THE YEAR 1889.

VOLUME VII.

MONTREAL:
DAWSON BROTHERS, PUBLISHERS.
1890.

PRINTED BY THE GAZETTE PRINTING COMPANY, MONTREAL.

TABLE OF CONTENTS.

PROCEEDINGS.

TRANSACTIONS.

SECTION I.

SECTION II.

SECTION III.

SECTION III.—*Continued.*

SECTION IV.

LIST OF ILLUSTRATIONS.

SECTION II.

SECTION III.

SECTION IV.

ROYAL SOCIETY OF CANADA.

PROCEEDINGS FOR 1889.

EIGHTH GENERAL MEETING, MAY, 1889.

SESSION I. (*May 7th.*)

The Royal Society of Canada held its eighth general meeting in the Railway Committee Room of the House of Commons, on Tuesday, May 7th. The President, Dr. Sandford Fleming, C.M.G., took the chair at 10 o'clock a.m. and formally called the meeting to order.

The Honorary Secretary then read the following

REPORT OF COUNCIL.

The Council of the Royal Society have the honour to submit the following Report:—

We are glad to be able to state that Vol. VI, of the 'Transactions,' which comprises the proceedings and papers of the meeting in May last, is now ready for distribution. The delay in appearance, though the volume is smaller in size, is explained in the following report from the Printing Committee:—

Report of the Printing Committee.

MONTREAL, May 4th, 1889.

"The Committee beg to report that the volume of Transactions for 1888 is complete and they now present copies to the Society.

"The volume is smaller than the previous volumes, but the matter is exceptionally difficult and costly to set, and the correction of the proof has been tedious.

"Great and unusual delay occurred in sending in the MSS. The Society has made a rule that all MSS. should be sent in before August 1st, and that the Secretaries of the Sections should furnish before that date a list of all papers to be printed. In Section I, the MSS. and the list were received in July. In Section II, the list was not received until October; the MSS. were also very late, and in any event nothing could be set until the authorized list was received. In Section III, the list and

some of the MSS. were sent in June. In Section IV, the list and some of the MSS. were sent in June.

"Your Committee at its meeting on Oct. 4th found that all the MSS. for which any authority existed to print were in the printer's hands and nearly all in type. They found also that a large number of MSS., which had been reported for publication, had not been received. A circular was then sent to authors of papers directing their attention to the rule of the Society and to the necessity for immediate transmission of papers. In response to this, the missing papers began to come in—the last of them arriving on Dec. 3rd.

"It happened, however, that some of the papers which were late were very difficult to print, and that one of them had to be in the hands of the printer before beginning Section IV. Much inconvenience arose from this cause.

"The Committee trust that no similar hindrances will be placed in the way of the issue of the next volume, and that the Society will authorize its Committee to postpone all papers delayed beyond the proper time, whatever excuse may be offered.

"The accounts are submitted herewith.

"Copies of the volume have been sent to Ottawa for the use of the members of the Society.

"The Committee have to express its obligations to Mr. S. E. Dawson for his care and attention in the matter of collecting MSS. and superintending the printing, and also to Mr. Boodle for the care bestowed upon some unusually difficult papers.

"All of which is respectfully submitted.

"J. W. Dawson,
"*Acting Chairman.*"

Montreal, May 4th, 1889.

The Royal Society of Canada,

To Dawson Brothers, Dr.

For Balance from last account		$1,498 79
" Editing		336 45
" Stationery		5 50
" Postages, Proofs, etc.		9 60
" Paper		1,054 00
" Illustrations		479 50
" Composition		932 95
" Press work		156 00
" Alterations		177 25
" Insurance and storage		46 31
" Cases, packing, shipping expenses		56 81
" Foreign and domestic freight, express charges		329 72
" Binding		551 40
" " extra copies		55 50
		$5,689 78

Cr.

By Cash	$ 1,300 00	
" " Sales of volumes	22 50	
" "	1,920 00	
" "	650 00	
		3,892 50
		$ 1,797 28

Since last May the Honorary Secretary has endeavored to obtain an expression of opinion from all the members of the Society as to the most convenient time for ensuring a larger attendance at the general meeting by issuing a circular dated February 15th. It will be seen from the tabulated statement appended to the circular that there is a great variety of sentiment on this subject. The following is the circular issued :—

Circular.—The Annual General Meeting.

" Dear Sir :—Will you at your earliest convenience send me definite replies to the following queries for the information of the Council of the Royal Society :—(1) When, in your opinion, is the most convenient time for holding the Annual General Meeting of the Royal Society ? (2) What date and month will suit you best as a rule, and probably ensure your personal attendance ? (3) Are you in favour of having the General Meeting this year in Ottawa at the end of May or the beginning of June ?

" Yours, etc.,

" J. G. Bourinot, *Hon. Sec.*"

Replies to Circular tabulated.

SECTION I.	Ques. 1.	Ques. 2.	Ques. 3.	Place.
Bégin, S. G. Mgr	Spring or Autumn	Sept. 19	May (end)	
Casgrain, l'abbé H.-R				
Chauveau, P. J. O	Sept. 15	Sept. 15		
Cuoq, l'abbé	No choice		No choice	
De Cazes, Paul	June 1	June	June 1	
De Celles, A. D				
Fabre, Hector				
Faucher de Saint-Maurice, N	Autumn	Oct	May	
Fréchette, Louis	No choice	No choice	No choice	
Legendre, Napoléon	Sept	Sept	June	
LeMay, Pamphile	Autumn	Sept	June	
LeMoine, J. M	Spring	May	May	
Lusignan, A	June (end)	Any time except Sept	June (end)	
Marchand, l'hon. F.-G	Summer	June	June	
Marmette, Joseph				
Routhier, A. B		May 1-15		
Sulte, Benjamin	Autumn (late)	Oct. or Nov	June	
Tanguay, Mgr Cyprien			May or June	
Tassé, Joseph				
Verreau, l'abbé Hospice				

SECTION II.	Ques. 1.	Ques. 2.	Ques. 3.	Place.
Bucke, R. Maurice	No choice	No choice	No choice	
Dawson, Rev. Æneas Macdonell	May or June	May	May	
Denison, Lt.-Col. G. T	do.	May or June	May or June	Montreal.
Grant, Very Rev. G. M	May	May	May	
Kirby, William	Autumn	Oct	June	
Lesperance, John Talon	May	May		Montreal.
Lyall, Rev. W	August	August	No choice	
Murray, Geo				
Murray, Rev. J. Clark	May (end)	May (end)	May or June	
McColl, Evan	June	June	June	
Reade, John	June 3-24	June	June	
Smith, Goldwin				
Stewart, George, Jun	Sept	Sept. (middle)	May (end)	
Watson, J				
Wilson, Sir Daniel	May (end)	May (end)	May (end)	
Withrow, Rev. W. H	June 1	June 1	June 1	
SECTION III.				
Baillargé, C	May	May	No choice	
Bovey, H. J	do.	May (middle)	May (end)	
Carpmael, C				
Chapman, E. J		June 1-5 or Sept. 25	June (beginning)	
Cherriman, J. B				
Deville, E	No choice	No choice	May (end)	
Dupuis, N. F	June 1, Sept. 1	June 1, Sept. 1	No choice	
Fleming, Sandford	As usual	May 24	May 24	
Girdwood, G. P	May	May (end)	May (end)	
Gisborne, F. N	March or Nov	Nov. 15 to March 15	No choice	
Haanel, E	May 18-31	May 22-31	May (end)	
Hamel, Monsignor	May	No holidays, May	June 12 or 19	
Harrington, B. J	May	May or Sept	June	
Hoffmann, G. C	May (end)	Any month but Sept.	May or June	
Hunt, T. Sterry	Summer (early)	June 1-15	June 1-15	
Johnson, A	Sept. 7-15	Sept. 7-15	May (end)	
Loudon, J. T				
Macfarlane, T	As usual	May 24	May 21	Ottawa.
MacGregor, J. G		May 1-7	May (end) or June (beg.)	

SECTION IV.	QUES. 1.	QUES. 2.	QUES. 3.	PLACE.
Bailey, L. W	June 1-15	June 1-15	May.	
Bell, Dr. Robert	May.	May.	May 7.	
Burgess, T. J.	May	Spring or Summer	May or June	
Dawson, G. M		Dec. to March	May (early)	
Dawson, Sir J. W.	Sept		No choice	
Fletcher, James	May (end)	May 24	May (end)	
Gilpin, Edwin	May or June		As usual	
Grant, Sir James	Session of Parliam'nt	April or May	May (beginning)	
Honeyman, Rev. D				
Laflamme, Abbé J. C. K	May (end)	May (end)	May 24	
Lawson, G	May 15-31	May 20	May (end)	
Macoun, J	Oct. to April	Dec. or Jan		
MacKay, A. H	July or Sept	July or August	June	
Matthew, G. F	Sept.	Sept.	May or June	
Penhallow, D. P.	Sept.	Sept.	No choice	
Provancher, Abbé	Midsummer	July 1-15	June 1	
Saunders, W	May (end)	May (end)	May (end)	
Selwyn, A. R. C.	As usual	As usual.	As usual	
Whiteaves, J. F.		Any time but July or August	May (end)	
Wright, R. Ramsay				

This spring, however, it was decided after consultation between the Secretary, the President and a number of prominent members within easy reach, to hold the general meeting a fortnight earlier, with the view of having the advantage of the presence of His Excellency the Governor-General, who has taken every opportunity, when he has met our members, to express his earnest desire to do all in his power to promote the objects of the Society. One of the first things that the Society will be called upon to do to-morrow will be the presentation of the following address, asking His Excellency to become our Honorary President in succession to his predecessors, the Marquis of Lorne and the Marquis of Lansdowne.

Address to the Governor-General.

"To His Excellency the Right Honourable Sir Frederick Arthur Stanley, Baron Stanley of Preston, in the County of Lancaster, in the Peerage of Great Britain; Knight Grand Cross of the Most Honourable Order of the Bath, Governor-General of Canada and Vice-Admiral of the same.

"May it please Your Excellency:—

"We, the Fellows of the Royal Society of Canada, take this opportunity, the first we have had since Your Excellency became the Governor-General of this portion of the Empire, to express the hope that you will be pleased to accept the position which your predecessors have heretofore filled, and to become our Honorary President.

"As Your Excellency is aware, the Royal Society was founded by the Marquis of Lorne during his administration in Canada, with the object of encouraging Science and Literature, and of assisting in the intellectual development of this country.

"Although the membership of the Royal Society is limited, yet it rests on no narrow basis, and its Transactions are open to the literary efforts of every person who has good work to offer. It is affiliated at the same time with all the leading Scientific and Literary associations of the Dominion, who send delegates to its annual meetings, and otherwise assist in the promotion of the work for which it has been established.

"Its membership recognizes no distinctions of race or creed, but is based on the same principles of liberality and unity on which the Confederation is founded. As the French Canadian has combined with the English Canadian to build up a great Dominion, studded with provinces from the Atlantic to the Pacific, the representatives of the two nationalities have united in this Society to prove to the world that in the walks of Letters and Science, as in the sphere of Politics, there are many opportunities for emulation and usefulness.

"We are confident that Your Excellency, like the two distinguished noblemen who immediately preceded you in the elevated position you now occupy, will extend to the Society that cordial sympathy which is essential to its success, and which will be not the least gratifying evidence that its members can receive of the value of the objects which they have at heart. In a country like this, where there is so much to do in the way of material development, Literature and Science must necessarily engross the time and ability of a relatively limited number of persons. This Society, however, has every reason to be gratified with the encouragement which its labours have received in every country where its Transactions are circulated; but no one fact is more satisfactory, or better calculated to stimulate exertion, than the readiness with which the Government and Parliament of Canada have come to its assistance since its foundation, and enabled it to give its Proceedings to the world in a form in every way worthy of the country.

"We feel that a Society which has the cultivation of Literature as one of its principal objects, has a special claim on Your Excellency's attention. All of us remember with the deepest interest that your illustrious father in his youth won many academic honours in the study of the great poets of ancient days. In the noted oratorical efforts of his brilliant career he displayed that fire and energy which were characteristic of the heroes of the immortal epic he had mastered so well. While the historian of politics will record his triumphs as the 'Rupert of Debate,' men of letters will like best to linger on his success in rendering the 'Iliad' into matchless English verse.

"In conclusion we can only repeat the numerous expressions of kindly wishes which Your Excellency has already received since your assumption of office. We are quite sure that both Your Excellency and Lady Stanley of Preston already know full well, how much respect the people of Canada entertain for the representative of the Sovereign they revere, and how deeply they are animated by the desire that your residence in this loyal dependency of the Crown will be made enjoyable in every sense, and that when you are called upon to retire from your high position in this country you will feel that you have left another England behind."

It is proposed that this address shall be signed by all the members in attendance and presented at Government House at 1.30 o'clock to-morrow. We may add that it has been engrossed and artistically executed under the direction of the Honorary Secretary, so that His Excellency may have always in a permanent form this expression of the kindly wishes of the members of the Royal Society.

Accommodation for the Society.

The Council do not think it necessary to call attention at any length on the present occasion to the necessity of having sooner or later more permanent accommodation for the work of the Society; but they content themselves with directing your notice to their previous reports, where the whole subject has been sufficiently emphasized. They may add that the books and pamphlets received from other institutions continue to accumulate, and are now stored away in the vaults of the Parliament Building, where they are necessarily inaccessible to those persons who might wish to see and consult them. Their value as works of reference, however, is greatly impaired by the fact that the greater part of them are still unbound.

Affiliated Societies.

The Council have much pleasure in extending a cordial welcome once more to a number of delegates from the leading scientific and literary societies throughout Canada, who will be able to present a summary of the important work that they have been performing in their respective spheres of labour during the past twelve months. No part of the Transactions is of greater utility than this evidence of the literary and scientific progress of Canada. It will be of much value to the future historian of this country. The following is a list of the delegates whose names have been so far received by the Honorary Secretary :—

Society.	Place.	Delegate.
Society of Canadian Literature	Montreal	W. D. Lighthall.
Natural History Society	do.	Rev. R. Campbell.
Société Historique	do.	
Numismatic and Antiquarian Society	do.	R. W. McLachlan.
Society of Historical Studies	do.	J. P. Edwards.
Cercle Littéraire Français	do.	Rev. A. B. Cruchet.
Canadian Society of Civil Engineers	do.	Col. Gzowski.
Literary and Historical Society	Quebec	W. C. H. Wood.
Geographical Society	do.	W. LeVasseur.
Institut Canadien	do.	J. J. Fremont.
Literary and Scientific Society	Ottawa	H. B. Small.
Field-Naturalists' Club	do.	Dr. R. W. Ells.
Institut Canadien-français	do.	Stanislas Drapeau.
Hamilton Association	Hamilton	James Fletcher.
Wentworth Historical Society	do.	
Murchison Scientific Society	Belleville.	
Entomological Society of Ontario	.....	H. H. Lyman.
Canadian Institute	Toronto	Sir Daniel Wilson.
Natural History Society of N.B.	St. John	Prof. Bailey.
N. S. Institute of Natural Science	Halifax, N.S.	
N. S. Historical Society	do.	J. M. Oxley.

Election to Vacancies.

During the past year it became necessary, in accordance with the Rules of the Society, to take steps to fill up three vacancies in Section II devoted to English Literature, and one vacancy in Section III devoted to the Mathematical and Physical Sciences. Accordingly, the Honorary Secretary, in the first place, transmitted to the members of these Sections circulars notifying them of the vacancies, and then having duly received the nomination papers hereto appended, he mailed the names of the candidates with voting papers to each member of the Sections in question in compliance with the Rules:—

Copies of Nomination Papers.

SECTION II.

(1.)

"Nominations to fill vacancies in Section II.

"The undersigned members of Section II of the Royal Society of Canada beg leave to nominate Mr. Horatio Hale as a gentleman eminently fitted to fill the vacancy in that Section. Mr. Hale occupies a high rank among the philologists of this continent; has given special attention to the native languages of Canada; is the author of numerous valuable papers on that subject, as well as on the languages of Polynesia; and on important departments of the Science of Language. He is one of three members of the British Association specially nominated to report on the physical characters, language, and social condition of the Northwestern tribes of Canada.

Jan., 1889.

DANIEL WILSON.
J. G. BOURINOT.
W. H. WITHROW.
GEORGE T. DENISON.
GEORGE STEWART, Jun."

(2.)

"Mr. George Patterson, of New Glasgow, Nova Scotia, has devoted much attention to the History and Archæology of that Province; and to its native Indian tribes. We believe he would be a useful member of the Section of English Literature, History and Archæology, and devote himself to the elucidation of the ethnology and archæology of the Maritime Provinces. We beg leave to recommend him as a member of Section II.

DANIEL WILSON,
GEORGE STEWART, Jun.,
J. G. BOURINOT."

(3.)

"We, the undersigned members of the English Literature Section of the Royal Society of Canada, hereby nominate as a member to fill the present vacancy in the Section caused by the retirement of Charles Lindsey, Esq., Mr. Charles Mair, of Prince Albert, in the Northwest Territories, on account of his high literary ability and his having published two complete books, viz.—

"1. 'Dreamland, and other Poems,' 1868.
"2. 'Tecumseh, a Drama,' 1886.

W. KIRBY,
J. T. LESPERANCE,
J. G. BOURINOT,
GEORGE STEWART, Jun.,
GEORGE T. DENISON,
ÆN. McD. DAWSON,
GEORGE MURRAY,
JOHN WATSON."

SECTION III.

(1.)

"The undersigned members of Section III of the Royal Society of Canada recommend W. H. Ellis, M.D., as a fit and proper person to fill the vacancy in this Section.

"Dr. Ellis was Professor of Chemistry in the Toronto Medical School from 1871 to 1879. He acted as Assistant Professor in the School of Practical Science, Toronto, from 1879 to 1882; and he has been Professor of Applied Chemistry in that institution from 1882 to the present time. He has also been the Public Analyst for Toronto since 1878.

"Dr. Ellis is well known throughout the Dominion as an eminent toxicological chemist. He has published in the 'Canadian Journal,' the 'Analyist,' and other sources, valuable papers on Canadian waters, on the Occurrence of Tellurium in Canada, Determination of Tannin in Spices, Tea Analysis etc., etc.; and he has lately issued an elaborate report on the water supply of Toronto. A communication on Milk Analysis was also read by him at the recent meeting of the Royal Society of Canada (May, 1887).

EDWD. J. CHAPMAN.
THOMAS MACFARLANE.
E. DEVILLE."

JULY 27th, 1887.

(2.)

OTTAWA, January 25th, 1889.

J. G. BOURINOT, ESQ., LL.D., Secretary of the Royal Society of Canada.

"DEAR SIR,—There being a vacancy in the membership of Section III of the Royal Society of Canada, in consequence of the death of the Hon. Dr. Fortin, of Montreal, we, the undersigned members of said Section, do hereby recommend for nomination as a candidate for membership Mr. Thomas C. Keefer, C.M.G., an eminent Engineer and Essayist, whose life is closely interwoven with the internal history of Canada, as will be recognized in the accompanying record.

F. N. GISBORNE, F.R.S.C.
HENRY T. BOVEY F.R.S.C.
B. J. HARRINGTON, F.R.S.C."

[T. C. KEEFER, ESQ., C.M.G.]

1838-45—Employed on the Erie and Welland Canals.

1885-88—Chief Engineer Ottawa River works.

1849—Gained Lord Elgin's prize for best essay on "The Influence of Canals of Canada on her Agriculture." Published "Philosophy of Railways."

1850—Employed upon surveys for the navigation of the rapids of the St. Lawrence, etc., and was sent by the Canadian Government to assist the U.S. Consul to report upon Canadian trade with the United States; and in the year 1852 went to New York at request of same Consul to assist in a second report on same subject. These two reports led to the Reciprocity Treaty of 1854.

1851—Made preliminary surveys for the Grand Trunk Railway and for the railway bridge over the St. Lawrence at Montreal. In same year was appointed one of the Canadian Commissioners for the International Exhibition at London.

1853—Engineer to Montreal Harbour Commissioners.

1862—Commissioner to International Exhibition at London.

1869-70—Published a series of letters advocating the Canadian Pacific Railway, which was commenced in 1871.

1878—Executive Commissioner for Paris Exhibition and member of International Jury for Architecture. Created C.M.G. and appointed Officer of Legion of Honor.

1887—President of Canadian Society of Civil Engineers.

1888—President of American Institute of Civil Engineers.

Is also a member of the Institute of Civil Engineers, London. Has constructed waterworks for the Cities of Montreal, Hamilton and Ottawa, and been largely engaged in harbour and bridge engineering, and was sometime Chief Engineer of Railways in Upper and Lower Canada.

Results of the Voting.

Subsequently a meeting of the Council was duly held, and the votes counted, with the following result, as set forth in the second circular mailed to the members of the Society at large:—

"SIR,—I have the honour to inform you that the three following gentlemen have received the two-thirds vote necessary to elect them to fill the three vacancies in Section II:—

MR. CHARLES MAIR	15 votes.
MR. HORATIO HALE	14 "
MR. GEORGE PATTERSON	12 "

"The Council therefore recommend that these three gentlemen be elected to fill the vacancies in question.

"No election has been made to Section III under the Rule."

It is now the duty of the Council simply to report to the Society at large the action they have taken in compliance with the Rules.

Imperial Scientific Affiliation.

The Council deem it advisable to direct your attention to a subject of considerable importance, respecting which the Honorary Secretary has received communications from Mr. Macfarlane and other members. It will be remembered that a Committee was appointed in 1887 to consider proposals for an Imperial Union of Geological Surveys and Societies. The Council would now call upon the Society to consider the report which the Committee made on the subject, and the circumstances which seem to be favorable to a certain course of action by the Royal Society of Canada in the immediate future as regards this matter. Several members of the Society objected to the recommendation of the Committee, at the time it was made, for the reason that it threatened to interfere somewhat with the meeting of the International Geological Congress, and because it was inconsistent with the idea of scientific federation to limit its scope to Geology. The circumstances are now changed. The Geological Congress met last year in London, and does not come together again until 1891, in Philadelphia, and, further, one of the results of the celebration of Her Majesty's Jubilee has been the establishment of the Imperial Institute, the object of which is "to illustrate the resources and capabilities of every section of Her Majesty's Dominions," and to "supply a foundation for that "scientific organization of our industries which the changed conditions of the times render indispensable to their prosperity." A building for the Institute is now in course of erection in London which will, no doubt, be well utilized for its purposes.

Mr. Macfarlane represents to the Council that, under these circumstances, it would seem well for the Royal Society of Canada to suggest to the managers of the Imperial Institute that the following would be advantageous methods of promoting its objects;—

I. To invite affiliation with the Institute of the Geological Surveys in the various divisions of the Empire, so that they might aid in illustrating its mineral resources. This would probably be the best way of carrying out Sir William Dawson's original plan of an Imperial Geological Union.

II. To invite the various Royal and other learned societies to become affiliated with the Institute, in some manner to be afterwards mutually agreed upon.

III. Inviting all those who are concerned in the advancement of industry throughout the Empire to become members or fellows of the Institute, and providing for qualification on a very broad basis. The following persons might be mentioned as probably eligible: Members of the learned societies above mentioned, officials serving any of the governments in the Empire in scientific capacities, members of the learned professions, professors and teachers in colleges and high schools, manufacturers, merchants, agriculturists, geologists, civil, mechanical and mining engineers, chemists, technologists, public analyists, etc. The entrance or annual fee for members not to exceed £1 sterling.

IV. Classifying the members according to their pursuits or studies, and supplying them with such publications of the Institute as might be of greatest interest to each. Lists of affiliated societies might be prepared, and a system of exchange and distribution of reports, blue books, etc., resembling the Smithsonian exchanges, established. Special exhibits relating to certain industries or subjects might be prepared from time to time by affiliated societies and placed on exhibition in London. An intelligence department might also be established there from which the latest facts or work done in particular lines might be ascertained, and the various workers placed in communication with each other.

V. Arranging for conferences of the affiliated societies, also for meetings of the various classes of the members, at which papers concerning one particular industry might be read, or subjects proposed by the council of the Institute discussed. A great advantage of these meetings would be the personal intercourse of the members, the interchange of experiences, and many might obtain information on special subjects at such conferences which might be supplemented by correspondence from headquarters, and by special reports printed and distributed. The subjects of geological, mineralogical or metallurgical nomenclature, gold and silver monetary standards, an imperial system of coinage, weights and measures, etc., might with advantage be discussed in this way. These meetings would of course chiefly be held in London at the rooms of the Institute, but there is no reason why they might not also occasionally take place in various cities of the colonies or the Indies.

No doubt many other ways in which the Imperial Institute might be made useful for the industrial advancement of Canada will occur to the members of the Royal Society. Perhaps the best action it could take would be to recommend the appointment of a Committee, having the wide basis above suggested, to make all necessary inquiries, to place itself in communication with the "authori-"ties of the Imperial Institute in order to ascertain the best means of promoting its objects in Canada, "and to report to the Royal Society at its next annual meeting."

The Council recommend to the favorable consideration of the Society the appointment of the Committee suggested in the communication just mentioned.

List of Members Present.

The Honorary Secretary then called over the roll of members, and the following gentlemen responded to their names:—

S. G. Mgr. Begin, Abbé Casgrain, A. A. De Celles, Faucher de Saint-Maurice, Hon. F. G. Marchand, L. H. Fréchette, Pamphile LeMay, A. Lusignan, Joseph Marmette, Judge Routhier, Benjamin Sulte, Mgr. Tanguay, John George Bourinot, Rev. Æneas Dawson, Col. George T. Denison, Evan McColl, Principal G. M. Grant, Sir Daniel Wilson, George Stewart, jun., Prof. Bovey, C. Carpmael, E. Deville,

Prof. Dupuis, Sandford Fleming, Dr. Girdwood, Monsignor Hamel, F. N. Gisborne, Prof. Harrington, G. C. Hoffmann, Profs. Johnson and Loudon, T. Macfarlane, Prof. Bailey, Dr. Robert Bell, Prof. Chapman, G. M. Dawson, Sir W. Dawson, James Fletcher, Sir James Grant, Prof. Penhallow, Abbé Provancher, W. Saunders, A. R. C. Selwyn, J. F. Whiteaves.

The minutes of the seventh general Meeting, May 1888, as printed in Vol. VI of the Transactions, were considered as read and approved.

The Report of Council and the recommendations contained therein were then taken into consideration.

Address to His Excellency the Governor-General.

The draft of the address to His Excellency Lord Stanley of Preston was formally adopted, and ordered to be presented at Government House at 1.30 p.m. this day by the President in company with all the members of the Society present, in accordance with the wishes of the Governor-General.

Miscellaneous Business.

The following resolutions were adopted:—

(1.) "*Resolved*, That Messrs. Charles Mair, Horatio Hale and George Patterson be duly elected Fellows of the Society." (On motion of Dr. G. A. Grant, seconded by Mr. G. T. Denison.)

(2.) "*Resolved*, That the matter of electing a fellow to fill the vacancy in Section III, be referred back to that Section for further consideration." (On motion of Mr. Carpmael, seconded by Mr. Gisborne.)

(3.) "*Resolved*, That the Committee appointed to consider the question of a Geological Union be discharged." (On motion of Sir W. Dawson, seconded by Dr. Selwyn.)

(4.) "*Resolved*, That the recommendation of the Council with respect to the Imperial Institute be adopted, and a Committee be appointed, to be nominated by the President, to communicate with the authorities of the Institute as soon as possible, assist in promoting its objects in Canada, and report at the next meeting of the Society." (On motion of Mr. Macfarlane, seconded by Mr. G. Stewart, jun.)

(5.) "*Resolved*, That it is desirable that a Conversazione be held on the first evening of each Annual Meeting, at which there may be an exhibition of scientific apparatus and objects of interest in connection with the work of the Society." (On motion of Prof Johnson, seconded by Dr. Girdwood.)

Reports from Affiliated Societies.

The Honorary Secretary then again read the list of Affiliated Societies, and the following Reports were submitted by their respective delegates:—

I.—From *The Ottawa Literary and Scientific Society*, through Mr. H. B. Small.

The President and Council of the Ottawa Literary and Scientific Society have to report, that during the past year this institution has maintained its reputation for usefulness, both as regards its reading room, which is well stocked with newspapers and periodicals, and in respect to its library, which now contains 2,666 volumes. The reading room is always well filled from early morning till late at night, an evidence of the good service rendered to its frequenters.

The citizens of the Capital are beginning to appreciate more largely, and to make a greater use of

this library than formerly, a fact probably due to the restrictions now in force in the Parliamentary Library, from which books are not as easily taken out by the public, as in former years. Considerable additions were made by the Society to the works on its shelves during 1888, and it is hoped further additions will be made this year.

An address of welcome to Lord Stanley of Preston was presented to him by the Council soon after his arrival here as Governor-General, and His Excellency was graciously pleased to become Patron of the Society.

A most successful course of lectures was delivered last winter, some of which were illustrated with lime-light views, or with experiments, as the occasion required.

The subjects of these lectures, and the lecturers, were as follows:—

1888. Nov. 8. Inaugural Address: Notes by the Wayside of Life, by Mr. H. B. Small, President.
" 22. The Worlds Around us: illustrated with Lantern and Slides, by Mr. W. H. Smith.
Dec. 6. Lessing's "Nathan the Wise," by Mr. Thos. Cross.
" 20. The Water Supply of Ottawa City, illustrated with Experiments, by Mr. F. T. Shultz, M.A.F.C.S.
1889. Jan. 10. Conversazione.
" 24. A Yorkshire Heroine, by Mr. J. T. Waters, M.A.
Feb. 8. Weather Prediction, by Mr. C. Carpmael, F.R.S.C.
" 22. Climatology, by Lieut. Gordon, R.N.
Mar. 28. The Moon, by Mr. H. B. Witton.

The two astronomical lectures, "The Worlds Around Us," and "The Moon," were especially instructive, and as a result of the influence exerted by them, steps are being taken for the formation of an Astronomical Society here. It is proposed to make the lectures next winter still more attractive, and, if practicable, to constitute a consecutive course.

It is a matter of regret that the audiences were not as large as the subjects might have been expected to draw together. This may be attributed, not to a want of interest on the part of the public, but to the various attractions of a similar nature which almost every public institution or society now afford, and to the entertainment courses provided, in many cases weekly, by almost every church congregation, for its members.

Afternoon lectures, or classes of instruction on Natural History and Science, were held in the Society's rooms during the winter by the Ottawa Field-Naturalists' Club, an organization affiliated with the Literary and Scientific Society, to which its members were admitted, and these classes were well attended.

And here, whilst speaking of lectures, the President of the Ottawa Literary and Scientific Society strongly urges upon all societies of a similar local character, the desirability of gathering together, and making public, in lecture form or otherwise, any incident bearing on the early history of their locality, and events in any way influencing its career. There are matters forgotten for want of record at the time, or which might have been gathered from older residents who have since passed away, that might form important links in history, a want already well known as regards our aboriginal races. The events of to day become the history of the future, and local history is generally the most imperfect of all. With one lecture in each course devoted to some particular branch of the surroundings of a place, its early history, its fauna, its flora, its geology, its trade, and so forth, there would be a record for reference.

At the Annual Meeting of the Society, held on April 26th, 1889, Mr. H. B. Small was reëlected President for the year 1889, and it is hoped that the operations of the Ottawa Literary and Scientific Society will continue to foster the object for which that Society was formed, intellectual progress.

II.—From *L'Institut Canadien de Québec*, through Mr. J. J. T. Fremont.

La position de l'Institut au point de vue littéraire et au point de vue financier est aussi bonne que par le passé.

Nos salles de lecture sont fréquentées.

Notre bibliothèque n'a pas perdu de sa popularité. Elle s'est augmentée dans le cours de l'année qui vient de s'écouler de plus de 300 volumes.

Les conférences de l'Institut ont attiré de brillants auditoires dans nos salles. Parmi les conférenciers, il me sera permis de citer les noms de Mgr Bégin, depuis évêque de Chicoutimi, de MM. Faucher de Saint-Maurice, Joseph Turcotte, Edouard Taschereau, Ludovic Brunet et B. Lippens.

Enfin, le 15 octobre dernier, dans une séance des plus solennelles, au milieu d'un auditoire très nombreux, l'auteur, si populaire parmi nous, de *La France aux Colonies* nous donnait une conférence sur la colonisation du Nord.

Le même soir, M. Adolphe Poisson nous faisait goûter les primeurs d'une poésie inédite, *Le Navire allemand*, accompagnée d'un charmant *envoi* à M. Rameau.

M. Léon Dessane et le sextuor vocal de Québec s'étaient chargés de la partie musicale du programme.

Cette soirée a été la dernière de l'année. L'incendie qui est venu dévaster notre édifice, le 7 janvier, nous a fait interrompre nos conférences de l'hiver, qui ne pourront être reprises que l'automne prochain.

Trois nouveaux membres honoraires ont été admis. Ce sont :

1° M. Léon Lallemand, de Paris, un écrivain distingué qui fera honneur à notre institution, l'auteur du livre *Les enfants pauvres et délaissés*, et d'autres ouvrages philanthropiques.

2° L'honorable C.-A.-E. Gagnon, qui a fait beaucoup pour classifier et réunir nos archives provinciales.

3° Enfin l'honorable M. A. Turcotte, qui a rendu de nombreux services à notre société.

Nous avons publié dans le cours de l'année l'Annuaire No 12, qui est, nous l'espérons, aussi intéressant que les publications analogues qui l'ont précédé, — et nous avons décidé de continuer cette publication dans le cours de l'été qui commence.

III.—From *The Society of Canadian Literature*, through Mr. W. D. Lighthall.

The Society of Canadian Literature, though a new organization, has been found to fill a want, and already exhibits the vigour of an institution which, to all appearance, has taken root. The almost complete ignorance by our people of the literature produced among them was the cause which led to its formation—the aim being mutual instruction. On January 17th, 1889, a circular was drawn up by several of those interested, announcing a first meeting to be held in the Fraser Institute, on the 23rd, and giving the names of a provisional President, John Reade, F.R.S.C.; Vice-President, John Talon-Lesperance, F.R.S.C.; and Secretary, Arthur Weir. The objects of the Society were to be "an examination of our national literature, English and French; the acquirement and diffusion of a knowledge of our best poetry, romance, historic works, and other writing; the provision of a centre for local literary life and for the introduction of visiting *littérateurs;* and the encouragement of all proper literary works and movements throughout the country."

The circular went on to say:—

"It is not as generally known as it should be, that a considerable quantity of beautiful and interesting writing has been produced in Canada, an acquaintance with which would add to our interest, pride and hope in our country. By this Society it is hoped to afford an opportunity of discussing and learning something about such writing and the authors concerned.

"The method proposed at present is that of having a leader for the evening, who shall give an account, with copious extracts, of whatever is then to be examined, the meeting afterwards to be open for remarks by others, who will be also expected to illustrate by extracts. The chief *littérateurs* of the country will be named honorary members from time to time."

Ladies and Gentlemen were invited to send in their names for membership, the affording of an opportunity for improvement to ladies being considered specially desirable.

This programme was carried out with success far beyond the anticipations of the projectors. From thirty to sixty members attended the meetings, which grew in interest and patronage; local attention to native authors was reported from a number of outside sources as greatly increased; and several side movements have either arisen from, or exhibited the impulse of, the Society. The course of evenings opened with the President's address on "The Development of Canadian Literature." A fortnight later, followed "Mrs. Moodie (Susanna Strickland)," by Mr. Harry Bragg; then came "Haliburton," by Mr. J. Fraser Torrance; "Fréchette," by Mr. Leigh R. Gregor; "Heavysege," by Mr. George H. Flint; "Crémazie," by Mr. Wm. McLennan; and "William Kirby," by the undersigned.

The lectures were in nearly all cases illustrated amply, sometimes profusely, and called forth much rare information from those in attendance.

A number of names of men known in our literature was placed on a roll of honorary members, but as the roll is not yet in complete shape I forbear to mention them.

It is trusted that other centres besides Montreal will follow the example, and that a union of such societies may be an influence in matters affecting Canadian mental improvement, together with whatever else depends thereon.

IV.—From *The Geographical Society of Quebec*, through Mr. N. LeVasseur.

La Société de Géographie de Québec, estimant bien haut l'honneur d'être associée aux travaux annuels de la Société Royale du Canada, s'est empressée d'accepter la gracieuse invitation de cette société, en me priant de vouloir bien la représenter dans cet important congrès littéraire et scientifique.

Notre société de Géographie a dû, depuis trois ou quatre ans, se tenir un peu à l'écart du mouvement des sciences et des lettres au pays, l'agent galvanisateur ordinaire de toute entreprise humaine lui faisant défaut.

Le fait est d'autant plus regrettable que la Société venait elle-même de provoquer des explorations dans un pays bien vaste, mais à peu près inconnu; explorations qu'elle aurait pu faire continuer et voir couronnées de résultats plus satisfaisants qu'ils ne l'ont été.

Dans un pays aussi jeune et aussi étendu que celui-ci, et dont l'organisation politique définitive n'a aujourd'hui que quatre lustres, il a fallu d'abord se préoccuper de l'outillage indispensable à son progrès matériel, et, certes, il faut le reconnaître, le Canada, en vingt ans, a merveilleusement changé de physionomie; mais son armature du côté des sciences abstraites et physiques, du côté des arts et de la littérature, a dû être considérablement négligée. Une société de Géographie devait donc et doit s'attendre à subir la fortune commune, à quelques exceptions près, aux autres associations scientifiques et littéraires.

Cependant, malgré tout, nous devons constater que le Canada est né viable au monde littéraire et scientifique. Nous cueillons çà et là, de temps à autres, des lauriers à l'étranger; la science de quelques-uns des nôtres fait autorité; nos poètes remportent des couronnes; nos artistes se font applaudir sur les premiers théâtres du monde.

Nous sommes toutefois bien éloignés d'avoir donné toute notre mesure, et la géographie au Canada n'a pas encore d'illustrations. Le champ d'études ne lui manque certainement pas; elle en a un à proximité, le grand pays qui s'étend au nord et à l'est de Québec, depuis la baie d'Hudson d'un côté, jusqu'à l'Atlantique, de l'autre. Les cartes qui donnent la configuration de ce territoire ne nous apprennent que fort peu de choses sur ses principaux traits géographiques, sa composition géologique

et ses ressources exploitables ; elles ne seraient même pas plus exactes qu'elles ne sont éloquentes. On ne connaîtra vraiment les particularités de ce pays, que lorsque ses divisions politiques et administratives seront définies, réglées et acceptées.

Ici se présente naturellement la question des frontières entre Ontario et Québec, et au nord de ces deux provinces respectivement, et cette question tombe d'elle-même dans le cadre des études, dans le champ d'opérations d'une société de géographie. Il y a dix ans, la société de Géographie de Québec attirait l'attention de nos gouvernants sur les frontières des deux provinces ; aujourd'hui encore elle s'occupe d'amener la solution prompte et définitive de cette grave question. Le point en litige est le choix d'une frontière tracée scientifiquement, ou d'une frontière dessinée par la ligne des cours d'eau qui partagent le territoire de l'ouest à l'est.

En 1886, une commission spéciale de la législature de Québec fut chargée d'étudier la question et de faire ès-matière un rapport à la Législature. La commission en arriva aux conclusions suivantes :

"Votre comité est d'opinion que les limites ouest, nord et est de la province sont et doivent être reconnues, fixées et déterminées comme suit : Tout le pays compris, vers l'ouest, par la prolongation de la ligne frontière actuelle entre Ontario et Québec, jusqu'à la rencontre de la rive sud de la baie James, par le littoral de cette même baie jusqu'à l'embouchure de la rivière East-Main ; vers le nord, par la rive droite de cette même rivière, de son embouchure jusqu'à sa source ; de ce point, encore vers le nord, par une ligne allant frapper les eaux les plus septentrionales du grand fleuve des Esquimaux, Ashuanipi ou Hamilton, et par la rive gauche du même fleuve jusqu'à son entrée dans la baie du Rigolet (Hamilton Inlet) ; vers l'est et le nord-est, par le méridien du point le plus oriental des sources de la rivière Saint-Paul ou petite Esquimaux, et, par cette même rivière, vers l'est, jusqu'au 52e degré de latitude nord, et suivant ce parallèle, jusqu'à la rencontre du méridien de l'anse au Blanc-Sablon, frontière actuellement reconnue de la province de Québec."

Il n'entre pas dans le rôle qui m'est assigné de discuter ici l'argumentation *pro et contra* la ligne scientifique ou la frontière naturelle. Qu'il me suffise de mentionner ces points-là pour démontrer à cette réunion distinguée que la Société de Géographie de Québec a là, entre autres, un intéressant sujet d'études, et qu'elle peut intervenir d'une manière très utile dans le débat.

C'est avec ces quelques remarques que je crois devoir présenter le rapport des travaux de la Société de Géographie de Québec depuis quatre ans ; ce rapport, un peu plus volumineux que ses prédécesseurs, est le cinquième et dernier fascicule du 1er volume des travaux de la Société. Il contient en grande partie ce qui a été publié jusqu'à ce jour sur le lac Mistassini et le pays environnant ; une lettre sur la première terre aperçue par Sébastien Cabot en Amérique ; un article sur les sauvages de la rivière de Cuivre, par le lieutenant Henry T. Allen, de l'armée américaine ; des notes sur le Labrador canadien, par le comte Henri de Puyjalon ; des notes pour servir au développement de la colonisation et du commerce, des rives du Saint-Laurent à la frontière du Maine, par M. Faucher de Saint-Maurice ; une étude sur les races primitives de l'Amérique du Nord, par M. Alphonse Gagnon ; une compilation de tous les témoignages qui ont été donnés devant des commissions parlementaires, des lettres publiées dans des journaux et des brochures sur la navigation du Saint-Laurent en hiver par N. LeVasseur ; un écrit sur Belle-Isle, par M. Chs H. Farnham.

Le tout humblement soumis au nom de la Société de Géographie de Québec.

V. — From *The Numismatic and Antiquarian Society of Montreal*, through Mr. R. W. McLachlan.

During the past year ten meetings were held, at which questions bearing on the Antiquarian side of Canadian History were discussed. Considerable progress has been made in the study of Canadian Numismatics and the early institutions of the country.

At a Historical Exhibition, held at Deerfield, Mass., our Society was represented by a delegate who was able to communicate some interesting facts bearing on the history of that town, which facts were recorded in ancient Canadian documents.

A series of original engravings of great value, illustrative of early Canadian History, has been added to the Society's collection through the kindness of Mr. R. B. Angus.

The following papers were read :—

1. The Hudson's Bay Company Beaver-Tokens, by R. W. McLachlan.
2. Fort Callières, Montreal, by A. C. DeLery Macdonald.
3. The Genealogy of some New England Captives in Canada, by H. J. Kavanagh.

The first number of a new series of 'The Canadian Antiquarian,' the resumption of the publication of which has been arranged for, is expected to be ready about July 1st next.

VI. — From *The Ottawa Field-Naturalists' Club*, through Dr. R. W. Ells.

I have the honor to submit the following report of the transactions of the Ottawa Field-Naturalists' Club for the past year.

The routine work of the Club has been carried on as usual. The excursions to points of interest in the neighborhood during the summer season have been well attended, and much interest has been displayed by many members in the study of the various branches of Natural History which have been taken up. The membership is steadily increasing and now numbers 230, and on the whole the Club may be said to be in a very satisfactory condition. His Excellency Lord Stanley has kindly consented to act as its patron.

As regards the Club's publications, the departure inaugurated two years ago, by which the Transactions were issued in monthly parts instead of in an annual volume has been reconsidered, and a change in this respect has been thought desirable. Although the monthly was found to possess several advantages, these were not held to be sufficient to counterbalance certain inconveniences and difficulties, more particularly pertaining to the editorship, and it has therefore been resolved to change the issue to a quarterly of not less than 48 pages.

Since the period of its organization in 1879, the members of the Club have done a very large amount of and most excellent work in Entomology, Botany, Conchology, Geology, etc. This work has of necessity, from the original constitution of the Club, been almost entirely of a local character; and while the members recognize that very much yet remains to be done in this direction about Ottawa, the feeling has been growing, that the time has now arrived when the scope of the Society's publications can, with much profit, be so extended as to embrace papers and notes on Natural History by members of the Society in any portion of the Dominion. This change was held to be particularly desirable in order to include many items of general scientific interest collected by the large staff of the Geological and Natural History Survey of Canada, the members of which have heretofore, owing to the local character of the organization, been almost entirely debarred from contributing to any considerable extent to the welfare of the Society, since their fields of work are for the most part at points remote from Ottawa. The resolution to enlarge the field of the Society's operations was unanimously adopted at the last General Meeting, and this Club can now congratulate itself, not only upon numbering in its list of members one of the largest bodies of scientific men in Canada, but upon having entered upon a much wider sphere of usefulness.

The winter course of meetings comprised nine afternoon lectures and six soirees. Of the former, which are supposed to be largely of an elementary character, two were given on Conchology by Messrs. F. R. Latchford and Rev. G. W. Taylor; two on Geology, by Messrs. R. W. Ells and H. M. Ami; two on Entomology, by Messrs. Jas. Fletcher and W. H. Harrington; two on Botany, by Messrs. James Fletcher and R. B. Whyte, and one on Zoology, by the Rev. G. W. Taylor.

At the evening soirees the following papers were read and discussed :—

1. The President's Inaugural Address, by Mr. R. B. Whyte.

2. Contributions to the Geology and Palæontology of the Townships of Cambridge and Russell, in Russell, Ont.; (1) Physiography and General Geology, by Mr. W. Craig, Duncanville; (2) Palæontology, by Mr. H. M. Ami.

3. Revision of the Post-Tertiary Formations about Ottawa with their fossils, by Mr. H. M. Ami.

4. Note on *Onclea sensibilis* var. *obtusilobata*, by Mr. H. M. Ami.

5. Notes on the Duration of the Leaves of some of the Coniferæ, by Mr. J. Ballantyne.

6. Notes on Bog Plants, by Mr. R. B. Whyte.

7. Poisonous properties of *Agaricus Rodmani*, by Prof. Macoun.

8. An account of the first lectures delivered in America on Botany at Harvard University, by Dr. H. B. Small.

9. Notes on the Cerambycidæ, by Mr. W. H. Harrington.

10. Notes on Ornithology, with special reference to Birds observed in the Vicinity of Renfrew, by Rev. C. J. Young.

11. Bird Calls, by Mr. J. M. Macoun.

12. What you See when out Without your Gun, by Mr. W. A. D. Lees.

13. Notes on the Skunk, *Mephitis mephitica*, by Mr. W. P. Lett.

The officers of the Society for the present year, are :—

President—Dr. R. W. Ells.
Vice-Presidents—1st, J. Ballantyne; 2nd, H. M. Ami.
Secretary—T. J. MacLaughlin.
Treasurer—James Fletcher.
Librarian—W. A. D. Lees.
Committee of Council—Messrs. R. B. Whyte, A. P. Low, Rev. G. W. Taylor.

The leaders of the various sections for the present year are :—

Geology—H. M. Ami, A. P. Low, W. R. Billings, F. D. Adams.
Botany—James Fletcher, R. B. Whyte, Wm. Scott.
Conchology—Rev. G. W. Taylor, F. R. Latchford.
Entomology—T. J. MacLaughlin, J. Fletcher, W. H. Harrington.
Ornithology—W. A. D. Lees, Prof. J. Macoun and G. R. White.
Zoology—J. Ballantyne, J. B. Tyrrell, W. P. Lett.
Editor—James Fletcher.

I beg to submit herewith Vol. II of the Publication of the Ottawa Field Nat. Club, being the Transactions of the past year.

VII.—From the *Société Littéraire et Musicale de Montréal*, through Rev. A. B. Cruchet.

La société que j'ai l'honneur de représenter au milieu de vous, Messieurs, s'appelle la *Société Littéraire et Musicale* de Montréal. Elle a été fondée en 1885 par MM. Coussirat, professeur de langues orientales à l'université McGill, Darcy, professeur de littérature française dans la même université, Lafleur, Doudiet, Duclos, Cruchet, pasteurs; Herdt, Amos, Gregor; et Mmes Coussirat, Cornu, Herdt, Duclos, Cruchet, Amos et Darcy. Mme Cornu, professeur de français à l'école normale McGill, agit en qualité de secrétaire.

Les séances ont lieu deux fois par mois dans les salons des sociétaires. La dame qui reçoit remplit les fonctions de présidente. Le cercle est fermé, mais les membres peuvent y inviter leurs amis. Il compte aujourd'hui environ trente-cinq membres, qui sont tous mis à contribution.

Cultiver la diction, la musique et la littérature française, tel est le triple but que la société s'est toujours proposé. Le dernier surtout et avant tout.

Tous les sociétaires savent la langue anglaise ; ils en apprécient la valeur et en goûtent les beautés, mais ils veulent rester fidèles à leur belle langue maternelle. Ils ont foi dans ses destinées. Ils nourrissent l'espoir, que vous partagez, Messieurs, de la voir se répandre, s'épurer et produire dans notre cher pays une littérature digne de celle de la mère patrie, dont elle est fière d'être la fille, — peut-être plus chaste.

Cet espoir bien légitime a inspiré aux membres de la société le louable désir de travailler notre langue et d'apporter une modeste contribution à notre littérature naissante.

C'est ainsi que depuis quatre ans ils ont préparé et lu cent soixante-dix travaux sur la littérature française en France et au Canada, les beaux arts, l'histoire, les voyages, la philosophie et la morale.

Plusieurs de ces travaux ont été publiés dans des revues et des journaux du Canada, de France et de Suisse.

Permettez-moi d'en nommer quelques-uns :

De monsieur le professeur Coussirat : 1° L'avenir de la langue française au Canada. 2° L'avenir du français comme langue internationale. 3° Le romantisme en France. 4° A quoi sert le latin. 5° Des éléments de la détermination morale.

De monsieur le professeur Darey : Etudes sur la chanson de Roland, sur LaFontaine, les Origines du français, Beaumarchais, la Pêche au saumon.

De M. Lafleur : Etude sur Béranger, l'Idée de Dieu dans les œuvres de Victor Hugo, Alexandre Vinet, la Fin justifie les moyens, Cinquante-cinq ans de souvenirs.

De M. Doudiet : Etudes sur Tennyson, Longfellow, les Fabulistes modernes, la Légende de Guillaume Tell, la Forêt canadienne.

De M. Duclos : La Fondation de Montréal, l'Histoire de la compagnie de la Baie d'Hudson, la Colonie de Montréal.

De M. Cruchet : Etude sur Crémazie, l'Œuvre lyrique de Victor Hugo, la *Légende d'un peuple* et son auteur, le Patriotisme, et toute une série d'études sur des écrivains que je ne nommerai pas de crainte de blesser leur modestie.

Pendant l'hiver écoulé la Société a entendu la lecture des travaux suivants :

De M. Lafleur : Le Sens commun et le bon sens, Chiens et chats, les Fêtes de Noël au Canada, la Religion de J. J. Rousseau, Voyage à Jérusalem.

De M. Coussirat : De l'Accent personnel, le Prix de la vie, l'Idéal moral.

De M. Darey : Rabelais, sur le Genre des noms, les Proverbes.

De M. Morin : L'Éclectisme de V. Cousin, les Boissons alcooliques.

De Mme Cornu : Un Littérateur neuchâtelois, et d'excellents comptes-rendus.

De M. Herdt : En Egypte, les Chiens utiles, les Musées espagnols, Tolède.

De M. Doudiet : Notes de voyage.

De M. Gregor : L'Art du silence.

De Mlle Amos : La Graphologie.

De M. Cruchet : A travers le dictionnaire de Littré, de l'Etymologie, trois articles sur le Socialisme, considérations sur l'art d'écrire, l'art de la conversation.

De M. Mathey : Histoire d'un violon.

Messieurs, encouragée par votre accueil bienveillant, la Société Littéraire fera mieux dans l'avenir !

VIII.—From *The Entomological Society of Ontario*, through Mr. H. H. Lyman.

As delegate from the Entomological Society of Ontario, it is again my duty to submit a brief report of the work of the Society during the past year, and I have much pleasure in saying that the Society continues to prosper under the fostering care of the Government of Ontario.

The monthly journal of the Society, the 'Canadian Entomologist,' under the able editorship of

the Rev. Dr. Bethune, of Port Hope, first claims attention on account of the important position which it holds among the scientific publications of the continent. The volume for 1888, Vol. XX, consists of 240 pages of reading matter, the contributors numbering 33, and many of the articles being of much interest. In addition to those of our own Canadian members, there were articles sent in from active workers in fourteen States of the American Union, from Florida in the south to Michigan in the north, and from Massachusetts in the east to California in the west. Among the most important papers published in the volume were several on the preparatory stages of various insects, including the complete life-histories of twelve species of Lepidoptera, besides partial descriptions of those of several others. The volume also contains the descriptions of four new genera and fifty-six new species of various orders. In Vol. XXI now publishing, a series of papers is appearing upon Popular and Economic Entomology, which the Council believe will be of value to the fruit-growers, farmers and gardeners of the country.

The Annual Report of the Society to the Minister of Agriculture of Ontario, for 1888, has been published, and contains, in addition to the usual report of the Annual Meeting of the Society, many interesting papers. One of the most important of these is the account by our President, Mr. Fletcher, of his last year's trip to Nepigon, whither he went for a week at the beginning of July, accompanied by Mr. S. H. Scudder, an associate member of the Society, and one of the most eminent entomologists of America, for the express purpose of obtaining the eggs of various species of butterflies. The expedition was very successful, eggs being obtained from no less than seventeen species and varieties.

At the Annual Meeting of the Society it was found that the finances were in such a satisfactory state as to render possible the voting of the handsome sum of $200 to the library fund for the purchase of books and the binding of periodicals and pamphlets.

The library now contains upwards of a thousand volumes, chiefly on Entomology, but also many on the other departments of Zoology and on Botany.

An important move has recently been made in opening the rooms of the Society to visitors at regular stated times in order to popularize the work of the Society as much as possible.

The Society's collections of Coleoptera and Lepidoptera have been carefully rearranged during the year by Mr. J. Alston Moffat, of Hamilton, a member of the Council, and now form standard reference collections of these insects of Ontario.

The Montreal Branch, I am happy to say, continues in active existence; regular monthly meetings are held and increased interest is being taken in the study of this science.

During the past year great activity has also been shown by many of the associate members of the Society, and several very important and useful works have been issued by them. The most important of these is Mr. Scudder's sumptuous work on "The Butterflies of the Eastern United States and Canada, with special reference to New England," the first part of which was issued on November 1st, and will be completed during the present year. Mr. W. H. Edwards is also carrying on his magnificent work on the butterflies of North America. Three parts containing nine beautiful plates were issued during last year. Several works of a very different scope from either of the above, but still very useful and issued at a moderate price, have been published by other associate members of our Society during the past year. Among these, special mention should be made of "Entomology for Beginners, for the use of Young Folks, Fruit-Growers, Farmers and Gardeners," by Dr. A. S. Packard, and "An Introduction to Entomology," Part I., by Prof. J. H. Comstock. A second edition of Mr. William Saunders' important work on "Insects Injurious to Fruits" has also been issued.

IX.—From *The Canadian Institute of Toronto*, through SIR DANIEL WILSON.

The past year has been one of gratifying success; a marked increase in the influence of the Institute is noticeable.

The adoption of cosmic time bids fair to come into general use in the course of a few years, all over the world. The Institute has possessed for over a year a clock with a movable dial to record cosmic time.

Through the generous aid of the Provincial Government, the archæological research has been extended, and many valuable specimens added to the museum.

The biological section has interested itself with success in the preservation of the natural beauties of High Park.

The collection of minerals obtained by the mining commission is now on view in the Institute.

There were twenty-four ordinary meetings, at which twenty-eight papers were read:—

Anthropology	1	Political Science	1
Archæology	3	Physics	3
Astronomy	2	Physiology	1
Chemistry	2	Sanitary Science	2
Economics	1	Social Science	1
Geology	3	Sociology	1
Mathematics	1	Miscellaneous	3
Philology	3		

Papers read in Section —

Biological Section	22	Geological and Mining Section	5
Architectural Section	3	Philological Section	9

The meetings of the Architectural Section are chiefly devoted to technical discussions, preparation and judging of competitions among the members, of points of detail occurring in their daily practice.

The appeals of the Committee on Sociology have received favorable consideration from the Hon. Minister of the Interior; and the Canadian Pacific Railway has kindly offered to carry free of charge specimens sent to the Institute on certain conditions.

A memorial is being prepared to lay before the Ontario Government on the subject of setting aside a reservation for the protection of the forests and wild animals.

ADJOURNMENT.

The Society then adjourned at 12.30 until 4.30 o'clock in the afternoon of the same day when the usual annual addresses would be delivered.

PRESENTATION OF ADDRESS TO HIS EXCELLENCY THE GOVERNOR-GENERAL.

At 1.30 o'clock the members of the Society assembled, in accordance with arrangement, at Government House, where the President read the Address to His Excellency, the Lord Stanley of Preston, who was pleased to accept the position of Honorary President, and to express at considerable length his desire to promote the objects of the Society.

SESSION II. (*Public Meeting.*)

In pursuance of notice a public meeting was held at 4.30 o'clock, on Tuesday, in the Railway Committee Room, and His Excellency the Governor-General was pleased to occupy the chair as Honorary President.

The President of the Society, Mr. SANDFORD FLEMING, then delivered the following address:—

MAY IT PLEASE YOUR EXCELLENCY.—It is my agreeable duty on behalf of this Society to offer you our united thanks for accepting to-day the position of Honorary President. It is especially my duty respectfully to thank your Excellency for presiding at this meeting on the opening day of the present session.

The Royal Society of Canada since its establishment, has enjoyed the friendship and countenance of each successive Governor-General. We have great satisfaction in knowing that your Excellency, takes an interest in our proceedings as your predecessors have done.

In fulfilling the duties of my office, it would, under ordinary circumstances, be my high privilege to address the Annual Meeting at some length. On this occasion I have the distinguished honor to speak by permission of your Excellency.

FELLOWS OF THE ROYAL SOCIETY:—At the closing meeting of last year I was impelled by a sense of duty to address you on the subject of the choice of President. Sensible of my own deficiencies in many respects in regard to those qualifications which the President of this Society should possess, I desired to relieve my fellow-members from any embarrassment which might arise from observance of the rule followed on previous occasions. I do not feel myself called upon to repeat the opinions I then expressed and which I still hold. They are recorded in my letter of May 21st, 1888, which appears in the last volume of the Proceedings. The views I submitted were overruled, and it consequently became my duty to bow to your decision. I can, therefore, only renew my sincere thanks to my fellow-members who saw fit to place me in this exalted position.

In addressing the Society on the opening of the eighth session, a primary duty exacts my attention. We cannot refer to the original list of eighty members, nor can we examine, even in a cursory manner, our published proceedings, without observing how many of our body, by their labors and the distinctions they have gained, have justified their appointment as Fellows by the founder of the association on its establishment. I feel warranted in saying that we all feel gratified by the knowledge, that not a few of our Fellows have distinguished themselves in their several walks of life, and that the services of a number have gained public recognition. Among the latter I point with unalloyed satisfaction to those who have obtained positions of importance in the Departments of State to those on whom have been conferred honorary academical degrees; to others who have received high ecclesiastical preferment; and to several who have been directly distinguished by the favor of Her Majesty the Queen. I am sure I only express the general feeling, when I say that every member regards these well merited distinctions as honours which reflect upon the whole Society.

While reference to the brighter side of the picture can only be a matter of common satisfaction, on the other hand it is my sad duty to allude to those whose deaths have left blanks in our midst. Although the years are few since the names of the eighty original members of the Society were nscribed on the charter roll, no less than seven of our Fellows have been removed from our ranks. The last name to be added to the list is that of Dr. George Paxton Young, late Professor of Metaphysics and Moral Philosophy in Toronto University, who has died since our last meeting. Dr. Young was a man eminent for his varied attainments, a mathematician of no common order, distinguished by profound scholarship and as a sincere and earnest seeker after truth. It falls to my lot to perform the sad duty of recording his loss and to pay my humble tribute of respect to his memory.

It is only necessary to point to the six volumes of published Proceedings in order to prove that since the formation of the Society its members have not been unmindful of their obligations, and that in no way have they failed to attain a fair measure of success. The volumes distributed among the

principal learned societies, libraries and educational institutions throughout the civilized world have been accepted as evidence of the intellectual advancement of the Dominion, and it is satisfactory to obtain testimony from many quarters that the good fame of Canada has thus been widely extended.

My distinguished predecessors in the office I have the honor to hold have referred in some detail to the objects of the Royal Society and the position it is destined to occupy in the Dominion. They have reviewed lucidly and at length the intellectual activity which has characterized the investigations of literary and scientific men throughout the world in recent years, and they have dwelt upon the researches of our own members as they have been submitted at our Annual Meetings.

It would in no way be profitable if I attempted to pass over the same ground as they have done; I could not hope to glean much of any real value, nor could I expect to add anything of interest to those learned expositions which have been submitted to you. I trust I may count upon your indulgence if I ask you kindly to grant your attention to my humble efforts in another direction.

There is one subject in connection with our Society which, I considers may with propriety be examined. It is one of wide ramifications, and I may fail to a large extent in the investigation which I purpose to attempt. All enquiry, however, is conducive to truth, especially when honestly made. I trust, therefore, that my examination of the question, however imperfect, will not be out of accord with the spirit that should animate us. If I should be so fortunate as to succeed in awakening the attention of my fellow-members to the subject, particularly those of the Historical Sections, I shall be greatly gratified; of this much I feel confident, that the topic I propose to bring before you, cannot be wholly barren of interest to us as Canadians.

In opening the volumes of our Proceedings, the reader in any part of the world must be struck with one peculiarity manifest in their pages: I refer to the use of two languages.

The division of the Society into French and English Sections cannot but arrest attention, so that the query naturally arises, Who, ethnologically, are the French and who the English? Whence arose those peoples thus represented? How came they to assume a position so distinctively traceable not only in this Society but in this country?

I hope that I shall not be considered a trespasser in entering into this field of research, and in attempting an enquiry which does not appertain to the Section with which I am directly connected. I have to ask the forbearance of those to whom the historical facts I may allude to are familiar, although perhaps not so well known to the ordinary reader. Equally I solicit the consideration of members of Sections I and II, if I attach, what may seem to them, undue importance to certain records and traditions of history which have attracted my notice; and I ask each of my fellow-members kindly to overlook any imperfections apparent in my argument.

We cannot fail to be aware that at no remote period in the world's annals the names of France and England had no place on the map of Europe. It is not necessary to revert to the geological period, when Europe and the British Islands were geographically connected to form one land. There was a time long after the first written memorials of history when the peoples whom we call French and English were unknown among the races of mankind. Writers agree that at one time Gaul and Britain were inhabited by tribes of a common origin. On excellent authority it is held that "in the extensive region of the Alps, in the South of France and in Spain and Portugal, there survives in the names of streams and headlands and mountain passes, imperishable evidence that in the far off past" Celts who spoke Gaelic occupied that portion of Europe. "There is much in the topography of Brittany to sustain the theory that Celts who spoke the language now heard in the Highlands of Scotland gave the names which the rivers and headlands and islands of Brittany still bear." In the south of England we have the same evidences. The nomenclature of the topography of Devonshire and Cornwall is held to be fundamentally Gaelic. In this part of Britain once known by the name "Dumnonia," also in Armorica, now Brittany, Gaelic appears to have been succeeded by another Celtic idiom resembling the Welsh. This language was in use in Dumnonia until the close of the last century. The language of the Celt is still spoken in Wales. It is a living language in Brittany; so late as 1838

it was stated by Le Gonidec "that no less than two millions of Bretons spoke the Celtic language of their native province." There is abundant evidence that a Celtic people occupied the whole of France and the British Islands, and we have in portions of these countries to-day as a common vernacular the descendant of the speech of the unromanized and unsaxonized Celt—a speech which has survived Roman, Saxon and Danish sway for many long centuries.

The records and traditions which have reached us establish that the Celtic peoples who occupied Western Europe generally were numerous, rich and prosperous. There can be no doubt that ancient Gaul and ancient Britain were inhabited by races identical in blood, and with but little difference in language. The language of the Celt is not only preserved but spoken as a living tongue in Scotland, Ireland, Wales and Brittany. The several dialects to some extent may vary, but the language is in all probability generally the same, as when it was the vernacular of the early inhabitants of Gaul and Britain.

Since the days when Gaul and Britain were wholly Celtic, both countries have passed through many vicissitudes—vicissitudes which in their leading characteristics have been remarkable in similarity. The first events to exercise a disturbing influence on the prevailing Celtic occupation, life and customs were invasions by the Romans. The Romans were followed by Teutonic tribes from that portion of Europe which modern geography describes as Germany. These invaders boldly made incursions into the cultivated lands of the Romanized Celts to become their masters. In course of time the Teutons were succeeded by hordes of Scandinavians from the shores of the Baltic, who, in their turn, gained power and possession of the soil in both countries.

Gaul first attracted the attention of the Romans a century and a half before the Christian era. With the view of obtaining additional lands and extending their power, they seized on the territory bordering on the Mediterranean, and transformed it into a Roman Province. It was not until a century later that Julius Cæsar completed the conquest of Gaul. Cæsar followed up his conquest by the invasion of Britain, B.C. 55, which became a Roman Province under the Emperor Claudius in A.D. 43, and so remained for nearly four hundred years. The Roman rule prevailed until the Empire approached it dissolution, and in A.D. 410, the legions were withdrawn. Britain was then released from its allegiance, and about the same time the Armorican Provinces in Gaul revolted from the Roman yoke.

Until this date both countries had been held in the iron grasp of their civilized and disciplined conquerors. For five centuries in Gaul, and for four centuries in Britain the continued presence of the legions of the Empire exerted an all-powerful influence on the conquered Celts, in many respects to modify their habits and customs, and by the laws of heredity their physique and character. Throughout the greater part of Gaul, the Celtic idiom was crushed out. The same result was not attained in Britain; it was left for conquerors of a different race, in the following centuries, to alter the primitive form of speech. Whatever the influence on the language, the prolonged presence of the Roman legions, and likewise the marriage of the soldiers with the native women when their term of service was ended, must have silently worked typical changes in the people. These changes were less noticeable in Britain than in Gaul, but the influence of the Romans in both countries must have left them more or less latinized. As the Roman power passed away, Gaul and Britain were exposed to new disturbing forces. Inroads were made in both countries by barbarous or semi-barbarous Teutonic tribes known by the various names of Frank, Frisian, Lombard, Suevc, Burgundian, Fleming, Jute, Saxon and Angle. Their character, religion and form of worship differed little; although on occasions they acted in concert, for the most part they engaged in independent expeditions. After unnumbered wars and struggles for the mastery, extending over years of suffering to the people they attacked, these foreign invaders obtained possession of the soil. In Britain the Celt in some districts was displaced and apparently exterminated by the intruding tribes; but a conquered race does not wholly become extinct. Its warriors may be killed in battle, every man may be dispersed or enslaved or destroyed, but the subject women and children are largely spared, to enter in course of time into new relations with the

conquerors. Thus, a Celtic element must have remained, even if its name and language in certain districts disappeared.

The invasions of some of the tribes eventually assumed the character of emigrations and colonizations, notably those of the Saxons and the Angles; the latter gave their name to Southern Britain and the language which they used, in common with other Teutonic tribes, prevailed in the invaded territory. The Franks, on the other hand, gave their name to part of Gaul to be extended eventually from the Atlantic to the Mediterranean; but yielding to the irresistible influence of overwhelming numbers, who generally possessed the Christian religion and a higher civilization than their conquerors, the Franks gradually assumed the language of the latinized Gaul.

In thus bringing before our view the national cradles, whence in the succeeding centuries, France and England have sprung, we fail to perceive an independent ethnological origin on the one part or the other. The people of both countries, originally of a common stock, have been moulded in an important manner by additional elements of great force. They were under Roman influence until the fifth century; Teutonic races became dominant until the ninth century, at which period bands of Scandinavian adventurers from the Baltic began to make descents on the coasts accessible to them. The sea-kings and vikings of the North, who regarded piracy and plunder as the most honorable of all careers, commenced a series of exploits which were continued for many generations. In France these adventurers received the name of Normans. In English history they are described as Danes. Alike in England and in France these Scandinavian tribes firmly established themselves in the most attractive parts of the territory invaded. As the victorious Franks at an earlier date, so in France the new conquerors gradually adopted the language and manners of the people they had overpowered.

In explanation of the comparative rapidity with which the conquerors became assimilated and absorbed in the general population, we have to remember that the invaders consisted only of men, and that the work of conquest being completed they entered into the ordinary pursuits of life; in establishing themselves in the territory they formed ties and relationships with the native women. They had power in their hands to enforce compliance, and according to the customs of those days, possession followed choice, when some rite of marriage in accordance with the manners of the northern tribes was performed. That willingness or unwillingness on the part of the native womanhood was not in the character of the times, we find an illustration in the conqueror Rollo. At the siege of Bayeau in 890, he captured and carried away a French damsel whom he married according to the Danish usage. The union proved a happy one. The wife of the Dane Rollo became the mother of William Longsword, who in his turn followed the example which his father had set him. Richard the Fearless, was the son of William, and as descent is not exclusively through the sire, in two generations the offspring of the Scandinavian became three-quarters French in blood. That this characteristic feature prevailed is obvious from results which show conclusively the new relationships which sprung up in a comparatively few years. Whatever course was followed, the fact is recorded by historians that in the time of Richard, grandson of Rollo, Normandy had become as thoroughly French as any part of France. To account for the fact that the Danish language should soon be lost, we have only to consider that as children are brought up by their mothers, and for the first years of their life are continually with them, it is not surprising that they should come to speak only their mother tongue. If the descendants of the Northmen in Normandy became so typically changed in two generations, it is obvious that the same intermingling of genealogy, continued through succeeding generations, would result in the French element in all respects becoming more and more predominant, until the line of separation between the intruding race and the people of the territory would practically cease to exist.

The Norman invasion of France commenced in the ninth century; Richard the Fearless reigned in the tenth century; by the middle of the eleventh century the descendants of the Scandinavian adventurers had become Frenchmen. They had adopted the Christian faith, and lived according

to the customs and habits of their maternal ancestors; with scarcely an exception, no language was spoken throughout Normandy but Romance or French.

If, in the middle of the eleventh century, an attempt had been made to define the ethnological difference between the French and English peoples the general answer must have been that in point of origin there was no difference. Varieties there were in the component parts of each; even at the present day we meet such varieties equally in France and the British Islands. South of the Channel we find the Celts, the Franks, the Latins and the Germans compounded in an infinite number of different proportions; in the British Islands we have differences between the Highlanders and Lowlanders, between the Irishmen and Englishmen, between the Welshmen and Yorkshiremen, between the men of Cornwall and the men of Kent; but taking the people of France as a whole and the people of the United Kingdom as a whole, at the period of which we speak, it would not be possible to say that in point of ancestry there were any striking distinctions between them. There undoubtedly was less ethnological difference between the two communities separated by the Channel, taking them as unities, than between many of the minor divisions in either country. In the middle of the eleventh century no one of the two peoples could be named as a pure race; both were of mixed blood; they were compounded substantially of the same original elements. There were minor differences in the admixture, in the combination and fusion of the elements; possibly there were modifications arising from climate and geographical position; but the two peoples had originated in the same primitive race; they had been subjected to like influences and exposed to the same vicissitudes, differing only in degree.

In the Celtic race, which formed the basis in both cases, had been infused Roman, Teutonic and Sandinavian stocks. The intruding races, on their arrival in the new countries, we can well imagine, were in the flower of manhood, bold and determined in spirit, the most daring of the tribes whence they sprang. We are warranted in the belief that among them there were those who would take preëminent position in the adventurous type of man. From such as these a healthy vigorous progeny would proceed. The Romans would introduce their civilization, their culture and their powers of organization, to elevate and refine the communities which they subdued. It was the pride of the Roman conquerors to treat their subject States with consideration so long as the central power on the banks of the Tiber was duly recognized. The Northern tribes which subsequently overran the more cultivated provinces of Gaul and Britain, were unlettered, savage barbarians, worshippers of Thor and Woden, who looked on the slaughter of an enemy as a righteous sacrifice to their gods. Under their savage exterior and ruthless natures there were, however, the germs of generous impulses and noble endowments. They had vigor, valor and resolution, and many of the ruder virtues; they required only contact and intercourse with a more cultivated race to be developed into a higher and more estimable condition. In course of years the best qualities of the conquering races becoming gradually absorbed in the populations of Gaul and Britain, could not fail to exercise powerful influences on the character of both nations. To these early influences we may attribute many of the prominent characteristics of the French and English as they are seen at the present day.

At the period referred to, the language of the two peoples had diverged into different directions. In France the dialect which came into use was the legacy of one set of conquerors; in England other influences led to different results, and the idiom of another set of conquerors prevailed. This difference in language has been continued to the present day; and if other evidence were wanting, it might be argued that the French and English peoples had sprung from entirely different primitive stocks.

Language, however, is but an indifferent test of race. There are ample proofs throughout the world that people nearly related may speak widely different dialects; while other communities, between whom there is no affinity of race, may converse in the same idiom. Amongst ourselves, instances are not unknown where an intruding stock, in the midst of a people greatly exceeding it in number, has in two or three generations yielded to the influence surrounding it, and lost the language of their ancestry.

Thus it is established by the records of history, that in the eleventh century the peoples of France and the British Islands had an ancestral kinship which was close and real. Before that century came to an end further relationships were created to make the connection still more intimate. The great territorial conquest of William dates from 1066, and it has proved the most important epoch in English history. It is described by English historians as the Norman invasion. It appears to me that with greater propriety and accuracy it might be called the French invasion; not because William himself was the son of a daughter of the soil; not because he was by blood at least five-sixths French, and by education and habit wholly French; not because every one of his ancestors, male and female, for a century and three quarters was, with one exception, native born; not because Normandy, so far back as the time of Richard the Fearless, great-grandfather of William, had even then become thoroughly French; but because the 60,000 followers of the Conqueror who crossed the channel with him, were gathered together from a great part of the whole realm of what is known as modern France.

To insure success, William offered good pay and a share in the spoils to all who should accompany him. Numerous trains of adventurous spirits poured in to join his standard. They came all ready for the conflict, not simply from Normandy but from Armorica, now called Brittany, on the west; from Flanders on the east, and from Maine, Anjou, Poitou, and the whole country to Aquitaine on the south. To all, such promises were made as should incite them to the enterprise, and thus he gathered the men of all classes from all districts to form his army.

William was faithful to his word; the subjugation of England was complete and the poorest soldier had his reward. The dominion passed into the hands of the invaders; and they were followed by a crowd of adventurers who became identified with the conquerors and shared in the spoils.

In the years which followed the invasion the original landowners were stripped of their estates. Universal spoliation was the means employed to reward the officers and men who had enlisted under William's standard. The barons and knights who followed his banner had the extensive domains of the dispossessed English allotted to them, while those of lower rank received humbler recompense. Some took their pay in money; others who had stipulated for Saxon wives received the booty they had bargained for. According to the Norman chronicle, William caused them to take in marriage noble ladies, the heiresses of great possessions, whose husbands had been slain in battle. Thus it was that barons of the one country became barons in the other; thus it was that men of no condition in France, whom love of adventure had induced to join William and share his fortunes, became men of rank and station; thus it was that in some cases names hitherto obscure became noble and illustriou in the country they helped to subdue.

The spoliation was not confined to landed property, for everything worth owning passed into the hands of Frenchmen. The hierarchy soon ceased to be English. French judges administered the law. Every important office in the State was filled by Frenchmen, who thus obtained all the wealth, power and influence in the kingdom. William himself was essentially French, he spoke his mother tongue; he did not and could not speak English; "he had not even a reminiscence of the language of his northern ancestors, the Danes, then nearly allied to English." French became the language of "the court and tribunal, the baronial castle and the merchant's counting house." French became the official language of England and so remained until a date nearly three centuries after the arrival of the conquerors. The seven kings who succeeded William on the English throne were French; the greater number of them were born and brought up in France. The effect of every political change during these reigns was to bring to England a fresh number of Frenchmen, and any lands falling to the King's disposal were almost invariably granted to his foreign favorites.

In the years following the arrival of William it may well be imagined that the fiercest antagonism existed between the conquerors and the conquered—antagonism so intense that no one then living could predict the outcome. In this age we are privileged to take a calm panoramic view of the state of affairs then existing and the results which have followed. It would indeed be difficult to find in

universal history a subjugation so complete, a hostility so intense, becoming the ultimate means of so much national prosperity.

In a remarkable lecture delivered last year by Sir William Groves at the Royal Institution, London, he submitted the proposition that antagonism is not the baneful thing which many consider it; that it is often the precursor of good: "that it is a necessity of existence and of the organism of the universe as far as we understand it; that motion and life cannot go on without it; that it is not a mere casual adjunct of nature, but that without it there would be no nature, at all events as we conceive it; and that it is inevitably associated with matter and sentient beings." The lecturer showed that, though itself an evil, antagonism is a necessary evil. I shall not venture to allude to the evidences of antagonism furnished by him in the physical world, in vegetable life, in the external life of animals and in human society. He pointed out that "in what is euphemistically called a life of peace, buyer and seller, master and servant, landlord and tenant, debtor and creditor, are all in a state of simmering antagonism;" that in tranquil commerce and in the schools we have the antagonism of competition; that in nearly all our games and amusements we have antagonism; that in daily life we have class antagonism, religious antagonism, political antagonism and individual antagonism, and that there is more or less antagonism in every condition of society. Sir William Groves did not attempt to explain the cause of this universal antagonism. He only gave evidence of the fact that it is not limited to time or space, and stated his belief that some day it will be considered as much a law as the law of gravitation.

If antagonism come to be considered a law, it will be necessary, I think, to recognize another principle with tendencies the very opposite. The two principles may be likened to the resultant of two forces; in one case the forces act in contrary directions; in the other case the forces operate in the same direction. As action is followed by reaction, so also it is possible that as the two forces revolve with time, antagonism may be followed by the opposite principle. When this takes place it is evident that, the stronger the forces in antagonism, the greater will be the resultant when these forces come to act as coöperative forces.

A change of this character is exemplified in the history of England. The reversal of the forces was not sudden, it took two or three centuries completely to effect the change. For a number of generations after the French invasion, the line between the descendants of the conquerors and the conquered, was sharply drawn. There was the contrast of manners and of thought; there was the primary difference of language; French, being the token of power and wealth and influence, established a defined line of separation between the two peoples. By degrees the feeling of hatred and dislike toned down, antagonism and antipathy yielded to other influences. In 1362, in the reign of Edward III, a statute was passed ordaining that thereafter all pleas in the courts should be pleaded in the English language. The first bill of the House of Commons written in the English language bears date 1485, but long before this the English language began to gain ground. The French and English had commenced to intermingle and intermarry, friendships and near relationships were developed, and, as a consequence, by the fourteenth century a new race had sprung up partaking by descent the qualities of its French and English ancestors.

The admixture of race has often proved advantageous in creating the tendency to develop the growth of new qualities. It has been known to bring out a type of character superior to either parent race, to produce a composite race to dominate over both the parent stems. This result may not be attained in all cases, but it cannot be denied that the blending together of the French and English stocks strengthened the intellect of the new nationality, greatly increased its power, and gave an impulse to its prosperity and glory. As the name of "Englishman" takes in all natives of the country, of whatever descent, the descendants of the French invaders became Englishmen, indeed the truest of Englishmen. Paradoxical as it may appear, it is mainly owing to French influences incident to the Conquest that the English nation has been moulded to the national character it possesses. It is owing to the introduction of the French element that Englishmen have become what we now find them.

The invaders took firm root in England; they engrafted upon the nation the best qualities of their own natures. Many of the men who from various parts of France accompanied William, became the founders of great English families. For eight centuries their descendants have held a dominant place in the national councils; they have assumed high command on land and sea, and they have been prominent in the roll of statesmen who have controlled the destinies of the kingdom.

William himself left a lasting impress on the monarchy; the dynasty which he established has continued through to our own time, although not in the direct lineage from father to son. Since the death of William in 1087, the blood of the French conqueror has flowed in the veins of every monarch of England. In the words of Palgrave, "Magnificent was William's destiny—can we avoid accepting him as the founder of the predominent Empire now existing in the civilized world? Nay, the stripes and stars of the Trans-Atlantic Republic would never have been hoisted, nor the Ganges flow as a British stream, but for the Norman gauntleted hand."

The French conquest is without a parallel in history. It is the most momentous event which our annals record. It humbled the nation to the last degree, and with other great changes it effected a vast territorial and social revolution. While all this was being accomplished with much pain and suffering for the time being, it must now be recognized that the landing of the French and the settlement of the kingdom by the French, and the ultimate fusion of the conquerors with the conquered, was conducive of the greatest possible good. The French element thus thrown into England under the circumstances in which it was introduced might be expected to produce great and lasting effects. The ethnological result has been to commingle the blood of the two communities, already possessing the affinity of ancestry, and to produce a new national type. By whatever name it may be known, it is a French-English type. The political effect has been to weld together the component parts forming the British nation in so compact a character as to withstand every shock to which it has since been exposed. If after the lapse of eight hundred years we dispassionately view the effects of the historical event, it is impossible to escape the conviction that the direct influences springing from the Conquest have been of lasting advantage to the world.

The general result of the enquiry into which I have been led may be briefly summarized. We may trace back the relations of the two peoples as they are represented in this Society to a period long anterior to the date when they were first known as French and English. We learn that they sprang originally from a great primitive race which, before the Christian era, spread over western Europe and flourished under a half-developed civilization. In both cases the orignal stock had been modified by foreign influences similar in character, until the eleventh century, when a powerful French element became intermixed with the English people and penetrated the highest and lowest grades of society. At that period the portion of Europe which is named France contributed the ruling class and the men to form the British aristocracy. To this day the prominent families of England, with few exceptions, trace to France the foundations of their names. From French sources have come those who have helped so much to make Great Britain strong and indissoluble.

Thus it was that the descendants of ancient Gaul, modified by the Romans, the Franks and the Danes, have been absorbed and assimilated in the great mass of the English people. The blood of the French intermingled with the blood of the English has since been carried in the veins of colonists to America, to Australia, and to every British colony, and by British sailors to every port in the two hemispheres; and thus, through the intermixture of the races an Empire has been raised up to girdle the globe.

These imperfect remarks will, I trust, be found to furnish an answer to the query, Who are the French, and who are the English? The records of history establish that they are not alien in blood, that they have often met in conflict, and that they have frequently coöperated in amity. The character of the relationship which sprung up eight centuries back connected England and France by domestic ties, and the same lineages spread over both lands. The histories of the two nations have been more or less interwoven ever since the French and English people had an existence, and for part of the time the two peoples have had one and the same history.

My remarks go to show that those whom I have the honor to address, with the people in the Dominion whom they represent, are equally the descendants of the races who laid the foundation of western Europe. Every individual man is more or less moulded by forces which date from a remote past. The subtle influences of ancestry and the conditions due to hereditary transmission affect us all. If the individual be the resultant of remote and occult forces, so also to a great extent is the family and the nation.

The population of Canada presents the spectacle of two peoples possessing early kinships and affinity of ancestry, subsequently separated for centuries, again forming a reunion in political and social life. A century and a quarter ago, a French population numbering some 60,000 souls, came under the British flag. It is a somewhat singular coincidence that seven centuries earlier the same number of Frenchmen crossed the Channel, eventually to become Englishmen, and to give to the British nation the strength and influence and distinctive characteristics we now find it possessing.

It is said that history repeats itself; are we warranted in assuming that it will do so in this instance? If the fusion of the French and English after William's conquest was productive of the results I have specified; if the difference of language five to eight centuries back failed to impede the vastly important conseqences now traceable; if the absence of complete homogeneity was in no way a hindrance, but on the contrary, proved a solid and substantial advantage by the diversity of talent and strength which it brought; if like causes produce like effects—are we not warranted in looking forward to our future with confidence? It is surely a happy augury that we have become a fully-organized political community, inheriting in common all that is to be cherished in French and English history. To my mind there is the best ground for hope that in coming years the successive generations of Canadians will be distinguished by the best qualities they inherit from their compound ancestry, developed under the free institutions which it will be our happiness to bequeath to them.

It is indeed true that in the past France and England have frequently been in conflict, but those conflicts have been much less frequent and not more fierce than the domestic struggles in either country. Happily a state of open warfare is no longer the normal condition of society, and all must acknowledge that hostility of race is entirely out of place in this age in this Dominion. We have now reached a stage in our country's progress when antagonism in its strongest and worst aspect has passed away. Whatever their origin or creed or color, all who live within the limits of the broad domain of Canada cannot fail to be convinced that they have interests in common. As the inhabitants of England discovered in the reign of King John in the thirteenth century, so the population of the Dominion must perceive, that no interests of real and lasting importance can exist which are not common to all. This feeling fully developed, the complete identification of general sentiment will be the pledge of lasting friendship, the Magna Charta of a united community. It will elevate our aims and promote aspirations worthy of our common ancestry and our common inheritance—an inheritance which throws upon us weighty responsibilities and the duty of employing our best efforts in working out our destiny. If we do well our part, it will be for the historian of the future to chronicle the results, which we anticipate will follow the reunion and comixture of the French and English on the soil of Canada.

Perhaps I have dwelt at too great length on this topic, and I should not venture further to trespass on your kind indulgence. In closing the remarks which I have the honor to make on this occasion, I shall only ask your permission to add a very few words on other matters. Looking at the four Sections into which the Society is divided and the definite objects for which they are organised, it is obvious that the scope of our researches as an association is broad and deep. The remarks I have submitted come within the cognizance of the Historical Sections. There is another Section which embraces subjects relating to past time. While history takes us back to the earliest dates of existing records, the Section which includes the science of geology carries us to periods in the world's annals a thousandfold more remote, and into fields of research immeasurably wider than the chroni-

cles of the human race. Unlike the historian and archæologist, the student of geology can look to no aid from human records, his researches go beyond all classical literature; he can find no guide in inscriptions, however ancient, which the hand of man has made.

Geology, to some extent, may be described as a new science, it was within the second decade of the century that it became a recognized study, yet with the aid of subsidiary sciences it has already given to us part of the story of the earth. The library of the geologist is found in the recesses of the rocks. He deciphers the writings which have therein been inscribed and which for unknown periods have been secured from the process of decay. Necessarily his researches must be patient and laborious, and it is only by the slow accumulation of facts that he is rewarded by bringing to light remains of manifold organisms which in successive epochs have animated the globe countless centuries before man was called into being. The geologist in his investigations approaches nearer to what we call the beginning; he has revealed to him traces of the natural forces which have operated in moulding the earth to its present form. He is privileged to follow the mutations in the structure of the world, which, if the element of time be not taken into account, are wholly inexplicable, and which can only be accounted for by a slow and gradual development, by the continuity of forces exerted over periods, compared with which the duration of human life on the globe as recorded in history can give but the faintest conception.

However much this science has advanced, and however greatly our knowledge has increased during the last sixty years, we are made to feel that we are only on the threshold of greater revelations. In the wide territory of the Dominion we have a boundless field for pursuing geological research. The Canadian Geological Survey has done excellent work in many directions, not simply in forming a vast accumulation of scientific facts, but in performing the great service of establishing the immense value of some of our hidden mineral treasures.

In the remaining Sections of the Society the subjects for consideration are not specially related to the past; the sphere of their investigations have to some extent a bearing in the opposite direction. I refer to the Section devoted to mathematics and physical and chemical sciences. The aims and hopes of this division of the Society rather lie in the future; not that we should forget our obligations to those who have toiled in past years and to whose reseaches in science we mainly owe much which is a striking feature in the daily life of modern civilization.

These sciences cannot be spoken of as modern. We have but to mention the names of Pythagoras, Aristotle, Archimedes, Ptolemy and others, to testify to the efforts of two thousand years back. The seventeenth and eighteenth centuries were made illustrious by men whose names will always be honorably associated with science. Without depreciating, however, the labors of the precursors of what we all recognize as modern times, it may be said that it is the nineteenth century which has witnessed the greatest triumphs in science. Indeed it is within little more than the last half-century that there has taken place a remarkable revolution in human affairs through the growth and influence of the physical sciences and the application of science to the daily life and the multifarious operations of man.

No one for a moment can suppose that science has exhausted every field of enquiry. Judging from the intellectual activity which everywhere prevails, the thought forces itself upon us that much will be discovered to astonish and bewilder the human family even in the comparatively short period of another fifty years. Who can foretell what our children may witness and experience in the middle of the twentieth century? Some of us may yet live to see the extent of the influences exerted by science in directions not hitherto dreamed of, and in fields which to many minds appear to set scientific investigation at defiance. Even in the complex domain of politics the wise and practical statesman may benefit his country by the application of scientific principles and methods to the solution of difficult problems.

Six years ago one of the most eminent of our colleagues, the late Dr. Todd, addressed the members at length on the relations of this Society to the State. He dwelt upon the benefits which may be

anticipated from the establishment in the Dominion of a body constituted as we are. By way of illustration he referred to the public services rendered during the last two hundred years by the Royal Society of England; services repeatedly acknowledged by the Imperial Government and confirmed by parliamentary votes of money. For many years annual sums have been granted to defray the cost of scientific investigations recommended by that Society as worthy of assistance.

The Home Government has found that it is of undoubted public advantage to have recourse to the aid and advice of the Royal Society of Great Britain. Our own Government, too, has given evidence of a wise liberality, which we cordially acknowledge. I am confident that I express the feelings of every member of our body, when I say that it will be the constant aim of the Royal Society of Canada to continue to command the respect and confidence of the people and Parliament of the Dominion.

The Vice-President, Abbé Casgrain then addressed the meeting as follows:—

Monsieur le Président, Mesdames et Messieurs, — Après le rapport si savant et si soigneusement élaboré que vient de lire M. le président, vous ne vous attendez pas que je vous fasse un long discours sur les travaux de la Société. Je ne ferais qu'amoindrir en l'affaiblissant ce qu'il a si bien dit. Je ne puis que joindre mes félicitations aux vôtres, et encore, est-ce le temps d'appliquer l'axiome littéraire: glissez, n'appuyez pas; car on est ici en présence d'une de ces rares modesties qui n'a d'égale que le mérite de celui qui la possède.

C'est, au reste, le privilège de la véritable science de s'ignorer soi-même.

Quand les réunions la Société Royale n'offriraient pas d'autre avantage que celui de nous mettre en relation avec de telles natures, ce serait déjà un motif suffisant pour nous les faire apprécier et nous y rendre fidèles.

Lorsque les étrangers visitent notre pays, ils s'étonnent de voir le sincère et profond attachement des Canadiens-français pour la couronne d'Angleterre. C'est que, de tout temps depuis la cession du Canada, ils ont été en contact avec de semblables caractères. Chacun de ces dignes représentants de la Grande-Bretagne est devenu comme un anneau de cette chaîne qui nous tient attachés à notre seconde patrie. Vous avez nommé, avant que je vous les mentionne, les plus illustres d'entre eux: les Dorchester, les Gosford, les Elgin, et, dans un rang plus modeste, les Neilson, les Baldwin, sans parler des vivants. C'est à leur école que nos générations ont appris à connaître le génie anglais, et, en le connaissant, à l'admirer; elles l'ont étudié et elles ont tâché de s'approprier surtout ce qui le distingue éminemment: la pratique de la vraie liberté et l'usage du *self-government*, source de tant de progrès. Elles cherchent aujourd'hui à s'initier, aussi bien que leurs modèles, à la science des affaires; elles se voient même dans l'avenir prendre part à ces hautes spéculations qui embrassent le monde entier.

Il y a deux siècles un de nos plus célèbres pionniers, Cavelier de La Salle, rêvait d'établir un commerce avec la Chine en se frayant un passage à travers les solitudes du Nord-Ouest. Ce passage est ouvert aujourd'hui; on peut se rendre par le Pacifique canadien, en passant par Lachine, près de Montréal, jusqu'au Céleste Empire. Ne sommes-nous pas autorisés à espérer pour nos neveux la seconde partie du rêve entrevu par La Salle?

A quoi ne peut-on pas aspirer quand on fait partie d'un empire sur lequel le soleil ne se couche jamais?

Mais, trêve à ces rêves d'ambition plus ou moins chimériques; je me contente de constater que les rapports de la Société Royale sont lus au Japon, en Australie, en même temps qu'en Europe et en Amérique.

D'ici à ce qu'on arrive à d'autres résultats, il est intéressant de suivre le double courant d'idées qui se fait jour à travers la collection des Rapports de la Société Royale. Je ne suis pas en mesure de juger du mouvement scientifique qui s'y manifeste; aussi me bornerai-je à étudier les deux sections réservées aux lettres.

Il y aurait une étude à la fois philosophique et littéraire très curieuse à faire, en examinant les

travaux de ces deux sections : deux génies nationaux, représentées par deux langues différentes, y sont en présence et prêtent à d'ingénieuses comparaisons. Il faudrait ici avoir la plume de Plutarque pour faire ce parallèle. Quand on songe surtout aux traits de ressemblance qu'il y a entre nos deux races et celles des Grecs et des Romains, on se prend à penser que le vieil auteur aurait aimé écrire ce parallèle. Il ne manquerait pas d'en remarquer un des traits les plus piquants : celui de voir ces deux races transportées sous d'autres cieux dans une région nouvelle, bien éloignée de celle où elles ont pris leur origine, et s'y trouvant toutes deux de nouveau en présence. Il les montrerait luttant d'abord l'épée à la main, l'une contre l'autre, puis se réconciliant et se livrant de nos jours à des luttes pacifiques sur le terrain de la civilisation et du progrès.

Quel spectacle plus digne de la pensée d'un philosophe ? Il ferait voir que, dans un siècle de lumière comme le nôtre, les préjugés d'un autre âge n'ont plus leur raison d'être, que l'harmonie et l'entente cordiales sont compatibles avec les divergences d'opinion, que, parvenus à ces sommets de l'intelligence et de la liberté, les peuples doivent être comme ces hautes cimes qui dominent les nuages, et garder toujours comme elles le calme et la sérénité.

Vous seriez les premiers à sourire si je prononçais le mot de chefs-d'œuvre en parlant de nos travaux littéraires et historiques : il ne peut guère être question que d'essais, mais en lisant ces essais si divers de nature et de valeur, on n'a pas l'impression de la banalité ; on éprouve, au contraire, ce je ne sais quoi de frais et de séduisant qu'inspire le printemps ou la jeunesse, et qui vous met sur les lèvres cette strophe italienne, si ancienne et toujours nouvelle :

Oh primavera ! gioventu dell' anno.
Oh gioventu ! primavera della vita.

C'est quelque chose qui ressemble à l'oiseau à peine sorti du nid, ou à l'enfant, encore voisin de son berceau, qui se sent heureux de vivre.

Du moment que l'on compare les travaux de la section anglaise avec ceux de la section française, on saisit sur le fait les aptitudes particulières aux deux races.

Ne remarquez-vous pas, en effet, chez nos auteurs anglais une tournure d'esprit plus sérieuse, une préférence marquée pour les sujets utiles ? La poésie chez eux brille par son absence. Il se glisse même parmi leurs essais des études philologiques et ethnologiques. On sent un peuple qui, tout en s'occupant volontiers du passé, préfère évidemment le présent, et qui a fait son choix entre le rêve et la réalité.

Tout autre est la physionomie de la section rivale. La pente naturelle de l'esprit français est visible à la simple lecture du sommaire des études choisies par les écrivains : la part faite à l'idéal est excessive, du moins le paraîtrait-elle aux yeux de la critique moderne ; sur les soixante-deux articles contenus dans les cinq premiers rapports de la société, on ne compte pas moins de vingt-six pièces de poésie : épîtres, poèmes, chansons, fables ou comédies.

On dit que les muses sont nées sous les tièdes climats, mais en présence de tant d'élans poétiques, on serait tenté de croire qu'elles ont déserté le Parnasse, et qu'il faut désormais les chercher sur nos froides Laurentides. On songe aux métamorphoses d'Ovide, et on se demande si les immortelles sœurs n'ont pas pris la forme de nos oiseaux de neige.

Je ne fais pas ici de la critique, j'analyse une situation. Cette analyse pourrait être poussée plus loin, mais devant un auditoire comme le vôtre, on indique, on n'insiste pas.

Je termine par une réflexion qui s'impose après l'examen des Rapports de la Société, soit au point de vue scientifique, soit au point de vue historique ou littéraire : c'est que la Société Royale, toute jeune qu'elle est, a assez vécu pour mettre hors de doute la raison de son existence.

At the conclusion of the Vice-President's address, a vote of thanks was formally moved to His Excellency for having given the Society the benefit of his presence on this occasion. The meeting then adjourned until Thursday, at 10 o'clock a.m., for the transaction of general business, while the members in the meantime went to work in their respective Sections.

SESSION III. (*May 9th.*)

The members of the Society assembled at 10 o'clock a.m., and the President called the meeting to order.

Reports from Affiliated Societies (*Continued.*)

The Societies which had not hitherto reported, presented the following reports:—

X.—From *The Literary and Historical Society of Quebec*, through Mr. William Wood.

The report which I have the honor to submit this year is more encouraging than that of last year.

The Provincial Government has again given an annual grant, this time of $500, which enables the Society to fulfil one of its most important functions, the publication of its Transactions and of original documents.

The membership has been slightly increased. The active membership is 190. His Excellency the Governor-General has accepted the patronship of the Society.

The Librarian's report shows an increase of 451 volumes during 1888. Among the most valuable of these are the reports of the Government Geological and Archælogical Surveys of India, which were obtained through the kindness of the Marquis of Dufferin. Thirty-eight volumes of MSS. were delivered to the Provincial Government, the Society being satisfied that it was only the custodian, not the owner of them. There were among them ten volumes of original papers—matières criminelles, civiles, de police, de voieries—extending from 1665 to 1759. The total number of volumes in the library at present is about 15,000, of which about 2,000 were taken out in the year.

During the winter there were five lectures delivered to very fair audiences:—

1. "The Merchant of Venice," by the Very Rev. Dean Norman, D.D., D.C.L.
2. Pre-Columbian Discoveries of America, by J. E. Prower.
3. John Keats, by William Wood.
4. Imperial Federation, by Casimir Dickson.
5. The Moon and the Weather, by W. A. Ashe, F.R.A.S.

At the Annual Meeting in January of this year, the following were elected to office:—

President.....George Stewart, D.C.L., D.Lit., F.R.G.S., F.R.S.C., LL.D.

Vice-Presidents.....
- C. Tessier.
- W. Hossack.
- J. M. Harper, Ph.D., F.E.I.S.
- Dean Norman, D.D., D.C.L.

Treasurer.....E. Pope.
Librarian.....F. C. Wurtele.
Recording Secretary.....J. E. Prower.
Corresponding Secretary.....W. A. Ashe, F.R.A.S.
Council Secretary.....A. Robertson.
Curator of Museum.....W. Clint.
Curator of Apparatus.....William Wood.

Additional Members of Council..
- J. M. LeMoine.
- A. Campbell.
- H. M. Price.
- P. Johnson.

XI.—From *The Natural History Society of Montreal,* through Rev. R. Campbell.

The report which I have the honor to present shows an exceptionally good year's work accomplished. The aims of the Society are twofold—to promote scientific research among the members, and to popularize science in the general community.

At the monthly meetings of the Society, for the former of these two objects, nineteen papers, containing original observations and investigations were read, and received the criticism of the members present. They were on the following subjects:—

1. Notes on Ringed Trees, by Prof. W. L. Goodwin, Ph.D., of Queen's University.
2. On Some Canadian Rocks containing Scapolite, with a few Notes on Rocks associated with the Apatite Deposits, by Frank D. Adams and Andrew C. Lawson, Ph.D.
3. On Modern Concretions from Boucherville, by Rev. Prof. Kavanagh.
4. Note on *Balanus Hameri* in the Pleistocene at River Beaudette, by Sir J. William Dawson, LL.D., F.R.S.
5. Recent and Fossil Specimens of Mya, by Sir J. William Dawson, LL.D., F.R.S.
6. Notes on the Lake St. John District, by E. T. Chambers.
7. On the Classification of the Cambrian Rocks in Acadia, by G. F. Matthew, M.A., F.R.S.
8. Notes on the Flora of Montebello, Quebec, the estate of the Hon. Mr. Papineau, by Henry R. Ami, Cor. Mem. Torrey Bot. Club.
9. The Influence of the Nervous System on Cell Life, by Prof. T. Wesley Mills, M.D.
10. Some Notes on the Fruit of the *Sheperdia Canadensis,* by Prof. Penhallow, B.Sc., F.R.S.C., of McGill College.
11. Landslip on the River Bayonne, by E. Cuthbert.
12. Coal from the Northwest, by Prof. Harrington, Ph.D.
13. Notes on Fossil Plants and Other Fossils in the Peter Redpath Museum, by Sir J. William Dawson, LL.D., F.R.S.
14. Supplementary Notes to Paper on Cambrian of New Brunswick, by G. F. Matthew, M.A., F.R.S.
15. Exhibition and Explanation of Specimens Bearing on the Reproduction in Birds, by Prof. T. Wesley Mills, M.D.
16. Gypsum Deposits of Northern Manitoba, by J. B. Tyrrell.
17. The Glaciation of Eastern Canada, by Robert Chalmers.
18. Notes on Bibliography of Canadian Mineralogy, and on the Number of Mineral Species known to occur in Canada, by Prof. Harrington, Ph. D.
19. Notes on Some Birds Observed at Montreal, by F. B. Caulfield.

These papers travel over a wide range of important scientific topics. Several of them have appeared in 'The Canadian Record of Science,' and the rest of them will find a place in future issues of that journal.

Besides these monthly meetings for original scientific work by the members, the Society arranged as usual a course of popular lectures, known by the name of the Somerville Lectures, to which the citizens were invited free of charge. The course, as in several years past, formed a connected series on important practical subjects, and was as follows:—

1. Agricultural Education, by Sir J. William Dawson, LL.D., F.R.S.
2. Forestry for Canada, by Hon. H. G. Joly de Lotbinière.
3. Our Fruits, Past and Present, by Charles Gibb, B.A.
4. Economic Entomology as a branch of Agriculture, by James Fletcher, F.R.S.C.
5. The Food of Plants, by Prof. Penhallow, B.Sc., F.R.S.C.
6. Sugar-Producing Plants, by W. F. Skaife, B.A.Sc.

These Lectures were well attended, and excited deep interest among those concerned with the subjects of which they treated.

In addition to this Course of Lectures, the Society held a Conversazione on February 28th, under the distinguished patronage of His Excellency the Governor-General and Lady Stanley, who graced it with their presence. About 400 guests attended the Conversazione, which thus became a means of spreading a taste for scientific knowledge and research. The Museum was thrown open on the occasion, and the Society had the kind coöperation of the members of the Microscopical Society, who exhibited specimens of great interest.

The Society also held two field days, excursions to the country, one in the early summer and the other in the autumn, on which they were accompanied by many friends, especially those who are intimately connected with the educational institutions of the city, among whom the Society considers it of great importance to promote scientific tastes.

During the past year a number of alterations and improvements were made in the Museum, which is under the care of Mr. J. S. Brown, greatly increasing the accommodation, and enabling the Society to display its valuable specimens to better advantage.

There were numerous donations to the Museum, but those most worthy of note were the following :—

1. A very fine specimen of sea-basket, *Astrophyton Agassizii ;* locality, Labrador; donor, J. S. Shearer.

2. A specimen of *Balanus Hameri* discovered at River Beaudette, P.Q., by Messrs. H. G. Stanton, C.E., and A. W. McNown.

3. White Chipmunk, *Tamias striatus ;* locality, Huntingdon Co., P.Q.; donor, W. H. Rintoul.

4. A magnificent specimen of the Woodland Caribou, presented to the Society by W. C. Van Horne.

A large amount of work was done amongst the specimens, nearly all those in the upper gallery having been rearranged, correctly named, and relabeled. The large collection from the Samoan Islands, presented last year, has been appropriately placed, the whole presenting a very attractive appearance. A new interest has been awakened in the Museum among the citizens and strangers visiting the city, as is evinced by the large number of persons admitted to inspect its contents, in 1888—an increase of 300 per cent. upon the previous year. Never has there been a year in the history of the Society in which so many scholars and students have taken advantage of the privileges of the Museum as during the year now closed. In these circumstances, the Society unanimously resolved to invite the pupils and students attending the various schools and colleges of the city to visit their Museum every Saturday, free of charge, when accompanied by a teacher. In this way, it is hoped that the educational influence of the Society will be greatly extended.

The Library, which is under the care of Mr. E. T. Chambers, contains upwards of 3,000 volumes, many of which are rare, and are to be found in no other library in Canada.

During the year four numbers of 'The Canadian Record of Science' were issued by a committee of the Society, in which the discoveries and observations made by members have been published, and thus preserved and put within the reach of future students of science.

There were thirty-eight additions to the membership during the past year, bringing up the number now on the list to 264. The only sources of income possessed by the Society, besides the fees of members, is the rental derived from the hall and other portions of their buildings. The Government of the Province of Quebec has, however, made a grant to the Society of $400, and this timely donation has enabled it to carry on its work in the modest manner that characterizes it.

The Royal Society, as the patron of the Science as well as of the Literature of the Dominion, may be disposed to listen patiently to these details regarding the work of one of the oldest of the Societies to which it has been pleased to extend its countenance. The Natural History Society of Montreal is

doing its share in promoting the advance of knowledge in Canada. It is a hopeful sign when merchants and manufacturers pause in the midst of their pursuit of gain to occupy themselves with the wholesome task of studying God's works in nature, by the help of the microscope or crucible. This is no uncommon phenomenon in Montreal, and to the Natural History Society a large share of the credit is due of fostering so enlightened a taste; while the success of the Society itself is, in turn, largely due to the hearty coöperation and countenance of the scientific experts belonging to the staff of McGill University. The field for observation and investigation presented by our country is large and varied; but the band of scientific explorers is still very limited. This, however, is a state of things which may be expected every year to improve, and the Royal Society, whose function it is to take the lead in all matters pertaining to the progress of knowledge in the Dominion, may, in return for its countenance and encouragement, count upon the continued zeal and earnestness of the Natural History Society of Montreal, in advancing that special department of knowledge with which its name is associated.

It is understood that the question of holding the meetings of the Royal Society in different parts of the Dominion is mooted. If it shall be thought advantageous to assemble occasionally elsewhere than at the Capital, I feel that I may take it upon me to say, that should it be your pleasure to fix upon Montreal as your next place of meeting, the Society which I have the honor to represent here to-day will extend to you a cordial welcome, and I am sure I may say also on behalf of the other affiliated societies, that they will join heartily in the endeavour to make your stay in the city pleasant and profitable.

XII.—From *The Natural History Society of New Brunswick*, through Prof. Bailey.

I have the honor to report, on behalf of the Natural History Society of New Brunswick, that in January, 1889, the Society completed the twenty-seventh year of its existence, under the presidency of Mr. G. F. Matthew, appointed in succession to the late Dr. LeB. Botsford, who for a number of years past has honorably occupied the presidential chair.

During the year now closed the Society has made a fair degree of progress, and has been assisted by the usual grant from the Provincial Legislature. Considerable additions have been made to the library by donations, by purchase, and by exchange of publications; among them there is a donation of books on English archæology, presented by the coadjutor Bishop, the Right-Rev. Dr. Kingdon.

The museum also has received considerable accessions during the past year, and affords a source of pleasure and instruction to numerous visitors.

Nine regular meetings have been held during the past year, at which the following papers were read:—

1888.

Feb'y 7. Echinodermata of New Brunswick, by W. F. Ganong.

March 6. Oyster beds of New Brunswick, by Rev. H. W. Winkley.

Does our Indigenous Flora give Evidence of a recent Change in Climate? by Jas. Vroom.

April 3. The Habits of Birds, by M. Chamberlain.

May 1. History of Fossil Plants, by G. F. Matthew.

" 16. Weeds, by G. U. Hay.

Oct. 2. Meteorological Instruments and their Uses, by W. F. Best.

Nov. 6. Earliest Denizens of the Land and Air, by G. F. Matthew.

Dec. 4. Zoological notes, by W. F. Ganong.

1889.

Jan. 6. Some Characteristics of Molluscs, by G. F. Matthew.

A series of elementary lectures in natural history, etc., specially designed for instruction of teachers, was given in the course of the winter, and was well attended.

The Society took advantage of the presence here during the summer of Sir Wm. Dawson, to tender him a reception. This was due to him not only on account of the eminent position which he has attained in the scientific world, but also because he, many years ago, suggested the formation of the Natural History Society of New Brunswick, of which he was the first honorary member. On this occasion a very pleasant and enjoyable hour was spent by the members of the Society and their guests.

The Seventh Annual Bulletin of the Society (which accompanies this report) contains Mr. Ganong's paper on the Echinodermata of New Brunswick and the papers read by Messrs. Winkley and Vroom. It also contains a historical sketch of the Society from the pen of our late president, Dr. LeB. Botsford.

XIII.—From *The Society for Historical Studies, Montreal*, through Mr. J. P. Edwards.

On behalf of the Society for Historical Studies of Montreal, I have the honor to report that during the past season regular meetings of the Society have been held, and its membership has shown a steady increase. The papers read have, with one exception, been devoted to Canadian history and biography; they comprise:—

1888. Nov. 21. The Family Compact, by Mr. John Fair, Jun.
Dec. 5. Canadian Histories, by Mr. John Reade.
" 19. Marquette, by Mr. John Lesperance.
1889. Jan. 30. Early Legislative Proceedings in Canada, by Mr. R. C. Smith.
Feb. 13. Sir James Kempt, by Mr. W. W. L. Chipman.
" 27. The Psychology of Realism in recent French Fiction, by Mr. Thos. McDougall.
March 13. The Battle of Chateauguay, by Mr. W D. Lighthall.
" 27. Sidelights in Canadian history, by Mr. Henry Mott.
April 24. The Jesuits Estates in Canada, by Mr. R. S. White, M. P.

The want of a publication connected with the Society has long been felt, but I am happy to report that this has been remedied by our Vice-President, Mr. W. J. White, who commenced in January last a monthly magazine called 'Canadiana,' devoted exclusively to Canadian history, and identified with the interests of this Society.

I may be permitted to state that special attention is being given by many of our members to the acquisition of rare books, letters, etc., bearing on the early history of this country, and that during the past season many such have been added to their collections; these will bear fruit in coming papers. To a large degree this is due to the interest in Canadian historical matters awakened by this and similar societies.

XIV.—From *The Nova Scotia Historical Society*, through Mr. J. M. Oxley.

List of papers read before this Society during the season of 1888–9:—

1888. Nov. 13. Pictographs on Rocks at Fairy Lake, by George Creed.
Dec. 20. The Northwest Territory and Red River Expedition, by Lt.-Col. George Wainewright.
1889. Jan. 15. Early Settlers of Sunbury County, by Jas. Hannay.
March 12. Memoir of Governor Paul Mascarene, by J. M. Hubbard.
April 19. Fables and Traditions of the Micmac Indians, by Rev. S. T. Rand.

XV.—From *The Hamilton Association, Hamilton, Ont.*, through Mr. JAMES FLETCHER.

The Session just closing has been, on the whole, a successful one, whether the character of the work done, or the interest of the members therein, be considered.

Six general meetings of the Association have been held during the season, at which the following papers were read :—

1. The Hittites, by the President, Rev. Samuel Lyle, B.D.
2. Notes on Primitive Man, by Mr. William Kennedy.
3. Notes on the Waverley Novels, (Part. II), by Rev. C. H. Mockridge, D.D.
4. History of Pottery and Ceramic Art, by S. J. Ireland, Principal of the Hamilton Art School.
5. Selenography, with photographic illustrations of the Moon's Surface, by Mr. H. B. Wilton.
6. Notes on the Lingulæ of the Silurian Rocks, by Col. C. C. Grant.
7. Notes on the Origin of Chert (Flint) in our local Niagara Rocks, by Col. C. C. Grant.

In addition to these meetings the Biological Section has held bi-monthly meetings, and has done a considerable amount of "field-work."

In Botany, this Section is engaged in getting together a complete collection to represent the Flora of the district. Already six plants have been noted which have not been included in any previously published list of the Flora Hamiltonensis.

In Entomology, Mr. J. Alston Moffat reports that during the past season he has found twenty-five specimens new to him, and some of them possibly new to Canada.

In Conchology, Mr. A. W. Hanham has done excellent work in the collection of sixty-four species of shells, one of which *Pomatiopsis lapidaria*, is a terrestrial specimen of a fresh-water genus new to the Dominion.

The following papers, some of which will be printed in full in the Transactions of the Society, were read before the Section:—

1. Is Species a Natural or an Artificial Division in Nature? by Mr. J. Alston Moffat.
2. Notes of a Trip to the West Indies, by Mr. B. E. Charlton.
3. The Lake Erie Shore as a Botanizing Field, by Mr. T. J. W. Burgess, M.B., F.R S.C.
4. Notes of a Trip to South Carolina, in February, 1889, by Mr. T. W. Reynolds, M.D.
5. Plant Color, by Mr. A. Alexander.
6. The Land and Fresh Water Shells of the Hamilton District, by Mr. A. W. Hanham.

Many valuable notes on Biological subjects have been contributed by Mr. Wm. Yates, of Hatchley, Ont , a corresponding member of the Association, giving evidence of much original thought and close and minute investigation.

Thirteen new members have been added to the roll during the session, making the present membership 153.

Many valuable additions to the Museum and Library have been made.

As the Annual General Meeting is not held until the second Thursday in May the list of Officers for the ensuing year, with statement of receipts and expenditure, cannot be furnished, but will be forwarded to the Secretary of your Honourable Body as soon as the elections take place, for incorporation in our report.

Reports of Sections.

The Secretaries of the four Sections then in due order presented their Reports, as follows:—

Rapport de la Section I.

Nous avons l'honneur de vous présenter le rapport suivant: —

Onze membres ont assité aux séances des 7, 8 et 9 de ce mois. Il a été lu huit études, et plusieurs discussions sur des matières historiques et littéraires ont occupé les membres.

Nos élections ont eu le résultat qui suit:

Président, Joseph Marmette.
Vice-Président, Napoléon Legendre.
Secrétaire, Alphonse Lusignan.

La section recommande qu'il soit accordé un diplôme d'honneur à M. Edmond Lareau, député, pour ses travaux historiques durant l'année 1889.

Le tout respectueusement soumis.

A. Lusignan, *président.*
Benjamin Sulte, *secrétaire.*

Report of Section II.

I have the honour to report that Section II has elected as office-bearers for the ensuing year:—

John Watson, M.A., LL.D., *President.*
George Stewart, Jun., D.C.L., LL.D., D. Litt., *Vice-President.*
J. Clark Murray, LL.D., *Secretary.*

The committee on publications is composed of Very Rev. Principal Grant, D.D., and Dr. George Stewart.

The following papers were read:—

I. On the Study of Political Science in Canadian Universities. By J. G. Bourinot, LL.D.
II. Trade and Commerce in the Stone Ages. By Sir Daniel Wilson, LL.D.
III. The Historical Influence of Physical Geography. By the Same.
IV. The Cartography of the Gulf of St. Lawrence, from Cartier to Champlain. By W. F. Ganong, M.A. (Submitted by Dr. Stewart.)
V. Expeditions to the Pacific. By Sandford Fleming, C.M.G., LL.D.

Excuses for non-attendance were received from Dr. Watson, and Messrs. Geo. Murray, John Lesperance and John Reade.

George Stewart, Jun., *Secretary.*

Report of Section III.

The number of members in attendance was fourteen out of a possible nineteen. The absent members were: Prof. Cherriman, Messrs. C. Baillargé, E. Haanel, T. S. Hunt, and J. G. McGregor. Of these, the first and three last-mentioned were known to be absent from unavoidable causes, and one of them, Mr. McGregor, contributed two papers, leaving but one whose absence was unexplained.

The papers laid before the Section amounted to eighteen; of these the following were read in full, in abstract, or by title:—

I. Trilinear coördinates on the Sphere and Oblique Coördinates in Geometry of Three Dimensions. By Prof. Alexander Johnson, LL.D.

II. On the Expansion of Sin $O.$, Cos $O.$, and Tan $O.$, Without the Use of Limits. By Prof. N. F. Dupuis, M.A.

III. On the Expansion of Δx Without the Use of Limits. By Prof. N. F. Dupuis, M.A.

IV. On the Expression of the General Bernoullian Number as a Combinational Determinant. By Prof. N. F. Dupuis, M.A.

V. On an Elementary Way of Obtaining the Discriminant of the General Quadratic. By Prof. N. F. Dupuis, M.A.

VI. On the Shearing Forces and Bending Movements Produced at the Different Points of the Chords of a Bridge Truss by the Passage of an Arbitrarily Distributed Live Load. By Prof. H T. Bovey, M.A., C.E.

VII. On the Variation of the Density with the Concentration of Weak Aqueous Solutions of Certain Salts. By Prof. J. G. McGregor, M.A., F.R.S.E.

VIII. On the Contraction of Weak Aqueous Solutions of Certain Sulphates. By Prof. J. G. McGregor, M.A., F.R.S.E.

IX. A Problem in Political Science. By Sandford Fleming, C.M.G., C.E.

X. Annotated List of Minerals Occurring in Canada. By G. C. Hoffmann, F. Inst. Chem.

XI. On the Hygroscopicity of Certain Canadian Fossil Fuels. By G. C. Hoffmann, F. Inst. Chem.

XII. Refraction Through a Prism. By Prof. J. Loudon, M.A.

XIII. Relations Between the Sum of the Moments (G) and the Virial (V) of a Set of Coplanar Forces before and after Rotation through an Angle $O.$ By Prof. J. Loudon, M.A.

XIV. Reciprocal Lines of Force. By Prof. J. Loudon, M.A.

XV. On a National Standard of Pitch. By Prof. J. Loudon, M.A.

XVI. On Some Unexplained Anomalies in the Flame-Reactions of certain Minerals and Chemical Bodies. By Prof. E. J. Chapman, Ph. D., LL.D.

XVII. On a Graphic Construction for Occultations and Eclipses. By Prof. N. F. Dupuis, M.A.

The following resolutions were adopted:—

It was moved by Prof. A. Johnson, LL.D., seconded by Dr. G. P. Girdwood, and carried:—"That this Section is of opinion that it is desirable that a Conversazione be held on the first evening of each Annual Meeting, at which there may be an exhibition of scientific apparatus and objects of interest in connection with the work of the Society."

It was moved by Prof. A. Johnson, LL.D., seconded by Mr. F. N. Gisborne, and carried:—"That a recommendation be submitted to the Society, that the following be appointed a committee to support and continue the action initiated by the British Association for the promotion of Tidal Observations in Canadian waters: Mr. Sandford Fleming, C.M.G., President; Sir William Dawson, Sir James Grant, Mr. C. Carpmael, Prof. H. T. Bovey, Mr. E. Deville and Prof. A. Johnson, with power to add to their number."

The consideration of the election of a new member, referred back from the General Meeting to the Section, resulted in its being moved by Mr. F. N. Gisborne, seconded by Mr. T. Macfarlane, and carried:—"That this Section is of opinion that the election for the present vacancy be commenced *de novo*."

The officers elected for the ensuing Session were:—

Sandford Fleming, C.M.G., C.E., *President.*
Monsignor T. E. Hamel, M.A., *Vice-President.*
G. C. Hoffmann, F. Inst. Chem., *Secretary.*

(Signed) Sandford Fleming, *Vice-President.*
G. C. Hoffmann, *Secretary.*

Report of Section IV.

The number of members of the Section present was eleven, but two who were not able to come sent papers which were duly read.

The number of papers read, either in full or by title, was sixteen.

The election of officers resulted as follows :—

President, G. M. Dawson.
Vice-President, Prof. W. Saunders.
Secretary, J. F. Whiteaves.

It was resolved :—

" That the Committee on Publication be the Retiring President, the President and Vice-President of the coming year, the Secretary, Sir James Grant, Dr. R. Bell and Prof. Saunders."

J. F. Whiteaves, *Secretary.*

Election of Officers, etc.

The meeting next proceeded to the election of officers for the ensuing year, and the following gentlemen were unanimously elected :—

President, Abbé Casgrain, LL.D.
Vice-President, Principal Grant, D.D.
Honorary Secretary, J. G. Bourinot, LL.D., D.C.L.
Honorary Treasurer, A. R. Selwyn, LL.D., C.M.G.

Miscellaneous Business.

The following resolutions were then adopted :—

1. " *Resolved*—That the second paragraph of Rule 5 be amended so as to read as follows : 'The Council of the Society shall consist of the officers so elected, and of ex-Presidents, during three years from the date of their retirement from the office of President, and of such ex-members of Council, not exceeding four in number, as may be selected by the Council itself. The ex-members, so elected, shall continue in office for three years, and afterwards until successors are appointed.' " (On motion of Prof. Johnson, seconded by Dr. Stewart.)

2. " *Resolved*—That the matter of electing the President of the Society for a longer term than one year, as by the present rule, be referred for consideration to the Council, who shall report thereon at the next general Annual Meeting of the Society." (On motion of Sir Daniel Wilson, seconded by Principal Grant.)

3. " *Resolved*—That the following gentlemen be appointed members of a committee to support and continue the action initiated by the British Association for the promotion of Tidal Observations in Canadian Waters :—Dr. Sandford Fleming, Sir W. Dawson, Sir James Grant, Mr. Carpmael, Prof. Bovey, Mr. Deville, Prof. Johnson, with power to add to their numbers." (On motion of Prof. Johnson, seconded by Mr. Gisborne.)

4. " *Resolved*—That the following gentlemen be appointed a delegation to the meeting of the American Association for the advancement of Science, in Toronto, on August 26th next:—Prof. Laflamme, Dr. Selwyn, Prof. Bailey, Mr. W. Saunders, and Dr. Harrington, with power to add to their number." (On motion of Dr. Selwyn, seconded by Sir James Grant.)

5. " *Resolved*—That the thanks of the Society be tendered to the Speakers of the Senate and

House of Commons, for the courtesies extended to its members during this session." (On motion of Sir James Grant, seconded by Sir W. Dawson.)

6. "*Resolved*—That the members of the Society, present in Ottawa at the time, form a delegation to extend a kindly greeting to the Mining Engineers who are to assemble in the Capital in October next." (On motion of Dr. Selwyn, seconded by Mr. Gisborne.)

The President announced that he had appointed the following gentlemen to act as a Committee with respect to the Imperial Institute, in conformity with the resolution passed by the Society on Tuesday last:—Dr. Bourinot, Dr. G. M. Dawson, James Fletcher, F. N. Gisborne, Benjamin Sulte, Thomas Macfarlane, and Prof. Laflamme.

The thanks of the Society having been given to the officers of the past year, the meeting adjourned.

THE ROYAL SOCIETY OF CANADA.

FOUNDER: THE RIGHT HONOURABLE THE MARQUIS OF LORNE.

OFFICERS FOR 1889-90.

HONORARY PRESIDENT AND PATRON:

HIS EXCELLENCY THE RIGHT HONOURABLE THE LORD STANLEY OF PRESTON, G.C.B.

PRESIDENT - - - -	ABBÉ H. R. CASGRAIN, LL.D.
VICE-PRESIDENT - - -	VERY REV. GEO. M. GRANT, D.D.

EX-PRESIDENTS.

MONSIGNOR HAMEL, M.A.
G. LAWSON, PH. D., LL.D.
SANDFORD FLEMING, C.M.G., LL.D.

OFFICERS OF SECTIONS.

SEC. I.—French Literature, History, and Allied Subjects.

PRESIDENT - - - -	JOSEPH MARMETTE.
VICE-PRESIDENT - - -	NAPOLÉON LEGENDRE.
SECRETARY - - - -	A. LUSIGNAN.

SEC. II.—English Literature, History, and Allied Subjects.

PRESIDENT - - - -	J. WATSON, LL.D.
VICE-PRESIDENT - - -	GEO. STEWART, JUN., D.C.L., LL.D.
SECRETARY - - - -	REV. J. CLARK MURRAY.

SEC. III.—Mathematical, Physical, and Chemical Sciences.

PRESIDENT - - - -	SANDFORD FLEMING, C.M.G.
VICE-PRESIDENT - - -	MONSIGNOR HAMEL.
SECRETARY - - - -	G. C. HOFFMANN, F. Inst. Chem.

SEC. IV.—Geological and Biological Sciences.

PRESIDENT - - -	G. M. DAWSON, D. Sc.
VICE-PRESIDENT - - -	W. SAUNDERS.
SECRETARY - - - -	J. F. WHITEAVES, F.G.S.

HONORARY SECRETARY - - - -	J. G. BOURINOT, C.M.G., LL.D., D.C.L.
HONORARY TREASURER - -	A. R. C. SELWYN, C.M.G., LL.D.

The Council for 1889-90 comprises the President and Vice-President of the Society, the Presidents, Vice-Presidents and Secretaries of Sections, the Honorary Secretary, and the Honorary Treasurer, besides ex-Presidents of the Society (Rule 7) during three years from the date of their retirement.

THE ROYAL SOCIETY OF CANADA.

LIST OF MEMBERS, 1889-90.

I.—LITTÉRATURE FRANÇAISE, HISTOIRE, ARCHÉOLOGIE, ETC.

Bégin, S. G. Mgr L. N., Évêque de *Chicoutimi.*

Casgrain, l'abbé H.-R., LL.D., *Québec.*

Chauveau, P. J. O., LL.D., L.D., *Montréal* (ex-President)

Cuoq, l'abbé, *Montréal.*

De Cazes, Paul, *Québec.*

De Celles, A. D., *Ottawa.*

Fabre, Hector, *Paris, France.*

Faucher de Saint-Maurice, N., *Québec.*

Fréchette, Louis, LL.D., *Montréal.*

Legendre, Napoléon, *Québec.*

LeMay, Pamphile, *Québec.*

LeMoine, J. M., *Québec.*

Lusignan, A., *Ottawa.*

Marchand, l'hon. F.-G., *Saint-Jean, P.Q.*

Marmette, Joseph, *Ottawa.*

Routhier, A. B., LL.D., *Québec.*

Sulte, Benjamin, *Ottawa.*

Tanguay, Mgr Cyprien, L.D., *Ottawa.*

Tassé, Joseph, *Montréal.*

Verreau, l'abbé Hospice, LL.D., *Montréal.*

II.—ENGLISH LITERATURE, HISTORY, ARCHÆOLOGY, ETC.

Bourinot, John George, C.M.G., LLD., D.C.L., *Ottawa.*

Bucke, R. Maurice, M.D., *London, O.*

Dawson, Rev. Æneas Macdonell, LL.D., *Ottawa.*

Denison, Lt.-Col. G. T., B.C.L., *Toronto.*

Grant, Very Rev. G. M., D.D., Principal of Queen's University, *Kingston.*

Hale, Horatio, *Clinton.*

Kirby, William, *Niagara.*

Lesperance, John Talon, *Montreal.*

Lyall, Rev. W., LL.D., Dalhousie University, *Halifax.*

Mair, Charles, *Prince Albert, N. W. T.*

Murray, George, B.A., High School, *Montreal.*

Murray, Rev. J. Clark, LL.D., McGill University, *Montreal.*

McColl, Evan, *Kingston.*

Patterson, Rev. George, D.D., *New Glasgow.*

Reade, John, *Montreal.*

Smith, Goldwin, D.C.L., *Toronto.*

Stewart, George, Jun., D.C.L., D.L., F.R.G.S., *Quebec.*

Watson, J., M.A., LL.D., Queen's University, *Kingston.*

Wilson, Sir Daniel, LL.D., F.R.S.E., President of University of Toronto, *Toronto* (ex-President).

Withrow, Rev. W. H., D.D., *Toronto.*

III.—MATHEMATICAL, PHYSICAL AND CHEMICAL SCIENCES.

Baillargé, C., C.E., *Quebec.*

Bovey, H. J., M.A., C.E., McGill University, *Montreal.*

Carpmael, C., M.A., Superintendent of Meteorological Service, *Toronto.*

Chapman, E. J., Ph.D., LL.D., University of Toronto, *Toronto.*

Cherriman, J. B., M.A., *Ottawa.*

Deville, E., Surveyor General, *Ottawa.*

Dupuis, N. F., M.A., F.R.S.E., Queen's University, *Kingston.*

Fleming, Sandford, C.M.G., LL.D., C.E., *Ottawa* (ex-President).

Girdwood, G. P., M.D., McGill University, *Montreal.*

Gisborne, F. N., M.I.T.E.E., C.E., *Ottawa.*

Haanel, E., Ph.D., Victoria University, *Cobourg.*

Hamel, Monsignor, M.A., Laval University, *Quebec* (ex-President).

Harrington, B. J., B.A., Ph.D., McGill University, *Montreal.*

Hoffmann, G. C., F. Inst. Chem., Geological Survey, *Ottawa.*

Hunt, T. Sterry, M.A., LL.D., F.R.S., *Washington, D.C.* (ex-President).

Johnson, A., LL.D., McGill University, *Montreal.*

Loudon, J. T., M.A., University of Toronto, *Toronto.*

Macfarlane, T., M.E., *Ottawa.*

MacGregor, J. G., M.A., D.Sc., F.R.S.E., Dalhousie University, *Halifax.*

IV.—GEOLOGICAL AND BIOLOGICAL SCIENCES.

Bailey, L. W., M.A., Ph.D., University of New Brunswick, *Fredericton.*

Bell, Robert, M.D., C.E., F.G.S., Geological Survey, *Ottawa.*

Burgess, T. J. W., M.D., *Hamilton.*

Dawson, G. M., D.Sc., A.R.S.M., F.G.S., Geological Survey, *Ottawa.*

Dawson, Sir J. William, C.M G., LL.D., F.R.S., Principal of McGill University, *Montreal* (ex-President).

Fletcher, James, the Entomologist, *Ottawa.*

Gilpin, Edwin, M.A., F.G.S., Inspector of Mines, *Halifax.*

Grant, Sir J. A., K.C.M.G., M.D., F.G.S., *Ottawa.*

Laflamme, Abbé J. C. K., D.D., M.A., Laval University, *Quebec.*

Lawson, G., Ph.D., LL.D., Dalhousie University, *Halifax* (ex-President).

Macoun, J., M.A., F.L.S., Geological Survey, *Ottawa.*

Matthew, G. F., M.A., *St. John, N.B.*

MacKay, A. H., B.A., B.Sc., *Pictou.*

Penhallow, D. P., B.Sc., McGill University, *Montreal.*

Provancher, Abbé, *Cap Rouge, Quebec.*

Saunders, W., Director of the Experimental Farm, *Ottawa.*

Selwyn, A. R. C., C.M.G. LL.D., F.R.S., F.G.S., Director of the Geological Survey, *Ottawa.*

Whiteaves, J. F., F.G.S., Geological Survey, *Ottawa.*

Wright, R. Ramsay, M.A., B.Sc., University of Toronto, *Toronto.*

CORRESPONDING MEMBERS.

The Marquis of Lorne.

Bonney, T. G., D.Sc., LL.D., F.R.S., *London, England.*

Doucet, Camille, secrétaire perpétuel de l'Académie française, *Paris, France.*

Le Roy, Alphonse, professeur de philosophie à l'université de Liège, et membre de l'Académie royale de Belgique, *Liège, Belgium.*

Marmier, Xavier, de l'Académie française, *Paris, France.*

Parkman, Francis, LL.D., *Boston, Mass.*

Rameau de Saint Père, Edmè, *Adon, Loiret, France.*

RETIRED MEMBERS. (See Rule 7.)

Bourassa, Napoléon, *Montebello.*

Gilpin, J. Bernard, M.D., M.R.C.S., *Halifax.*

Osler, W., M.D., Johns Hopkins University, *Baltimore, Md.*

LIST OF PRESIDENTS.

1882–'83	Sir J. W. Dawson.
1883–'84	Hon. P. J. O. Chauveau.
1884–'85	Dr. T. Sterry Hunt.
1885–'86	Sir Daniel Wilson.
1886–'87	Monsignor Hamel.
1887–'88	Dr. G. Lawson.
1888–'89	Sandford Fleming, C.M.G.
1889–'90	Abbé Casgrain.

SOCIÉTÉ ROYALE DU CANADA

MÉMOIRES

SECTION I

LITTÉRATURE FRANÇAISE, HISTOIRE, ARCHÉOLOGIE, ETC.

ANNÉE 1889

I — *Montcalm peint par lui-même d'après des pièces inédites,*

Par L'ABBÉ H.-R. CASGRAIN.

(Lu le 9 mai dans la séance publique présidée par Son Excellence le gouverneur général, lord Stanley de Preston.)

I

Les grandes lignes de notre histoire sont tracées ; on ne les refera pas. Mais pour celui qui remonte aux sources, qui étudie à fond les textes originaux, que de lacunes encore à combler ! que de points laissés dans l'ombre ! que de physionomies à peine ébauchées ! Celles mêmes qui ont été étudiées avec soin manquent souvent de ces détails intimes qui donnent du relief et de la vie.

Une des figures les plus attachantes de notre histoire, celle de Montcalm, est de ce nombre. L'homme public, le militaire, a été mis en pleine lumière ; mais l'homme privé, le compagnon d'armes, l'ami, l'homme de société, est demeuré relativement peu connu.

C'est sous ce dernier aspect et dans ce nouveau jour que je me propose de le faire connaître aujourd'hui, en m'appuyant sur des pièces authentiques dont l'existence n'avait pas même été soupçonnée jusqu'à ces derniers temps. Je m'effacerai autant que possible pour ne laisser parler que le héros lui-même ; ce sera le côté piquant et vraiment original de cette étude.

On va voir revivre Montcalm, on va l'entendre converser, agir, méditer, discourir et même bavarder, selon sa propre expression, dans sa correspondance intime avec sa famille ; dans son journal, "écrit pour lui seul" ; dans cette multitude de lettres et de petits billets qu'il adressait continuellement à son grand ami, le chevalier de Lévis, pour qui il n'avait rien de caché, à qui il dévoilait les moindres replis de son âme, ses joies comme ses chagrins, ses espérances comme ses mécomptes, ses colères, ses penchants, ses antipathies, ses jugements secrets sur les hommes et les événements, et jusqu'à ses parties de plaisir, ses soirées chez l'Intendant, chez le beau monde de Québec : car c'est à Québec qu'il faisait son principal séjour ; tandis que son ami était obligé de résider à Montréal. Aussi, est-ce durant cette saison où les opérations militaires étaient suspendues, que la correspondance devient intéressante par les épanchements auxquels Montcalm se livre à loisir, en priant son confident de garder pour lui seul ces intimités.

On regrette que les réponses de Lévis, écrites sur le même ton, n'aient pas été conservées ; mais le chevalier n'a gardé copie que des lettres qu'il considérait comme importantes, et qui font aujourd'hui partie de la collection de ses manuscrits. Ces réponses compléteraient le tableau déjà si curieux et si vivant tracé par Montcalm. Toutefois il est probable qu'elles n'ajouteraient rien de bien saillant à son portrait ; car le meilleur peintre de Montcalm, c'est Montcalm lui-même.

On le sait, il était méridional ; son tempérament avait la chaleur du ciel de Provence ; il s'emportait facilement, mais revenait avec la même facilité. Un jour — c'était avant ses campagnes d'Amérique — il commandait à une grande revue qui avait lieu dans une des villes du Midi ; un de ses officiers, qu'il eut à réprimander pour sa tenue, hasarda quelques remarques un peu vives. Montcalm fut suffoqué de colère, et accabla le malheureux officier d'un tel flot d'invectives que toute sa suite en fut consternée. Il s'en aperçut et en éprouva de la confusion. Peu de temps après, dans une circonstance tout aussi solennelle, ayant vu venir le même officier, il courut à lui, l'embrassa en le serrant dans ses bras, et en lui disant : "Je vous aime comme mon fils, voilà pourquoi je vous reprends comme un père[1]."

Ce trait peint Montcalm au naturel : caractère impétueux, irascible, mais bon enfant. C'est dans ces qualités et ces défauts qu'il faut chercher l'explication des succès et des revers du général.

Sa correspondance se partage presque exclusivement entre trois personnes : sa mère, sa femme et son ami Lévis. Sa mère, la marquise de Saint-Véran, femme supérieure, véritable romaine, qui avait sur son fils une influence souveraine ; sa femme, caractère timide, un peu effacé, plus à la hauteur de son mari par le cœur que par l'intelligence ; Lévis, esprit mâle, froid, calculateur, en qui Montcalm reconnaissait un maître dans l'art militaire. Ses lettres portent une forte empreinte des sentiments que lui inspirait chacune de ces personnes. Avec sa mère, elles sont pleines de respect ; avec sa femme, elles respirent la tendresse ; avec Lévis, elles sont toutes d'abandon, d'amitié fraternelle et de confiance, même excessive.

Le style en est rapide, concis, souvent elliptique et même haché quand le temps ou la besogne le pressent ; alors sa petite écriture en pattes de mouches est presque illisible. Il en fait ses excuses à Lévis et lui promet d'être plus soigné la prochaine fois.

Partout on reconnaît un homme nourri des classiques et d'une lecture variée et assidue. Il avait eu pour précepteur son oncle de la main gauche, M. Dumas, un helléniste remarqué dans ce siècle où le grec et le latin étaient en si grand honneur. Il laisse courir sa plume à l'aventure, sachant bien que ses lettres ne sortiront pas du cercle de la famille et de l'amitié. C'est là un des grands charmes de sa correspondance. Il ne songeait pas que son nom allait devenir immortel sur cette terre d'Amérique où il s'en venait mourir, et qu'un jour la curiosité publique chercherait le secret de ses pensées sur ces feuilles jaunies laissées après lui.

Aussi le révèlent-elles tout entier dans ses plus nobles aspirations comme dans ses petits défauts, dans ses imperfections mêmes.

C'était un délicat : il aimait les choses de l'esprit, il dégustait un bon mot, une fine raillerie. Il dégustait aussi les bons pruneaux et les olives de Candiac : c'était un gourmet.

Il faisait grand cas des plaisirs de la table ; ce péché mignon de l'âge mûr. Il se félicite d'avoir emmené avec lui un excellent cuisinier. Il complimente sa femme sur le délicieux vin muscat qu'elle lui a envoyé.

"... Après vous avoir parlé de nos peines et de nos souffrances, écrit-il en remontant le Saint-Laurent à bord de la *Licorne*, il faut vous dire un mot de nos plaisirs : ç'a été de

[1] Cette anecdote est de tradition dans la famille du général et m'a été racontée par son arrière-petit-fils, le marquis Victor de Montcalm.

pêcher de la morue et d'en manger ; elle a un goût exquis ; la tête, la langue et le foie, qu'on n'envoie jamais en Europe parce qu'il faudrait trop de sel pour les conserver, sont des morceaux dignes de nos friands ; cependant je ne conseille à aucun de faire exprès le voyage. On fait avec le foie une sauce à la morue comme on la fait au rouget. Les têtes de morue font de très bonnes soupes [1]."

Dans un endroit de son journal, il ajoute : " La viande de boucherie m'a paru très bonne, de même que la volaille. Les bécassines, canards, sarcelles, aussi bonnes qu'en France, les perdrix excellentes, avec beaucoup de fumet. Malgré ce qu'en dit le P. de Charlevoix, je n'ai pas fait cas de l'outarde."

Le marquis était extrêmement soigneux de sa personne, il avait même un faible pour les parfums et les eaux de senteur. Dans ses lettres à sa femme, il lui recommande itérativement de lui envoyer des sachets, de l'eau de lavande, etc., etc.

Montcalm était d'une activité infatigable ; il pouvait passer autant d'heures à son bureau qu'à cheval ; le plus souvent il dictait : ses secrétaires en étaient parfois éreintés.

" ... J'ai reçu, je crois, trois cents lettres [2]," écrit-il à Lévis ; et il y répond sans désemparer.

La *Licorne* était venue mouiller non loin du cap Tourmente, où elle attendait le bon vent, qui ne s'élevait pas. Le général s'impatiente ; les pieds lui brûlent dans cette prison flottante où il est enfermé depuis six semaines. Il veut débarquer. Le rivage de Saint-Joachim est si proche ; la plage est si belle, et il n'y a que dix lieues de là à Québec. On lui représente qu'à cette saison les chemins sont presque impraticables. N'importe, il essayera. Il ordonne de descendre le canot, et se met en frais d'aller à terre.

Je cite son *Journal :*

" Du 10 may 1756. — ... Le temps étant toujours contraire, j'ai voulu me rendre à Québec par terre en abordant en chaloupe à un endroit appelé la Petite-Ferme, où l'on m'avait assuré que je trouverais des calèches ; mais, n'ayant pu y aborder, malgré les indications qu'on nous avait données, faute de connaître une petite rivière qui y mène, j'ai été jusqu'à la Grande-Ferme. Je n'y ai trouvé que des charrettes ; on m'a assuré que je ne pourrais m'y rendre dans le jour, et qu'il y aurait du danger à passer le Sault de Montmorency, qui a grossi par la fonte des neiges. J'ai pris mon parti de rejoindre la frégate, qui avait appareillé sur les onze heures, pour, en louvoyant et profitant du flot, venir au pied de la traverse, où elle a mouillé sur les deux heures, après avoir fait trois lieues."

" Du 12 may 1756. — ... Les vents continuant d'être toujours contraires, j'ai pris mon parti pour débarquer à un petit endroit appelé la Petite-Ferme, et me rendre par terre à Québec avec des petites voitures du pays, charrettes ou calèches, qui sont, comme nos cabriolets, conduites par un seul cheval. L'espèce de chevaux est dans le goût de ceux des Ardennes pour la force, la fatigue, et même la tournure. Le chemin de la Petite-Ferme à Québec est beau ; on le fait dans la belle saison en six heures ; on change à chaque paroisse de voiture, ce qui retarde, à moins qu'on n'en ait fait prévenir. On paye ces voitures à un cheval à raison de vingt sols par lieue. Les lieues sont déterminées sur celles de l'Ile-de-France. Je fus obligé de coucher en chemin chez M. de Buron, curé de la paroisse du Château. Les cures sont ordinairement possédées par des gens de con-

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[1] *A Madame la marquise de Montcalm, à Montpellier*, ce 11 may 1756.

[2] *Lettre au chevalier de Lévis*, datée de Québec, le 25 mai 1759.

dition ou de bonne famille du pays ; ils sont plus considérés qu'en France, mieux logés, et comme ils ont la dîme de tous grains, les moindres cures valent douze cents livres, et communément deux mille livres."

"Du 13 may 1756. — ... Les vents étant hier devenus nord-est, *Le Héros* est entré dans la rade de Québec et a débarqué ce matin neuf compagnies du régiment de La Sarre. La *Licorne* a profité du même vent pour entrer ce matin dans la rade, au moyen de quoi je ne suis arrivé que quelques heures après, et, en voulant me presser, j'y ai été pour de la pluie, de la fatigue et de la dépense."

Montcalm accompagne ce récit d'observations qui méritent d'être citées :

"... La côte, depuis l'endroit où j'ai débarqué jusqu'à Québec, m'a paru bien cultivée, les paysans très à leur aise, vivant comme de petits gentilshommes de France, ayant chacun deux ou trois arpents de terre sur trente de profondeur. Les habitations ne sont pas contiguës, chaque habitant ayant voulu avoir son domaine à portée de sa maison.

"J'ai observé que les paysans canadiens parlent très bien français, et comme sans doute ils sont plus accoutumés à aller par eau que par terre, ils emploient volontiers les expressions prises de la marine.

"Le Canada doit être un bon pays pour y vivre à bon marché en temps de paix ; mais tout est hors de prix depuis la guerre. Les marchandises qu'on tire de France viennent difficilement ; et, comme tout habitant est milicien, et qu'on en tire beaucoup pour aller à la guerre, le peu qui resté ne suffit pas pour cultiver les terres, élever les bestiaux et aller à la chasse ; ce qui occasionne une grande rareté pour la vie.

"Le seul gouvernement de Québec a fait marcher depuis le premier de mai trois mille miliciens, dont dix-neuf cents guerriers et onze cents hommes pour le service, et le roi qui ne leur donne aucune solde est obligé de les nourrir.

"M. Bigot, intendant, m'a donné à dîner avec quarante personnes. La magnificence et la bonne chère annoncent que la place est bonne, qu'il s'en fait honneur, et un habitant de Paris aurait été surpris de la profusion des bonnes choses en tout genre.

"L'évêque, M. de Pontbriand, prélat respectable, voulut me donner à souper, et M. le chevalier de Longueil, commandant la place en l'absence de M. de Vaudreuil, gouverneur général, que les opérations de la campagne retiennent à Montréal."

Montcalm n'aurait pas été un homme du dix-huitième siècle, s'il n'avait pas aimé le plaisir ; mais il savait le concilier avec le travail. La société de bon ton était pour lui un besoin. Avant même son départ pour le Canada, il s'enquiert de celle qu'il y rencontrera. "Je lis avec grand plaisir, écrit-il de Lyon, l'histoire de la Nouvelle-France par le P. de Charlevoix. Il fait une description agréable de Québec : compagnie choisie. Cependant rassurez-vous, j'en reviendrai toujours avec plaisir[1]."

Après un an de séjour au Canada, quand il a connu cette société, il ajoute :

"Montréal vaut Alais dans les temps de paix et mieux par le séjour de la généralité, car le marquis de Vaudreuil n'a aussi passé qu'un mois à Québec. Pour Québec, c'est comme les meilleures villes du royaume, quand on en a ôté une dizaine ; moins que Montpellier, mieux que Béziers, Nîmes, etc. ; le climat sain, le ciel pur, un beau soleil, ni printemps, ni automne, hiver ou été. Juillet, août et septembre comme en Languedoc ; et au camp de Carillon, où l'on est plus vers le sud, comme à Naples. Des jours de pou-

[1] A Lyon, ce 8 mars, 1756, à Mme de Saint-Véran.

drerie, l'hiver, insupportable, où il faut rester renfermés. Les dames spirituelles, galantes, dévotes à Québec, joueuses à Montréal, conversation et danse[1]."

Six mois après, il raconte à son ami la vie qu'il mène à Québec :

" ... Nous allons avoir des concerts. J'aimerais mieux causer avec M. le chevalier de Lévis que tous les plaisirs de Québec. Aussi, laissez venir les glaces, je gagne ma petite chambre de Montréal. Ma maison cependant fume moins, et il faut convenir qu'il y a bonne compagnie ici et plus de ressources qu'à Montréal pour les soirées. Nous avons deux bonnes maisons : l'hôtel Péan et Mme de la Naudière ; de loin en loin l'évêque, et parfois ma chambre ; l'intendance, deux jours de la semaine. Voilà ma vie[2]."

Le marquis se répandait volontiers dans la société, où il était recherché à cause de sa haute position, mais aussi à cause des grâces de son esprit, de sa gaieté et des charmes de sa conversation.

La vie douce et tranquille qu'il menait l'hiver était chèrement achetée durant le reste de l'année. L'activité de Montcalm pouvait à peine y suffire. Il en faisait une maladie à la fin de chaque expédition.

Trois mois après son entrée en campagne, en 1756, il s'était déjà signalé par la prise du fort Chouaguen (Oswego), 14 août. Il avait d'abord paru très satisfait des préparatifs de cette expédition, ordonnée par le marquis de Vaudreuil ; il avait même loué son activité ; mais, avant la fin de cette campagne, apparaissent déjà dans sa correspondance les premiers indices de ces tristes querelles entre lui et le gouverneur, qui devaient toujours aller en s'envenimant et devenir une des causes de la perte du Canada.

Il était difficile de trouver deux hommes moins faits pour se comprendre et pour agir de concert ; c'étaient deux natures absolument incompatibles. Montcalm, bouillant, impératif, orgueilleux de sa supériorité, souffrant mal la contradiction et humilié de recevoir des ordres qu'il méprisait ; Vaudreuil, esprit bienveillant mais faible, peu éclairé, jaloux de son autorité et entouré d'hommes corrompus qu'il était incapable de dominer.

Des conflits ne pouvaient manquer de s'élever entre ces deux commandants, et ces conflits, renouvelés sans cesse, aggravèrent leurs divisions et finirent par les rendre insupportables l'un à l'autre.

Une autre cause de mésintelligence naissait de l'antipathie profonde qui existait entre les troupes régulières et les milices canadiennes ; cette antipathie était encore plus violente entre les officiers de chaque corps, qui excitaient sans cesse la mauvaise humeur des deux commandants.

Trois jours après la prise d'Oswego, Montcalm annonce ce brillant succès à son ami Lévis, qui opérait alors à la tête du lac Champlain. Il lui donne en confidence son jugement sur quelques-uns des officiers français et canadiens ; c'est une boutade originale et satirique :

" ... Bourlamaque s'est très bien conduit, et, pour vous le prouver, Bougainville en convient. Je ne saurais trop me louer de mes aides de camp, de La Pause, de Malartic ; j'eusse succombé à la besogne sans eux, et La Pause est un homme divin qui m'a bien soulagé. Cela n'empêche pas que je sois excédé. Dites à votre camp que j'ai été très-content de Messieurs de la colonie. Souvenez-vous que Mercier est un ignorant et un

[1] A Montréal, ce 16 avril, 1757. — Dans une autre lettre, citée par M. Parkman, Montcalm fait une description semblable, mais moins détaillée.

[2] A Québec, le 7 novembre 1757.

homme faible ; Saint-Luc, un fanfaron et un bavard ; Montigny admirable, mais un pillard ; Ligneries, Villiers, Léry, bons ; Langy, excellent ; Marin, brave mais sot ; tout le reste ne vaut pas la peine d'en parler, même mon premier lieutenant-général Rigaud [1]."

L'approvisionnement de l'armée avait été une grave question pour cette expédition ; mais elle le fut bien plus encore pour celle de l'année suivante contre le fort William-Henry.

A son retour à Québec, en septembre 1757, Montcalm se trouva en face d'un ennemi plus redoutable que celui qu'il venait de vaincre ; cet ennemi, c'était la disette. Elle était générale dans toute la colonie et devait s'agraver durant les années suivantes, car la guerre enlevait presque tous les bras à la culture. Le cri d'alarme, que fait entendre Montcalm dans la lettre qu'on va lire, se continue à travers toute sa correspondance, jusqu'au dernier petit billet, en quatre lignes, qu'il adresse à Lévis, l'avant-veille d'Abraham.

"14 septembre 1757. — Nous allons nous trouver, Monsieur, dans les circonstances les plus critiques par le défaut de vivres. Nous manquons de pain, cette année ; les moyens que l'on va prendre pour y suppléer nous feront manquer de viande la prochaine. Quelques difficultés que les troupes qui sont dans les côtes éprouvent pour vivre chez l'habitant, leurs soldats seront encore moins à plaindre que ceux qui seront en garnison dans les villes. Les temps vont être plus durs, à certains égards, qu'à Prague. Je suis en même temps persuadé que ce va être le beau moment de gloire pour les troupes de terre, sûr d'avance qu'elles se prêteront à tout avec le meilleur ton et que nous n'entendrons aucunes plaintes ni jérémiades sur la rareté des vivres, puisqu'il n'y a aucun remède. Aussi, nous allons donner l'exemple de la frugalité nécessaire par le retranchement des tables et de la dépense, et qu'au lieu de se piquer de bonne chère, de dépense, et de se régaler, comme fait l'officier français, accoutumé à penser avec autant de noblesse que de générosité, celui qui vivra, si j'ose le dire, le plus mesquinement et qui par là consommera le moins, donnera les marques les plus sûres de son amour pour la patrie, pour le service du roi, et sera digne des plus grands éloges.

"Le régiment de la Reine, que j'avais cru bien traiter en lui donnant la ville de Québec, éprouvera, ainsi que celui de Béarn, que le séjour des villes n'est pas à désirer. Accoutumé à se prêter à tout et en ayant déjà donné des preuves à Prague, je n'attends pas moins d'eux dans les circonstances dont je vais vous informer.

"On espère que les habitants nourriront les bataillons qui seront dans les côtes ; ainsi il n'y a rien à prescrire à cet égard, que d'exhorter les soldats à se contenter du genre de nourriture de son habitant. Pour dans les villes, à commencer du 1er novembre, suivant ce qui vient d'être arrêté après un examen du peu de ressources que nous avons dans le pays, la ration du soldat sera de :

Une demi-livre de pain Un quarteron de pois	par jour.
Six livres bœuf frais Deux livres de morue	pour huit jours.

Et il est à craindre que nous ne puissions soutenir ce taux et qu'on ne soit obligé, avec le temps, de donner un peu de cheval. On ne donnera pas de lard actuellement, parce

[1] *Au chevalier de Lévis, au camp de Chouaguen*, 17 août 1756.

que cette ressource ne peut manquer, que les bœufs sont actuellement dans le temps de l'année où ils sont les meilleurs et rendent le plus.

"M. le marquis de Vaudreuil et M. l'Intendant, avec qui nous sommes convenus de ce que j'ai l'honneur de vous écrire, envoient leurs ordres à cet effet; le munitionnaire général en écrit à M. Pénissau, et je vous prie de vouloir bien y faire conformer les troupes.

"Les habitants de Québec et les Acadiens, plus à plaindre, seront réduits au quarteron [1]."

Au retour d'une excursion, Montcalm trouva la ville de Québec tout alarmée des mauvaises nouvelles reçues de Louisbourg. Il se moque en style de Rabelais de ces frayeurs qui ne devaient être que trop vite réalisées :

" Le 15 septembre 1757. — Je ne suis arrivé que d'hier au soir, mon cher chevalier ; je n'ai encore vu personne. De vous à moi, et ne citez pas : tout le monde fait ici c. c. dans ses culottes pour Louisbourg ; pour moi, qui ne suis pas naturellement peureux, j'attendrai tranquillement les événements."

Il continue : "Ce 20 septembre. — On court, mon cher chevalier, avec vos paquets et ceux de M. le général, après les deux vaisseaux qui sont partis ce matin ; on les attrapera. J'ai écrit comme saint Augustin, et j'ai tant travaillé que j'ai gagné mal de gorge, hémorroïdes, et clou à la joue. J'ai mis hier couteaux sur table : quatorze couverts cinq jours de la semaine, un quarteron de pain par tête... Je crois que je me plais à Québec. C'est pour vous seul. Je ménage les deux autels. Je n'ai encore été qu'une fois avec assez d'indifférence à celui où je voulais brûler de l'encens l'année dernière [2]."

" A Montréal, le 24 septembre 1757. — ... J'ai des clous, mon cher chevalier ; la pituite me suffoque ; l'asthme tue Bougainville. Je ne mange qu'un quarteron de pain ; je me purge demain, et me trouve bien ici ; c'est une capitale. J'avais résolu de ne jamais tenir d'enfant au baptême après l'honneur d'en avoir tenu un avec Mme la marquise de Vaudreuil ; cependant Arnoux m'y force avec Mme de la Naudière pour commère. J'alterne entre elle et Mme Péan, parfois Mmes Marin et Saint-Ours."

" A Québec, le 14 octobre 1757. — J'ai ouvert hier l'avis du retranchement des tables. M. de Vaudreuil l'a adopté et a promis de donner l'exemple ; toute la colonie a applaudi ; l'Intendant, pas trop. Il aime le faste, et ce n'est pas le cas. J'ai été d'avis d'un seul service, conformément à l'article seize de l'ordonnance. J'ai été d'avis qu'il ne fallait de tout l'hiver ni bals, ni violons, ni fêtes, ni assemblées. J'ai donné hier mon dernier grand repas, où j'avais nos puissances et cinq dames. Il a été splendide par le goût, la profusion et un double service d'entremets. J'aurai demain dix personnes avec un potage, quatre grosses entrées, une épaule de veau, une pièce d'entremets froid ; le tout servi ensemble, le bouilli relevant la soupe. Et voilà mon plan fait pour tout l'hiver. Je vous exhorte, comme votre ami, à n'avoir qu'un gros dîner bourgeois à un seul service pour les officiers arrivant des quartiers, ni violons, ni bals, ni fêtes...

" ... On crie beaucoup contre l'Intendant et la grande société, et je crois entre nous qu'on n'a pas tort. Moi, je me tais, mais j'ai un petit ami qui est homme à écrire la vérité et à la faire parvenir.

" J'ai été trois jours dehors pour faire la tournée de la côte du nord comme un maréchal

[1] *Lettre au chevalier de Lévis*, datée de Québec le 14 sept. 1757.

[2] Allusion au palais de l'Intendant.

de logis ; je l'ai faite par eau en allant et par terre en revenant avec Montbéliard, Bougainville et Pellegrin.

"M. de Vaudreuil n'est que d'avant-hier ici. Je lui ai déjà lâché quatre mémoires. Heureusement je les ai donnés à lire à Saint-Sauveur ; l'écriture m'absorbe et Marcel aussi."

"Le 24 octobre 1757. — L'Intendant a, d'avant-hier, commencé à servir à un seul domestique, et supprimé la pâtisserie, à cause de la farine.

"Dès qu'on commencera en décembre à donner du cheval au soldat, j'en fais ma provision pour l'hiver, et il y en aura toujours chez moi un plat...

"... Mon valet de chambre vous dira ma vie : ainsi toute la journée, lundi, mardi, mercredi, douze personnes ; jeudi, l'Intendant ; vendredi, quatre personnes ; samedi, douze ; dimanche, l'Intendant. Mes compliments à La Roche[1]. On ne peut vous aimer plus que je ne le fais. On ne saurait moins voir les dames."

"Le 2 novembre 1757. — ... Il me semble que notre ami Roquemaure est toujours le même et de plus en plus insupportable par son ton et ses propos...

"... Poulhariés est joueur..."

Le 26 octobre, Montcalm s'inquiétait de la maladie de M. de Villiers, attaqué de la petite vérole. M. Coulon de Villiers, frère de Jumonville, était un des officiers les plus estimés de la colonie. Il s'était distingué dans plusieurs expéditions, entre autres à la prise du fort Nécessité où il commandait, et au combat des Mines en Acadie.

"Le 2 novembre. — ... Je suis inconsolable de la perte du pauvre Villiers. Je n'écris pas à sa veuve ; mais dites-lui combien je regrette son mari et qu'indépendamment de tout ce qu'elle mérite par elle-même, je serai toujours fort aise de lui témoigner en toute occasion l'estime singulière que j'avais pour Villiers.

"... M. de Vaudreuil m'a fait l'honneur de dîner chez moi aujourd'hui, et part demain ou après..."

"Le 7 novembre. — ... J'ai été d'autant plus content du ton des soldats d'ici (entre nous) qu'ils ont été sollicités par le peuple à se mutiner ; et cela vient de ce que ce même peuple n'a point de confiance dans le gouvernement. Il croit, quoique cela ne soit pas vrai, que c'est une famine artificielle pour contenter l'avidité d'aucuns. Il a tort, mais l'exemple du passé et du présent l'autorise à cette opinion...

"... Que tous vos propos, mon cher chevalier, tendent toujours à inspirer une diminution dans le luxe et la dépense à nos officiers ; car le pays s'épuisera, et ils laisseront des dettes, d'autant plus que les Canadiens ont une grande facilité à leur prêter.

"... Comment diable ! votre ami Roquemaure et le mien, est-il toujours le même ? aussi, il passe dans l'esprit de tout le monde, sans excepter le maréchal de Mirepoix, pour une tête brûlée. J'ai eu beau lui rompre en visière, allant son train, il soutient que Chevert est un Jean-Foutre, un homme sans talents et un pillard. Je crois que, hors le maréchal de Mirepoix, le comte de Lautrec, le duc de Broglie et M. de Monconseil, quoique ce dernier soit haï et peu estimé, il n'y a guère d'officier général qu'il ne blâme. L'autre jour, il voulait que sa compagnie de grenadiers, qui a fait trois campagnes, ne fît pas fond à la formation de la nouvelle et me fît époumonner.

"Et j'ai beau l'interrompre, il croit faire l'éloge de d'Hébecourt et des officiers français,

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[1] M. de La Rochebeaucourt, 2d aide de camp de Montcalm.

en disant devant des Canadiens, qu'ils ont mené à Carillon, pour cinq, huit cents poules, soixante moutons, cinq ou six bœufs, du vin étranger ; moyennant quoi, on crie que le pays est dévasté. Quand celui-ci, qui ne manque pas d'esprit, m'a impatienté, arrive Trivio, qui heureusement est parti ce matin pour Beauport. Il joint à l'ennui, à la bêtise, le dessous d'un Dauphinois. Privat, qui est bon homme, est digne d'être de l'Académie française, auprès de ce nouveau venu."

"Le 11 novembre. — ... Je ne parle ni ne parlerai du petit écu du lieutenant de la Sarre détaché du camp de Saint-Jean à La Prairie. L'Intendant ne l'accorde que pour les officiers détachés pendant la campagne ès-villes de Montréal et Québec. Comme il accordait tout au commencement, il serait tenté de refuser tout. Les extrêmes se rencontrent toujours ; la règle est une suite du désordre ; l'avarice, de la prodigalité ; le retranchement des dépenses justes, la suite des dépenses inutiles ; la sévérité, de l'indulgence ; la diète, de trop manger ; la médecine, des mauvaises digestions : c'est ce qui est cause que je me suis purgé aujourd'hui."

La verve satirique de Montcalm avait de quoi s'exercer ; il ne s'en faisait pas faute dans l'intimité, et se vengeait ainsi de la réserve extérieure qu'il était forcé de s'imposer. L'administration coloniale avait toujours été plus ou moins entachée de péculat par suite de l'insuffisance des traitements accordés aux fonctionnaires publics ; mais le gouverneur La Jonquière inaugura un système de concussion inconnu avant lui, et Bigot y mit le comble.

Montcalm continue dans la même lettre :

" ... Cent trente-sept Acadiens, nouvellement arrivés, parce qu'ils mouraient de faim à l'île Saint-Jean, augmentent la consommation.

" ... Bourlamaque deviendrait quasi amoureux ; mais je crois qu'on aime ailleurs, sans beaucoup de retour. Pour moi, comme il me convient, aimant toujours à commercer les mêmes personnes, les voyant toutes, plus souvent celles chez qui je me trouve plus à l'aise et avec permission de tout dire, mais non de tout faire, dernier article qui m'intéresse peu, aussi je tiens à rester ici. Nous avons bien écrit et bien travaillé cet automne. Actuellement les rêveries du maréchal de Saxe me font rêver. Que La Roche vous fasse sa cour, vous plaise ; ce sera le moyen de me plaire."

" Le 19 novembre. — ... Ce n'est, Monsieur, que pour entretenir commerce que j'ai l'honneur de vous écrire par M. de Boishébert. Je n'ai voulu lui faire aucune interrogation concernant l'Acadie, d'où le P. Germain m'a écrit. Nous n'avons rien de nouveau. Vous verrez un grand garçon que je crois courageux et ingambe. Au retour je l'interrogerai et le jugerai mieux."

" Le 2 décembre. — ... On va donner du cheval à nos troupes. M. l'Intendant voulait une distribution toute en cheval et une toute en bœuf. Nous avons obtenu qu'on donnerait, à chaque distribution, moitié l'un, moitié l'autre ; et M. Cadet m'a dit écrire les même choses pour Montréal. Nos Acadiens meurent de misère, petite vérole.

" — ... Je vois des friponneries criantes de toutes parts. Ingénieur, artilleur ! Pauvre roi !..."

Quand on se rappelle que ce pauvre roi, c'était Louis XV, on est moins porté que Montcalm à s'attendrir sur son sort. Il aurait été plus juste de dire : pauvre peuple ! car, en définitive, la vraie victime c'était le peuple ; c'était sur lui surtout que retombait le fardeau de la guerre avec toutes ses calamités. Sous prétexte que les troupes du roi venaient défendre le pays, les habitants étaient forcés de servir sans aucune solde, et

tandis que leurs terres restaient sans culture, le prince fainéant qui siégeait à Versailles, leur envoyait à peine de quoi ne pas mourir de faim. Le peu de grains ensemencés par les vieillards, les femmes et les enfants, restés presque seuls dans les champs, étaient enlevés à l'automne au nom du roi, qui les payait en assignats dépréciés, que ce même roi devait renier plus tard, et qu'on retrouve aujourd'hui par liasses dans nos campagnes.

L'Intendant poussait la tyrannie jusqu'à faire poser les scellés sur les moulins, afin d'empêcher les habitants de mettre leur grain en farine.

D'autre part les officiers de l'armée régulière semblaient tenir peu de compte des sacrifices de tout genre imposés au peuple. Ils exigeaient des milices les plus durs travaux, et les faisaient servir aux postes les plus dangereux, soit comme éclaireurs, soit comme partisans dans les expéditions avec les sauvages. Ajoutez à cela que, suivant l'habitude des militaires dans tous les pays, ils les méprisaient et traitaient tout haut de lâcheté leur mode de faire la guerre, mode qui leur avait pourtant valu tant de succès. Ce ne fut qu'aux dernières campagnes que l'on comprit l'utilité de combiner ensemble les deux tactiques.

Presque tous ces officiers étaient sans fortune[1] et menaient la vie dissipée de leur siècle. Un trop grand nombre aimaient le jeu, et profitaient de l'imprévoyance et de la libéralité des Canadiens pour leur emprunter de l'argent, qu'ils prodiguaient ensuite à tout hasard. C'était une nouvelle cause de mésintelligence entre les militaires et les colons.

Au reste, tout en combattant ensemble pour la France, ils avaient des vues particulières bien différentes. Les soldats français, étrangers au pays, n'y avaient pas d'attache ; ils ne songeaient à se battre que dans l'espérance d'avoir de l'avancement et d'aller en jouir en France. Les Canadiens, au contraire, défendaient leurs propres foyers, combattaient *pro aris et focis*. Ils craignaient avec trop de raison que le roi de France, qui leur donnait si peu de secours, ne finît par les abandonner complètement, après avoir tant contribué à les ruiner. Ils s'inquiétaient de savoir si, à la fin de la lutte, on laisserait une bouchée de pain à leurs familles.

Ces divergences deviennent de plus en plus sensibles à mesure que les événements s'avancent ; mais elles éclatent surtout pendant les derniers mois de la guerre. Après la mort de Montcalm, les commandants français eurent le dessein de faire sauter la ville de Québec, s'ils ne pouvaient la garder, et de faire un désert de ses environs. Les habitants furent consternés et protestèrent énergiquement.

Bourlamaque, dans sa correspondance avec Lévis, l'année suivante, au moment où tout était désespéré, où trois armées avaient envahi le pays, où toute résistance devenait insensée, s'indigne contre les Canadiens parce qu'ils l'abandonnent et rentrent dans leurs foyers ; il rage contre la faiblesse de Vaudreuil, qui ne les fait pas fusiller. Or, le général Murray avait lancé une proclamation déclarant qu'il incendierait les maisons de tous les habitants qui ne seraient pas trouvés chez eux, et il tenait parole. Les Canadiens avaient fait pour l'honneur de la France plus qu'ils ne devaient ; mais cela ne faisait pas l'affaire de Bourlamaque et de ses compagnons d'armes, qui auraient voulu terminer la guerre avec plus de distinction, afin de pouvoir demander des grâces à la cour de Versailles. Les Canadiens n'espéraient plus rien de ce côté ; et il était tout naturel qu'ils cherchassent à sauver le peu d'épaves qui restaient de leur naufrage.

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[1] *Journal de Montcalm*

II

Montcalm était le type du soldat français : gai, entraînant, prenant les choses par le bon côté, supportant facilement la fatigue et les privations. Il badine avec Lévis sur la maigre pitance que la disette l'oblige de faire, et sur les divers plats de cheval, apprêtés à toute sauce, que lui sert son cuisinier.

" Le 4 décembre. — M. l'Intendant m'a dit, hier au soir, écrire à M. le général pour que l'on mît la garnison de Montréal au cheval comme celle d'ici, et de vous en prévenir. Nos troupes s'y prêtent ici de bonne grâce, et je ne doute pas qu'il en soit de même de celles qui sont sous vos ordres. Cet article ne regarde que la ville de Montréal. C'est un si petit objet que le fort de Chambly que je doute qu'il faille l'y étendre, d'autant mieux que les soldats n'ont pas déjà été trop contents d'une différence entre eux et ceux du fort Saint-Jean, sur le fait du pain. Cependant, si l'on voulait qu'ils fussent aussi à la chair de cheval, il faudrait bien qu'ils y passassent comme les autres. Ils ne sont pas de meilleure maison, ni plus difficiles à mener. Observez que nous sommes convenus qu'au lieu de donner toute une distribution en cheval et toute une distribution en bœuf, on donne moitié l'un, moitié l'autre. Nos soldats l'ont mieux aimé comme cela. Si les vôtres l'aimaient mieux autrement, on peut leur donner cette douceur. Au reste on mange chez moi du cheval de toute façon, hors à la soupe :

" Petits pâtés de cheval à l'espagnole,

" Cheval à la mode,

" Escaloppe de cheval,

" Filet de cheval à la broche avec une poivrade bien liée,

" Semelles de cheval au gratin,

" Langue de cheval en miroton,

" Frigousse de cheval,

" Langue de cheval boucanée, meilleure que celle d'orignal,

" Gâteau de cheval, comme les gâteaux de lièvres,

" Cet animal est fort au-dessus de l'orignal, du caribou et du castor."

" Le 16 décembre. — Je réponds par celle-ci, mon cher chevalier, à votre épitre du 10. J'ai lu avec plaisir votre détail, et je vois que votre présence est aussi utile à Montréal que la mienne ici. Tout y va bien sur le fait du cheval. Les grenadiers de la Reine avaient un peu tortillé ; mais Bras-de-fer, c'est-à-dire d'Hert, a tortillé le premier caporal ; et cela n'est pas même su. Il faut même vous dire que les soldats de la Reine qui sont casernés, avantage que vous n'avez pas à Montréal, sont contents. Le soir, ils mettent cuire le cheval, l'écument bien, jettent la première eau, le retirent, en font le lendemain de la bonne soupe en le remettant au pot avec le bœuf, mangent le bœuf qui a servi à faire la soupe, bouilli le matin, et le soir le cheval en frigousse. La colonie fait de même...

" ... Rien n'est mieux que votre conduite au sujet des jeux de hasard. Voici le détail de ce qui se passe à cette occasion à Québec, que vous pouvez ne pas laisser ignorer à nos officiers. On n'a jamais joué chez Mme Chevalier, mais bien chez une madame du régiment de Guyenne, il y a un mois ; le mari puni par moi ; défense ; nulle récidive. Chez M. l'Intendant, il a ouvert lui-même par un beau tope-et-tingue, où il a gagné cent louis ; beaucoup de quinze aux douze francs la fiche ; de gros passe-dix, de gros tris aux vingt francs la fiche, six francs pour spadille et deux louis de queue. Dimanche, il

y aura grand souper à quatre-vingts couverts, beaucoup de dames, concert, lansquenet à neuf coupeurs, qui seront : M. l'Intendant, Mme Péan, MM. de Béran, de Saint-Félix, capitaines dans Berry ; L'Estang, de Selles, de la Sarre ; Belot, de Guyenne ; La Naudière, Saint-Vincent, Mercier, de la colonie.

" Demain, MM. de Roquemaure, d'Aiguebelle, de Manneville, de Villemontée font lecture d'une lettre que je leur ai écrite pour annoncer : 1o que, si l'on joue partout ailleurs que dans les maisons privilégiées par des considérations qui leur sont dues, je punirai ; 2o que j'exhorte à jouer, s'il est possible, avec sagesse. Je remontre la différence de notre position avec celle des colons, mes regrets de voir quitter le service à un officier pour dérangement, et celui de laisser pour gage un officier, au départ des bataillons, qui aurait des créanciers qui se plaindraient. D'Hert a ordre de s'informer si l'on joue ailleurs, de m'en rendre compte, d'ordonner punition si c'est chez nous, et de m'avertir si l'on joue chez des officiers de la colonie ou des bourgeois. Le jeu chez La Veranderie a dû être occasionné par un M. des Auniers, grand joueur, qui y est logé. Bougainville, que je vois, on ne saurait moins, perd ; ce sont ses affaires, ainsi que La Rochebeaucourt ; ce dernier a moins de ressource que le premier.

" Rien de mieux, ce me semble, que ce que fait actuellement M. de Vaudreuil, et la seule chose à faire cet hiver.

" L'Intendant aura le malheur de finir par être détesté, et cela doit être pour qui ne met aucun ordre dans les commencements.

" L'Intendant supprime aujourd'hui, demain, samedi et dimanche matin, sa table, en tout ou partie ; et moi, j'augmente un peu la mienne ; il le fait pour avoir des petits pains qui ne pèsent pas trois onces.

Bourlamaque a commencé à donner à manger trois fois la semaine. Il est triste, ce me semble, s'ennuyant. Il a fait l'*inamorato* de ma commère ; il n'a pas réussi, pour moi. Mme Péan, ma commère, de loin en loin l'évoque ; voilà mes veillées. Je suis bien avec nos dames, comme je veux être.

" Je suis bien aise que vous ayez Péan ; dites-le lui. De tout ce qui approche le général, c'est le plus sage, le moins sujet à prétentions et préventions, et le plus capable de lui faire prendre un bon parti sage et ferme dans l'occasion..."

III

La petite rue du Parloir était un des principaux centres où se réunissait le beau monde de Québec ; deux salons surtout y étaient recherchés : celui de Mme de la Naudière et celui de Mme de Beaubassin, toutes deux renommées pour leur élégance et leur esprit. Montcalm s'y plaisait si bien, qu'il prend la peine d'indiquer l'endroit précis qu'occupait chacune de ces deux maisons : l'une, dit-il, au tournant de la rue près des ursulines ; l'autre, à l'encoignure de la rue du Parloir et de la rue Saint-Louis. Mme de la Naudière, née Geneviève de Boishébert, était fille du seigneur de la Rivière-Ouelle, et Mme Hertel de Beaubassin, née Catherine Jarret de Verchères, était fille du seigneur de Verchères. Leurs maris servaient tous deux en qualité d'officiers de la milice canadienne. C'est aussi dans la rue du Parloir que demeurait Mme Péan, née Davennes des Meloises, dont il est souvent question dans les lettres de Montcalm.

Les charmes de la conversation de Mme de Beaubassin semblent avoir eu particulièrement de l'attrait pour Montcalm, car son salon était celui qu'il fréquentait le plus souvent. Ailleurs, comme chez l'Intendant, ou chez Mme Péan, il se désennuyait, quelquefois il s'étourdissait ; chez Mme de la Naudière, il s'intéressait ; mais chez Mme de Beaubassin, il s'attachait. La condescendance ou la politesse l'entraînaient ailleurs ; ici, c'était l'amitié.

A l'aide de la correspondance de Montcalm, on ressuscite à peu près toute la société qui animait cet élégant salon. Le plus assidu était ce grand officier ingambe, que Montcalm croyait courageux, mais qu'il n'aimait pas : c'était M. de Boishébert, frère de Mme de la Naudière, qui revenait chaque hiver de l'Acadie, où il exerçait le commandement et encore plus le pillage. Un autre personnage bien plus important y apparaissait aussi, mais rarement. Quand son équipage s'arrêtait dans la rue du Parloir et que ses gens lui ouvraient la portière, les domestiques de la maison se précipitaient à sa rencontre et le conduisait au salon, où son arrivée suspendait pour un moment la conversation. A l'élégance de son habit, aux fines dentelles de son jabot, à ses manchettes richement brodées, à ses cheveux roux, poudrés, musqués, on reconnaissait l'intendant Bigot. Péan et sa femme l'accompagnaient souvent. Puis venaient les Longueil, les Saint-Ours, les La Naudière, les Baby, les Villiers, le docteur Arnoux avec sa femme, plusieurs des officiers de l'armée de terre, — c'est ainsi qu'on nommait les troupes régulières. Bourlamaque y portait sa figure triste et mélancolique ; Bougainville s'y faisait remarquer par son esprit janséniste, ses critiques mordantes, quelquefois par son humeur maussade ; Roquemaure, par ses excentricités.

Envisagée dans son ensemble, la haute société canadienne offrait alors un spectacle navrant. L'exemple de celle qui arrivait de France lui avait été funeste, et les désordres de la guerre, la présence des troupes, achevaient de la perdre, du moins en grande partie.

On était témoin d'un état de choses qui ne pouvait durer : l'anarchie du haut en bas de l'échelle sociale. On pressentait la fin d'un règne ; on voyait venir un orage terrible. Cet orage allait-il tout engloutir ? On ne le savait pas ; on en détournait la tête ; on ne voulait pas y penser, et l'on tâchait de s'étourdir sur le danger. Pour y mieux réussir, on se plongeait dans le plaisir ; on s'y livrait avec fureur. Toute cette société aveuglée dansait sur un volcan.

" Le 26 décembre. — ... On ne parle ici, écrit Montcalm, que de cent louis gagnés, perdu cent cinquante louis, des momons de mille écus. Les têtes sont totalement tournées. La nuit dernière, Mercier a perdu trois mille trois cents livres. M. de Cadillac, à quatre heures après-midi, hier, avait perdu cent soixante louis ; avant minuit, il en gagnait cent. On dit que ce sera le jour des Rois que cela sera beau. Pour moi, je joue aux cinq sols le tri, aux trente sols le piquet, aux petits écus à tourner...

" ... De tout ce qui se mêle de gouvernement, Péan est le plus sensé. Poli, honnête, obligeant, bon usage de son bien ; la tête ne lui tourne pas. Il saisira un bon avis que vous ou moi ouvrirons, et le fera passer, s'il peut. Parlez-lui d'avance des mauvaises peaux de chevreuil.

" Une lettre n'est jamais longue, mon cher chevalier, que par les inutilités. Il n'y en a point dans les vôtres. Je regrette fort Mme de Repentigny...

" Votre petit Johanne[1], hardi joueur, gagne de trois à quatre cents louis ; il joue des cent louis par coup de dés...

" ... Vous pourriez trouver mes lettres longues, d'après ma définition, vu les inutilités bien étrangères au service ; mais mon bavardage vous prouve ma satisfaction à m'entretenir avec quelqu'un sur l'amitié duquel je compte autant."

" Le 30 décembre. — ... Toujours gros jeu. L'Intendant hier et avant-hier avait perdu quatre cent cinquante louis. Il a tantôt fait un seul coup où il y avait six cent cinquante louis de la perte au gain. Johanne a perdu ce soir trois cents louis. Enfin, l'Intendant, ayant le carnet ou les cartes à la main, est quelquefois effrayé et refuse. M. de Selles gagne de cinq à six cents louis, mais il combat encore."

" Le 4 janvier 1758. — ... Je n'ai rien à vous écrire, mon cher chevalier, et Roquemaure est en état de vous rendre compte de ma vie unie, des plaisirs de Québec et de ceux qui se préparent pour dimanche. Jamais la rue Quincampois n'a produit autant de changement dans les fortunes. Bougainville se rattrape, de Selles décline, l'Intendant perd, Cadillac reprend le ton, de Bréau est noyé (ce nom est heureux pour aimer le jeu), Marin continue à jouer et perd , les petits pontes se remplumaient hier ; Saint-Vincent et Belot perdent, Bonneau réalise. Votre petit ami, Johanne, avait gagné cinq cents louis, mais il voulait en avoir mille ; le pot au lait a versé. Le ton de décence, de politesse de société, est banni de la maison où il devait être. Je crains d'être obligé, avant la fin du carnaval, de punir quelque joueur qui aura oublié que son camarade au jeu est l'homme du roi. Aussi, je ne vais plus chez l'Intendant que le matin ou un jour de la semaine avec les dames, ou dans des grandes occasions. C'est vous écrire pour avoir occasion de vous renouveler les assurances de la tendre amitié que je vous ai vouée pour toujours, mon cher chevalier."

Toute la correspondance de Montcalm avec Lévis témoigne d'une amitié vraiment extraordinaire entre ces deux hommes ; celle de Montcalm allait jusqu'à la tendresse. Il avait besoin de l'exprimer, et il trouvait des tournures ingénieuses et charmantes pour la dire, comme dans ces fins de lettres par exemple :

" On ne peut vous aimer plus tendrement, mon cher chevalier."

" Je suis éloquent quand je parle de quelqu'un que j'estime et que j'aime autant que vous."

" On ne peut vous être plus dévoué et plus tendrement que le meilleur de vos amis."

" Aimez-moi autant que je vous aime, mon cher chevalier, et je n'aurai rien à désirer."

Les réponses du chevalier de Lévis, que celui-ci a conservées, ne renferment pas d'expressions aussi chaleureuses. Son amitié était peut-être aussi solide, mais moins expansive. C'était un esprit plus froid, plus réfléchi, qui s'observait davantage, et qui ne se livrait pas avec autant d'abandon.

Placé entre Vaudreuil et Montcalm, il savait ménager sa position avec une singulière habileté. Dès les premiers temps, il avait deviné que Montcalm jalousait le gouverneur, et il mettait un tact rare à ne pas blesser sa susceptibilité, sans toutefois se compromettre vis-à-vis de Vaudreuil, avec qui il fut toujours en bons termes.

" ... Je dois ne pas vous laisser ignorer, écrit-il au maréchal de Mirepoix, la conduite que j'observe. Je suis fort bien avec M. le marquis de Vaudreuil ; j'y serais encore mieux

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[1] Joannès, aide-major du régiment de Languedoc.

si je voulais, mais je ne me soucie pas d'avoir plus de part que je n'en ai à sa confiance, parce que M. de Montcalm en serait jaloux, et que cela ferait des tracasseries, chose que j'éviterai toute ma vie avec grand soin [1]."

Ce fut un grand malheur que Montcalm ne comprît pas cette leçon indirecte si délicatement donnée par celui qu'il regardait comme son meilleur ami. Lui qui répétait sans cesse à cet ami qu'ils ne devaient toujours avoir à eux deux qu'un seul et même avis, pourquoi ne suivait-il point celui-là, le plus important de tous ? Qui peut dire les conséquences qui en seraient résultées ?

Le sage Lévis avait tant à cœur la fin de ces querelles qu'il aurait voulu y voir intervenir le roi. Il l'insinue avec son tact ordinaire dans une lettre au marquis de Paulmy, secrétaire d'Etat au ministère de la guerre. "Quand on est aussi éloigné, dit-il, il faut toujours être d'accord avec tout le monde, lever les difficultés et n'avoir à cœur que le bien du maître.

"Je me conduis sur ces principes, dont je ne m'écarterai jamais. Je vous supplie d'en être bien persuadé et *d'en assurer Sa Majesté* [2]."

En admirant cette grande sagesse, il ne faut pas croire cependant que Lévis ait échappé entièrement à l'esprit frivole de son siècle. Il écrit à sa protectrice la maréchale de Mirepoix :

" A l'égard du mariage que le chevalier de Mesnon vous a proposé, vous savez que je n'ai jamais eu beaucoup de goût pour me marier, dans la crainte de prendre une femme qui ne vous fût pas agréable, ce qui ferait le malheur de ma vie.

"S'il s'en trouvait une dont vous fissiez choix, je la prendrais volontiers, dès que je serais assuré qu'elle vous conviendrait. Ainsi vous pouvez faire la réponse que vous désirez à M. le chevalier de Mesnon, à qui je suis toujours bien obligé de son souvenir et de l'amitié qu'il me témoigne. Si cette affaire n'a pas lieu et que vous trouviez quelque autre parti qui vous convienne, vous pourrez en disposer de même ; je tiendrai tous les engagements que vous aurez pris.

" C'est tout ce que je peux avoir l'honneur de vous mander à ce sujet, en vous priant de faire attention que je voudrais trouver une femme qui vous fût aussi attachée que je vous le suis...

" ... Il paraît que nous allons être vivement attaqués. Mon avis sera de nous battre jusqu'à extinction [3]..."

Singulier mélange de folie et d'héroïsme ! Il croit marcher à la mort ; mais en attendant, "mariez-moi à qui vous voudrez ! "

Montcalm lui écrit : "Le 9 janvier 1758. — ... Grand souper au palais, j'y eus comme de raison la fève, et Mme Péan fut ma reine. Au reste je me suis retiré à une heure, fou de voir autant jouer et berlander. J'ignore les destins des joueurs. Je compte (*inter nos*) y être pour une quinzaine de louis ; il y a des sociétés qu'on ne peut refuser. Le souper (pour vous seul) de quatre-vingts personnes, froid à la glace, servi à meilleure heure ; la gaieté de la fin du repas du ton de la taverne, et le gros jeu l'occupation, le métier...

" Vous voyez que, si j'écris mal, j'écris beaucoup..."

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[1] *Lettre au maréchal de Mirepoix*, le 4 sept. 1757.

[2] *Lettre de M. le marquis de Paulmy*, le 20 juin 1757.

[3] *Lettre à Mme la maréchale de Mirepoix*, le 17 mai 1759.

"Le 11 janvier. — ... Toujours du jeu : Johanne perd gros du sien et s'arrête ; Belot et Saint-Vincent s'écrasent ; Marin ne trouve plus de prêteurs ; Bougainville pourrait bien se rembourber de ce soir ; les Berry remontent et gagnent ; l'Intendant court après son argent, et moi après le sommeil, que je n'ai pas à mon ordinaire. Je mange trop, je digère mal et je ne fais aucun exercice d'aucune espèce, je vous jure. Bourlamaque passe sa vie dans la rue du Parloir, au fond du cul-de-sac. J'en fais autant, mais c'est à l'entrée. Mme Péan inquiète de sa petite fille ; je pense que ce n'est rien, au moins hier il n'y avait qu'une fiévrote de rhume..."

"Le 13 janvier. — ... Je vous renvoie une lettre de M. le marquis de Vaudreuil, qui vous prouvera que vous ne serez pas consulté du tout, ou je serais bien surpris. Vous pouvez me la renvoyer ou me la garder. Quant à moi, on me la communiquera par manière d'acquit, ou point du tout. *Bisogna di compatire, cara patria...*

"... Je suis toujours bien aise d'avoir écrit à M. de Vaudreuil. Il aura vu qu'au moins je m'aperçois des manquements du sieur Mercier, qui croit faire sa cour en me manquant.

"... Quelles dames chez M. le marquis de Vaudreuil ? Voyons si je devinerai. Quatre Deschambeau, Mme Barante et Mme de Vaudreuil, six en tout et trente-quatre hommes.

"Longueil a eu un coup de sang manqué ; mais il va bien...

"... De la façon dont l'Intendant m'a parlé, nous aurons bals et, je pense, pharaon ; il s'autorisera de Montréal."

"Le 16 janvier. — Je me suis fait saigner avant-hier, mon cher chevalier ; hier l'émétique, deux lavements et de l'huile d'amande douce. Cela s'appelle donc une carène entière...

"... Adieu, mon cher chevalier, ne doutez pas de ma sincère amitié.

"P. S. Tous écrasés, même Lestang, de Selles ; le seul Cadillac gagne mille louis."

"Le 18 janvier. — Je dois quelques réponses de bonne année, mon cher chevalier, ne fût-ce qu'à Mme de Villiers, que j'honore fort, à Villars, Cormier, Bellecombe ; mais je me trouve trop fatigué pour leur répondre, ce courrier. Mes fortes évacuations m'ont fatigué ; j'en avais grand besoin. Je digère mal et je suis dans un pays à mal digérer ; car tout impatiente quand on est citoyen..."

"Le 20 janvier. — Le retour des Hurons qui ont mené Schuyler et Martin donne lieu à de grands raisonnements dans une ville où les plus petites nouvelles s'amplifient, où l'on passe de la plus grande confiance à la plus grande crainte, et où tout le monde est général d'armée. Pour moi, j'attends de vos nouvelles, de celles du marquis de Vaudreuil et du récit que Langy vous aura fait..."

"Le 22 janvier. — J'ai été hier voir en grande cérémonie la gent huronne à Lorette. Le jour était bien beau. Il a fallu se rendre à l'empressement des missionnaires et des sauvages ; et dites, mon cher chevalier, que je vous ai chargé de remercier le P. Saint-Pé des politesses que j'ai reçues à Lorette des jésuites.

"Grand bal ce soir chez l'Intendant ; gros jeu, cela va sans dire. Ma santé bonne...

"P. S ... Les nouvelles de la nuit sont mauvaises pour l'Intendant. Mme Péan, Lestang, Johanne ; bonnes pour Cadillac, Bougainville, de Braux ; le reste ne vaut pas la peine d'être nommé, quoiqu'il y ait des acteurs qui gagnent ou perdent cent ou cent cinquante louis ; mais, pour qu'on parle de vous, il faut être homme à perdre trois ou quatre cents louis."

"Le 26 janvier. — ... Le jeu continue toujours. L'Intendant heureusement, perd quatre-vingt mille francs et, entre nous, en est très piqué. Nos officiers en général gagnent ; quelques malheureuses victimes et Saint-Vincent, de la colonie ; mais il y a loin d'ici au mercredi des Cendres..."

"Le 27 janvier. — ... L'Intendant perd quatre-vingt-onze mille livres, excédé de pertes, du ton de sa maison et de l'officier. Adieu, mon cher chevalier..."

"Le 3 février. — ... Si on a été mécontent d'un bal que l'Intendant a donné, on le sera bien plus d'un second, donné hier, et d'un troisième, qu'il doit donner mardi[1]. Toujours le plus effroyable jeu. L'Intendant a perdu cette nuit quinze cents louis, en trois quarts d'heure. Il est à cinquante mille écus de perte, au moyen de quoi toute la ville, le militaire, gagnant peu ou prou, et ses valets qui jouent gros contre lui. Peu de militaires perdent heureusement, Johanne et Lestang du leur ; mais les petits pontes hardis sont gras à pleine peau.

"Ce que vous écrivez sur le manque de grain est plus sérieux... Nous raisonnerons ensemble pour le mieux, soit avant rien proposer au marquis de Vaudreuil, soit pour lui répondre, si jamais on nous consulte à l'extrémité. Je crois que jusqu'à présent notre conduite à tous a été bonne. Elle le sera toujours par l'union, le concert et nous consulter. Quatre yeux, mon cher chevalier, valent mieux que deux, et vous savez que, si je ne prévoie pas toujours tout, j'ai le tact assez bon pour saisir les avis qu'on me donne...

"Adieu, mon cher chevalier. Plus ne sais, sinon que je vous suis très dévoué de corps et d'âme."

"Le 9 février. — Le jeu fini d'hier ; Johanne, de Selles, Bougainville, Baros (?), les Berry vainqueurs, surtout Cadillac, qui gagne quarante ou cinquante mille francs ; l'Intendant perdit encore hier six cents louis ; je le crois bien fou du jeu.

"Adieu, mon cher chevalier ; aimez-moi autant que je vous aime."

"Le 12 février. — ... L'Intendant a dit aujourd'hui qu'on le regardât comme un misérable si on jouait les jeux de hasard, l'année prochaine, chez lui...

"Voici les noms des douze femmes qui ont dîné le mardi-gras chez Mme de Vaudreuil. Voyons si j'aurai bien deviné : Mme de Vaudreuil, deux dames Martel, Mme de Longueil, Mme de Villemonde, Mme de Ligneris, Mme de Contrecœur, Mme de Céloron, Mme Duplessis, Mme Trémond, Mme de Saint-Luc, Mme de la Corne, l'aînée ; peut-être à la place d'une de ces douze, Mme de Beaucourt...

"Adieu, mon cher chevalier ; plus à vous qu'à moi-même. Je cachèterai mieux mes lettres...

"Le 12 février. — ... Le jeu est fini. L'Intendant paraît honteux, fait amende honorable, perd deux cent mille francs ; ce qui n'empêche pas que quelques particuliers ne perdent trop, entre nous, de Selles, capitaine au régiment de la Sarre. L'Intendant et ses adhérents veulent diminuer sa perte. Aimez moi, mon cher chevalier, autant que je vous aime..."

A cette même date, Montcalm était engagé dans une correspondance bien plus sérieuse avec le commandant des troupes anglaises au sujet de la rupture de la capitulation du fort Georges. Les massacres et les captures faites par les sauvages, en violation du traité, avaient, non sans raison, soulevé l'indignation dans le camp ennemi. Quoique

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[1] Allusion au mandement publié quelques jours auparavant par l'évêque de Québec.

Montcalm et ses officiers eussent exposé leur vie pour arrêter le désordre, il lui était impossible de faire arriver la vérité à l'oreille de ses adversaires. Le tragique événement était trop récent pour qu'il pût être jugé avec sang froid.

Montcalm y fait allusion dans la lettre suivante adressée à sa femme:

" Le 19 février. — ... Je ne puis vous rien pronostiquer sur la campagne, les vivres, le bien ou le mal joué des ennemis qui peuvent et doivent nous primer. Je suis ici depuis le 15 septembre ; je pars demain pour Montréal, et jusqu'à ce que je me porte sur quelque frontière. J'augure de ma bonne fortune que la campagne tournera bien. Quand nous ne ferions qu'une défensive, pourvu qu'elle arrête l'ennemy, elle ne sera pas sans mérite ; nous nous sommes écrit avec Mylord Loudon sur la capitulation du Fort Georges. C'est un procès qui se traite à coups de plume, en attendant de traiter quelque incident à coup d'épée, de fusil."

Ce coup d'épée, ce fut celui de Carillon.

Montcalm continue dans la même lettre :

" J'avais été ce printemps chanter la guerre, et festiner mes enfans, les Iroquois, les Algonquins et les Nipissings. J'ai été cet hiver faire même cérémonie chez les Hurons, et ce printemps j'irai chez les Abénakis. Ces sauvages m'aiment beaucoup ; en vérité je leur trouve plus de vérité, de franchise souvent qu'à ceux qui se piquent de polices. Malgré la misère publique, des bals et un jeu effroyable...

" Adieu, mon cœur, je t'adore. Je soupire après la paix et toi. Mille choses à ma mère. J'embrasse mes enfants, et il me tarde de retourner dans le sein de la patrie... "

IV

Après la brillante campagne de 1758, Montcalm vint reprendre ses quartiers d'hiver à Québec. Il occupait, sur les remparts, une maison faisant face à la Canardière. Cette résidence lui plaisait, parce qu'il y jouissait d'une magnifique vue de la vallée du Saint-Charles et de la côte de Beaupré.

Sa correspondance avec Lévis se continue :

" Le 21 décembre. — ... Les affaires, ou, pour mieux dire, petites tracasseries courantes sont :

" 1 — Altercation entre le P. Roubaud et M. de Mattissart[1] sur des grâces achetées par les jésuites, et les habitants refusent de remettre par l'obligation de nourrir le soldat. Le fond de la question regarde M. le marquis de Vaudreuil.

" J'ai écrit au père pour l'apaiser sur la forme, et à Matissart sur les égards dus.

" 2 — Les plaintes de l'hôtesse de M. de Boisset, suite du petit intérêt de la boisson occasionnée par une visite du chevalier de La Corne, qui en a été témoin, et qui se plaît assez dans le désordre pour s'en être amusé... "

Les premiers jours de l'année 1759, furent signalés par un soulèvement populaire qui n'attendait qu'une occasion pour éclater. La patience du peuple était à bout. Déjà on a entendu Montcalm justifier la défiance publique dans une autre occasion : celle où les soldats avaient été excités à l'insubordination. L'irritation du peuple avait toujours été

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[1] Capitaine au régiment de Languedoc.

depuis en s'accroissant, et l'on eût dit que l'aristocratie civile et militaire avait pris à tâche de la fomenter en lui donnant journellement le spectacle des réjouissances scandaleuses, du jeu effroyable et des excès de tout genre auxquels elle se livrait. A mesure que la misère publique augmentait, ces plaisirs et ces désordres devenaient plus effrénés. En vain la voix de l'Eglise s'était fait entendre, en vain l'évêque de Québec avait tonné du haut de la chaire et publié des mandements pour exhorter tout le monde à détourner la colère du ciel par un retour à de meilleurs sentiments. Sa voix s'était perdue dans le tourbillon des fêtes. Du moins, ses exhortations avaient-elles eu pour effet d'enhardir le peuple.

Une ordonnance de l'Intendant, annonçant une nouvelle réduction dans la distribution des vivres, acheva d'exaspérer la population. Les hommes n'osant se mettre en émeute dans les rues où ils auraient été immédiatement balayés par les troupes qui remplissaient la ville, engagèrent leurs femmes à faire une démonstration publique ; quatre cents de ces femmes vinrent en tumulte assiéger le palais de l'Intendant, et lui firent entendre des menaces si formidables qu'il en fut intimidé et retira son ordonnance.

Montcalm en dit un mot à son ami dans le passage suivant :

" Le 4 janvier 1759. — ... Dieu fait bien tout ce qu'il fait, le contraire de Montréal ; nullité dans ma personne, tant mieux...

" ... La misère excessive ici ; l'Intendant voulait nous mettre au quarteron ; quatre cents femmes l'ont fait trembler hier ; il a cédé à la demi-livre... "

En entrant dans cette année de 1759, qui s'annonçait si menaçante, Montcalm fut pris d'une immense tristesse, comme s'il avait eu le pressentiment de sa mort prochaine.

" Ah ! s'écrie-t-il dans l'extrait qu'on va lire, que je vois noir ! ... "

La suite de sa correspondance contient d'autres expressions qui indiquent les sombres pensées dont son esprit était obsédé.

" Souvenez-vous que, faute de vivres, trois à quatre mille hommes à Carillon au plus à la fin de may ... La paix, ou tout ira mal. 1759 sera pis que 1758. Je ne sais comment nous ferons. Ah ! que je vois noir ! M. de Vaudreuil, et un peu l'Intendant, attendent des miracles. Je vous écrirai exactement. Mes vœux, mes sentiments sont et seront toujours sans bornes, mon cher chevalier, dans cette nouvelle année et suivante."

" Le 6 janvier. — ... Bougainville s'est raccroché, gagne et croit avoir plus de conduite que Saint-Vincent, Belot, Johanne, Marin, etc. Je ne le pense pas ; avec de l'esprit et du talent, c'est, comme vous le dites, quelquefois une tête.

" Demain, grand souper et dames.

" Mardi, l'Intendant, chez moi ; jeudi, monseigneur. Je soutiens noblesse et dignité ; mais je mange mon bien, et je frémis pour l'avenir. Du 1er avril 1756 au 1er janvier 1758, cinquante sept mille livres d'argent sec dépensé. Et si j'avais eu quelques provisions. Que faire ? Celui qui est dans ma place doit faire ainsi. Nous en faisons tous trop pour les circonstances...

" ... Rigaud nous a écrit des lettres en style badin et noble, capable de faire croire à qui les lirait que c'est un homme de beaucoup d'esprit.

" Ne doutez pas, mon cher chevalier, de ma tendre et inviolable amitié."

" Le 8 janvier. — ... Hier grand bal ; j'y ai resté jusqu'à une heure. Je suis beaucoup plus cette année de la cour de Mme Péan ; cela prouve le désœuvrement. Ma santé a besoin de ménagement... "

" Le 12 janvier. — ... L'aventure de la Belle-Rivière me fâche un peu ; je ne la voulais

qu'au printemps. Elle n'a pas empêché hier une jolie fête dont je n'étais pas prié ; et, si l'on dit à Montréal que j'y ai été en masque, dites que je ne me masque jamais. Cependant j'y étais avec le plus joli officier de la Sarre que l'on puisse voir. Je vous jure que vous lui donneriez la préférence sur la Naudière. Mais *motus*...

" ... La misère est grande. Je suis de votre avis : nourrir le peuple avant de songer à entrer en campagne. Heureux qu'on ne nous consulte pas ! De vous à moi, avant mon départ, je conclurai avec Cadet pour le vin pour nos officiers ; mais mot à personne. Ce sera un bon service à nos troupes.

" Nous méditons une grande fête, pour jeudi prochain, avec Roquemaure, qui sera sur son compte, où je serai de hasard. Ma santé me reprend. Je suis inquiet pour du Verny.

" Adieu, mon cher chevalier ; amusez-vous, portez-vous bien, aimez-moi autant que je vous aime. Ma laconicité vient de ce que j'ai trop de lettres à écrire... "

" Le 17 janvier. — ... Bourlamaque est triste. Demain, grande partie de campagne, cinquante-deux personnes : pique-nique ; Roquemaure, Mme Gauthier, Mme de La Naudière ont tout arrangé. J'en suis ; on m'en a mis, on a compté sur moi ; je ne puis jamais être un homme ordinaire. Aussi je fournis l'illumination, violons, orgeat, bière, partie du vin et de quoi faire vingt-six plats sur soixante-six qu'il y aura à deux tables servies également en ambigu. Ce détail pour vous seul ; mais, comme Montréal est l'écho de Québec, on dira : " M. de Montcalm donne la fête." Le chevalier répondra : " Non, c'est " un pique-nique ; c'est la répétition de celui de la Sainte-Catherine ; on y a mis M. de " Montcalm. Je crois bien que, noble et galant comme il est, il aura suppléé à tout ce qui " aurait pu embarrasser la société qui l'en a mis, et fourni par là plus que les autres." L'Intendant en avait fait un, moins arrangé que celui de demain, jeudi dernier. Les dames de la société Péan, avec qui je suis très intimement, en méditent un pour jeudi d'ensuite."

" ... Dites à Pouchot et faites écrire par Cormier à Fontbonne et la Pause qu'il me prend un ennui d'écrire des lettres de bonne année. Ce sont tous trois mes amis ; je suis le leur ; j'aime mieux ne pas répondre à mes amis que manquer aux indifférents. D'ailleurs, des excuses faites par vous, mon cher chevalier, valent mieux qu'une mauvaise lettre. Soyez autant de mes amis que je suis des vôtres, et j'y compte... "

" Le 22 janvier. — Je cherche à tuer le temps et à m'amuser. La partie de campagne a été au mieux jalousée. On a fort approuvé le refus total des momons. Hier au soir, grand dîner et souper à l'intendance ; j'y donnai, la journée, essai d'un cavagnole le soir, où Cadillac et moi instruisions...

" ... On ne peut vous aimer plus véritablement et plus tendrement, mon cher chevalier."

" ... Je crois partir le 3 mars. Partir plus tôt n'eût pas convenu ; mais, ou les choses changeraient bien, ou je ne crois pas que Québec me possède l'hiver prochain, si le malheur s'obstine à nous retenir en Canada. On se divertit, on ne songe à rien, tout va et ira au diable.

" Mon amitié pour vous est sans bornes."

" Le 30 janvier. — Vous êtes fait pour plaire, pour aimer, être aimé et être heureux ; mais vous ne le serez jamais autant de personne que du meilleur de vos amis, et votre amitié me dédommagera de tout. Que ferons-nous, la campagne prochaine ? Elle sera

épineuse. Nous agirons d'accord, pour le mieux, et, dans un malheur général qu'il faut éviter, nous nous tirerons d'affaire."

" Le 2 février. — ... Qui diable sait où tout en sera au 1er novembre 1759 ? Sans me décourager, je redoute cette campagne."

" Le 5 février. — ... Quand est-ce que la pièce que nous jouons en Canada finira ? "

" Le 9 février. — ... Je prévois avec douleur les difficultés de la campagne prochaine, et je crois qu'on y entrera encore tard. Dieu sur tout ! Ici je végète, et soit ennui, mécontentement, difficultés de la campagne prochaine, je n'y ai pas autant de satisfaction que l'hiver dernier. Au plaisir près de vous voir, mon cher chevalier, je crois que je m'ennuierais autant à Montréal...

" ... Bourlamaque reprend bien ce me semble, et est plus gai ; pour lui, s'entend, qui est naturellement triste. Aimez-moi autant que je vous aime, et je le mérite par l'amitié inviolable que je vous ai vouée pour toujours...

" ... Dimanche, bal à l'intendance, et de gros momons sûrement... "

" Le 15 février. — Rien de nouveau, mon cher chevalier ; les plaisirs à l'ordinaire ; deux bals encore ; ma vie accoutumée entre les maisons Péan et La Naudière ; beaucoup de tranquillité dans la tête et le cœur... "

" Le 17 février. — Comme certainement, mon cher chevalier, mes deux aides de camp vous font leur cour, je vous prie de leur dire que j'ai reçu leurs deux lettres, qu'une grande paresse pour écrire m'a pris, que je les en remercie et que je ne leur réponds pas. Mes réflexions sur les dernières nouvelles sont : les pays d'en haut perdus. Chouaguen rétabli, M. de Vaudreuil endormi par la déclaration vraie ou fausse des Hollandais sur la partie de Québec, et sans vivres pour aller à Carillon... "

" Le 24 février. — ... D'après les conseils sauvages, je les vois accommodés, et les pays d'en haut perdus, mais des millions dépensés, soit là, au Détroit, ou en Acadie, sans nécessité.

" Nuls vivres pour entrer en campagne. L'année dernière, un tiers des terres ne fut pas ensemencé ; cette année-ci, il y en aura moitié. Les bœufs à la charrue enlevés ; quatre à cinq cents quarts de bœuf qu'on sale pour attendre le lard de France. La colonie est perdue, si la paix n'arrive pas ; je ne vois rien qui puisse la sauver. Ceux qui la gouvernent ont de furieux reproches à se faire ; pour moi, je n'en ai point à me faire ; j'attends avec bien de l'impatience les nouvelles de notre patrie ; Dieu veuille qu'elles soient satisfaisantes !

" Nous avons eu hier un bal, mardi le dernier ; et ne croyez pas que je m'amuse beaucoup."

Les derniers bruits de fêtes, échappés du palais de l'Intendant, furent couverts par le bruit du canon. Cette société insensée, qui, jusqu'au dernier moment, avait jeté un insolent défi à la misère publique, allait avoir un terrible réveil. Une bonne partie se trouvait peu de temps après à bord de l'*Auguste*, où elle se livrait au même dévergondage, lorsque le navire fut jeté à la côte sur l'île du Cap-Breton. L'un des sept survivants, le chevalier de la Corne, a raconté les dernières scènes de cet épouvantable naufrage : " Que de vœux au ciel, s'écrie-t-il, que de promesses ! ... le dirai-je ? combien de parjures ! "

La flotte de Wolfe remontait le Saint-Laurent, lorsque Montcalm écrivait à Lévis :

" Le 25 may. — J'ai encore moins de temps, mon cher chevalier, pour écrire, depuis l'arrivée de M. le marquis de Vaudreuil ; car il faut lui faire jouer le rôle de général. Je

lui sers de secrétaire et de major. Il me tarde que nous vous ayons et de vous embrasser...

"Je vous embrasse. J'ai reçu, je crois, trois cents lettres."

Il n'entre point dans le cadre de cette étude de suivre Montcalm dans les opérations du siège de Québec. Je note seulement quelques-unes de ses dernières impressions.

"Le 1er juillet. — Depuis vous avoir quitté, mon cher chevalier, je suis à cheval et je cours, et je suis effrayé de notre position, sur laquelle je vous conjure de réfléchir, sans opiniâtreté pour une première opinion...

"... Je suis sûr que demain vous serez la plume à la main, effrayé du détail des gardes. Il faut faire un habit suivant l'étoffe, qui est courte. Je vous écris avec ouverture ; je défère volontiers à votre avis ; mais tâchons de n'en avoir qu'un, mon cher chevalier. L'amitié et l'intérêt nous y doivent porter..."

"Le 5 juillet. — ... Tout ce que vous faites, mon cher chevalier, est toujours très-bien. S'il ne fallait que votre vigilance pour sauver le pays, la besogne serait sûre ; mais il faut autre chose..."

"Au camp de Beauport, le 9 juillet. — Je suis persuadé, mon cher chevalier, que la plus grande partie de l'armée des ennemis est de l'autre côté du Sault. Nous n'avons que trois partis à prendre, et pourvu que vous et moi soyons d'accord, je déterminerai M. le marquis de Vaudreuil à celui que nous voudrons. Après quoi, il en arrivera ce qu'il plaira à Dieu."

"Le 11 juillet. — M. le marquis de Vaudreuil, mon cher chevalier, a dit *amen* au mouvement projeté, d'autant que, dès qu'on lui parle de détermination à combattre, c'est lui faire bouillir du lait. Il n'y sera pas, et la pièce en sera plus tôt finie en bien ou en mal. En conséquence de ce, tous les ordres sont donnés..."

"Le 16 juillet. — Ainsi que je l'avais prévu, mon cher chevalier, malgré les raisonnements canadiens de Pouchot, les ennemis ont débarqué, le 6, trois mille hommes, sans qu'il s'en soit douté. Il a envoyé des courriers pour rappeler son armée du fort Du Quesne. Va-t-en voir, Jean, s'ils viennent. Il était plus simple de ne pas les y faire aller. Je vois le Canada attaqué par six endroits : le sault de Montmorency, la pointe de Lévi, Carillon, la tête des rapides, Niagara, le fort Machault. Le bel *ex-veto* si nous en sauvons une partie cette campagne."

Le soir de la bataille de Montmorency (31 juillet), Montcalm écrit :

"Je doute d'une attaque pour ce soir, mon cher chevalier. Vous avez Royal-Roussillon à portée de vous ; Guyenne va bientôt s'ébranler pour relever la tranchée ainsi vous auriez dans le moment assez de troupes sous la main. Vos volontaires seront augmentés demain avec Pinsen. Vous faites la guerre à l'œil, et il n'y a rien de mieux...

"... A l'entrée de la nuit, nous serons tous sous les armes à notre poste. Il y a du mouvement dans l'escadre vis-à-vis de nous. La démonstration qu'ils ont faite en plein jour me persuade que ce sera la fausse attaque. Vous avez le coup d'œil bon ; si ce qui vous occuperait ne vous paraissait pas considérable, il faudrait, mon cher chevalier, nous faire appuyer.

Les craintes qu'inspirait l'ennemi du côté du lac Ontario, depuis la prise du fort Niagara, avaient obligé d'envoyer le chevalier de Lévis dans le gouvernement de Montréal. Montcalm lui écrit de la maison de Salaberry, où il venait de s'établir de sa personne (3 septembre), "pour être, dit-il en belle vue et à portée de tout."

" Le 8 septembre. — Je garderai, mon cher chevalier, votre lettre et instruction. *Bene.* Il s'en faut bien que la campagne soit finie ici, depuis le départ du Sault. Ainsi au contraire, augmentation de batterie et de feu sur la ville. Une petite escadre de vingt bâtiments, cinquante ou soixante berges, depuis trois jours, vis-à-vis Sillery et le cap Rouge, Bougainville côtoyant ; la ligne (très longue) ! Hier, sur les dix heures du soir, démonstration d'attaque ; cent berges en bataille à mi-chenal. J'avoue que je vous voudrais ici, et que je voulais que M. le marquis de Vaudreuil vous en envoyât un ordre conditionnel, s'il n'y avait rien à craindre et que tout fût bien...

" ... Je vous voudrais ici pour cette épineuse queue où je crois à une tentative quelque part..."

" Le 9 septembre. — ... Voici un travail à faire, où La Pause peut vous servir d'avance, au cas où la colonie soit sauvée ; car elle ne l'est pas encore. N'en écrivez rien au marquis de Vaudreuil, mais à moi seul..."

" ... En vérité, s'il n'y a rien à craindre pour votre partie, j'avoue, mon cher chevalier, que je vous désirerais bien pour celle-ci, où tout n'est pas encore dit."

Enfin, le 11 septembre, l'avant-veille d'Abraham, Montcalm écrit à son cher ami ce petit billet qui renferme les derniers mots qu'il devait lui adresser :

" Je réponds par celle-ci, mon cher chevalier, à la lettre que vous m'avez écrite le 7. Je manquai le courrier par la faute de M. de Saint-Sauveur. Rien de nouveau ici. L'article des vivres, pain et viande ; mais n'importe, l'Anglois restât-il jusqu'au 1er novembre, nous soutiendrons..."

Hélas ! le brave Montcalm ne soutint pas. C'est son frère d'armes lui-même qui va nous conter ce désastre. Avec le tact et la réserve qui le distinguaient, il s'est donné bien garde de blâmer son ami. Il s'est contenté d'exposer les faits ; mais il y a mis habilement son appréciation sans qu'elle y paraisse trop.

" ... M. de Bougainville avait environ *deux mille trois cents hommes* non compris les sauvages, *et les meilleures troupes de l'armée.*

" Pour la garnison de la ville, *on n'en fit aucun usage*, de sorte que, lorsque tout fut assemblé, il ne se trouva que trois mille cinq à six cents hommes pour combattre, dont très peu de troupes réglées.

" — M. le marquis de Montcalm, qui n'avait pas eu le temps d'avertir M. de Bougainville, qui était au cap Rouge, comptait qu'il l'aurait été par ses postes. Il attendait d'apprendre qu'il était à portée pour attaquer les ennemis dans le temps qu'il en ferait de même. *Mais il n'attendit que jusqu'à dix heures*, et, voyant alors que les troupes montraient beaucoup de fermeté et de zèle, lui disant continuellement que les ennemis faisaient arriver du canon et prenaient poste en se retranchant, il résolut de tout tenter, malgré la disproportion des forces...

" Notre armée se mit en mouvement, ne consultant que son ardeur et connaissant peu l'ordre, *la plus grande partie de ce qui la composait étant des habitants.* Les bataillons mêmes étaient farcis d'un nombre d'habitants qu'on avait incorporés parmi les soldats...

" ... Il est aisé de concevoir par l'exposé ci-dessus que cette armée ne fit pas grand chemin sans être en désordre. On commença à tirer de loin, ce qui acheva d'y mettre la confusion, de sorte que, lorsqu'elle arriva à la demi-portée du fusil des ennemis, elle n'eut nulle consistance..."

Il est très-curieux de placer à côté de ce récit ceux de Vaudreuil et de Bigot. Voici ce qu'écrivait Vaudreuil à Lévis, immédiatement après la bataille.

"Au quartier général, ce 13 septembre 1759,
"A 4 heures ½ du soir.

"Monsieur,

"Nous venons d'avoir une très malheureuse affaire. Dès l'aurore, les ennemis ont surpris M. de Vergor, qui commandait à l'anse du Foulon. Ils se sont bien vite emparés des hauteurs.

"...M. le marquis de Montcalm est arrivé avec le premier détachement. Je faisais l'arrière-garde et faisais hâter le pas aux troupes de milice qui étaient sur ma route. J'avais fait prévenir M. de Bougainville, qui, dans l'instant, s'est mis en marche au cap Rouge avec les cinq compagnies de grenadiers, deux pièces de campagne, la cavalerie et tout ce qu'il avait de meilleur. Quoique l'ennemi nous eût prévenus, sa position était très critique. Il ne nous fallait qu'attendre l'arrivée de M. de Bougainville, parce que, tandis que nous l'attaquerions avec toutes nos forces, il serait pris par les derrières, mais le malheur nous en a voulu, au point que l'affaire s'est engagée avec trop de vivacité. L'ennemi, qui était sur une éminence, nous a repoussés, et malgré notre opiniâtreté, nous a contraints à faire notre retraite...

"...Nous avons eu beaucoup de monde de tué et de blessé. Le temps ne saurait me permettre de vous faire aucun détail à ce sujet; d'ailleurs je n'en suis pas encore bien instruit. Ce qu'il y a de certain et de plus fâcheux, c'est que M. le marquis de Montcalm a reçu plusieurs blessures également dangereuses; on craint beaucoup pour lui. Personne ne désire plus que moi que ce ne soit rien..."

De son côté, Bigot écrivait à Lévis, le 15 septembre:

"...N'auriez-vous pas pensé, Monsieur, comme moi, qu'il aurait été mieux de rassembler tous les corps de M. de Bougainville, qui étaient l'élite des troupes et des milices, faire sortir tout de la ville, à la réserve de l'artillerie et des éclopés, et donner sur l'ennemi?..."

L'année suivante, après la victoire de Sainte-Foye, le même Bigot apprenant les difficultés qu'avait le général de Lévis à ouvrir la tranchée devant Québec à cause du roc, lui faisait cette réflexion:

"Ce n'est pas la faute de l'armée, si le terrain est si ingrat...

"...Nous voyons bien clairement que vous auriez bien eu le temps de secourir Québec, l'année dernière, avant que l'ennemi eût pu se retrancher par derrière, et former ses batteries et prolonger sa tranchée..."

Enfin voici venir un témoin plus humble qui ne songe pas aux mouvements militaires, mais uniquement à la douleur qu'éprouvera Lévis en apprenant la perte de son ami; c'est Marcel, le secrétaire de Montcalm, qui écrit du lit de mort où il vient de recevoir le dernier soupir du général.

Marcel s'était trouvé auprès de lui, lorsqu'il avait été blessé, et l'avait soutenu sur son cheval pour l'aider à rentrer en ville et se rendre à sa maison. C'est alors qu'on cite du général ce dernier trait. Apercevant des femmes qui le suivaient en se lamentant et criant: "Monsieur le marquis est tué! Monsieur le marquis est tué!" il se tourna vers elles et les calma en leur disant: "Ce n'est rien, mes enfants, ce n'est rien."

Marcel écrit du 14 septembre :

" Mon général,

" C'est avec un cœur pénétré de la plus vive douleur que j'ai l'honneur de vous donner avis de la perte que nous venons de faire de M. le marquis de Montcalm, ce matin à cinq heures. Je ne l'ai pas quitté un seul moment jusqu'à sa mort, et je crois que c'était ce que je pouvais faire de mieux surtout après en avoir eu la permission de lui. C'était une marque d'attachement et de reconnaissance que je lui devais des bontés dont il m'a honoré, et des services qu'il m'a rendus ; aussi ne les oublirai-je de ma vie..."

On a discuté, et l'on discute encore pour savoir jusqu'à quel point Montcalm commit une faute en livrant la bataille d'Abraham. On a dit que, s'il avait eu Lévis à ses côtés, comme à William-Henry, comme à Carillon, comme à Montmorency, il ne l'aurait pas engagée avec autant de précipitation.

Quoi qu'il en soit, ce n'est pas aux Canadiens à lui faire un reproche de sa défaite, car elle les a débarrassés de leurs pires ennemis, les Bigot et les Louis XV. Les vainqueurs d'Abraham, de qui ils n'attendaient que des chaînes, leur ont finalement apporté la liberté.

II — *Le Golfe Saint-Laurent* (1625-1632),

Par BENJAMIN SULTE.

(Lu le 8 mai 1889.)

Pour faire suite au petit travail que la Société Royale a bien voulu imprimer dans son quatrième volume, je me propose de vous lire aujourd'hui des notes et renseignements, que j'ai groupés dans le but de rendre plus contrôlables les événements qui se sont passés depuis la formation de la compagnie des Cent Associés (1627), jusqu'à la prise de Québec (1629), et de là jusqu'à la reddition de ce poste à la France (1632). On aura ainsi l'ensemble des faits sous les yeux.

I

C'était plutôt par gloriole qu'autrement que le duc de Montmorency avait accepté le titre de vice-roi de la Nouvelle-France, le 10 février 1620 ; mais il se figurait peut-être aussi que le commerce des pelleteries lui rapporterait des revenus, puisqu'il avait versé à son beau-frère, père du grand Condé, la somme ronde de onze mille écus pour l'obtenir de lui[1]. Champlain, son lieutenant à Québec, continua de travailler seul, pour ainsi dire, car le duc, tout à son penchant pour la carrière des armes, et sans cesse mêlé aux intrigues de la haute politique, était plus souvent à cheval que dans son cabinet à lire les papiers de sa colonie. Vers 1624, il disait à qui voulait l'entendre que la charge de vice-roi lui rompait la tête, plus que les affaires importantes du royaume. En écoutant les récits malheureusement si vrais de Champlain, il sentit s'évanouir le reste de son enthousiasme à l'égard du Saint-Laurent, et, le 15 février 1625, passa le titre à son neveu, Henri de Lévy,[2] duc de Ventadour, lequel confirma Champlain dans le poste de lieutenant au Canada, par lettres en date du même jour.

En ce moment, les Basques donnaient le cauchemar à la compagnie du Canada en allant traiter et pêcher dans le fleuve jusqu'à l'île Verte. Leur quartier général était l'île Saint-Jean, aujourd'hui île du Prince-Edouard. Le vaisseau de pêche de Guers, l'un des subordonnés de Champlain — le seul vaisseau que possédât ce dernier pour la pêche du golfe — avait été capturé par les Basques en 1623, et amené sous les canons de l'île Saint-Jean, car ces hardis coureurs de mer avaient su se fortifier (1623) en toute règle pour ne pas être pris à leur tour dans le chef-lieu de leurs opérations. Ils ne reconnaissaient pas

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[1] Voir *Société Historique* de Montréal, IIe livraison, p. 107.

[2] Montmorency a laissé son nom à la belle chute d'eau qui est près de Québec, et Lévy à la Pointe-Lévy, où est la ville de Lévis, ainsi nommée en 1861, à l'instigation de notre poète Louis Fréchette, en souvenir du chevalier de Lévis, qui servait sous Montcalm, et qui appartenait à la famille de Henri de Lévy.

les ordres du roi qui accordait le privilège de la traite et de la pêche uniquement à la compagnie du Canada. Un de leurs principaux capitaines, nommé Guérard avait même été jusqu'à Tadoussac en 1622. Celui-ci s'était associé avec un Hollandais ou Flamand, comme on disait alors. Ils étaient armés de quatre pièces de canon d'environ sept ou huit cents livres pesant chacune, et de deux breteuils ; le navire portait vingt-quatre hommes. Un bâtiment espagnol, de deux cents tonneaux rôdait dans ces parages. Plusieurs Flamands faisaient la pêche dans le bas Saint-Laurent. Un vaisseau de la Rochelle, commandé par un homme masqué, traitait au Bic avec les sauvages. LeBaillif, commis à Tadoussac, vivait dans des inquiétudes continuelles. Ce port, si commode pour les Français, n'eût pas suffi à contenir tous les aventuriers qui le recherchaient, et par conséquent, LeBaillif comprenait qu'on l'en chasserait pour prendre sa place. Dans un récent travail sur Tadoussac, dû à la plume de M. Joseph-Edmond Roy, nous lisons : "Les anciens écrivains ont répété tour à tour que c'était un bon port que celui de Tadoussac, où vingt-cinq vaisseaux de guerre pouvaient se tenir à l'abri de tous les vents. Cette capacité a été grandement exagérée. C'est tout au plus si cinq ou six vaisseaux de moyenne taille y pourraient mouiller." Champlain, très-alarmé aussi, ne se voyait pas en mesure de braver le péril, car il n'avait pas même une quinzaine d'hommes pour faire au moins la patrouille aux environs du Saguenay.

Guérard partit de Tadoussac presque en même temps que Raymond de la Balde, lieutenant d'Emeric de Caen. De la Ralde se trouvait donc avoir le commandement maritime et avait ainsi pour premier devoir de chasser les intrus, Basques, Espagnols et Flamands, du fleuve et du golfe Saint-Laurent. Il était à Miscou en 1623 lorsque les Basques se fortifièrent à l'île Saint-Jean. Sa situation devenait embarrassante. Catholique, toutefois très attaché à ses maîtres protestants, les de Caen, il exerçait son pouvoir sur les sujets des deux religions, mais que pouvait-il faire contre les "étrangers" nombreux qui résistaient à ses ordres ? Ce personnage devait s'identifier bientôt avec l'histoire du golfe Saint-Laurent, et rendre de bons services à la cause du Canada. En 1623 donc, il envoya à Québec le pilote Doublet informer de Caen de ce qui se passait vers Miscou. Le 23 août, de Caen et Pontgravé s'embarquèrent pour la France, et prirent chemin faisant à Gaspé, des renseignements nécessaires à la politique qu'ils auraient à suivre pour parer aux circonstances du moment. Voyons ce qui se passait à Québec.

Voyant que le vice-roi était changé, Louis Hébert demanda la rectification du droit de propriété que le duc de Montmorency lui avait accordé en 1623. Le 28 février 1626 on lui fit cette concession.

La situation de la colonie n'était guère enviable. Si d'un côté Champlain parvenait à faire comprendre aux marchands la nécessité de certains petits travaux de défense ou de logement, il ne gagnait absolument rien du moment qu'il parlait d'établir des familles sur les terres à titre de simples cultivateurs. En dix ans, de 1617 à 1627, on ne voit que Louis Hébert jardinant un peu, et semant quelques poignées de blé, après avoir bêché le sol. Il n'y avait pas de charrue aux mains des colons. Marsolet, Hertel, Nicolet, Le Tardif, les trois Godefroy étaient encore interprètes ou employés de la traite. Peut-être Couillard, Martin, Pivert, Desportes, Duchesne cultivaient-ils, mais rien ne l'atteste, et tout nous fait supposer le contraire. La cause de l'agriculture a toujours été mal vue des compagnies qui se succédèrent à Québec, de 1608 à 1627. Les premières tentatives de culture dans la Nouvelle-France avaient eu lieu à la baie de Fundy, sur l'île Sainte-Croix (1604), et à

Québec (1608). Ces travaux ne dépassaient pas ceux d'un jardin potager ; leur objet n'était point de nourrir les émigrés, mais de procurer à de Monts et à Champlain des échantillons de ce que le nouveau sol pouvait produire. En 1613 et en 1615, Champlain, à Québec, agrandit cette petite exploitation. Louis Hébert, qui arriva en 1617, avait dû faire comme en Acadie, c'est-à-dire attaquer la terre avec la bêche pour tâcher de la connaître. Il possédait un "labourage" en 1620, mais il n'avait pas les outils essentiels à ces sortes de travaux, puisque Champlain dit positivement que la veuve Hébert fit usage de la charrue, pour la première fois, le 26 avril 1628. Hébert était mort le 25 janvier 1627. On élevait des vaches et des moutons. Quant aux chevaux, ils ne vinrent ici qu'en 1665. En 1622, sur l'invitation de Champlain, quelques sauvages s'étaient mis à défricher et à semer du blé-d'Inde, à la Canardière, joli endroit englobé, quatre ans plus tard, dans les limites de la seigneurie de Notre-Dame-des-Anges, près Québec.

Le P. Charles Lallemant, écrivant de Québec, le 1er août 1626, dit : "Nous sommes si éloignés de la mer que nous ne sommes visités par les vaisseaux français qu'une fois par année, et seulement par ceux qui en ont le droit, car cette navigation est interdite aux autres. Ce qui fait que, si par hasard, ces vaisseaux marchands périssaient, ou s'ils étaient pris par les pirates, nous ne pourrions compter que sur la Providence de Dieu pour pouvoir nous nourrir. En effet, nous n'avons rien à attendre des sauvages qui ont à peine le strict nécessaire." L'un des capitaines qui visitèrent ainsi le poste de Québec en 1624 se nommait Charles Daniel, de Dieppe ; c'est probablement sur son bord que Champlain et sa femme s'embarquèrent, le 15 août de cette année, pour repasser en France Les vaisseaux des capitaines Pontgravé et Gérard ou Guérard étaient alors à Miscou.

Le sieur de la Balde était resté à Miscou et à Gaspé. Au commencement de septembre 1624, il accompagna Champlain en France, ainsi que Pontgravé et le pilote Cananée.

Emeric de Caen était resté à Québec l'hiver de 1624-25 en qualité de commandant. Cinquante et une personnes, tant hommes que femmes et enfants, composaient toute la population blanche du poste. Emeric retourna en France, l'été de 1625, avec son oncle Guillaume de Caen. Comme celui-ci était huguenot, il se vit refuser la direction de la flotte du Canada, laquelle passa au sieur de la Ralde, ayant Emeric de Caen sous ses ordres. La *Catherine*, de cent cinquante tonneaux, commandée par la Ralde, et la *Flèque*, de deux cent soixante tonneaux, commandée par Emeric de Caen ; l'*Allouette*, de quatre-vingts tonneaux, appartenant aux jésuites ; un bâtiment de deux cents tonneaux, un autre de deux cent vingt, mirent à la voile à Dieppe, et arrivèrent à Québec le 5 juillet 1626, ramenant Champlain avec Eustache Boulé, son beau-frère, et le sieur Destouches, enseigne de Champlain, qui retourna en France au bout d'un an. Champlain rencontra (1626) des pêcheurs basques dont le navire avait été brûlé par accident. De Caen et de la Ralde s'occupèrent du golfe, tandis que Champlain se rendait à Québec. Pontgravé avait commandé à Québec durant l'hiver de 1625-26. On souffrait tellement du manque de provisions qu'on avait envoyé une chaloupe à Gaspé pour en obtenir ; la plupart des hivernants voulaient abandonner Québec. Le P. Chs Lallemant écrivait le 1er août 1626 : "Il n'y a que trois ou quatre familles (de sauvages) qui ont défriché deux ou trois arpents de terre, où elles sèment du blé-d'Inde, et ce depuis peu. On m'a dit que c'étaient les RR. PP. récollets qui le leur avaient persuadé. Ce qui a été cultivé en ce lieu par les Français est peu de chose ; s'il y a dix-huit ou vingt arpents de terre, c'est tout le bout du monde."

Le 25 août 1626, dit Champlain, "Pontgravé se délibéra de repasser en France... Cornaille de Vendremur, d'Anvers, demeura en sa place, pour avoir soin de la traite et des marchandises du magasin, avec un jeune homme appelé Olivier Le Tardif, de Honfleur, sous-commis qui servait de truchement."

Le premier soin de Champlain fut de restaurer les bâtiments de Québec. Voulant aussi tirer avantage des prairies naturelles situées près du cap Tourmente, où l'on faisait des foins depuis deux ou trois ans, et où l'on élevait du bétail, il y fit construire sans retard une habitation, et y envoya le sieur Foucher avec cinq ou six hommes, une femme (Mme Pivert ?), et une jeune fille. "Les récoltes, écrivait plus tard le P. Leclerq, allaient à une petite mission formée au cap de Tourmente, à sept lieues au-dessous de Québec, où l'on avait construit un fort avancé, non seulement contre les sauvages, mais principalement contre les ennemis (venant) de l'Europe."

En 1625 étaient arrivés les premiers pères jésuites. L'année suivante, ceux qui étaient dans la colonie se nommaient Enemond Masse, Jean de Brebeuf, Anne de Noue et Charles Lallemant, sans compter les frères Gilbert Burrel, Jean Goffestre et François Charreton. Le P. Lallemant disait, le 1er août 1626 : "Pour nos Français, qui sont ici au nombre de quarante-trois, nous ne nous sommes pas épargnés ; nous avons entendu leur confession générale."

II

Après avoir dit que, du temps de Henri III, Henri IV et Louis XIII (de 1575 à 1640), la littérature française ne daigna point s'occuper de l'idée coloniale, M. Léon Deschamps fait observer que, pourtant, Montluc et Montaigne, sous Henri III, avaient formulé des arguments, plutôt contre que pour la colonisation, et il ajoute : "Au XVIIe siècle, l'unanimité est absolue ; aucune voix discordante ne se fait entendre et ne produit d'écho dans la littérature. Une seule question provoque une courte discussion et deux ou trois livres ; c'est celle de l'origine des Américains, soulevée par Hugo Grotius en 1642. Elle est importante, puisqu'elle recèle la question de l'esclavage, que nous retrouverons plus tard ; mais elle ne crée pas en ce moment un courant littéraire. Notons ce point important : Au début, et jusqu'à Champlain, l'action s'est manifestée surtout par des voyages d'exploration, qu'il n'était pas besoin de taire, qu'on divulguait bien plutôt par orgueil national ; chacun voulait avoir sa part dans cette œuvre surtout scientifique. Mais quand on eut compris le profit qu'on pouvait tirer de ces terres vierges, quand la question d'économie eut été soulevée — et nous avons vu que ce fut en France, aux temps de Bodin et de Lescarbot — on changea de sentiment et de méthode. L'action devint commerciale et politique, c'est-à-dire qu'elle se cacha[1]. On ne la retrouve que dans le fait accompli ou dans les documents d'Etat. Cela explique le silence des littérateurs ; au XVIIe siècle, et trop souvent depuis, on a laissé en France, au gouvernement, au roi, le soin des choses d'Etat ; c'eût été crime, et un crime promptement puni, d'en raisonner[2]."

Les dispositions que montrait Richelieu à l'égard des entreprises coloniales furent

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[1] Note de M. Deschamps : "Razilly dit expressément, dans un mémoire remarquable adressé à Richelieu, en 1626 : Fayre des conquestes et traficqs... le tout avec prudence et secret."

[2] *Revue de Géographie*, Paris, 1885, p. 364.

bientôt connues. Dans la seule année 1626, il lui fut adressé cinq mémoires ou lettres sur "le fait du commerce de la marine;" lui-même est l'auteur ou le promoteur d'un très-grand nombre de contrats, lettres, rapports et statistiques ayant le même objet. De ces documents, les plus intéressants sont le mémoire de Richelieu touchant la marine, et les mémoires que le chevalier de Rasilly et un anonyme adressent à Richelieu en 1626. Le premier a été publié dans la collection des documents inédits, et il suffit d'un mot pour l'analyser. Richelieu y dit en substance qu'il est nécessaire que le roi relève la puissance maritime, sans laquelle "il ne fallait plus faire estast d'aucun trafficq," et qu'il est prêt à consacrer 1,500,000 livres par an à l'entretien de "trente vaisseaux de guerre pour tenir les côtes nettes[1]."

Sous l'influence bienfaisante de ce ministre, naquirent une dizaine de compagnies destinées à exploiter les pays lointains et à y transporter le nom de la France: La Nacelle de saint Pierre, 1625; la compagnie du Morbihan, 1626; les Cent Associés, 1627; la compagnie des Iles d'Amérique, 1627; la compagnie de l'Ile Saint-Christophe, 1635; la compagnie du Cap-Nord, 1638; la nouvelle compagnie de l'Ile Saint-Christophe, 1642; la compagnie de Madagascar, 1642.

Citons encore M. Deschamps, puisque son étude représente une page toute faite pour les annales canadiennes. Les commerçants, dit-il, n'ont pas été "les seuls à prendre intérêt aux conquêtes coloniales. Toutes les classes de la société, depuis le roi jusqu'au public oisif, y ont pris part; acteurs, auteurs ou lecteurs se trouvent à la cour comme à la ville, en province comme à Paris, au cloître comme dans les ruelles... Il est remarquable que presque tous les capitaines chargés de conduire les expéditions sont de petite noblesse, à commencer par le sieur de Champlain, *écuyer*. Ainsi, le chevalier de Rasilly, qui appartenait à une famille de Touraine, apparentée à Richelieu, et qui fut commandeur de l'ordre des hospitaliers de Saint-Jean; ainsi le sire de Lauson qui devient seigneur de Montréal; ainsi Pierre de Blain, écuyer, sire de Desnambuc."

Dans la liste des Cent Associés, les noms de noblesse et de hauts fonctionnaires sont des plus nombreux. Citons-en quelques-uns: le marquis d'Effiat, surintendant des finances, Isaac Martin de Mauvoy, intendant de la marine, Claude de Roquemont, écuyer, sieur de Brisson, Isaac de Rasilly, chevalier de l'ordre de Saint-Jean de Jérusalem, Jean de Tayot, trésorier de France, Ythier Holner, secrétaire du roi, Claude Bragelonne, surintendant et commissaire général des vivres, des camps et armées de France.

Je relève à dessein dans cette liste les noms des associés appartenant à la Normandie, parce que, en 1629 principalement, nous rencontrerons leurs navires dans le golfe Saint-Laurent: — David Duchesne, conseiller, échevin du Havre-de-Grâce; noble homme Simon Dablon[2], syndic de Dieppe; Jean Rosée, marchand de Rouen, qui fut le premier seigneur de l'île d'Orléans près Québec; Simon Lemaître, marchand de Rouen, qui fut le premier seigneur de la côte de Lauson; Adam Mannessier, bourgeois et marchand du Havre-de-Grâce; maître André Daniel, docteur en médecine, demeurant rue d'Ecosse, à Dieppe; Charles Daniel, capitaine pour le roi en la marine, frère du précédent, marié à Dieppe; maître Pierre Boulanger, conseiller du roi et élu à Montivilliers; maître

[1] Léon Deschamps: *Revue de Géographie*, Paris, 1885, p. 366.

[2] Probablement le P. de Charles Dablon, jésuite, qui, de 1642 à 1694 au moins, fut missionnaire au Canada, chez les Iroquois, dans l'ouest, et devint recteur du collège de Québec et supérieur des missions de la Nouvelle-France.

Jean Féron, conseiller du roi et payeur des espèces de messieurs de la cour du parlement de Rouen ; Henry Cavelier, mercier grossier, de Rouen, frère de Jean Cavelier, marchand, qui fut le père du découvreur René-Robert Cavelier de la Salle ; Jean Papavoine, marchand, de Rouen ; Jean Guenet[1], marchand, de Rouen ; maître Michel Jean, avocat à Dieppe ; Jean Vincent, conseiller et échevin de Dieppe ; Nicole Langlais, veuve de Nicolas Blondel, conseiller et échevin de Dieppe ; Claude Girardin, marchand, de Rouen, Antoine Novereau, marchand, de Rouen ; François Mouet, marchand, de Rouen ; Jacques Duhamel, marchand, de Rouen. J'en conclus que la Normandie comptait pour le quart, ou bien près de ce chiffre, dans le nombre des Cent Associés ; le principal groupe se trouvait néamoins à Paris. Le midi de la France figure pour un petit nombre de membres. A ce sujet, il est bon de noter que les protestants s'étaient soulevés dans le midi et avaient été écrasés par Richelieu, en 1625 ; de plus, que les chefs de ce soulèvement avaient péri sur l'échafaud en 1626. C'est aussi du camp devant la Rochelle, dernier boulevard des protestants, que fut signé, le 6 mai 1627, l'acte d'établissement des Cent Associés. Les circonstances connues du moment, et peut-être d'autres encore, expliquent l'abstention des gens du Midi, car M. Deschamps observe que deux systèmes de commerce divisaient alors le royaume : au nord, protection ; au Midi, libre échange. La compagnie des Cent Associés[2] était visiblement une création protectionniste, et ne devait pas trop plaire aux commerçants de Marseille, par exemple, qui demandaient " qu'on tienne la main à ce que les étrangers soient bien traités."

III

La nouvelle du changement dans les affaires du Canada trouva Champlain occupé à régler une querelle survenue entre les sauvages. Les Iroquois, voulant tirer vengeance d'une nation appelée les Loups ou Mahingans (les Mohicans de Fenimore Cooper) avaient massacré plusieurs de ceux-ci, sans épargner cinq Hollandais d'Orange (Albany) qui trafiquaient dans ces endroits. L'hiver de 1626-27, un certain nombre d'Algonquins des bords du Saint-Laurent s'étant rencontrés avec les Loups, promirent à ces derniers de les seconder dans la guerre qu'ils allaient entreprendre contre les Iroquois. Champlain déploya toute son adresse pour conjurer l'orage, car les Iroquois ne devaient pas manquer de porter leurs armes jusqu'à Québec, si les sauvages amis des Français allaient les attaquer chez eux. Malgré les précautions qu'il prit, la guerre menaçait d'éclater sur toute la ligne, lorsque les navires anglais se montrèrent sur le fleuve, en 1628.

Le cardinal de Richelieu et le maréchal d'Effiat devinrent les chefs de la compagnie des Cent Associés ; mais Razilly, Champlain, l'abbé de la Madeleine, M. de Lauson en furent les véritables têtes et les instruments actifs. Dans sa relation de 1627, Champlain ne fait pas la moindre allusion aux Cent Associés. Il est vrai que la compagnie ne se proposait de commencer ses opérations dans la Nouvelle-France qu'en 1628, et, en attendant, les sieurs de Caen étaient encore regardés comme les principaux officiers de l'ancien ordre de choses. Emeric de Caen, revenu de France le 30 mai 1627, avait assisté aux

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[1] Etait-il parent de Marie Guenet, dite la mère de Saint-Ignace, première supérieure des hospitalières de Québec, en 1639 ? Elle venait du monastère de Dieppe.

[2] Pour la liste de ses membres voyez *Documents* publiés à Québec en 1883, I, 80, et *Histoire des Canadiens-français*, II, 31.

assemblées des sauvages au sujet de la querelle des Loups et des Iroquois. Au mois d'octobre suivant, il faisait la pêche à la baleine dans le bas du fleuve. En ce moment Québec était très-mal approvisionné. "Je m'étonnais, dit Champlain, comme l'on nous laissait en des nécessités si grandes, et en attribuait-on les défauts à la prise d'un petit vaisseau par les Anglais qui venaient de Biscaye... Nous demeurâmes cinquante-cinq personnes (hiver 1627-28), tant hommes que femmes et enfants, sans comprendre les habitants du pays. (Les sauvages ?) Sur ces cinquante-cinq personnes, il n'y avait que dix-huit ouvriers, et il en fallait plus de la moitié pour accommoder l'habitation du cap Tourmente, faucher et faire le foin pour le bétail pendant l'été et l'automne."

Cet état de gêne allait en s'aggravant, et à la fin de juin 1628 les secours de France n'étaient pas encore arrivés. De Caen avait eu la prévoyance d'emporter de Québec les barques, voiles et cordages dont Champlain eût pu tirer parti pour aller au-devant des navires de France ; il avait fait plus dans sa trahison, car c'en était une : il avait donné avis aux Anglais de la détresse de la colonie. Le siège de la Rochelle durait toujours. Cette guerre servait de prétexte à un marchand dépité pour se venger d'avoir perdu le commerce du Canada. Par son moyen, les huguenots trouvaient à satisfaire leur haine contre l'établissement de Québec, qu'ils avaient constamment vu d'un mauvais œil, et qu'ils voulaient ruiner par le fer et le feu, puisque l'occasion s'en présentait. Les frères Louis, Thomas et David Kertk, protestants, natifs de Dieppe, mais entrés au service de l'Angleterre, conduisirent dans le Saint-Laurent (1628) dix-huit vaisseaux pour se saisir de tout ce que les Français y possédaient. Au mois de juillet ils commencèrent à capturer les bâtiments français dans le golfe. Tout fut détruit à Tadoussac : meubles, maisons, barques, etc[1]. La guerre entre les deux couronnes excusait tout. Les Kertk, quoique Français, tenaient du roi d'Angleterre une commission en règle pour s'emparer, s'ils le pouvaient, du golfe et du fleuve Saint-Laurent. Le bénéfice du commerce était le mobile des Kertk. Ils firent une fortune dans cette entreprise, qui eut au commencement des allures mystérieuses, car ces marchands, devenus militaires pour leurs besoins, ne paraissent pas avoir été connus comme naviguant vers le Canada avec des projets hostiles. Cent douze navires de Saint-Malo, ne se doutant de rien, mirent à la voile pour aller pêcher la morue sur les côtes de Terre Neuve. On peut s'imaginer ce que les Kertk, armés en guerre et avec de nombreux vaisseaux, recueillirent de butin sur ces pauvres gens !

Le désastre de Tadoussac ne devait pas être le dernier. Les Kertk approchèrent de Québec. La ferme du cap Tourmente, où l'on employait huit ou dix hommes, fut brûlée par eux avec quarante ou cinquante têtes de bétail renfermées dans les étables. Foucher, qui avait la surveillance de ce lieu, y fut fort maltraité. Nicolas Pivert, Marguerite Lesage sa femme, leur nièce et un homme furent amenés captifs. David Kertk envoya sommer Champlain de remettre le fort, mais la courageuse réponse qu'il en reçut le détermina à attendre quelque temps. Peu après, Thierry Desdames, arrivant à Québec malgré tous les obstacles, apporta une commission du roi pour Champlain, et annonça que le sieur de Roquemont s'avançait avec les premiers navires des Cent Associés. L'espoir fut de courte durée. Louis Kertk rencontra Roquemont dans le voisinage de Tadoussac, et, après une lutte acharnée qui dura plus de quatorze heures, l'enleva. Le frère Sagard dit qu'il y fut tiré plus de douze cents volées de canon. Néanmoins, Québec ne tomba pas cette année au pouvoir de l'ennemi. La prise de la Rochelle eut lieu le 28 octobre 1628.

[1] Voir sur l'année 1628 dans le *Canada-Français*, 1889, p. 443, une bonne étude du docteur N. E. Dionne.

IV

L'hiver de 1628-29 fut très-dur à Québec. Mme Hébert avait quelques provisions qu'elle partagea avec les récollets. On comptait réunies soixante-seize personnes, parmi lesquelles vingt Français et un missionnaire revenus du pays des Hurons. Le printemps arrivé, tout ce monde se jeta dans la forêt pour y vivre de racines. Champlain et les chefs de familles parlaient de se réfugier chez les sauvages. Pontgravé, souffrant de la goutte, songeait à partir pour Gaspé, mais il changea d'avis. D'autres montèrent sur une chaloupe et se dirigèrent du côté du golfe. Ceci avait lieu au commencement de l'été 1629.

La paix entre la France et l'Angleterre avait été signée à Suze le 24 avril ; on n'en savait rien sur le Saint-Laurent. Deux bâtiments de la compagnie des Cent Associés firent voile de Dieppe le 22 avril pour Québec, en même temps que deux navires sous les ordres du capitaine Charles Daniel, et dont il sera parlé bientôt. Trois autres expéditions eurent lieu, le même printemps, pour la Nouvelle-France, savoir : l'une dirigée par un capitaine du nom de Joubert ; la seconde préparée par les jésuites, et portant les PP. Charles Lallemant, Alexandre Godefroy de Vieuxpont et Philibert Noyrot. Ce navire fut capturé avec quatre autres appartenant aux Cent Associés. Le troisième convoi était équipé par les de Caen.

Un nommé Jacques Michel, huguenot, de Dieppe, servait de guide aux Anglais. A l'île Percée il captura un navire basque, puis se rendit à Tadoussac, d'où sa présence fut signalée à Champlain. Il y avait à Québec un jeune interprète de nationalité grecque ; on l'envoya à Tadoussac prendre connaissance de ce qui s'était passé. En même temps le gros des navires des Kertk s'avança comme pour tout emporter jusqu'à Québec, après avoir pris quelques bâtiments basques. Le golfe n'était plus qu'un vaste champ de bataille.

Enfin, le 20 juillet les Anglais parurent devant Québec, qui se rendit à Louis Kertk. Il n'y avait pas de nouvelle de la conclusion de la paix. Louis Kertk comprit qu'il serait sage de ne pas alarmer les familles établies, et il leur fit entendre dès l'abord qu'elles ne seraient aucunement inquiétées. Champlain, jugeant que tout espoir n'était pas encore perdu pour la colonie, conseilla aux habitants de demeurer jusqu'à plus ample information, et, en attendant, de faire la récolte des grains, puis de s'en tenir à leurs ressources particulières autant que possible, avis aussi prudent que patriotique, et qui fut suivi à la lettre. "Ils me remercièrent, raconte-t-il, espérant nous revoir la prochaine année avec l'aide de Dieu."

Champlain s'embarqua le 24 sur le navire de Thomas Kertk pour se rendre, prisonnier, en Angleterre. Par le travers de la Malbaie, du côté du nord, on aperçut le vaisseau d'Emeric de Caen qui tâchait de gagner le vent pour échapper, mais Kertk le serra de si près qu'il dut engager le combat et fut pris. De Caen aussitôt sur le pont de Kertk remit à Champlain des lettres annonçant des vivres et des renforts d'hommes, et dit qu'il croyait la paix conclue entre les deux couronnes. Plus loin, à la rade de Tadoussac, se présentèrent Louis Kertk et Jacques Michel qui commandaient cinq vaisseaux de trois à quatre cents tonneaux, de plus de cent vingt hommes chacun. Eustache Boullé, beau-frère de Champlain, était prisonnier en cet endroit. Celui-ci avait vu, vers Gaspé, le capitaine Joubert sur un navire de soixante-dix tonneaux destiné à ravitailler Québec, et qui lui avait dit qu'il croyait bien la paix faite, puisque les Français n'avaient plus la permission

d'attaquer les Anglais. Il ajoutait que des navires, notamment ceux du capitaine Daniel, étaient en route pour le Saint-Laurent.

Le fondateur de Québec passa douze jours à Tadoussac, chassant avec Kertk, et tuant plus de vingt mille pièces de gibier. Ensuite il fut conduit en Angleterre, non sans avoir appris en route qu'il y avait des vaisseaux français près de Gaspé, et que c'étaient ceux qu'il avait vainement attendus à Québec.

V

Suivons maintenant le capitaine Charles Daniel dans son voyage, après avoir dit un mot de sa famille et de lui-même. Son père, Antoine Daniel, bourgeois de Dieppe, "marchand mercier, grossier," exerçait une charge municipale importante en 1620 ; il avait épousé Marguerite Martin. Leur fils aîné, André, fut envoyé à Londres, en 1629, au sujet des affaires du Canada ; il mourut en 1637. Charles, le second fils, est notre capitaine ; marié à Dieppe, le 4 octobre 1620, avec Hélène Lemare, il est mentionné en 1624 comme ayant commandé un navire de Dieppe pour le Canada, et soutenu sans désavantage un rude combat contre les bâtiments anglais ; remarié en secondes noces (1632) avec Louise Duplix, il a laissé une descendance qui existe de nos jours près de Rouen ; anobli en 1648 pour ses services, il était encore employé dans la marine à sa mort survenue en 1661. A cette époque, on le regardait comme le plus ancien capitaine de mer de toute la France. Adrien, son frère, fut avocat à Dieppe. Antoine, quatrième garçon, devint le père jésuite, missionnaire des Hurons, tué par les Iroquois en 1648.

La société des Bibliophiles de Rouen a tiré à soixante exemplaires, en 1881, une brochure élégante qui porte pour titre : *Voyage à la Nouvelle-France du capitaine Charles Daniel*, et qui renferme des renseignements précieux sur ce qui s'est passé dans notre golfe en l'année 1629. Je dois à l'amitié de M. Julien Félix, conseiller de la cour d'appel de Rouen, un exemplaire de ce beau travail, dont voici un extrait :

"*La prise d'un seigneur escossois et de ses gens*... par monsieur Daniel de Dieppe, capitaine pour le roy en la marine, & général de la flotte de la Nouvelle-France, dédié à monsieur le président de Lauzon, intendant de la compagnie du dit païs, par le sieur Malapart, Parisien, soldat du dit sieur Daniel." Publié à Rouen, 1630.

Malapart commence ainsi : "L'exploit dernier du capitaine Daniel en la Nouvelle-France, est avantageux à trop de gens pour estre cogneu à si peu de personnes... j'ai creu que comme mon espée avoit servi au combat, de mesme après la victoire, ma plume devoit rendre ce tesmoignage à la generosité de mon capitaine... On verra dans ce narré l'exercice de la pesche assuré pour nos François, l'hérésie qui commençoit, arrachée dès sa naissance, la saincte foy de l'Eglise Romaine installée, & un petit tyranneau débusqué aussi honteusement, qu'il avoit injustement usurpé ce nouveau païs, & traité iniquement les sujets de de notre France..."

Récit du capitaine Daniel[1] : "Le 22 iour d'avril de la présente année 1629, ie suis party de Dieppe soulz le congé de monsieur le cardinal de Richelieu, conduisant les navires nommées le *Grand S. André* & la *Marguerite*, pour (suivant l'ordre de messieurs les Intendant, & Directeurs da la compagnie de la Nouvelle-France) aller trouver monsieur

[1] Cette narration se trouve aussi à la page 1283 des *Œuvres* de Champlain, avec quelques variantes.

le Commandeur de Rasilly en Broüage, ou à la Rochelle, & de là aller soulz son escorte secourir & enuitailler le sieur de Champlain, & les François qui estoient au fort de Québec en la Nouvelle-France, & estant arrivé au chef de Baye[1] le 17 de may, on publia le lendemain la paix faicte avec le roi de la Grande-Bretagne, & après avoir séjourné au dit chef de Baye l'espace de 39 iours en attendant ledict sieur de Rasilly, & voyant enfin qu'il s'aduançoit de partir à raison des mandements[2] nouveaux de la part du roy, & que la saison se perdoit pour ledict voyage ; sur l'aduis de mesdits sieurs les Intendant et Directeurs sans plus attendre le dit sieur de Rasilly, ie partis de la rade du dit chef de Baye le 26 de juin avec quatre vaisseaux & une barque appartenant à ladite Compagnie, & continuant mon voyage iusque sur le Grand Banc surpris que ie fus de brumes et mauvais temps, ie perdis la compagnie de mes autres vaisseaux & fus contraint de poursuivre ma route, iusque à ce qu'estant environ deux lieuës proche de terre i'apperçeus vn navire qui arrivoit sur moy portant au grand mast vn pavillon anglais, lequel ne me voyant aucun canon m'approcha à la portée du pistolet, ce qui m'obligea de mettre tout mon canon hors, dequoy s'estant ledit Anglais apperçeu il s'efforça d'euader, & moy de le poursuivre luy faisant commandement de mettre son pavillon bas comme estant sur les costes appartenantes au roy de France, et lui dis que la paix estait faicte[3], et qu'il ne devait rien craindre, & sur le refus qu'il fit de me monstrer sa commission, croyant que ce fust quelque forban, ie fis tirer quelques coups de canon, l'aborday et le pris. Ce faict ayant recognu que sa commission estait d'aller vers le cap de Mallebarre[4] trouver quelques siens compatriotes, qu'il y portoit des vaches & autres choses, ie le laissay aller, et estan le 28 iour d'aoust entré dans la rivière nommée par les sauvages Chybou[5], i'enuoyay le iour d'après dans mon basteau dix de mes hommes le long des costes pour chercher quelques sauvages, & apprendre en quel estat estait l'habitation de Québec, arrivans mes dix hommes au port aux Baleines[6] y trouuèrent vn nauire de Bordeaux, le maistre duquel se nommait Chambreau qui leur dit que le sieur Jacques Stuard[7] milort escossois estoit arrivé audit lieu environ deux mois auparavant avec deux grands navires & vne patache angloise, et qu'ayant trouvé audit lieu Michel Dihourse de S. Iean de Luz[8] qui faisait sa pescherie & secherie de molluë s'estoit le dit milort saisi du nauire & molluë dudit Dihourse, & permis que ces dix hommes fussent pillés, & peu après auoit le dit milort envoyé les deux plus grands de ses vaisseaux avec le nauire dudit Michel Dihourse & partie de ses hommes vers le Port Royal pour y faire habitation, comme aussi iceluy milort depuis son arrivée auait faict construire un fort audit port aux Baleines & luy auait enlevé de force les trois pièces de canon qu'il auait dans son nauire pour les mettre dans ledit fort, mesme luy donna vn escrit signé de sa main, par lequel il protestoit de ne luy

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[1] Cap ou chef de baie, à l'extrémité nord-ouest de la grande rade de la Rochelle.

[2] Rasilly avait ordre de partir avec Daniel pour Québec, mais après la signature de la paix (24 avril), Louis XIII le dirigea avec ses vaisseaux, sur le Maroc — contre les pirates barbaresques.

[3] On était au milieu du mois d'août, et cependant ni la paix de Suze ni la prise de Québec n'étaient connues au cap Breton.

[4] Au large de Boston.

[5] L'île Sibou ou Chibou est en face de la rade du port Dauphin, cap Breton. Dans cette île est une baie, où Daniel bâtit un fort (Sainte-Anne) du côté du nord-ouest.

[6] Petite baie qui avoisine Louisbourg.

[7] Jacques Stuart, lord d'Ochiltrie, du nom d'une baronnie située en Ecosse.

[8] Golfe de Biscaye.

permettre, ni à aucun autre Français de pescher dorenauant à la dite coste, ni traicter avec les sauvages qu'il ne luy fust payé le dixiesme du tout, & que sa commission du roy de la Grande-Bretagne luy permettoit de leuer quinze pour cent & de confisquer tous les vaisseaux qui yroient audit lieu sans son congé. Lesquelles choses m'estant rapportées, iugeant estre de mon deuoir d'empescher que ledit milort ne continuast l'vsurpation d'vn païs appartenant au roy mon maistre, & n'exigeast de ses subjects le tribut qu'il se promettoit, ie fis préparer 53 de mes hommes en armes, & me pourveu d'eschelles et autres choses nécessaires pour attaquer ledit fort, fis faire les exercices à mes gens, suiuant l'assiette du fort qu'il fallait forcer, & estant arriué le 8 de septembre audit port aux Baleines où estait construit ledit fort sur vn rocher environné d'eaux des deux costés, sur l'advis qui me fut donné, que les Anglais auaient apperçeu, quittant le dessein que i'avais de le prendre à la diane, ie mis pied à terre & fis aduancer sur les deux heures après midi tous mes hommes vers ledit fort selon l'ordre que ie leur avais donné, & iceluy attaquer par divers endroicts avec force grenades, pots à feu, & autres artifices, nonobstant la résistance & les mousquetades des ennemis, lesquels espouvantez de voir comme nous leur respondions & auansions, se presentèrent sur leur rempart avec un mouchoir blanc demandant la vie & quartier au sieur le Tourneur mon lieutenant cependant que j'estois à la porte dudit fort faisant enfoncer icelle, par laquelle estant entré ie me saisis du dit milort que je trouuay armé d'une espée & d'un pistolet & quinze de ses hommes armez de cuirasses, brassarts, & bourguignotes, tenant chacun une arquebuze à fuzil en main, et tout le reste des dits hommes armés de mousquets & picques seulement, lesquels ie fis tous désarmer, & ayant osté les estandarts du roy d'Angleterre, ie fis mettre au lieu d'iceux, par le sieur Castillon [1] mon porte enseigne, ceux du roy mon maistre : puis visitant ce qui estoit au dit fort i'y trouuay un Français [2] natif de Brest detenu prisonnier iusques à ce que son maistre qui estoit arrivé deux iours auparavant en un port esloigné de deux lieuës de ce port aux Baleines, eust apporté une piece de canon qu'il auait en son navire, et payé le dixiesme de tout ce qu'il pescherait, et le iour suivant ie fis equipper une caravelle espagnolle que i'ai trouvée eschouée deuant le dit fort, & charger les vivres & munitions qui estoient en iceluy, & après l'avoir fait razer & démolir, le tout porter à la rivière de Chibou ie fis avec toute diligence travailler 50 de mes hommes et 20 desdits Anglais à la construction d'vn retrenchement ou fort sur ladite rivière, pour empescher les ennemis d'y entrer, dans lequel ay laissé 40 hommes compris les PP. Vincent et Vieulpont Ie suites [3] et 8 pièces de canon, 18 cents de poudre, six cents de mesches, 40 mousquets, 18 picques, artifices, balles à canon & mousquets, viures et autres choses nécessaires, avec tout ce qui auait esté trouué dans la dite habitation & fort des Anglois, & ayant faict dresser les armes du roy & de monseigneur le cardinal, faict faire vne maison, chappelle, & magasin, pris serment de fidélité du sieur Goulde [4] natif de Beauuais, laissé par moy pour commander audit fort & habitation pour le service du roy, et pareillement du reste des hommes demeurés auec ledit sieur Goulde, ie suis party dudit lieu le 5 de novembre, & ay amené les dits Anglois femmes & enfants desquels en ay mis quarante & deux à terre près Falmuë (Felmouth) port d'Angleterre avec leurs hardes, & amené dix-huit ou

[1] Dans la liste des Cent Associés on voit François Castillon et Jacques Castillon.

[2] Le texte des *Œuvres* de Champlain le nomme David Cochoan.

[3] Ces religieux, accompagnés du P. Noyrot, avaient fait naufrage sur l'île de Sable, le 24 août 1629.

[4] Claude dans le texte de Champlain.

vingt à Dieppe avec le dit milort attendant le commandement de mondit seigneur le cardinal ; ce que ie certifie estre vray. Fait à Paris le 12 décembre 1629. (Signé) Charles Daniel."

Malapart ajoute : "Tel a esté le rapport qu'a signé au Conseil notre général ; mais quoy que pour ce deuoir, il n'ayt esté besoin de marquer d'autres circonstances, il sera bon, même important, d'en mettre icy quelques-vnes qu'il a obmises : —

" La première, que nostre capitaine estant en grande perplexité de sçavoir que l'ennemy se fortifiait puissamment, et que ce pendant il ne pouuait l'aller visiter pour n'auoir point de chaloupes prestes, Dieu luy envoya des sauvages qui luy en presterent trois, & mesmes quelques vns d'eux le voulurent accompagner.

" La seconde, que le mesme capitaine remonstra efficacement à ses soldats, tous les maux qui pourroient naistre de cette usurpation des Escossois, que tous d'vn commun accord dresserent vne requeste pour le supplier de les mener à l'ennemy, protestans tous par escrit, qu'au cas que quelqu'vn d'eux mourut au combat ils vouloient que la requeste qu'ils lui presentoient, luy seruit de response aux demandes de tous ceux de leurs parents qui pretendroient estre par luy dédommagez de leur mort, attendu qu'ils auroient voulu mourir, & tenu leur vie bien employée à restablir par leur sang, et maintenir à quelque cent mille Français la liberté de gaigner leur vie. J'ay dit cent mille, mais c'est pour le moins, car il va tous les ans en ce païs quelques deux cents grands navires à la pesche tant de mollue & de saulmon, que de petites baleines du lard desquelles on fait de l'huylle. Or dans chaque nauire combien de matelots y a-t-il qui ont leur famille à entretenir ? Combien faut-il de charpentiers de nauires ? combien de calfutreurs ? combien de taillandiers ? combien de forgerons pour les clous et pour les ancres ? Combien de gens employez pour les chables et les cordages, pour les voiles, & une infinité d'autres aggréements nécessaires ; ie ne dis mot des pistoles qu'on tire tous les ans d'Espagne pour la mollue, ie ne parle point de tout plain de marchands, qui la vendent maintenant à bon marché, qui eussent esté contraints de l'acheter bien cher des Anglois, et ainsi vuider insensiblement l'argent du Royaume, et nous la reuendre encore plus cher, mais laissant tout cela à part, si on eust laissé l'Escossois continuer comme il avait commencé, & comme il se promettait de faire, contraignant nos pauvres pescheurs français à luy payer le dixième (disant que c'estait une grace particuliere qu'il leur faisait, en ce que par sa commission il luy estoit permis de leuer quinze pour cent) & (qui pis est) de confisquer les vaisseaux qui n'auraient congé du roy d'Angleterre. Quelle servitude eust-ce esté à la France catholique de garder les abstinences, & les jeusnes de l'Eglise, à la discretion de celuy qui est d'vne profession toute contraire ? Quelle somme n'eust il point tiré tant de ses congez que du poisson qu'il eust raui par delà à nos François ? Car la commission de ce beau seigneur portoit pouvoir comme dit est de prendre quinze pour cent des estrangers & cinq des vaisseaulx d'Angleterre.

" La 3e circonstance est, que le capitaine & tous ses hommes, excepté trois, s'estoient confessez & communiez auant que d'aller attaquer l'ennemy.

" La 4e, qu'il y auait dix ou douze puissants & furieux dogues selon le jugement de beaucoup de personnes aussi à craindre que des hommes sans peur et bien armez ; & néantmoins (comme s'ils eussent eu le sentiment & respect pour les armes du roy & le capitaine Daniel, pareil à celuy qu'eurent autre-fois les lyons pour vn autre Daniel) ils ne nous ont faict aucune peine ; & (chose merveilleuse) pas vn de tous les coups qui

furent tirez par les Anglois ne porta sur un seul de nos Français, quoy que ce fut en plein iour, et que l'ennemi nous veist venir il y avait fort long temps, & qu'il en fut plus grand nombre que nous, qu'il nous eust veu auparavant prendre deux de leurs chaloupes & six de leurs pescheurs, quoy qu'ils fussent à couvert de leur fort et de leurs armures, au contraire nous a descouuert & en butte à tous tant qu'ils estoient, bref quoy que les trois pieces de canon, qu'ils auaient ostées à vn Français, fussent capables de nous rompre par le rejaillissement des cailloux dessus lesquels nous marchions. Tant il est vray que ce que Dieu garde est bien gardé. La saincte Eucharistie que nos soldats français auaient reçuë, leur estait vn ferme bouclier, vn charme puissant & assuré, & vn charactère à l'espreuve aussi bien contre les armes des hommes, que contre les dents des bestes.

" La 5e, que les soldats ont esté si obéissants à leur capitaine qui leur auait deffendu de s'amuser au butin, qu'il n'y en a pas vn seul de tous ceux qui ont esté prist qui ayt perdu la valeur d'un sold de ce qu'il auait en son particulier. En quoy il est à douter lequel des deux est plus admirable ou le pouvoir qu'a sur les soldats le capitaine, ou l'obeissance & respect des soldats envers leur chef.

" La 6e, qu'il y auait vingt-cinq lieuës du fort que commençoient nos François à celui des Anglois, de là il appert de la diligence de ceux qui cherchoient les vaisseaux de leur capitaine & les novuelles de Québec, veu qu'ils n'estoient que dans un petit batteau de nef, & cependant s'esloignoient si fort. Il appert aussi de cette distance, quel estoit le zele & le courage de ceux qui furent combatre les Anglois. C'est beaucoup de se defendre quand on se trovue attaqué par des ennemis plus forts, c'est plus de les attaquer quand on les rencontre ; mais de les aller chercher si loing & auec si peu d'avantage, c'est un faict sans aucun exemple, ou pour le moins extremement rare, lors particulièrement qu'on n'y est point enuoyé, ni gagé pour cet effect.

" La 7e, que le fort que nous auons commencé, & doit estre parfaict au retour de monsieur Daniel, est à l'entrée du port, le plus asseuré, le plus capable & commode qu'on puisse souhaiter. Premierement il est au commencement des terres de la Nouvelle France, & partant est très-propre à receuoir les navires de France s'il fallait relascher auant que de monter le fleuue S. Laurens. Secondement, il est entre l'Acadie & le Canada où est l'habitation de Québec, & partant très-propre pour la communication de l'un & l'autre païs, & mesme pour y faire assembler les nauires s'il estoit besoin de les voir. Tiercement, il est en vn lieu ou il y a quantité de beaux et gros arbres, & des eaux douces en abondance. Outre cela il eut dans le port plus de trois milles nauires, & cependant ne laisse point d'estre fort tranquille & assuré ; car l'embouchure estant si estroitte, qu'il n'y peut entrer plus d'vn navire à la fois, l'eau y est tranquille comme en un estang qui est à l'abry d'vne haute forest ; d'ailleurs, le fort est tellement placé qu'il n'y a nauire qui ne puisse estre crevé du canon qui donne dessus ce destroit au cas qu'il voulut entrer sans le congé du dit fort, & ainsi peut seruir d'azile assuré aux François s'ils estoient attaquez. Il s'y rencontre encor beaucoup d'autres commoditez, mais ie serois trop long à les deduire : comme aussi si ie voulais marquer par le meme le soin amoureux qu'a eu de nous nostre bon Dieu, comme il nous delivra du poison de nos captifs escossois, comme il nous obligea tous à nous confesser enuoyant une tempeste qui choquoit à chaque vague notre vaisseau, & à chaque coup le brisait et creuait contre vn rocher ; & puis nous ayant contraincts de nous abandonner à sa mercy, il porta vn Pere Jesuitte à mettre dans cette mer enragée vn reliquaire garni d'vn morceau de la saincte Croix, ce qui nous donna le calme.

" Ie ne puis non plus m'arrester à descrire comment s'est faict, qu'vn petit Sauuage ayant receu en la teste de grands coups de hache fut guari quand vn Pere Jesuitte l'eut beni & faict quelque vœu pour luy. Aussi peu comme vn vieux sorcier aagé d'environ 90 ans, qui estoit comme le grand Prestre de ces misérables Sauvages, se convertit, & de son propre mouvement se mit à brusler tous les outils dont il se servait au culte du diable ; ie pourrois estre ennuyeux si ie disois tout ce que ie sçay, neantmoins ie ne peux que ie ne regouste encor vne fois le traict de douceur que la divine bonté nous fit sentir en allant.

" La trauerse de Dieppe en ce nouveau païs tirant en si grande longueur, que quelque cinq mois se sont passez à la faire (ce qui se faict d'ordinaire en un mois) nostre général estoit contrainct de faire tenir les viures fort courts ; & comme si Dieu nous eust voulu faire la mesme faueur qu'il fit autre-fois au peuple d'Israël lors qu'il le tenait dans le desert, & l'empeschait d'auancer deuers la terre promise, voyant qu'on ne distribuait quasi plus de pain à manger, fit venir une grosse trouppe d'excellents poissons, qui suiuit iour et nuit le nauire & ce en si grande affluence qu'on les prenait comme en vn reseruoir à mesure qu'il fallait disner ou souper. Je dis à chaque iour ou repas, car comme la manne se cueillait tous les iours, & ne se gardait point, de mesme cette manne novuelle se cueillait tous les iours & ne se gardait point, & estoit ce poisson nommé la bonite[1] ou grande aureille, à cause d'un grand aisleron, qui s'esleue vers sa teste lors qu'il nage ; il est plus gros que nos grosses carpes. Or comme si cette benite trouppe eust senti qu'il n'estoit plus de besoin que sa mort soutint notre vie, aussi tost que nous fusmes prez du Grand Banc, ou l'on pesche la molluë, elle commença à nous quitter, nous laissant un sentiment de la bonté de nostre Seigneur aussi doux que ce délicieux secours nous auait esté necessaire. Ce souvenir m'est si agréable que ie serois content de faire un recueil de tous les discours que nos gens tenoient sur ces poissons, comme ils disoient allons au viuier que Dieu nous a donné, allons prendre le disner que Dieu nous a préparé, allons receuoir ce qu'il nous enuoye. Toute-fois il y a encore plus de plaisir, plus de douceur & de consolation à considérer vn peu la prudence de Dieu sur la conduite de notre voyage.

" Le dessein de la Compagnie & de nostre général estoit d'aller à Quebec & ce pendant, si Dieu par la contrariété des vents ne l'eust empesché ; comme il estoit demeuré seul sans l'escorte des nauires du roy, & mesme de tous ses vaisseaux, il estoit presque impossible qu'il ne fut prins des Anglois, qui auoient dans S. Laurens huict fort navires, & quand il ne les eust point rencontrez ayant attendu si long temps à la Rochelle, il n'eust sceu secourir les Français de ce quartier ; & qui pis est, l'Escossois se fut tellement fortifié le reste de l'année, que je ne sçay pas si on l'eust pu auoir par après, veu qu'il estoit desià en tel estat, que le canon ne l'eust peu endommager du costé de l'eau tant il s'estoit bien couuert de gazon ; & pour ce qui est du costé de terre ses retranchements s'étoient tellement haussez en huict ou dix iours qu'on avait tardé de les venir reuoir, que nostre capitaine les ayant esté reconnaistre luy-mesme auant que d'en faire les approches iugea que les eschelles qu'il avait fait faire suiuant le rapport de ses gens, estoient desormais trop courtes de 3 ou 4 pieds, & partant fut contrainct d'en faire despecher quantité d'autres d'enuiron dix à douze pieds. Je vous laisse à penser ce qu'il eust fait tout le long de cet hyuer iusqu'à ce qu'on eust eu la commodité de l'aller visiter,

[1] La bonite. *Sarda Mediterranea.* Un peu plus gros que la morue. Du genre des thons.

& en quel poinct de force il se fust mis, puis qu'en si peu de temps il auait tant auancé. Il n'eust pas esté possible de le tirer de sa citadelle : car il auoit des vivres pour plus de deux ans, & en prenoit encore tous les jours à nos pescheurs, tesmoin celuy qui fut trouué prisonnier jusqu'à ce que son maistre eust rendu le canon qu'il auait, & payé pour deux mois de viures avec la dixme de tout ce qu'il pescherait. Il auait deux excellents moulins à bras, une forge, du fer en quantité, des carrières de charbon de terre contre luy, du cuir, de quoy faire de la biere, bref toute sorte de commoditez, d'outils, d'instruments & d'ouuriers. D'ailleurs s'estant transporté en ce païs par vn zele tres-ardent de sa fausse religion, l'ayant receu en don du roy d'Angleterre qui la nomme *Nova Scotia*[1] dans son breuet, l'ayant dis-je auecques pouuoir d'y mettre telles loix que bon luy sembleroit, & comme il se voit par sa commission, d'exiger de si grands imposts sur les François, en un mot se promettant de si grands profits & honneurs de cette entreprise, qu'il auait abandonné la baronnie d'Ochiltri pour posséder ce païs à guise d'un petit roy de la nouuelle Ecosse, comme ses ancestres l'auaient esté de celle que tient maintenant l'Anglois, sans doute il n'euct pas aisement quitté toutes ces belles prétentions, qui luy auaient cousté desià si cher, & ainsi il ne pouuait que donner beaucoup de peine à ceux qui l'euessent voulu par après deposseder, & faire bien du mal à nos pauvres pescheurs, et gaster tout ce païs d'vne heresie à laquelle il est tres-zelé, & bien versé, parle bien latin, & est entendu en quantité de sciences, & ce mal n'eust pas esté pour peu de temps, car enuiron cinquante ans dont il est aagé, luy ont peu fournir assez de ruses pour se deffaire des commandements du roy d'Angleterre au cas qu'il luy en eust voulu faire pour quitter ce qu'il luy auait donné. A tout le moins ce seigneur n'eust pas manqué à demander bonne somme de deniers pour les frais qu'il eust deu auoir faicts. Ainsi Dieu nous est bien souvent plus favorable s'opposant à nos desseins, qu'en les conduisant selon nostre desir."

S'adressant aux directeurs & associés de la compagnie de la Nouvelle-France, le sieur de Malapart continue : "... Quand vostre pieuse Compagnie n'apporteroit iamais autre bien que celuy qu'à produit l'action heroïque de monsieur Daniel, il ne fera iamais que la France n'aye sujet de benir tous ceux qui l'ont erigée... Pour moy il faut que je vous ouvre franchement mon cœur, ie perdis il y a enuiron dix-huict mois vn œil, & quasi vne de mes mains pour le suiet qui vous lie ensemble & conjoint d'un sainct desir ; ie considere neantmoins ces espreuues pour faveurs... ie m'estime dès maintenant assez bien recompensé de la part que Dieu m'a donnée en la gloire de ce dernier exploit..."

Le même adresse au capitaine Daniel un dizain gracieusement tourné : —

Monsieur ie crains bien fort que vostre modestie
N'aye pas pris plaisir à lire ce discours,
Mais si cette vertu tient en vous amortie
Toute la vanité, l'idole de nos iours,
Au moins laissez le cours libre à la vérité,
Laissez aller le los à qui l'a mérité.

Que si vous ne voulez cet acte de justice,
Et aymez mieux me voeir exercer la milice,
Dittes-moi au plustost : "Soldat : l'espée au poing !"
Et vous verrez bien tost que ie n'escriray point.

Votre plus obéissant soldat & serviteur,

ANDRE MALAPART[2].

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[1] Jacques I, roi d'Ecosse et d'Angleterre, avait désigné l'Acadie sous le nom de Nouvelle-Ecosse, huit ou neuf années avant 1629.

[2] En 1635, Malapart était aux Trois-Rivières ; en 1639 il y commandait.

Mais le lord Ochiltrie a la parole à son tour. Voici sa réponse : —

"La barbare et perfide conduite des Français envers le lord Ochiltrie dans l'île du Cap-Breton, prouvée en la cour d'amirauté de Dieppe." — "Vers le 10 septembre ou environ, un capitaine Daniel, habitant de Dieppe, accompagné de trois vingtaines de soldats et d'un certain nombre de sauvages en six chaloupes, vint à la côte de Cap-Breton et surprit deux chaloupes et six pêcheurs qui les montaient, qui étaient à pêcher pour la nourriture du dit lord Ochiltrie et de sa colonie, dans laquelle il a été envoyé en vertu de la commission du roi d'Angleterre. Ayant surpris les chaloupes, il s'empara des pêcheurs et les enferma dans une île de l'ouest, sans viande, sans boisson, sans feu, sans maison, sans aucun abri contre la pluie ou le froid. Puis, avec ses soldats et six chaloupes, il entra dans le port, le dit lord Ochiltrie et la majeure partie de ses hommes étant éloignés par leurs occupations. Le dit lord Ochiltrie, les voyant arriver à son fort et pensant avec le peu de monde qui s'y trouvait que le dit capitaine Daniel et ses gens étaient des sauvages, fit décharger quelques mousquets sur les chaloupes pour leur faire déclarer qui ils étaient. Comme ils ne s'approchaient pas immédiatement du fort et que lord Ochiltrie trouvait à leur extérieur qu'ils n'étaient pas des sauvages, il leur demanda qui ils étaient. Ils répondirent qu'ils étaient Français, ils dirent que les Français et eux étaient amis, à cause de la paix entre les deux rois ; ils répliquèrent qu'ils étaient Français, qu'ils connaissaient la paix et étaient leurs amis ; il dit alors qu'en ces termes ils étaient bienvenus. Aussitôt qu'ils entrèrent (l'on n'attendait pas de procédés nuisibles après les paroles qui s'étaient échangées) il s'emparèrent d'eux tous, les désarmèrent, les rassemblèrent avec toutes leurs marchandises, chassèrent les pauvres gens du fort et les exposèrent sans abri ni couvert, et sans vêtement à la merci de la pluie et du vent froid qui étaient excessifs à cette époque, de sorte que ces malheureux (parmi lesquels des vieillards, des femmes, des mères avec leurs enfants et de jeunes enfants à leur sein) ces malheureux, dis-je, furent forcés de renverser la carcasse d'une vieille chaloupe et de s'y blottir en rampant pour sauver leurs vies de la rigueur du froid et de la pluie qui était extrême à cette place. Ensuite, le dit capitaine Daniel et son monde entrèrent dans le flibot que le dit lord Ochiltrie avait là, s'emparèrent de toutes les marchandises et immédiatement ils vidèrent avec gloutonnerie trois barriques de vin, deux barriques de cidre fort et toute la bière que l'on avait conservée, n'en réservant pas assez pour faire vivre le dit lord Ochiltrie et ses gens pendant leur voyage en France, de sorte qu'ils furent forcés de boire de l'eau puante au grand détriment de lord Ochiltrie qui en tomba malade et de beaucoup de ses gens, sujets de Sa Majesté, qui perdirent la vie. Ils enlevèrent du vaisseau du dit lord Ochiltrie les couleurs de Sa Majesté, les foulèrent aux pieds et hissèrent les couleurs du roi de France avec un tel dédain que chose semblable n'a jamais été vue ni lue dans le cours d'une paix existant entre deux rois. Après peu de jours, ils expédièrent la majeure partie des gens du dit lord Ochiltrie dans des chaloupes, environ trente lieues par mer, à Schibo où mouillait le navire du dit capitaine Daniel et pendant ces trente lieues, ils firent travailler les pauvres gens aux avirons comme s'ils eussent été des esclaves, n'ayant pour vivre pendant tout ce temps que du pain et de l'eau et beaucoup d'entre eux n'ayant pas de vêtement pour couvrir leur nudité ou se préserver du froid. De quelle plus grande barbarie le Turc pourrait-il user contre des chrétiens ? Peu de jours après, le dit lord Ochiltrie, avec deux ou trois gentilshommes anglais et leurs femmes furent emmenés en chaloupe au dit Schibo, et, la tempête les ayant forcés d'attérir la nuit, ils couchèrent sur la terre

froide sans abri, la pluie tombant à torrents sur eux, ce qui causa une maladie extraordinaire au dit lord Ochiltrie qui contracta un flux de sang dont il n'est pas probable qu'il soit bientôt délivré. Dès son arrivée à Schibo et dès que le capitaine Daniel vint à son vaisseau, il y hissa les couleurs du roi d'Angleterre comme sur une prise, acte inusité en temps de paix. A Schibo, pendant l'espace de six ou sept semaines, tous les malheureux furent forcés comme des esclaves à travailler péniblement, étant au pain et à l'eau seulement, et beaucoup étant nus et sans vêtements, de sorte que, par pitié pour ces pauvres gens, le dit lord Ochiltrie fut contraint de leur donner les couvertures de son lit pour couvrir leur nudité et les garantir en partie de la rigueur du froid, et de leur partager les draps de son lit. Quand le dit lord Ochiltrie et ses gens eurent enduré ces injustices et ces misères pendant l'espace de deux mois, ils furent tous embarqués dans le vaisseau du dit capitaine Daniel, cinquante hommes, femmes et enfants étaient enfermés dans la cale du vaisseau dans un réduit si étroit qu'ils étaient forcés de coucher les uns sur les autres comme s'ils eussent été des poissons, couchant dans leurs propres immondices et nourris au pain et à l'eau, de sorte que par la faim et par l'odeur pestiférée de leurs propres ordures beaucoup d'entre eux furent jetés à la mer ; la famine faisant perdre le lait de leurs mères, les pauvres petits enfants perdirent la vie et furent jetés à la mer. En ce temps, le dit lord Ochiltrie, affecté d'un flux de sang, fut alors qu'il réclamait contre le traitement infligé à ses gens, menacé d'avoir la gorge coupée et de recevoir un coup de pistolet ; le domestique qui le soignait dans sa maladie fut empêché de venir lui donner un verre d'eau ; ses coffres, avec ses vêtements et ses papiers, qui seuls n'avaient pas encore été fouillés et saisis, furent pris et ouverts et ses quittances de grandes sommes d'argent qu'il avait payées, les reconnaissances de sommes prêtées, ses titres de créances sur les terres de ses amis furent pris par le dit capitaine Daniel et jetés à la mer. Et pour couronner le reste des insolences du dit capitaine Daniel, devant le sergent-major de Dieppe, monsieur Schobnell[1], il a appelé le roi d'Angleterre un usurpateur. Dans cette action, le dit lord Ochiltrie a prouvé que, partie pour les marchandises qui lui ont été prises, pour ses pertes pendant son voyage, et pour la valeur des quittances précitées qui ont été jetées à la mer, il éprouve un préjudice d'environ vingt mille livres sterling. Le dit lord Ochiltrie a prouvé cette relation dans son entier devant la cour de l'amirauté de Dieppe ; a obtenu sentence sur ce et étant gardé prisonnier enfermé à Dieppe pendant un mois, il a été appelé devant ses juges par l'entremise de l'ambassadeur de Sa Majesté. On lui a objecté ses offenses contre le roi de France ; il s'est défendu en invoquant la mission à lui donnée par Sa Majesté, qu'il n'a jamais transgressée pour rien de contraire ; et comme on n'avait rien de plus à dire contre lui il a été remis à l'ambassade de Sa Majesté. Il a présenté au Conseil sa relation des torts et pertes qu'il a éprouvés, avec leur vérification à la cour d'amirauté de Dieppe, en y joignant la sentence des juges. Mais il n'a pu encore avoir réparation de ses griefs, paiements de ses pertes, ou punition de son agresseur ; au contraire, le dit capitaine Daniel est employé par une nouvelle commission pour aller en Amérique sur un vaisseau du roi de France avec deux autres, pour assurer la possession du Cap-Breton, et l'île de Cap-Breton lui a été donnée pour les injures qu'il a faites au roi d'Angleterre et à ses sujets. Et, ce qui est plus barbare et plus injuste encore, la sentence de la cour d'amirauté qu'il a présentée au Conseil de

[1] On croit qu'il s'agit de Channel, d'une famille bourgeoise de Dieppe.

France, on refuse de la lui rendre, par un procédé aussi odieux qu'on puisse le consigner. Aussi, lord Ochiltrie est forcé d'avoir recours à Sa Majesté, et son humble désir est : — Qu'il plaise à Sa Majesté prendre ses griefs et pertes en sa princière et royale considération et qu'il lui plaise y pourvoir par tel remède qui, dans son jugement souverain, se trouvera le plus convenable. Et pour la vérité de sa relation, il est prêt à en répondre sur sa vie ; et en même temps il s'en remet pour le prouver à la relation du capitaine Constance Ferrer,[1] du lieutenant Thomas[2] Stewart, de Henry Pew, gentilhomme, et de tels autres qu'on trouvera et qui étaient témoins des dits faits : — et qu'il plaise à Sa Gracieuse Majesté de les faire appeler pour vérifier ce récit, en témoignage de la vérité duquel le dit lord Ochiltrie a signé ces présentes. (Signé) J. L. Ochiltrie."

VI

Dans l'*Histoire des Canadiens-Français* (II, 37), j'ai tâché de faire la liste des Français demeurés à Québec durant l'occupation de Kertk. La voici : Des vingt personnes du sexe masculin dont la présence est constatée, dans l'intervalle de 1608 à 1628, cinq repassèrent en France, mais devaient revenir ; ce sont : Samuel de Champlain, Olivier le Tardif, Thierry Desdames, Jean-Paul Godefroy et Robert Giffard. Hébert et Jonquest étaient décédés. Les treize qui restaient au Canada étaient : Nicolas Marsolet, interprète non encore marié, Etienne Brulé, interprète et célibataire, Guillaume Couillard, artisan et cultivateur, Guillemette Hébert, sa femme et leurs enfants : Louise, Marguerite, Louise[3] ; Abraham Martin, pilote, Marguerite Langlois, sa femme et leurs enfants : Anne, Eustache, Marguerite, Hélène ; Nicolas Pivert[4], Marguerite Lesage, sa femme avec leur nièce et un jeune homme ; Pierre Desportes, Françoise Langlois, sa femme et leur fille Hélène ; Jacques Hertel, interprète resté chez les sauvages, non encore marié ; Jean Nicolet, interprète resté chez les Algonquins de l'Ottawa, non encore marié ; Adrien Duchesne, chirurgien et sa femme de nom inconnu ; Jean Godefroy, interprète resté chez les sauvages, non encore marié ; Thomas Godefroy, interprète et célibataire ; Guillaume Hubou, cultivateur marié à Marie Rollet, veuve de Louis Hébert, et un enfant : Guillaume Hébert ; François Marguerie, interprète resté chez les sauvages et non encore marié. En tout, trente-et-une personnes[5]. Ceux qui restaient dans le pays formaient déjà depuis quelques années la partie stable de la population. Il est donc faux de dire que le Canada fût abandonné de ses habitants. D'autres Français, qui ne devaient pas faire souche ici, continuèrent à y résider sous les Kertk. Ce sont : Gros-Jean, de Dieppe, interprète des Algonquins, ami des Anglais ; Le Baillif, natif d'Amiens, arrivé en 1622 en qualité de sous-commis et chassé par de Caen " pour être grandement vicieux ;" il se donna aux Kertk, qui en firent leur commis et lui confièrent les clefs du magasin des Français, qu'il avait eu la précaution de se faire remettre afin de se venger de de Caen. On l'accuse d'avoir enlevé à Corneille, sous-commis, cent livres en or et en argent outre certains effets ; c'est lui, dit-on, qui s'empara des vases sacrés de l'église de Québec ; les Anglais finirent par s'indigner de sa

[1] Il existe une pétition de lui demandant une indemnité pour les pertes subies en cette occasion.
[2] Fils de lord Ochiltrie.
[3] Elisabeth fut baptisée le 9 février 1631.
[4] Ramené à Québec par les Anglais, après avoir été pris au cap Tourmente.
[5] Voir *Société Royale*, 1882, p. 51, 131.

conduite scandaleuse. Le Baillif maltraita tant qu'il le put les familles qui n'avaient point voulu repasser en France. Pierre Reye ou Raye, charron, natif de Paris, qualifié par Champlain de "renégat, perfide, traître et méchant," passa également au service des Kertk. Un nommé Jacques Couillard, sieur de l'Epinay, capturé par Thomas Kertk, comme il arrivait de France, fut conduit à Québec. Des hommes, l'un appelé LeCocq, charpentier, et l'autre Froidemouche, envoyés de la Malbaie à Québec par Emeric de Caen, se firent prendre par les Anglais de Québec, qui les gardèrent pour les faire travailler. Sur un navire de Roquemont, le sieur Le Faucheur, bourgeois de Paris, qui se rendait à Québec avec sa famille, fut pris, et probablement renvoyé en Europe. Celui-ci peut être regardé comme le premier colon que tenta de nous envoyer la compagnie des Cent Associés.

Dans l'automne de 1630, on reçut à Paris des nouvelles de Québec par deux Français qui avaient passé par Londres. L'un était charpentier et l'autre laboureur. "Ils nous dirent, raconte Champlain, qu'il était mort quarante Anglais, de nonante qu'ils étaient, de pauvreté et misère durant l'hiver, et autres qui avaient été assez malades, n'ayant fait bâtir ni défricher aucune terre... et étaient restés quelques septante Anglais." C'est-à-dire que sur quatre-vingt-dix Anglais il en était mort quarante le premier hiver, et que, dans l'été de 1630, il en était arrivé vingt. Je ne sais à quelle date les occupants de Québec apprirent la signature de la paix.

VII

Le 27 octobre 1629, Champlain écrivit à M. Jean de Lauson, à Douvres, en France, lui racontant ce qui s'était passé au Canada, et combien les Anglais étaient embarrassés de ce que la capture de Québec eût eu lieu après la signature de la paix. Lorsqu'il eût passé quelque temps à Londres, il en repartit pour la France, avec la permission de M. de Châteauneuf, l'ambassadeur de Louis XIII, ayant obtenu parole que le fort et l'habition de Québec seraient restitués par l'Angleterre. C'est le cas de dire ici, comme dans les procès-verbaux de nos chambres d'assemblées : "Et des débats s'en suivirent," car tout ce qui était déjà arrangé se trouva dérangé. M. de Châteauneuf fut rappelé incontinent et remplacé par M. de Fontenay-Mareuil. Dans l'hiver de 1629-30, le docteur André Daniel, frère aîné du capitaine Charles Daniel, alla négocier à Londres, avec l'aide du nouvel ambassadeur, pour obtenir la reddition du Canada et régler l'affaire du seigneur écossais, sans savoir que Charles I tenait en réserve une carte de son jeu qui transformerait à un moment donné toute la situation. Un diplomate habile peut encore gagner beaucoup, même lorsqu'il est battu.

Richelieu, créé premier ministre en 1629, n'eut pas plutôt écrasé le parti protestant à la Rochelle, qu'il tourna les armes de la France vers l'extérieur, en affermissant le duc de Nevers dans les importantes positions de Mantoue et de Montferrat (1630) ; puis, absorbé par la politique intérieure du royaume, il triomphait de nouveau de ses ennemis personnels à la "journée des dupes," le 11 novembre 1630, forçant Gaston d'Orléans et Marie de Médicis à quitter la France. Etait-ce bien le moment de lui rappeler le Canada ? Ce qui est certain, c'est qu'il n'y pensa plus jamais autant qu'autrefois, depuis de l'heure où il embrassa l'Europe dans ses projets.

Des vaisseaux devaient partir de Dieppe, le 20 février 1630, pour le golfe Saint-

Laurent. Le 7 avril, ordre était donné de mettre six navires sous voiles dans six semaines, et de les diriger vers le Canada, savoir : l'un commandé par le chevalier de Montigny, amiral de cette flotte, et les autres par le chevalier de Saint-Clair (ou Montclair), le sieur de Nest de Fécamp, le sieur de Lombards, le capitaine Daniel et le capitaine Arnaud. Je ne sais ce qui résulta de ces préparatifs ; mais en l'année 1630 il n'est fait mention que de deux navires français qui parvinrent en Acadie. Les Basques et les autres bâtiments pêcheurs qui, de temps immémorial, fréquentaient les eaux du golfe sans trop s'occuper des luttes entre les couronnes, continuaient leurs opérations en dépit des Anglais.

D'une part, la compagnie des Cent Associés avait à cœur de se refaire de ses pertes d'argent ; Champlain appuyait dans ce sens, afin de reprendre le travail de la colonisation, qui était le grand but de sa vie ; Richelieu était engagé d'honneur à ne point laisser jeter au panier le traité de Suze, si explicite à l'endroit des prises faites après le 24 avril 1629. D'un autre côté, le sentiment hostile aux colonies, dont le ministre de Henri IV, Sully, avait été l'expression en son temps existait toujours ; on discutait en France, en l'année 1630, pour savoir s'il fallait garder le Canada, tout comme en notre siècle le peuple anglais se pose la question de soutenir ses établissaments lointains ou de les abandonner. De Caen demandait que les Anglais lui vendissent les pelleteries qu'ils avaient enlevées à la faveur des troubles et de la prise de Québec. Se croyant bien certain du prompt retour de cette place à la France, et voulant en finir avec les réclamations de ce marchand, Richelieu permit à de Caen d'exploiter le golfe et le fleuve durant une année, ce que les Anglais empêchèrent, comme on le verra. Les Kertk faisaient un commerce profitable, et se montraient disposés à tenir bon dans leurs postes, même à résister aux ordres de se retirer, s'il leur en venait de la cour de Londres. Charles I reprochait à la France l'attaque du capitaine Daniel contre lord Stuart, et voyant Richelieu fort occupé en Europe, feignait de ne pas vouloir céder un pouce de terrain ni un ballot de marchandises. Ainsi s'écoula l'année 1630.

VIII

Attendant toujours la lettre écrite qui devait leur rendre le Saint-Laurent, les Cent Associés se décidèrent néanmoins à faire acte d'occupation. Le 25 mars 1631, le capitaine Hubert Anselme partit de Dieppe en destination de Tadoussac, et relâcha à Miscou pour éviter les Anglais, car il venait d'apprendre de quelle manière il serait reçu par eux dans le fleuve. Il ne paraît pas avoir dépassé Miscou. Au mois d'avril, le capitaine Laurent Ferchaud mit à la voile, de Bordeaux, et cingla vers l'Acadie, où il retourna trois fois dans le cours de cette année, ravitaillant chaque fois le poste français du cap Sable, y transportant des colons et des religieux. Ce fut le seul succès des Cent Associés en 1631.

Le capitaine Daniel avait pris la mer le 26 avril pour se rendre à Sainte-Anne du cap Breton. Arrivé près de Terre-Neuve, il eut connaissance d'un pirate turc et voulut lui donner la chasse ; mais celui-ci, ne se voyant pas de force à résister, vira de bord et alla se jeter sur un bâtiment basque, où il perdit son drapeau, sans toutefois se faire prendre lui-même. Daniel s'arrêta à Sainte-Anne et envoya Michel Gallois à la traite de Miscou sur son propre navire. Gallois rencontra dans ces parages un frère du capitaine Dumay, qui montait une barque de trente-cinq tonneaux seulement, équipée au Havre-de-Grace. Tous deux s'entendirent pour intimider les Basques qui exploitaient les pêcheries sans l'auto-

risation des Cent Associés, et ils mirent d'abord la main sur le capitaine Joannis Arnandel, de Saint-Jean-de-Luz dans le golfe de Biscaye ; mais les Basques revenant sur eux les forcèrent de prendre la fuite, tandis que le captif s'évadait en plongeant dans la mer, d'où ses gens le retirèrent en peu de temps.

Emeric de Caen était parti de Dieppe sur un navire appartenant à son oncle Guillaume. A Québec, les Anglais lui défendirent de trafiquer en dehors des mois d'hiver ; il reprit le chemin de la France.

Tandis que ces événements avaient lieu au Canada, Charles I écrivait de Greenwich à sir Isaac Wake, son ambassadeur près la cour de France, une dépêche en date du 12 juin 1631, qui expose, il me semble, tous les côtés et aspects de la situation entre les deux pouvoirs, et surtout cette curieuse affaire du non payement d'une partie de la dot de Henriette-Marie, sœur de Louis XIII, mariée en 1625 à Charles I. Celui-ci s'explique nettement : payez la dot, ou pas de Québec ni de Port-Royal ! On y voit aussi plus d'un point qu'il est à propos de connaître au sujet des navires capturés en 1629. Cette curieuse pièce a été mise au jour en 1884 par M. Douglas Brymner, archiviste du gouvernement canadien. La voici en son entier :

" Par vos différentes dépêches au vicomte Dorchester, depuis que vous êtes arrivé à votre lieu de résidence en cette cour (de France) nous avons particulièrement remarqué les retards qu'on vous a fait éprouver avant de vous présenter d'abord au roi et à ses principaux ministres, ainsi que les manières et le langage dont on s'est servi à votre égard, lors de votre première audience. Et de même que nous ne pouvons nous empêcher d'être surpris que vous n'ayiez pas été admis plus tôt en la présence du roi, sur vos instances réitérées, et après la sollicitation d'une audience faite par d'Angier, ainsi d'un autre côté, nous estimons avoir lieu suffisamment d'être satisfaits de la réparation qui vous a été faite par la déclaration si significative d'amitié fraternelle et la déclaration d'un ferme propos d'entretenir exactement avec nous des relations amicales, qui vous ont été faites de la bouche même du roi. Quant au bon accueil dont vous avez été l'objet de la part de quelques-uns des ministres de ce roi et à la réserve que d'autres ont observée avec vous, au sujet du cardinal de Richelieu, vous avez bien fait de vous conformer à vos instructions, et pour le reste nous devons vous laisser agir avec eux à votre discrétion. Et comme nous voyons par votre conduite que vous n'êtes pas novice dans les ambassades, ainsi nous n'avons pas besoin de vous donner de nouvelles instructions sur les égards à avoir pour ceux avec qui vous avez à négocier en cette cour, si ce n'est de continuer comme vous avez bien commencé, en ce qui regarde le cérémonial de votre emploi. Cette dépêche vous en apprendra la partie essentielle, qui est de mettre fin à tous les différends entre les deux couronnes, et d'établir les bases d'une plus ferme amitié que celle des années dernières ; ce n'est pas là une œuvre nouvelle ; il ne s'agit, en réalité, que de renouveler d'anciennes alliances, en mettant d'accord les faits avec les promesses. C'est ce que comportait l'objet principal, et le premier article même du dernier traité, conclu il y a deux ans, après une rupture malheureuse ; et ce qu'il embrassait ou ce qu'on pouvait prétendre en vertu de ce traité a été ponctuellement exécuté de notre part : sauf seulement ce qui exigeait dans le temps, et ce qui exige nécessairement une exécution mutuelle. Nous avons, conformément au traité (comme vous le verrez spécifié au troisième article) admis une modification dans la maison de votre digne épouse, en augmentant le nombre des ecclésiastiques attachés à sa personne, comme on l'a jugé convenable, de gré à gré ; et

nous avons fait faire à cette nation (française) diverses restitutions de navires avec leurs chargements d'une très-grande valeur, sans avoir rien pris ni gardé de ce genre, attendu que la remise en était exigée de nous par droit d'arrêt ou de représailles. La même satisfaction ne nous a pas été donnée, non plus qu'à nos sujets, sous ce double rapport ; car bien que le troisième article déjà mentionné requière expressément la confirmation de tous les articles et stipulations de notre contrat de mariage, en n'exceptant que la particularité relative à la maison de notre chère épouse, objet d'une clause particulière dans ce dernier traité, et que la dot soit clairement stipulée, et quant au montant, et quant à l'époque du paiement précisé dans ces articles et conventions matrimoniales, et que promesse de paiement nous ait été souvent faite en conséquence, spécialement par M. de Châteauneuf, maintenant garde des sceaux, lorsqu'il était ici en ambassade, cependant la moitié n'en est pas encore payée, et non seulement trois riches bâtiments appartenant à nos sujets, capturés et gardés sans aucune raison légitime, ni même l'ombre d'un prétexte, sont encore retenus, malgré des demandes réitérées de restitution ; mais aussi il a été pratiqué dans ce pays (en France) diverses saisies de draps et de tissus fabriqués en notre royaume, en contradiction directe avec les stipulations et le traité. Le paiement de la balance de la dot a été depuis promis de rechef, à nous de même qu'aux personnes que nous avons employées dans cette cour, et par les ministres de ce roi et par l'ambassadeur de France résidant auprès de nous. Nous ne pouvons accorder plus de délai pour ce paiement et nous l'avons en conséquence joint aux autres conditions d'une entière et parfaite réconciliation. L'ambassadeur français, persistant encore dans sa promesse de paiement, désire néanmoins que les affaires en question soient séparées, en se faisant un point d'honneur d'être tenue par un nouveau traité, de payer la dette déjà reconnue par une convention antérieure, ce à quoi nous avons consenti volontiers, parce qu'une formalité ne doit pas interrompre les négociations — mais comme nous sommes plus particulièrement tenu en honneur de faire prudemment des conventions qui, si elles n'ont pas été exécutées auparavant dans l'ordre des temps, devraient l'être au moins simultanément et effectivement avec des choses d'une grande importance qu'on nous demande d'accomplir, nous ne pouvons nullement consentir à les séparer de façon que l'une pourrait être prescrite et accomplie sans l'autre. Ce que nous entendons principalement devoir être employé pour amener le paiement de la balance de la dot, est la reddition de Québec, en Canada, ville prise, en vertu d'une commission donnée sous notre grand sceau, pendant la dernière guerre, par une compagnie de sujets de notre royaume d'Angleterre, et l'évacuation de Port-Royal, situé près de la Nouvelle-Angleterre, et où une compagnie de nos sujets de notre royaume d'Ecosse était fixée et établie en vertu de la même commission, sous le sceau de notre royaume, également donnée pendant la guerre — pour donner suite à une autre antérieurement accordée par le roi notre père d'heureuse mémoire. Il est vrai qu'une de ces villes a été prise et que l'établissement s'est effectué dans l'autre après la paix, et pour cette considération (afin d'accommoder tous les différends) nous avons formellement consenti, et nous persistons dans notre dessein et résolution, que l'une, c'est-à-dire Québec, soit rendue, et que ceux de nos sujets qui sont établis dans l'autre s'en retirent, en les laissant toutes deux dans le même état où elles étaient avant la conclusion de la paix : ce que nous ne faisons point par ignorance, comme si nous ne comprenions point à combien peu nous oblige sous ce rapport le dernier traité (le septième article de ce traité, relatif aux restitutions ne mentionne que les navires qui étaient alors à l'étranger avec

des lettres de marque), mais par affection et par désir de plaire à notre bon frère le roi de France dans tout ce qui peut nous être amicalement et raisonnablement bien que non justement et légitimement demandé. Et on peut établir à bon droit cette distinction entre les demandes faites réciproquement et ce que nous demandons, savoir : le paiement de la balance de la dot ; la restitution de certains bâtiments pris et gardés sans même le moindre prétexte, et la main-levée des saisies pratiquées dans ce royaume contre nos sujets, contrairement au traité — tout cela est de droit légitime ; tandis que ce que l'on nous demande au sujet des susdites localités, au Canada et autres lieux, et de quelques navires de cette nation, qui n'ont pas encore été rendus, mais ont été condamnés à la confiscation par notre haute cour d'amirauté, pour des raisons valables en justice, ne sauraient être accordés que par courtoisie et dans l'intérêt d'une entente cordiale. Après vous avoir ainsi exposé complètement l'état de la question en général, je vous réfère pour les détails aux pièces échangées entre l'ambassadeur de France, et celles de nos lords commissaires qui étaient chargés de cette affaire, ainsi qu'à Philippe Burlamachy, que nous vous envoyons exprès avec les mémoires et les pouvoirs qu'il vous présentera. Les mémoires se rapportent aux bâtiments, aux marchandises et autres choses propres à vous donner une connaissance complète de tous les détails en ce qui regarde une restitution mutuelle ; et à cet égard, nous vous laissons la latitude de concéder, plus ou moins, selon que vous le jugerez à propos, pour la conclusion d'un accord satisfaisant. Les pouvoirs, consistent, pour la part de M. Burlamachy, à recevoir le reste de la dot qui nous est dû, soit en argent ou en une bonne et valable procuration, de nature à le satisfaire ; et pour notre part à rendre Québec et à évacuer Port-Royal ; ce pourquoi Philippe Burlamanchy vous livrera certaines pièces convenables pour cette fin. Notre plaisir est que vous les remettiez à ce roi, ou à tel membre de son conseil qu'il nommera lorsque Burlamachy aura reçu l'argent ou les assignations susdites, et qu'il vous aura été donné satisfaction quant aux autres détails plus haut spécifiés ; mais en cas de refus ou de délai relativement au paiement ou à la remise de bonnes garanties (ce dont Burlamachy est tenu responsable envers nous), vous devrez alors les retenir et les lui remettre, car, dans cette éventualité, il ne devra pas rester plus longtemps à attendre la fin de sa mission. Quant à la balance de la dot, il reste une chose à régler : c'est la déduction que nous faisons des sommes que nous avions autrefois allouées aux personnes de la maison de notre chère épouse qui sont retournées en France, déduction à laquelle nous acquiesçons volontiers. Un autre point reste aussi à résoudre touchant l'obligation imposée à nos sujets de se retirer du Canada et autres lieux — c'est que révocation soit faite de tous les actes publiés en France contre tous ceux qui ont été engagés dans cette entreprise, particulièrement contre les trois frères Kirk, ainsi que nous l'avons autrefois demandé au sujet du baron de Latour et de son fils, avec lesquels sir William Alexander avait traité, ce qui fut jugé raisonnable par les ministres de ce roi, et ce sur quoi il faut encore insister. Il y a un règlement pour la liberté du commerce, négocié et formulé par écrit, entre nos commissaires et le garde des sceaux de ce royaume, quand il était ambassadeur extraordinaire ici, et comme l'ambassadeur de France résidant aujourd'hui en notre cour demande que ce réglement soit ratifié et sanctionné, nous y donnons volontiers notre assentiment, principalement parce qu'il donne vigueur et activité au traité antérieurement conclu entre les deux couronnes ; et tant pour cette affaire particulière (à cet effet nous ordonnons qu'il vous soit remis une copie du règlement) que pour les autres affaires dont vous êtes actuellement chargé, nous vous donnons une ample commission sous notre grand sceau, dans la forme usitée en pareils cas."

IX

L'année 1632 s'ouvrit sans règlement de comptes. Il fallut attendre au 29 mars pour voir signer le traité dit de Saint-Germain-en-Laye, qui fit cesser toutes les difficultés. Le 13 juillet, Thomas Kertk rendit Québec à Emeric de Caen, et partit emportant une riche cargaison de fourrures ; les années 1629-32 lui procurèrent des sommes énormes. Les de Caen avaient obtenu le droit de la traite pour l'année 1632. Les Cent Associés envoyaient quelques colons. L'année suivante Champlain arriva de France : c'était le commencement réel du régime des Cent Associés. Malheureusement, des circonstances multiples entravèrent son action. Les guerres que soutenait continuellement la France ; un penchant nouveau chez les armateurs à se porter vers l'Amérique centrale ; la mort de Champlain (1635) et les guerres des Iroquois qui suivirent bientôt — tout se conjura pour paralyser le développement du Canada. A Port-Royal, en Acadie, même chose ; Razilly n'eut pas assez de secours ni assez de temps à sa disposition pour exécuter l'œuvre qu'il avait rêvée ; il mourut, lui aussi, laissant de petits groupes français, isolés les uns des autres, végétant, peu rassurés et nullement aidés dans leurs entreprises. Ils se maintinrent néanmoins dans ces vastes contrées, et posèrent, avec patience et longueur de temps, les assises d'un empire français dont Colbert comprit la valeur en 1663.

III — *Parallèle historique entre le comte de la Galissonnière* (1747-9) *et le comte de Dufferin* (1872-1878), *par* J.-M. LEMOINE.

(Lu le 7 mai 1889.)

Je me propose d'appeler votre attention sur l'administration de deux des plus remarquables vice-rois que la France et l'Angleterre nous aient envoyés, depuis la fondation de Québec jusqu'à ces derniers temps ; je veux dire le comte de la Galissonnière et le comte de Dufferin. La carrière de ces deux hommes présente, à mon sens, de singuliers contrastes, de fort curieux rapprochements.

Le 19 septembre 1747, le *Northumberland*, mouillé dans la rade de Québec, y déposait le remplaçant du marquis de la Jonquière, nommé gouverneur en 1746, et fait prisonnier de guerre, le 3 mai 1747, par les Anglais, à la suite d'un combat naval, près du cap Finistère. Le même navire ramenait en France, le 18 octobre de la même année, le gouverneur sortant de charge, le marquis de Beauharnois. Le nouveau titulaire se nommait Rolland-Michel Barrin, comte de la Galissonnière. C'était un marin français distingué, un érudit, un naturaliste, un fin observateur, voire même un diplomate. "Son premier soin en prenant les rênes du gouvernement fut de connaître le pays, son climat, sa population, ses ressources et son commerce," comme l'a remarqué l'historien Ferland.

Le comte de la Galissonnière débarquait sur nos rives dans un temps fort critique Restaurer le prestige affaibli de la vieille France, utiliser la position exceptionnelle de la France nouvelle, vis-à-vis de la mère patrie, tels furent les problèmes qu'il se posa d'abord.

A cette époque, la marine française, négligée, osait à peine se montrer sur l'Océan, où l'Angleterre, battue sur terre, était toute puissante par son énorme flotte. Un avenir prochain, il est vrai, réservait encore aux armes françaises d'éclatants triomphes en Amérique, mais William Pitt devait changer la face des choses du tout au tout. Heureusement pour la Galissonnière, Pitt n'arriva au pouvoir qu'en 1756, année de la mort de l'illustre comte, — ce qui épargna à celui-ci le chagrin de voir accomplir la prédiction du célèbre ministre anglais, qui avait juré de chasser les Français de l'Amérique.

Deux sujets d'importance première semblent avoir préoccupé le nouveau gouverneur : l'interminable question des frontières de l'Acadie, cédée à l'Angleterre en 1713 par le traité d'Utrecht, et celles de la Nouvelle-Ecosse. La Grande-Bretagne prétendait que les véritables frontières de la Nouvelle-Ecosse ou de l'Acadie, suivant ses anciennes limites, étaient : 1o — " Une ligne droite tirée depuis l'embouchure de la rivière Penobscot jusqu'au fleuve Saint-Laurent ; 2o — Ce fleuve et le golfe Saint-Laurent jusqu'à l'océan au sud-ouest du Cap-Breton ; 3o — L'océan, de ce point, à l'embouchure de la rivière Penobscot. Elle disait même que le fleuve Saint-Laurent était la ligne de démarcation la plus naturelle et la plus vraie, entre les possessions des deux peuples. Le pays ainsi réclamé hors de la péninsule acadienne avait plus de trois fois l'étendue de la Nouvelle-Ecosse, et commandait le golfe, et l'embouchure du Saint-Laurent. C'était la porte du Canada, et la seule par où l'on pût y entrer du côté de l'océan en hiver, c'est-à-dire, pendant cinq mois de l'année."

Cette prétention parut excessive, et, comme l'a remarqué l'historien Bancroft, ne pouvait prévaloir d'après le droit des gens ; car la France n'avait jamais cédé à l'Angleterre la rive sud du Saint-Laurent, ni aucun territoire au nord du 41e degré de latitude.

La prétention de la Grande-Bretagne, du côté de l'Ohio, était encore plus outrée, et si elle eût prévalu, elle lui eût alors assuré l'immense contrée qui forme maintenant les Etats de New-York, de la Pensylvanie, de l'Ohio, du Kentucky, de l'Indiana et de l'Illinois, outre les terres situées à l'est et à l'ouest du lac Michigan : "Le Canada se serait trouvé séparé de la Louisiane par de longues distances, et complètement mutilé[1]. Des murs de Québec et de Montréal, comme le remarque Garneau, on aurait pu voir flotter le drapeau anglais sur la rive droite du Saint-Laurent. De pareils sacrifices équivalaient à un abandon total de la Nouvelle-France."

Bien que le traité d'Aix-la-Chapelle (1745) eût rendu à la France ses anciennes possessions, Louisbourg et le Cap-Breton, ce fameux traité était loin de satisfaire les Français : on avait négligé d'y désigner les bornes de la Nouvelle-Ecosse. "Entre la péninsule et la rivière Saint-Jean, dit Ferland, s'étendait un territoire réclamé depuis longtemps, par la France et l'Angleterre. Pour maintenir les droits de son maître, la Galissonnière fit investir Misagouche (Fort Lawrence), Beaubassin et quelques autres postes du côté de l'Acadie. Dans ce dernier endroit résidait l'abbé Le Loutre, qui avait acquis beaucoup d'ascendant sur les Acadiens, aussi bien que sur les Micmacs. Très attaché à la France, il voulait engager les Acadiens des Mines et de Port-Royal à quitter leurs terres pour se retirer dans la partie assurée à la France. Le gouverneur général approuva les projets de Le Loutre ; en peuplant d'Acadiens le territoire réclamé par la France, il fortifiait les frontières de ce côté, et enlevait à l'ennemi ceux qui pouvaient, par la suite, le favoriser.

En même temps que M. de la Galissonnière travaillait à fortifier l'influence française dans l'Acadie, il cherchait à assurer les limites de la colonie vers l'Ouest, opération d'autant plus importante qu'il s'agissait de conserver ou de perdre une des branches les plus fructueuses du commerce intérieur du Canada. Il importait de conserver la possession du cours de l'Ohio, afin d'entretenir des communications faciles avec la Louisiane, et de restreindre les colonies anglaises aux Apalaches. M. Celoron de Blainville (Bienville) fut chargé de se rendre au Détroit, à la tête de trois cents hommes.

L'expédition de Celoron et des trois cents soldats, en vingt-trois canots, n'eut cependant qu'un demi-succès.

Au rapport du jésuite Bonnecamp, qui accompagnait Celoron comme aumônier, le parti avait parcouru, au milieu de périls sans nombre, douze cents lieues, depuis son départ de Montréal jusqu'à son retour en cette ville. Dans son magnifique récit des incidents de la route, Parkman fait remarquer que l'influence des traiteurs anglais dans la vallée de l'Ohio s'accroissait de jour en jour, et menaçait tôt ou tard d'isoler la Louisiane du gouvernement central de Québec, auquel elle n'était reliée que par une série de petits forts, très faibles pour la plupart. Restreindre l'expansion des colonies anglaises, les reléguer entre l'Atlantique et les Alléganies, remplir de colons français l'Acadie contestée, ainsi que le vaste territoire de l'Ouest, voilà ce qui s'imposait à la Galissonnière, et, comme il le disait dans son mémoire[2] : "Si nous permettons aux Anglais d'être les maîtres en Amérique, leur commerce et leur prestige sur mer prendront des proportions

[1] *Histoire du Canada*, 4e éd., Garneau, vol. II, p. 194.

[2] Mémoire sur les colonies de la France dans l'Amérique septentrionale.

colossales, jointes aux profits qu'ils retireront de leurs colonies, suffisantes pour leur assurer la prépondérance en Europe." Certes il ne se trompait pas. On vient de constater, par des preuves indiscutables, la sollicitude et la sagacité du comte de la Galissonnière, lorsqu'il s'agit des grands intérêts de la France en Amérique. Maintenant ce courageux apôtre du progrès va se manifester sous un jour nouveau.

En 1749, il n'existait pas d'imprimerie au Canada, bien que les colonies anglaises "jouissassent depuis longtemps des bienfaits de la presse." Le gouverneur français fit d'actives démarches auprès du ministre des colonies, alléguant que l'établissement d'une imprimerie à Québec serait d'une grande utilité pour la publication des ordonnances et des règlements de police ; le roi de France refusa d'autoriser cette dépense. La Pompadour et le Parc-aux-Cerfs devaient, en effet, au chapitre des dépenses, passer devant les "quinze mille arpents de neige." La royale concubine seule coûta, paraît-il, à peu près $36,000,000 cours actuel.

C'est au milieu de ces patriotiques et incessantes préoccupations pour l'avenir de la France nouvelle, que le comte de la Galissonnière fut rappelé dans sa patrie, où la Cour avait besoin d'un négociateur habile et bien renseigné sur les faits, pour discuter de graves questions de frontières avec les commissaires anglais Shirley et Mildmay. Le 24 septembre 1749, le comte s'embarquait à Québec sur le *Léopold* pour repasser l'océan.

"De retour en France, dit Garneau, il continua de s'intéresser au Canada. Il proposa au ministère l'envoi de dix mille paysans pour peupler les bords des lacs et le haut de la vallée du Saint-Laurent et du Mississipi. A la fin de 1750, il lui adressa un nouveau mémoire, où il disait que si la paix paraissait avoir assoupi la jalousie des Anglais en Europe, cette jalousie éclatait de toute sa force en Amérique ; qu'il fallait fortifier le Canada et la Louisiane, et surtout s'établir solidement dans les environs du fort Saint-Frédéric et des postes de Niagara, du Détroit et des Illinois."

Mais la France fit la sourde oreille aux sages représentations de l'éminent homme d Etat.

La Galissonnière, cinglant un jour dans les eaux de Minorque, fut rencontré par une escadre anglaise commandée par l'amiral Byng. Celui-ci, craignant une défaite, à cause de ses forces inférieures, crut devoir reculer devant l'ennemi traditionnel d'Albion. Il fut traduit devant les tribunaux et cruellement sacrifié comme la bête noire du ministère impotent, moribond, auquel succéda celui du grand Pitt. On fusilla Byng pour n'avoir pas engagé le combat quand même.

La carrière glorieuse du brave marin français se termina sans gloire. La fin du héros fut presque aussi tragique que celle de son rival, l'amiral anglais. Byng, de retour en Angleterre, fut fusillé pour avoir refusé de se mesurer avec un ennemi plus fort que lui, et la Galissonnière, appelé à Fontainebleau, où était le roi, mourut en chemin, à Némours, le 26 octobre 1756, sans avoir pu faire reconnaître ses services et son vrai mérite. Louis XV ne l'avait pas même fait vice-amiral, disant, mais trop tard pour être cru[1], qu'il l'avait appelé à Fontainebleau pour lui donner de sa main le bâton de maréchal.

Les marins français regrettèrent universellement leur vaillant capitaine. Hélas ! à quoi aboutissent les sentiers de la gloire ? Comme l'a dit Gray :

The paths of glory lead but to the grave.

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[1] *Histoire du Canada*, Garneau, t. III, p. 198.

L'histoire lui conférera un diplôme plus glorieux que ceux qui viennent des rois.

Voici comment parle un savant contemporain, le célèbre naturaliste suédois, Pierre Kalm, qui fut l'hôte du comte de la Galissonnière, au château Saint-Louis, à Québec, durant quarante-cinq jours : " C'était un homme d'environ cinquante ans, dit-il ; de petite stature, un peu difforme même, mais d'un extérieur agréable ; quand je pense à toutes les belles qualités qui brillaient en lui, je ne puis en faire assez d'éloges. Il a des connaissances étonnantes dans toutes les sciences, mais surtout dans les sciences naturelles, où il est tellement versé que, quand il commençait à me parler sur ce sujet, je m'imaginais voir notre grand Linnée sous une nouvelle forme. . . . Jamais l'histoire naturelle n'a eu, en ce pays, un plus grand protecteur, et il est douteux qu'on ne revoie ici son pareil."

LE COMTE DE DUFFERIN (1872-1878).

Frederick Temple Hamilton Blackwood, comte de Dufferin et baron de Clandeboye, est de très-noble et très-ancienne famille d'extraction écossaise. On trouve l'un de ses ancêtres à la cour de la reine Marie Stuart. Il est né à Florence, le 21 juin 1826. En 1841, il hérita du titre nobiliaire et des domaines, en Irlande, de son père, le capitaine Price Blackwood, qui avait été anobli. Sa mère appartenait à l'illustre lignée des Sheridan. Elle semble avoir transmis à son fils les aptitudes littéraires et le beau parler de cette famille privilégiée. Ayant fait ses classes à Eton, le jeune Blackwood fut gradué par l'université d'Oxford. Un de ses premiers soucis fut de s'occuper des affaires de l'Irlande, qu'il visita en 1847, lorsque ce malheureux pays était en proie aux horreurs de la famine. De retour, il publia le résultat de ses observations, et suggéra des réformes. A l'âge de vingt-deux ans, il fut nommé chambellan de la reine, et remplit ces hautes fonctions presque sans interruption, jusqu'en 1858.

C'est vers la même époque qu'il explora dans son yacht, le *Foam*, — de temps en temps remorqué, comme il le dit, par la frégate française la *Reine Hortense*, portant le prince Napoléon, — les Geysers de l'Islande et du Spitzberg. Son volume : *Letters from High Latitudes* contient le récit de son voyage. Ce livre fit sensation dans le monde littéraire et scientifique. Il fournit d'utiles renseignements sous une forme fort attrayante. A peine de retour des glaces du pôle nord, " il partait pour les régions que brûle le soleil," chargé d'une importante mission politique. Il allait en 1860, comme haut commissaire, faire une enquête sur les massacrés des chrétiens en Syrie. Les résultats de sa mission furent tels qu'ils lui valurent l'honneur d'être nommé chevalier du bain. Lord Dufferin avait réussi à rétablir la bonne entente entre les chrétiens et les Druses ; il se revélait pour la première fois comme diplomate. Son mariage avec Harriet, fille d'Archibald Hamilton, de Killyleah Castle, Irlande, petite fille de Hamilton Rowan, date du 23 octobre 1862. Qui de nous n'a vu et admiré la spirituelle et séduisante comtesse ?

De 1864 à 1866, lord Dufferin remplit la charge de sous-secrétaire pour les Indes. En 1866, on le retrouve sous-secrétaire au ministère de la guerre. Deux ans plus tard, il devient chancelier du duché de Lancaster, — poste honorifique et lucratif qui avait été offert à notre ancien gouverneur lord Elgin, à son retour du Canada, en 1854.

Lord Dufferin avait, en 1867, présidé le congrès des Sciences à Belfast, où il fit, en termes émus et avec une éloquence entraînante l'éloge de sir Walter Scott, à l'occasion

du centenaire de la naissance de l'Arioste du Nord. On lui offrit vers ce temps le gouvernement de Bombay, mais la faible santé de sa mère lui fit refuser ce pro-consulat lointain. En 1866, il avait publié un mémoire remarquable sur l'état de l'Irlande, hérissé de chiffres, d'arguments, saupoudré d'une fine ironie et de mille grâces de style.

Le comte de Dufferin, dès le début, marcha dans les rangs du parti libéral de la Grande-Bretagne. C'est au Grand Vieillard, à l'illustre M. Gladstone, que le Canada est redevable des services de l'éminent homme d'Etat, du sympathique et puissant protecteur des Canadiens, dont le départ a causé de si justes regrets.

Sa souveraine ne lui a pas marchandé les honneurs, en récompense des services inappréciables qu'il a rendus à l'empire. Il est du petit nombre des nobles ayant droit aux cordons des trois ordres de chevalerie. Il devint pair du royaume-uni de la Grande Bretagne et d'Irlande, en 1871. Il vient d'être créé marquis.

Invité à répondre au discours du Trône dans le parlement impérial, peu de temps après la mort regrettable du prince Albert, lord Dufferin prononça, le 6 février 1862, une chaleureuse harangue, qui semble avoir enlevé l'auditoire et qui fit verser d'abondantes larmes, par la peinture qu'il fit des vertus domestiques et de l'excellent cœur du royal époux de Sa Majesté la reine. Ce fut là, pour ainsi dire, son premier, et l'un de ses plus beaux triomphes oratoires. Le noble lord répondit aussi, par un discours qui est resté légendaire, à l'adresse qui lui fut présentée dans un banquet public à Belfast, le 19 juin 1872, à la veille de son départ pour son gouvernement du Canada. Après avoir admirablement défini les attributs d'un gouvernement constitutionnel, il rappela avec cette magie de diction qui le distingue, en parlant de nos voisins, la sage inspiration, l'esprit d'ordre, le culte de la patrie, qui dictèrent le chef-d'œuvre de Washington et de Franklin : la constitution de la république de 1775. Puis, au moment de faire ses adieux à ses bons amis de la Verte-Erin, il résuma en quelques mots "les progrès de notre jeune et virile nationalité canadienne," et termina par une péroraison pleine de noblesse, dans laquelle il prédit pour le Canada, les plus merveilleuses destinées. "C'est une jeune et chaste déesse, s'écria-t-il, errant à travers un monde nouveau, encore inconsciente de ses charmes, perdue dans des bois radieux tout sillonnés de limpides rivières. De temps à autre, elle se retourne pour saisir au miroir de leurs ondes crystallines quelques traits furtifs de sa rayonnante majesté, sans se douter des splendeurs qui l'attendent à l'olympe des nations."

Son discours prononcé à Winnipeg, par son ampleur, ses aperçus frappants, sa prescience de l'avenir, est un chef-d'œuvre — une vraie révélation.

Inutile d'assayer, dans ce cadre étroit, une analyse réelle des innombrables et éblouissants tableaux que présente cette galerie oratoire commencée par le comte de Dufferin, en 1872, et que son départ de Québec, vint interrompre en 1878. A Halifax, à l'île du Prince-Edouard, à Ottawa, à Saint-Jean, Nouveau-Brunswick, à Chicago, à Windsor, au Détroit, à Guelph, à Brantford, à Oshewaken, à Woodstock, à Toronto, au *Canada Club* de Londres, aux juges de la cour suprême d'Ottawa, à Victoria, Colombie Anglaise, aux Mennonites, aux Islandais, à Gimli, à Winnipeg, à New-York, à Boston, à Granby, à l'université Laval, à la société Saint-Jean-Baptiste, à Québec, sans oublier une réponse élaborée, de sa part, en latin, une autre en grec, aux adresses que lui présenta l'université McGill, à Montréal, — c'est une série de chefs-d'œuvre.

On ne sait ce qu'il faut admirer davantage, dans cette interminable nomenclature d'éloquentes harangues ? Sous combien de formes toutes plus attrayantes les unes que

les autres se présente ce merveilleux Protée de la tribune, cet habile prestidigitateur de la phrase ? Tantôt votre oreille écoute, ravie, l'ingénieux apôtre du progrès national, le voyant, le prophète, arrachant à l'avenir ses insondables mystères, tantôt l'homme d'Etat consommé, planant bien au-dessus de la sphère agitée des partis, équilibrant, au sein d'une colossale crise politique, les attributs, les limites de la constitution. Aujourd'hui vous suivez pas à pas l'habile publiciste, éclairant, dans une dépêche officielle, la métropole sur le rôle qui lui incombe pour consolider le faisceau des diverses nationalités dont se compose notre peuple, lui signalant les écueils dont la plage coloniale est semée. Demain, vous entendrez tout émus, la voix vibrante du professeur d'histoire ou de belles-lettres, ou du docteur en droit constitutionnel, vous retraçant avec enthousiasme les fastes aimés de notre passé, ou bien commentant les traités qui sauvegardent nos libertés, arborant vaillamment l'étendard de la tolérance, de la confraternité, parmi les cultes divers qui divisent nos rangs, et conviant les nationalités aux différentes croyances à se réfugier en toute sécurité sous l'égide du vieux drapeau britannique, les exhortant à fuir les discordes, et à marcher dans le droit chemin, — comme le dit sa noble devise : *Per vias rectas !*

C'est surtout quand, nous ouvrant intimement son cœur, il fait appel à nos sentiments comme hommes, à notre patriotisme comme citoyens d'une naissante nationalité, et nos implore à vivre en paix sous nos institutions libres, sans oublier ni Dieu, ni nos semblables, que sa voix prend les accents de l'inspiration. Aujourd'hui il dérobera à Parkman une de ses pages émouvantes, sur l'héroïsme des premiers missionnaires de la Nouvelle-France, et se complaira à rendre un hommage éclatant aux martyrs Brebœuf et Lallemant. Demain, il redira aux Canadiens-français qu'ils sont de bonne lignée, qu'à l'exemple de leurs pères, ils doivent savoir de quelle manière accueillir l'envahisseur de leurs foyers, le cas échéant.

Le soir, présidant à côté de sa spirituelle et aimable épouse, un banquet d'amis ou de savants, lord Dufferin lancera un feu roulant de bons mots et de fines allusions, qu'il clora, à sa manière, par un ingénieux trait d'esprit, un compliment aux dames, avant d'aborder la discussion de quelque grave mesure d'utilité publique, ou d'un problème social, auquel ses agréables propos ont servi d'introduction. N'oublions pas surtout le généreux patron de l'éducation, qui, pour encourager notre jeunesse de nos universités, nos lycées, et de nos couvents, a taxé si lourdement son patrimoine, déjà entamé, pour faire frapper cinq cents médailles d'or et d'argent.

L'érudit comte de Dufferin, à l'instar de son devancier, le savant comte de la Galissonnière, était dévoré de la soif de la science et des lettres. Comme l'ami du professeur suédois, Kalm, en 1749, lord Dufferin étonnait son entourage par ses connaissances variées et le charme de sa conversation. On n'est pas surpris de le trouver prêt à répondre, dans le même idiome, aux félicitations que l'université McGill lui adressa un jour, dans la langue de Cicéron et dans celle de Démosthènes. Une de nos villes surtout avait toutes ses complaisances : la vieille cité de Champlain. Il y venait chaque année, à la belle saison, s'y reposer. Il traversait à toutes les heures ses quartiers les plus populeux, seul ou avec un aide-de-camp ; le peuple se pressait sur ses pas pour saluer le *comte Dufresne*, son bon ami. Québec lui doit une éternelle reconnaissance pour les améliorations dont il gratifia l'antique capitale.

Aidé de l'expérience de l'ingénieur de la ville, M. Charles Baillargé, et éclairé par un savant architecte, M. Wynn, qu'il avait fait venir expressément d'Europe, lord Dufferin,

puisant jusque dans la bourse royale à Windsor, a trouvé moyen de faire relever nos murs, et, par ce qu'on appelle les *Dufferin Improvements*, d'orner Québec et de lui conserver son cachet d'antiquité, sans nuire aux besoins du progrès présent. Le prolongement de la terrasse Durham — qu'on doit encore à son initiative — couronna dignement tous ces travaux dont notre ville est si fière aujourd'hui.

En souvenir de ce fait, Son Altesse Royale, la princesse Louise et lord Lorne, à la demande expresse du maire et du conseil de ville, ont conféré son nom à cette terrasse — la terrasse Dufferin[1] — unique au monde.

Enfin, à l'instar de l'illustre comte de la Galissonnière, notre bon ami lord Dufferin, quittait Québec, à la demande expresse de la métropole. On requérait ailleurs ses services. Plus heureux que l'illustre Français, il n'aura pas à reprocher à sa patrie d'avoir été ingrate. Tâchons de marcher toujours dans la voie droite que lord Dufferin nous a tracée : *Per vias rectas*

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[1] La terrasse Dufferin fait partie des fortifications de Québec. Elle relève donc, ni de la municipalité, ni du gouvernement de la province de Québec, ni même de celui de la Confédération, mais des autorités impériales et du bureau de la guerre à Londres, représentés au Canada par le gouverneur général du Dominion, dont la commission le nomme aussi, commandant en chef des forces de Sa Majesté au Canada, etc. Ce qui lui donne le le contrôle de tout ce qui touche à la défense de notre territoire. La municipalité a contribuée pour $7,500 au coût de cette superbe terrasse, qui, avant sa prolongation d'après les plans Dufferin, portait le nom de terrasse Durham, en l'honneur de lord Durham, gouverneur général du Canada, en 1838, qui l'avait fait construire à ses frais sur les ruines du vieux château Saint-Louis, incendié le 23 janvier 1834.

Le gouvernement canadien a aussi contribué pour une large part aux dépenses de cette restauration. La terrasse fut ouverte solennellement le 9 juin 1879, par Leurs Excellences le marquis de Lorne et Son Altesse Royale, la princesse Louise, qui, à la demande expresse du conseil de ville présent et présidé par le maire, Son Honneur Robert Chambers, lui conférèrent le nom de l'illustre homme d'Etat, lord Dufferin, à qui nous la devons. La municipalité fit dresser procès-verbal de la cérémonie, et fit apposer sur la terrasse même des plaques métalliques avec les mots suivants :

Dufferin Terrace. H. Hatch, contractor. C. Baillargé, Engineer.

La *Société Historique et Littéraire* ayant présenté au Conseil de ville un placet demandant de commémorer le souvenir de certains personnages éminents en associant leurs noms à cette terrasse, le conseil, sur motion de M. P. Johnson, adopta le 9 mai 1879, une proposition donnant aux cinq jolis kiosques qui y sont érigés les noms de *Victoria, Louise, Lorne, Frontenac et Plessis.*

IV — *Maximilien voyageur, écrivain, critique d'art, poète, marin, observateur, philosophe, bibliophile et chrétien, par* FAUCHER DE SAINT-MAURICE, docteur ès-lettres.

(Conférence lue devant la Société Royale du Canada, le 24 mai 1889.)

I

MAXIMILIEN VOYAGEUR ET ÉCRIVAIN.

Le 30 juillet 1851, Maximilien quittait son palais de Miramar.

"Le soleil était à son lever, nous dit-il. Je fis à la hâte un tour de jardin, je cueillis les dernières violettes, je promenai mes regards de tous côtés ; enfin je descendis l'escalier de marbre de l'embarcadère, et je m'éloignai avec la chaloupe, le cœur oppressé d'une mélancolie profonde. Le monde est ainsi fait. Possède-t-on les plus beaux, les plus admirables sites, ceux-là même que vous envient les riches de la terre, on fuit."

Et pourtant il l'aimait son château de Miramar, sis sur un des bords les plus enchanteurs de l'Adriatique ; il l'aimait autant que l'Océan, ce qui n'est pas peu dire pour un marin.

Plus tard, dans un jour d'expansion, n'est-ce pas ainsi qu'il en parlait ?

"La mer vibre, et chante des légendes merveilleuses ; elle roule l'écume blanche des vapeurs, et dépose au pied du château les frais baisers des nymphes. Et quand elle recule bruyante, un frisson agite l'air des salles : c'est la réponse qui s'échappe de la fière demeure de Miramar, parfum de fleurs bercées par le vent du soir emporté vers la mer bleue. Les rayons du soleil couchant embrasent la barque ; le crépuscule enveloppe encore l'Occident, et déjà la lune éclaire le Levant ; elle étincelle tremblante sur l'onde.

"Le silence se fait sur la vaste mer ; on n'entend que le bruissement de la barque qui, sur les flots phosphorescents glisse vers les bords fleuris. Elle vole vers eux, guidée par la lampe qu'on voit briller au balcon comme un phare lointain.

"L'esquif s'arrête près du château. Une rose tombe du balcon. Alors la vague bruit et chante de nouveau ; d'elle s'élève un chant d'amour ; et, chancelante, elle atteint la rose, la rose, divin gage de celle qui porte mon nom."

Mais, trève de souvenirs. Hélas ! oui, le 30 juillet 1851, Maximilien fuyait Miramar.

Maximilien fuyait sur sa belle frégate la *Novara* — la *Novara* sur laquelle il allait faire une partie du tour du monde, la *Novara* qui devait le conduire au Mexique comme empereur, et qui devait l'en ramener mort et défiguré par les balles mexicaines. Est-ce que les navires seraient comme des livres ? Auraient-ils leurs destinées ? *Habent sua fata libelli.*

Ses premières impressions de voyage sont sur Naples et sur le Vésuve :

"A mesure que se fait l'ascension du volcan, la belle vie terrestre ne se montre plus que par de rares échappées ; on se voit entouré de l'image incolore de l'universel néant. De sombres murs, d'énormes blocs grisâtres de noires masses, des montagnes de cendres

mouvantes et de laves calcinées se dressent de toutes parts, et enveloppent le groupe des pauvres voyageurs qui s'aventurent au milieu de ce royaume de la mort, immense, lugubre, au milieu de cette dévastation de la nature, dans cette vallée de la mélancolie. Les deux pointes de *Monte Somma* du Vésuve étaient autrefois réunies ; mais les entrailles du globe se révoltèrent ; la montagne s'entrouvrit, et par le gouffre béant se répandirent des flots de lave qui se refroidissaient à la longue et formèrent la mer inanimée, pétrifiée, incolore, entourée d'un sable de cendres mouvantes qui sépare les deux sommets. Le regard se promène avec angoisse sur ces masses monotones qu'ont enfantées la montagne, et devant lesquelles toute vie s'est enfuie. Par intervalles seulement, on aperçoit au loin, comme de rares clartés dans une nuit ténébreuse, quelques fragments de paysage, la ville de la joie, les flots argentés de la mer, la riante et fertile plaine. Ainsi enveloppé par la mort, le voyageur songe involontairement à ces âmes meurtries auxquelles il ne reste plus que de beaux souvenirs. Naguère elles étaient, comme les autres, verdoyantes ; mais éloignées de la foi, privées des secours d'une religion consolatrice, elles se sont abîmées dans une mélancolie profonde. Leur observation peut avoir quelque attrait pour le psychologue, mais elle nous remplit le cœur d'une tristesse infinie.

"Nous voilà arrivés dans l'enfoncement qui sépare l'extrémité des deux points du Vésuve. Quel coup d'œil, quelle sensation inexprimable ! Les escarpements étaient revêtus de soufre blanc ; le sol de lave était tout noir, la cendre grisâtre, des morceaux de soufre jaune et rouge gisaient à terre çà et là. Des vapeurs bouillantes s'échappaient de dessous les grands blocs de lave ; le panorama de Naples et de la mer nous était caché par le cône de la montagne. La vapeur et le brouillard voilaient le firmament ; l'air était tantôt froid et âpre, tantôt d'une lourdeur étouffante et surchargée de soufre. Tout respirait la mort et la destruction. On devinait sous ses pieds l'action de forces puissantes et inconnues ; on voyait des couleurs comme on n'en voit jamais ; on se sentait enveloppé d'une atmosphère toute nouvelle ; on ne croyait plus vivre sur notre belle terre, mais au sein du chaos, au milieu des éléments primordiaux avec lesquels Dieu créa le monde, parmi les vapeurs empoisonnées qui planaient sur l'abîme, avant que l'air et l'eau eussent été séparés, avant que le soleil eût séché et animé toutes choses. C'était un de ces aspects qui ne peuvent se décrire, et qu'il faut avoir contemplés pour se faire une idée du travail de la nature, et comprendre combien l'homme est petit, et petite est sa science ! Nous n'étions pas encore au bord du cratère, que j'étais impressionné par la vue de ce qui m'entourait, comme je ne l'avais été par aucune autre chose dans le cours de ma vie.

"Le cratère a réellement quelque chose d'une gueule, de la gueule des dragons légendaires ; ce sont bien là les couleurs dont l'imagination se plait à revêtir ces monstres fabuleux. L'intérieur du cratère exhale ces mêmes vapeurs empoisonnées et humides qui enveloppaient jadis de terreur et de mort les chevaliers chasseurs du dragon.

"A la hauteur où j'étais, sur le bord de l'abîme, je me sentais comme perdu ; je croyais être sur les confins d'une autre planète, sur le seuil mystérieux d'un monde étrange et nouveau. Je me sentais abandonné au milieu de cette solitude, au sein de ce chaos silencieux ; j'étais comme environné du frisson des mondes légendaires ; sans mes amis qui étaient là, une indicible épouvante m'eût chassé de ces lieux, et j'aurais fui devant les forces muettes et assoupies de la nature. Je ne me sentais pas assez fort pour résister à de pareilles impressions ; j'étais comme subjugué par le charme mystérieux et souverain de ces puissances souterraines. Déjà des spectacles moins étranges font fris-

sonner l'homme quand il est seul ; un entourage de glace ou de granit, la chute d'une cascade de rocher en rocher lui font croire souvent que l'eau l'enchante et l'attire, que le murmure sinistre lui parle, et si alors un orage vient à gronder dans le ciel, si l'ouragan mugit, si la foudre enveloppe d'un réseau de feu le pauvre abandonné, son cœur tressaille et se resserre, il jette autour de lui des regards d'angoisse, comme si le tonnerre menaçait son âme défaillante, comme si chaque trait de foudre lui était destiné ! Il y a de la vérité dans ces impressions ; c'est le langage de la nature qui remplit de frayeur la conscience de l'homme et lui fait voir son néant ; c'est la force mystérieuse et profonde des éléments que l'homme frivole ne considère pas quand ils sommeillent, mais dont les avertissements sont d'autant plus redoutables dans leurs réveils momentanés.

" Nous sortîmes enfin ; nous quittâmes les bords du cratère, et nous redescendîmes dans la sombre vallée. Je me retournais encore par moments pour contempler le vieux Vésuve, ce laboratoire de la nature, où il est donné à l'homme de se rapprocher des forces primitives. Une image triste et nue se dresse devant nous avec des couleurs d'un autre monde, avec une majesté imposante et terrible. On se croit transporté à l'époque où la race pécheresse ne foulait pas encore un sol enfermant dans son sein les germes de la vie, et où la molle masse d'argile n'avait pas encore été touchée par le souffle du Tout-Puissant. L'esprit de Dieu semble encore planer sur la terre et sur les eaux, méditant sur la matière inerte avant de prononcer les paroles de vie, le *fiat* créateur, qui devaient retentir comme un tonnerre à travers la nature. Le Vésuve est une portion survivante du chaos, sans autre nuance que le gris terne et mort qui est la teinte fondamentale de toutes choses.

" Voilà ce que nous enseignent ces époques primitives vers lesquelles nous reporte la montagne géante ; mais elles nous font en même temps soulever le voile de l'avenir. De même que Dieu a créé, il détruira ; de même que les différentes couleurs ont été engendrées par le gris, ces couleurs admirables, vivants témoignages de l'œil tout-puissant, s'effaceront un jour pour retourner à la teinte fondamentale. Comme le feu qui purifie, comme la nature est sortie de la fumée et des nuages, si belle que Dieu lui-même s'est réjoui de son œuvre et a dit : " Elle est bonne," un jour viendra où les nuages et la fumée soustrairont de nouveau le vieux globe pourri aux yeux fécondants du Créateur.

" Tout obsédé de ces pensées redoutables, je demandai un asile à la petite église de l'Ermitage pour y implorer le pardon de mes péchés. Quand la société tout entière se trouva réunie, l'aumônier de la frégate nous dit la sainte messe, et l'on reprit à la hâte, à travers de riches vignobles, le chemin de Résina. Le ciel s'était éclairci, la perspective était encore plus riante que dans la matinée ; au milieu d'une verdure incomparable et baignée par les flots étincelants de la mer, Naples apparaissait dans toute sa magnificence à nos yeux éblouis.

" Dans cette ville, le peuple *vit*. Il n'est pas moralement atrophié, replié sur lui-même comme dans les autres villes : tous ses faits et gestes s'exécutent en plein. Son activité se déploie dans la rue, et c'est pour le voyageur nouvellement débarqué un spectacle d'un attrait sans égal, un merveilleux divertissement. Les boutiques sont à l'air, libres et découvertes ; les comestibles sont entassés par les rues. Au milieu des plus beaux produits du Midi vous voyez les moutons et les pourceaux, les chiens et les enfants jouer et se bousculer. Ceux-ci sont les derniers vrais petits Murillos ; ils vont et viennent hardiment dans leur costume primitif, entre les boutiques de macaroni et les gargotes, et attrapent leur dîner là où ils le peuvent, au besoin même dans le fumier. A tous les

coins de rue pour ainsi dire, on voit des caisses de bois aux couleurs vives sur lesquelles s'élève un berceau à colonnes, orné d'oranges et de feuillage et entourant l'image de la Madone. Derrière ces colonnes se trouvent de petits barils allongés, posés horizontalement ou verticalement, selon la circonstance, et versant de l'eau fraîche.

"Le soir arriva calme et pur ; le soleil s'abaissait à l'horizon. Nous avions devant nous la ville et sa mondaine munificence, ses palais, ses musées, ses villas couronnées de verdure, de fleurs, sa physionomie sensuelle et joyeuse ; les flots dorés du golfe baignaient les rives enchantées de Castellamare, et au milieu des bois d'orangers apparaissait la poétique Sorrente, la ville aux belles femmes. Une vapeur violette enveloppait le Vésuve ; la riche et fertile *campana* se déroulait à nos pieds, et tout autour de nous, au milieu du parfum des fleurs, du bruissement des cyprès et des lauriers, des voluptueuses caresses de la brise du soir, parmi ces monuments de marbre, la mort étendait son empire.

"A quoi tend votre agitation, joyeux Napolitains ? Où allez-vous ainsi en dansant ? Vous allez au tombeau ; et les martyrs ont beau répandre leur parfum, la rose épanouir ses brillantes couleurs, le nérium et le laurier frémir harmonieusement, le marbre resplendir et étaler des inscriptions orgueilleuses . . . la tombe, la froide tombe est le sinistre terme du pèlerinage terrestre."

Naples pour Maximilien est la ville du plaisir et du printemps de la vie ; Florence celle des âmes fatiguées et rêveuses. Gaëte est le port dans lequel la barque de Pierre jeta l'ancre pour se mettre à l'abri des tempêtes du monde.

"Déjà, écrit-il dans son livre de bord, les portes toutes béantes de l'enfer se flattaient d'avoir vaincu la tiare trois fois sainte ; déjà elles croyaient le chef de la chrétienté tombé pour ne plus se relever. Tout à coup, parmi de sombres nuages, d'effrayants éclairs, le tonnerre retentit. Il ébranla les cieux, et les réels supports du prince de ce monde entendirent en tremblant une voix qui criait :

"—Tu es Pierre, et sur cette pierre je bâtirai mon Eglise, et les portes de l'enfer ne prévaudront pas contre elle !

"Le pasteur des âmes trouva dans sa fuite un refuge assuré sur les rochers de Gaëte, et les portes de l'enfer durent engloutir de nouveau la tourbe écumante, et retomber sur elles-mêmes devant la force du Tout-Puissant. Une plaque de marbre placée au haut de la citadelle indique l'endroit où l'illustre fugitif donna un jour le seul bien que lui eussent laissé les orages du monde, et que tant de créatures humaines voulaient encore recevoir malgré la fureur de ses ennemis, la bénédiction apostolique. Pie IX apparut sur ce rocher, et prononça à haute voix sa toute puissante bénédiction. Des témoins occulaires m'ont affirmé que ce fut un spectacle singulièrement imposant de voir le prince de l'Eglise se dressant au-dessus des remparts, dans son simple habit blanc, et prononçant d'une voix calme et ferme les paroles sacrées sur la foule des fidèles qui, abimés dans un muet recueillement, courbaient la tête devant lui. Le lieu semblait merveilleusement choisi pour un acte aussi sublime et aussi solennel."

De Gaëte les hasards du voyage conduisent Maximilien à la grotte de Capri. Elle lui arrache ce cri d'enthousiasme :

"Le bateau nous déposa près d'un mur de rochers ; de petites barques miniatures nous emportèrent plus rapides que le vent ; c'était à croire que, comme au temps de la fable, une baguette magique allait nous entr'ouvrir ces retraites mystérieuses, et nous donner accès dans un temple de fée.

"Ce n'était point un rêve; une ouverture étroite perçait l'escarpement; encore quelques coups de rames et nous voguions légèrement, comme poussés par le souffle des elfes, sous la voûte de pierre; derrière nous se fermait le monde habité avec ses agitations terrestres et la lumière de son soleil, et, soulevés par les ailes du zéphir, nous glissions sur les lames d'azur entre des profondeurs scintillantes, sous les vapeurs irisées d'un dôme féerique. Des reflets argentés pareils à ceux des rayons fantastiques de la lune se jouaient dans la pénombre bleuâtre, teintaient le cristal des stalactites, et caressaient la transparence du marbre. Nous nous trouvions dans la retraite de la nymphe de Capri. De petites crêtes d'argent couronnaient les vagues légères, l'eau murmurait doucement, une fraîcheur délicieuse était partout répandue. Mais la nymphe était absente, et pour notre bonheur! Le monde est ainsi fait: aussi longtemps que les déesses ont hanté cet asile, aucun mortel n'a pu les découvrir, et quand les hommes y pénétrèrent, elles avaient disparu; et la lueur mystérieuse de la grotte est seule restée comme un charmant reflet, comme un poétique souvenir des naïades qui se berçaient mollement sur les flots argentés."

Gibraltar fascine Maximilien:

"C'est un rocher monstrueux qui s'élève comme un Titan gigantesque au-dessus de l'Océan et de la Méditerrannée. De quelque point qu'on le contemple il présente aux regards un aspect toujours nouveau. Gibraltar a la puissance et l'attraction à la fois séduisante et horrible, que ne manque jamais d'exercer la grandeur écrasante. En elle résident la beauté et l'attrait de Gibraltar, ce rocher chauve, dénudé, calciné par les rayons du soleil, image toujours changeante, mais une image de l'éternel repos et de la force majestueuse."

Mahon, la capitale de l'île Minorque est pour lui l'image de la mélancolie sans fin:

"Le pays tout entier me parut désolant, sans une ombre de poésie. Les moulins à vent jouent ici un grand rôle; de toutes parts on voit leurs ailes tourner, de toutes parts on les entend gémir. Semblables à des arbres desséchés ou à des fantômes gigantesques, ils se dressent au milieu d'une contrée nue, et augmentent l'ennui qu'on y éprouve. Autant un moulin à eau, avec son écume et son bruit cadencé paraît beau, animé et poétique, autant un moulin à vent, avec sa masse grisâtre et ses grands bras, semble laid, endormant, insipide. Le premier annonce l'animation et la fraîcheur de l'eau; le second a l'air d'un télégraphe destiné à nous écarter d'un pays aride et désert; et c'est bien là, en effet le caractère de cette contrée."

Lisbonne ne lui plaît pas:

"C'est un immense amas de moisons sur le bord d'un fleuve, sans rien de caractéristique ni de pittoresque. Pour être caractéristique il lui manque des édifices saillants et originaux; pour être pittoresque il lui manque la campagne. La ville s'élève sur une colline, et se termine brusquement à l'horizon, sans avoir cet arrière plan si nécessaire à l'harmonie de la perspective. Tout cela est si étendu, si large, et se détache tellement sur le bleu du ciel que l'on cherche involontairement une chaîne de montagnes où la vue puisse reposer. On se représente Lisbonne comme une ville riche en monuments historiques, située dans la contrée la plus riante, sous le climat le plus doux. On l'embellit de tout l'éclat des teintes méridionales, de toute la magnificence d'une végétation tropicale; on s'imagine que le Tage coule sous un ciel d'azur, au pied d'antiques palais de marbres, portant sur ses ondes argentées des centaines de gondoles dorées et de gallions chargés de métaux précieux. Sur ces bords, on se figure un peuple gai, chantant des

stances mélodieuses aux accords de la guitare. Pure fantaisie que tout cela ! La ville est grande, mais disséminée sans aucun plan. Il n'est pas rare de rencontrer des champs parmi les maisons, et les maisons sont d'une architecture vulgaire et monotone."

Madère le console de Lisbonne :

" Le 4 juillet, au lever du jour, quand je montai sur le pont, il semblait qu'une œuvre magique se fût accomplie pendant la nuit. Sous les rayons dorés du soleil des tropiques, au sein d'une mer étincelante et azurée, baignée d'un air limpide, une île majestueuse se dressait devant moi, une île de basalte, aux teintes violettes, revêtue de la verdure la plus fraiche du printemps. C'était une image saisissante et bien faite pour transporter l'âme et la remplir d'allégresse. Une sérénité céleste régnait dans ce tableau, et cependant il était saturé d'une légère vapeur. La lumière était d'une clarté surnaturelle, comme une âme qui se manifeste dans des yeux inspirés. Un air délicieux pénétrait à flot dans la poitrine allégée ; on pressentait un monde nouveau, un paradis terrestre.

" J'ai beaucoup parcouru le monde, et je puis dire que je n'ai rien vu d'aussi beau. J'ai cueilli la rose des Alpes sur les glaciers étincelants ; j'ai traversé, sur le fier coursier arabe, les bois de cyprès de Smyrne ; j'ai ravi le nérium aux rives enchantées du golfe de Lépante ; je me suis bercé sur les flots azurés de la grotte de Capri ; j'ai dérobé des fleurs aux jardins féeriques de l'Alhambra ; mais ici je trouvais réunis tous ces trésors de la nature, et je ne sais quoi encore d'inexplicable qui fait pour moi de Madère un paradis terrestre. Est-ce l'air transparent comme le cristal, où respirer est une volupté ? Est-ce la variété infinie et enchanteresse des fleurs ou leur parfum pénétrant ? Et ce printemps éternel qui fait que juillet même a plus de charme ici que notre mois de mai ? Est-ce enfin ce climat toujours égal, toujours frais et vivifiant, aussi beau dans la nuit que dans la journée, toujours caressant, toujours doux ? Je ne puis le dire, mais je sais du moins que j'ai vécu ici doublement, toujours heureux, toujours ravi, et que ce serait pour moi une félicité sans égale de posséder une maison de campagne en ce pays.

" La végétation de l'univers entier est représentée à Madère de la façon la plus grandiose. Les plantes du Nord, chênes vigoureux, fougères touffues, chèvrefeuilles odoriférants ; celles de l'Italie, châtaigniers et oranges ; les superbes camélias de la Chine ; le caféier d'Arabie, que je n'avais pas encore vu ailleurs aussi fécond, aussi répandu ; le précieux ananas d'Amérique, que je voyais aussi pour la première fois en plein air ; le bananier toujours chargé de fruits ; cent autres plantes rares qui ne se voient chez nous que dans les serres des palais, où elles sont étiolées, et où cependant on les admire, sont ici comme chez elles, dans leur éclat, dans leur fleur ; puis ajoutez les vignes les plus précieuses du monde."

La ville de Bahia l'émerveille. Quant au nouveau monde, où la mort l'attendait sept ans plus tard, il lui causa une curieuse sensation :

" Dès les premiers jours passés sur le sol d'Amérique, j'ai senti le fardeau qui m'écrasait."

Et comme s'il avait eu un presssentiment, il parle ici pour la première fois du Mexique.

" Mon digne hôte nous montra un vieil ouvrage des plus intéressants sur le Mexique. On y voyait dessiné, avec des armes et des costumes, un zodiaque des anciens Mexicains. Encore un pays que je visiterai, si Dieu me prête vie."

Les pages qu'il consacre à Alger, à Blidah, aux gorges de la Chiffah, aux paysages de

l'Atlas, aux fantaisies arabes, aux trappistes de Staouëli, et la réception que lui fait le général Yusuf, sont admirables de coloris et de vérité.

Puis Maximilien tourne la proue de sa frégate dans une autre direction.

"Aux confins de la civilisation se trouve, dit-il, un pays sauvage qui porte le nom harmonieux d'Albanie. Ce sont des cantons forestiers où l'homme et le sanglier, le Turc et le chrétien se font tour à tour une chasse furibonde, et vivent animés de haines et de ressentiments implacables. En ces lieux, la messe se dit encore comme au temps de Dioclétien, dans les transes de la peur ; les fidèles se rassemblent dans des endroits ténébreux qui ne sont éclairés que par les lumières de l'autel."

Pendant cette croisière, Maximilien protège ses coreligionnaires, et sème partout le bien et la paix sur ses pas.

Mais en voilà assez. Dans ces pages prises au hasard dans son journal de route, je vous ai montré l'écrivain.

Jugeons maintenant le critique d'art et le poète.

II

Maximilien critique d'art et poète.

Nous sommes à Florence, au palais Pitti. Maximilien écrit à l'impératrice sa mère :

"La madone de saint Sixte est une vierge calme, victorieuse, au regard profond et empreint d'une mélancolique fierté. Comme elle comprend la nature surhumaine de l'enfant qu'elle porte dans ses bras, comme elle sait que ses mains sont le trône auguste du fils de son Dieu ! On lit dans son regard qu'elle s'honore elle-même comme étant l'instrument immaculé de la puissance créatrice, qu'elle sent toute la grandeur de ses souffrances, mais aussi toute la splendeur infinie de sa glorification. C'est pourquoi elle s'avance sur les nuages comme la noble reine des anges, pleine de majesté, et elle montre, à la foule de ceux qui espèrent, le Sauveur du monde. Elle entend l'hosanna des mille et mille bouches qui chantent l'allégresse, mais son oreille semble aussi percevoir les lointaines clameurs du peuple qui demande le crucifiement. Nulle auréole n'entoure sa tête ; nul joyau ne relève son simple et modeste vêtement : la mère du Christ dans ce tableau n'a besoin d'aucune parure éclatante, d'aucun accessoire qui détourne le regard de l'objet principal, comme en emploient si souvent les artistes de nos jours pour diviser et distraire l'attention du spectateur. Le plus bel ornement de la madone de saint Sixte est le divin Enfant, et la plus sainte auréole, l'éclat de ses grands yeux limpides qui remplissent d'une pieuse confiance ceux qui les contemplent. Il y a dans ces yeux de la consolation, de la vérité et une profondeur infinie ; la sérénité du ciel s'y reflète comme dans un lac tranquille. Et quelle création admirable que cet Enfant qui repose dans ses bras ! On devine en lui le Rédempteur ; sur ses traits pleins de gravité on pressent la tâche divine qu'il doit acomplir ! Sous ses boucles foncées s'ouvrent deux grands yeux noirs qui regardent fièrement sur le sombre monde du péché, comme s'ils voulaient dire : — Je triompherai de vous, pécheurs endurcis ; tremblez devant l'Enfant qui vous jugera un jour, et qui vous punira !

"Et il se penche en arrière, il soulève ses épaules comme pour se préparer, dans une attitude calme et sereine, à la lutte avec le monde.

"Dans une autre salle où nous entrâmes, de nombreux artistes étaient en train d'étudier la *Vierge à la Chaise*. Comme ces pauvres madones doivent s'ennuyer d'être éternellement copiées par la foule inintelligente des barbouilleurs! Heureusement que ce sont de saintes femmes que la vanité ne tourmente guère. Pourquoi donc fallait-il qu'en contemplant ce tableau de Raphaël, la madone de saint Sixte me revint toujours à la mémoire? Cela tenait sans doute à la ressemblance des visages; toutes deux ont le même corps, mais elles n'ont point le même esprit, la même expression, la même façon d'être éclairées par la lumière. Pour l'une, c'est la lumière céleste; pour l'autre, la lumière de la terre. La *Sixtina* est une vision qui plane, une image transfigurée après l'épreuve du combat et de la douleur; la madone à la Chaise est une femme de la terre pour qui l'heure de la souffrance n'a pas encore sonnée; elle est assise tranquillement et, si j'ose m'exprimer ainsi, à l'*aise* sur ce siège que la gloire à venir n'a pas encore transformé en trône. Les plis d'un turban lui tombent sur l'épaule; ses vêtements sont choisis. Elle se penche doucement sur son enfant; elle le serre dans ses bras; elle regarde le spectateur avec de grands yeux réfléchis, comme Raphaël seul pouvait les peindre, et qui, tels que la lune dans une nuit calme et sereine, répandent dans le cœur malade des rayons d'une douceur ineffable et d'un profond apaisement.

"Raphaël a peint la madone de saint Sixte avec des intentions célestes, la *Seggiola* avec des inspirations d'un profond amour, la madone du Grand-Duc avec un sentiment de pureté enfantine. Cette dernière est une calme et silencieuse prière, tandis que la *Sixtina* est une extase, et que la *Seggiola* exprime l'admiration des œuvres du Créateur adressée à lui-même dans la personne de son Fils. Dans la *Sixtina*, je vois sous une seule et même forme la mère auguste du Christ et la servante du Seigneur; dans la madone à la Chaise je ne vois que la mère heureuse et florissante; dans celle du Grand-Duc que l'humble et pieuse servante.

"J'aurais voulu pouvoir m'arrêter des heures entières devant la *Vision d'Ezéchiel*. C'est un petit cadre doré d'un pied et demi de haut sur un de large, et qui renferme le ciel dans sa magnificence et son immensité. Oui, c'est bien Dieu le Père que nous voyons ici, le Dieu créateur et souverain maître du monde. Le roi de l'univers est sur son trône de nuages, porté par les mystérieux symboles des évangélistes, le Dieu de l'Ancien Testament. C'est bien là Jéhova devant la face de qui l'on s'affaisse tremblant dans la poussière, abîmé dans l'adoration et en même temps relevé par la pensée consolante que chacun de nous a été créé à son image, et que l'âme immortelle emprisonnée dans cette enveloppe éphémère, émane de Celui qui était, qui est et qui sera. La chevelure grise ondoie majestueusement; la barbe imposante flotte autour du visage tout rayonnant de grandeur divine et de puissance créatrice; les bras étendus pour bénir s'élèvent au-dessus des nuages qui ne sont point là rassemblés pour former un point d'appui et de repos, mais un trône glorieux. C'est une volupté céleste de méditer devant ce tableau et d'abîmer son âme dans cette contemplation sublime. On croit entrevoir l'instant suprême où l'on verra un jour le Maître face à face. L'art d'un Raphaël était seul capable de produire un pareil effet et de trouver sa récompense dans sa propre création.

"Je retrouvai ici Van Dyck dans son thème le plus admirable, le royal et infortuné couple d'Angleterre. Ce ne sont que deux bustes; je reconnus avec bonheur l'image vaporeuse et poétique de la noble reine, un peu différente de celle que possède le musée de Dresde, mais remplie d'un charme original et d'une suave mélancolie. On voit là, Charles et Henriette en vêtements de deuil."

Et Maximilien ajoute d'un ton presque prophétique :

" L'avenir a répandu comme un voile sur les traits sérieux de Charles ; il fut une victime de l'ordre le plus élevé, et n'eut que le tort de se soumettre à sa destinée avec trop de résignation et de douceur. Il pécha par faiblesse ; il a dû être infiniment plus gracieux et moins roide que Louis XVI. Il a été donné à tous deux, sinon de vivre, du moins de mourir énergiquement. Pourquoi faut-il que leurs femmes aient été si séduisantes et si belles ? Pourquoi faut-il que ce qui est tendre et exquis soit toujours froissé et brisé ? "

Ce jour-là, Maximilien a-t-il vu dans l'avenir ? Ne lisons-nous pas entre ces lignes poignantes son nom et celui de la malheureuse impératrice Charlotte ?

La chapelle de Michel-Ange, à San Lorenzo, lui déplaît souverainement. Elle lui produit une impression des plus désagréables, un effet glacial et repoussant :

" Ici reposent dans le sommeil de la mort, dit-il à son entourage, des cœurs à jamais perdus, et leur vaine philosophie en s'élevant à elle-même ce tombeau n'est parvenue qu'à exprimer le malaise de la conscience. Si Michel-Ange a eu de son époque une connaissance exacte et profonde, ce monument lui a merveilleusement réussi, et les statues indécentes qui l'entourent, dépourvues de grâce et d'âme, si je puis le dire, ne montrent que trop clairement d'où soufflait l'esprit qui a hanté ces lieux. La position demi-assise, demi-couchée des grands Médicis exprime, sous une forme sensible et matérielle, l'aversion d'une philosophie orgueilleuse et frivole pour le repos de la mort. Ils semblent se débattre et ne vouloir point du linceul, qu'aucune créature humaine n'a encore soulevé, mais qui recouvre dans la paix la dépouille du croyant. Ces monuments portent l'empreinte d'une lutte maladive de la grandeur terrestre contre le soi-disant néant ; le marbre reste froid, et sous cette enveloppe de pierre la mort semble ricaner et se moquer de la vie. Le mot paix ne saurait retentir sur ces tristes parvis qu'aucun souffle chrétien ne réchauffe."

En lisant cette page écrite par Maximilien, on songe involontairement à ces lignes du chapelain Burchard. Parlant d'un Médicis, il disait :

— Il mourut *sine luce, sine cruce, sine Deo.*

Tour à tour le groupe de Niobé avec ses enfants, le *Vase de Médicis*, la *Flore* du Titien, la *Méduse* du Carrache, l'architecture de la *Tribune*, la *Vénus* de Médicis, la rêveuse et superbe *Fornarina*, le *Jean de Monfort* et le *Charles-Quint* de Van Dyck, l'*Hercule* de Rubens, l'*Adoration des Mages* de Durer, l'*Adam et Eve* de Cranach lui arrachent des critiques et des descriptions pleines de logique et de vie.

Raphaël, Rubens et Van Dyck lui font faire les réflexions suivantes :

" Sérieux et rêveur, consumé par une ardeur profonde, sans énergie virile, mais sans faiblesse féminine, sorte d'être intermédiaire et mélancolique, n'appartenant à la terre que par une enveloppe frêle et nerveuse, moitié chérubin, moitié génie, avec un regard profond, plein d'une douce langueur, tel nous apparaît Raphaël dans un portrait charmant. C'est bien là le jeune homme qui a vu plus haut que tous les autres, qui dans l'extase de l'amour le plus brillant a exprimé par la peinture une philosophie profondément religieuse, et qui dans l'accès même du sentiment n'a rien perdu de la sincérité intelligente et de la force.

" Van Dyck est grand et beau comme ses admirables personnages ; c'est le peintre des princes et des grands de ce monde, un artiste aristocratique, et son portrait nous le présente bien ainsi, plein de dignité, de noblesse et de génie.

" Rubens nous a laissé son visage, un visage voluptueux et presque effronté, avec

un regard entreprenant qui a savouré déjà bien des choses, une moustache finement retroussée, une expansion saine et vigoureuse. Il peignait avec humour ; il aimait la plénitude des formes et la fraîcheur des chairs enlacées de guirlandes bachiques, et ce même homme était capable de créer avec une foi énergique un François-Xavier sublime, un imposant Loyola. Tout cela est exprimé et se lit sur les traits du visage. Raphaël succomba à l'ardeur qui le consumait lentement, Rubens florissait au sein des jouissances et des joies de la vie. Il y puisait sa force pour enfanter de grandes œuvres."

La collection des chefs-d'œuvre de la *Tribune* de Florence laisse à Maximilien "l'impression que cause une société appartenant aux conditions et aux spécialités les plus diverses, aux âges les plus différents, aux croyances les plus opposées."

"Ici, Adam et Eve, monarques et madones, Vénus et Apollon, bacchantes, enfants Jésus, faunes plongés dans l'ivresse, les temps de Raphaël et ceux de Praxitèle, tout cela est confondu et mis en harmonie par le sentiment véritable et le goût de l'art. La *Tribune* à elle toute seule mérite que l'on fasse un grand voyage à Florence."

L'Espagne, Séville, l'Andalousie, Grenade vont maintenant accaparer l'esprit de ce poète. La cathédrale de Séville est une merveille.

"C'est, dit-il, un des plus beaux monuments de l'art chrétien. La gravité du style gothique règne ici sous ces voûtes mystérieuses et immenses, surchargées d'ornements et de gracieuses dentelles frémissantes du souffle de la foi ; les élégants arceaux courent de pilier en pilier comme autant de fleurons d'un superbe diadème ; les hautes fenêtres qui s'élancent vers le ciel et leurs sombres vitraux qui ne répandent qu'une lumière adoucie et mystérieuse achèvent cet ensemble vraiment incomparable. A l'extrémité de la nef nous franchissons la grille d'une chapelle assez grande. Ici reposaient les ossements de celui, sous le nom duquel j'ai été baptisé, celui de qui j'ai l'honneur de descendre et que l'Eglise a constitué mon principal défenseur devant le trône de Dieu. On célébra la grand'messe derrière les grilles dorées du chœur. La cathédrale se montrait dans son imposante majesté. Le moment suprême de l'élévation arriva ; les sons graves et touchants de l'orgue retentirent sous les voûtes gothiques ; les têtes des fidèles s'inclinèrent au son des cloches ; une colonne d'encens monta comme un nuage vaporeux au-dessus de l'autel pour saluer le sacrifice auguste qui faisait descendre parmi nous le maître du monde, le fils de Dieu. C'était un de ces moments sublimes, émouvants, solennels qui n'appartiennent qu'à la vraie religion catholique, et ravissent en adoration et en extase le cœur de l'homme. Je me sentis tout à fait transporté, et j'invoquai pour ma famille absente l'intercession de saint Ferdinand, qui a joint les exploits de l'épée aux pieux élans de la prière. Je me levai fier d'être chrétien. Je me sentis affermi dans ma foi, je me sentis rassuré à l'ombre toute puissante de l'Eternel."

Nommez-moi un prince catholique qui ait su parler d'une manière plus sublime.

Pour Maximilien, l'Alcazar est "l'œuvre d'un peuple croyant, mais pour qui n'a pas brillé la véritable lumière. La sensualité qui joue un si grand rôle dans la vie musulmane a marqué de son sceau cet édifice merveilleux. On s'étonne, on admire et cependant on ne ressent autre chose qu'une excitation agréable de l'imagination ; la gravité supérieure fait entièrement défaut. L'Alcazar est une tente royale et magnifique dont les colonnes élégantes soutiennent de superbes brocards de Damas, des tapis de l'Inde et des voiles de dentelles aux merveilleux tissus. On regarde et l'on se demande si les tièdes haleines du vent ne vont pas soulever le voile de dentelle, si les tapis dorés ne vont point

se mettre à onduler sous la brise du soir. Illusion merveilleuse produite par la magie de l'art oriental ! Les siècles ont passé, les générations se sont succédées sous ces voûtes féeriques, et les tapis de l'Inde sont encore là suspendus aux mêmes colonnes auxquelles les califes les ont jadis attachés. Cette tente fantastique que les rois de l'Orient ont dressée sur les bords du Guadalquivir est bâtie toute en pierre et en solides matériaux. Ces riches tapisseries, ces ingénieux entrelacements de figures régulières qui témoignent de la science des maîtres qui les ont dessinés, ne sont autre chose qu'une mosaïque de briques peintes et de pierres délicatement sculptées ; ces voiles de dentelle qui ravissent nos yeux sont le travail à jour le plus léger et le plus fin qu'une main humaine ait jamais façonné avec du mortier et de l'argile. Dans ces lieux où florissaient jadis la splendeur et l'éclat du despotisme oriental, ne règne plus maintenant que le calme de la mort, et le pas de l'étranger retentit seul dans ces salles où les riches tissus de Cachemire protégeaient les pieds des califes contre le froid du marbre, où les vapeurs légères de l'ombre montaient gracieusement sous les voûtes dorées, où les roses enlaçaient de leurs festons les colonnes de jaspe, où le son des luths et le murmure des jets d'eau retentissaient dans le calme des nuits éclairées par la lune."

Il visita seul l'Alhambra, avec un ami.

" La reine des nuits, dit-il, trônait radieuse dans le sombre azur ; les étoiles brillaient comme des diamants ; la nuit sereine et paisible avait je ne sais quoi de mystérieux. Les arcades et les portiques paraissaient plus gracieux, plus élancés que jamais sous cette lumière dont les rayons inondaient les cours de marbre et dansaient comme des sylphes sur les eaux des fontaines. Les bassins et les terrasses portaient le sceau mystérieux des nuits andalouses, les roses exhalaient en silence leurs parfums, une haleine légère faisaient frémir le feuillage des orangers, et les calices d'ivoire du jasmin nous envoyaient le salut discret de leurs senteurs enivrantes. Les reflets de l'eau ressemblaient à une légion de lutins, dansant au bord des plates-bandes, se perdant sous les fleurs couvertes de rosée, pour ressortir et étinceler de nouveau à la clarté de la lune, comme si, au milieu de leurs éclats folâtres et parés de leurs robes d'argent, ils voulaient faire leur cour aux rayons de l'astre des nuits.

" Shakespeare a révélé le *Songe d'une nuit d'été ;* Mendelssohn en a entendu les harmonies et les chants ; moi je puis dire que je l'ai vu !

" Du haut de la tour de Comack, j'aperçus vers l'orient la montagne du dernier Soupir du Maure, *el ultimo Suspiro del Moro.* C'est de là qu'Abou-Abdallah, le roi vaincu par les chrétiens, put dans sa fuite apercevoir pour la dernière fois sa belle Grenade et son féerique Alhambra. Il s'y arrêta quelque temps ; d'amers soupirs s'échappèrent de son sein, et des larmes coulèrent sur son visage.

" Comme on comprend cette douleur ! ajoute Maximilien."

Hélas ! l'histoire se répète ! Seize ans plus tard, le 19 juin 1867, il contemplait lui aussi du haut du Cerro de las Campanas, son ingrate ville de Queretaro qui l'envoyait à la mort.

Avant de quitter l'Espagne, Maximilien résume ainsi ses idées sur l'art :

" Ce sont les Grecs, ces artistes si ingénieux, si délicats qui ont su inventer l'harmonie des jouissances. Les Romains plus grossiers se sont formés à leur école. Chez nous autres Autrichiens, buveurs de bière, le sentiment de ces choses nous fait complètement défaut. Nous aussi, nous n'avons pas de soleil pour nous sourire, nous n'avons pas

un climat auquel on puisse se fier. Notre air est âpre, rude comme notre vie. Ce n'est que dans le Midi qu'on retrouve encore l'écho des bons vieux temps classiques. Les anciens Arabes ont semé en quelques sortes des oassis dans la suite des âges; nous voyons encore les restes de leurs rêves pétrifiés et comme cristalisés, à Séville, à Grenade, au Caire, à Damas

"L'harmonie des jouissances entendues dans un sens élevé, suppose la fleur de tous les arts, les lignes heureuses de l'architecture, les riches couleurs de la peinture, les nobles formes de la sculpture, les plus doux accents de la musique. Elle fond tout cela avec les parfums de la nature, avec les avantages d'un climat et d'un siècle privilégiés, avec tout ce qui flatte les sens sans les troubler, avec tout ce qui embellit l'existence et raffine l'esprit. C'est ainsi que se forment les talents, que l'esprit devient créateur et que le cœur sait trouver la poésie et les chants."

Voilà en peu de mots quelles sont les pensées de l'empereur sur le vrai et sur le beau. Etudions maintenant ses idées en général sur les hommes et sur les choses.

III

Maximilien : marin, observateur, philosophe, bibliophile et chretien.

Je vous ai parlé de Maximilien voyageur, homme de lettres et critique d'art.

Causons du marin, de l'observateur, du philosophe, du poète, du bibliophile et du chrétien.

L'empereur aimait à citer souvent ces mots anglais :

— *Take it coolly.*

Il en avait fait sa devise particulière. En aucune circonstance il ne l'a démentie. Il se plaisait à les répéter à son équipage, quand il était dans la marine autrichienne. Les loups de mer étaient ses hommes. Il les aimait comme on aime sa famille.

Un jour, en parlant d'eux, il disait :

"Le vrai matelot a raison d'être fier. Le monde lui appartient, l'Océan est sa patrie ; son esprit ne connaît d'autres bornes que celles du vaste globe. Il a droit de cité dans tous les pays de la terre, il est reçu partout en ami ; et pourtant il est partout dans sa patrie, car son vaisseau en est une portion et lui sert jusqu'aux antipodes de forteresse puissante et redoutée. En lutte incessante avec les éléments, environné de dangers continuels, il acquiert le sérieux et l'énergie du caractère ; élevé au sein des privations, il reste enfant en quelque sorte, et il jouit des moindres choses avec candeur et naïveté."

Le capitaine de vaisseau anglais est pour cet amiral autrichien le modèle du marin :

"Dans les petites marines, principalement dans celles qui sont encore en voie de formation, on se fait une idée tout à fait fausse du capitaine tel qu'il se comporte en réalité dans les grandes marines. Le capitaine anglais est le souverain de son vaisseau. C'est lui qui le conduit en mer, le fait rentrer dans le port, ou le mène au combat ; il regarde ses sujets d'un œil de maître. Pour les affaires secondaires, il a ses organes, ses mandataires, qu'il laisse agir selon son grade ; et il reste souvent des jours entiers sans se montrer sur le pont ; un long apprentissage et une longue pratique lui donnent la ferme assurance que le service se fait ponctuellement et sévèrement, comme il doit être fait. Il

n'apparaît que dans les grandes circonstances, pour fonder la réputation du vaisseau par de brillantes manœuvres ou pour la victoire, ou encore, comme un *Jupiter tonnans*, pour répandre autour de lui la terreur et le respect. Les autres ont à s'occuper des choses moins importantes.

"Dans les marines en voie de formation, au contraire, le capitaine est tout : il est le génie universel, le secours indispensable dans les moments difficiles, le factotum en activité perpétuelle. Il doit commander et exécuter à la fois ; il doit monter le quart lui-même, bien qu'il ait sous ses ordres de nombreux officiers, sans quoi sa propre vie et celle de l'équipage ne seraient pas en sûreté. Il doit faire le maître d'école pour la jeunesse et le geôlier pour les mutins ; il doit faire lui-même la ronde, et s'assurer que ses ordres sont réellement exécutés. Il doit en personne envoyer de tous les coins du vaisseau l'équigage à la manœuvre ; il doit être le surveillant, et à la place des cadets hisser les signaux de sa propre main. Mais le pire inconvénient d'un tel état de chose est, que, avec le temps, capitaine et officiers s'y accoutument, que le capitaine n'a jamais confiance en ses officiers, et que ceux-ci naturellement n'acquièrent jamais cette confiance en soi-même si nécessaire au marin. Ils se laissent bientôt aller à la paresse inhérente à l'humaine nature, et se trouvent heureux de se décharger du fardeau de la responsabilité sur les épaules de leur chef. Insensiblement, celui-ci de son côté, trouvera plaisir à s'occuper des détails insignifiants, et toujours prêt à se louer lui-même, il n'aura que des paroles chagrines sur l'impéritie des officiers et des cadets. Mais comment ceux-ci peuvent-ils apprendre quelque chose, quand on ne laisse aucun jeu au développement de leur spontanéité, et qu'on ne le mesure pas aux progrès de leur éducation ? C'est une nécessité désolante que, chez les petits, tout soit petit fatalement."

Maximilien aimait son équipage et il savait s'en faire aimer. En 1853, il commandait la *Minerve*, sur les côtes de l'Albanie. Un de ses matelots, Marco Rugger, tomba tout à coup à l'extrémité.

Que disent à ce propos les mémoires du futur empereur ?

"L'équipage s'était groupé, par un mouvement de sympathie, autour du moribond. Je demandai que quelqu'un commençât les prières des agonisants ; mais personne n'en eut le courage. Dans notre siècle, on se sent aux heures solennelles pris d'un embarras étrange. La religion est devenue un objet incommode ; c'est un feu qui brûle encore, mais qui ne réchauffe plus. Je vis le cercle demeurer muet et honteux autour de moi. Le moment important d'où dépend le salut peut être perdu par légèreté. Je ne réfléchis pas longuement ; en un instant je descendis dans ma cabine et je rapportai un fragment de la vraie croix avec mon livre de prières. Je fis assujettir la précieuse relique sur le hamac ; moi-même je m'agenouillai auprès du moribond. Cet acte rompit le charme jeté par le mauvais esprit, et bientôt un chœur de pieuses prières s'éleva pour le salut de la pauvre âme. Au moment où les derniers rayons du soleil nous éclairaient par les ouvertures de l'avant, mon jeune matelot expira. La cloche du vaisseau fit entendre un glas funèbre, et la nuit qui tombait étendit paisiblement son linceul sur celui qui n'était plus.

"Je n'avais encore vu mourir personne. Il me fallut faire un effort extraordinaire pour rester jusqu'au dernier moment. Mourir me sembla alors beaucoup plus facile que je ne me l'étais figuré. La mort de Rugger fut solennelle, et grâce à Dieu, édifiante. Je vis des larmes dans les yeux de nos jeunes officiers. D'ordinaire ils ne pensent guère à ces choses-là. Cette grave leçon fut salutaire à moi-même et à tous. Dans le cours de la

soirée, les matelots me demandèrent encore — ce qui me causa un vif plaisir — la permission de dire le chapelet en commun auprès du défunt. Avant minuit, le cercueil fut prêt ; on le descendit lentement dans ma baleinière ; les rames se mirent en mouvement. Appuyé sur la lisse de plat-bord, j'entendis longtemps dans le silence de la nuit la chaloupe ramer vers la falaise. Le corps fut déposé dans une petite chapelle où il fut confié à la garde de la population catholique de la côte.

"Je priai encore, car il convient à celui qui voit sa famille éprouvée de se tourner vers son Dieu. Ce Dieu n'est pas sourd aux prières de ceux qui ont une foi inébranlable en sa toute puissance, et une supplication filiale a toujours soulagé l'âme du fardeau qui l'oppressait. Il n'y a que le libre penseur dont l'orgueil refuse de s'incliner . . . jusqu'à la mort ; mais ce moment suprême apprend même à un Voltaire à bégayer des prières et à chercher en tremblant des consolations."

Maximilien pratiquait depuis sa plus tendre enfance les idées saines et pieuses.

Mais remettons-nous en route. Nous sommes au Brésil. L'illustre voyageur voit un jour la foule se ranger respectueusement devant le passage rapide d'un palanquin.

Ecoutez ceci :

" Chacun se demande : — Qu'est-ce ?

" C'est un riche Brésilien qui s'en va faire la sieste. Un instant après, il repose au milieu de ses trésors, et s'endort dans son hamac élégant, sous sa froide véranda où pénètre la brise de mer. De fidèles esclaves l'environnent ; il sommeille doucement et sans mauvais rêve. Si vous voulez savoir comment il est parvenu à la richesse, comment il a rassemblé les millions qui lui font un oreiller si commode, vous avez facilement la réponse en pleine rue. C'est par le commerce de la chair humaine, par le trafic des noirs fait sur une échelle gigantesque, ou par la fabrication de la fausse monnaie. Cet homme n'en est pas moins un personnage très honorable ; il aura quelques beaux titres de noblesse ; il va à la cour. Il dort aussi paisiblement que les saints au paradis. Et pourquoi ne dormirait-il pas ? La notion de la conscience est tout à fait absente sous le ciel des tropiques ; sous ce climat d'une éternelle douceur, ce degré de sensibilité morale paraît être inconnu. La conscience faisant défaut, il ne saurait y avoir de religion véritable, et naturellement le besoin ne s'en fait pas sentir. Mais ce que ces nababs du Brésil ne peuvent supprimer, c'est l'expression féroce de leurs yeux noirs, sombres, toujours en quête de quelque chose : on ne peut les regarder sans éprouver un sentiment d'horreur, une sorte de frisson.

" Il y a proprement quatre facteurs — trois d'entre eux sont négatifs — dont les influences diverses et combinées concourent à détruire, au Brézil, le lien domestique et social :

" L'absence de la maison patriarcale, héréditaire, solidement constituée et cohérente, dans laquelle les générations successives poursuivent leur existence avec les mêmes principes et les mêmes mœurs ; — l'absence complète de l'idée et du sentiment de la conscience, effet inévitable d'un climat toujours égal, de la richesse d'une nature exubérante, ce qui entraîne à son tour le troisième point ; — l'absence absolue de cette base religieuse qui fait que l'homme aspire à quelque chose de supérieur à la simple nature ; mais justement le malheur a voulu qu'ici la nature fût trop belle ; — quatrièmement enfin la plaie hideuse et à jamais flétrissable de l'esclavage, cette plaie qu'il est du devoir de tout honnête homme de combattre par la parole et par les actes, à quelque condition sociale et à quelque pays qu'il appartienne.

" Or l'esclavage suppose et engendre à son tour les trois vices précédents.

" Comment donc la prospérité d'une maison pourrait-elle subsister à côté de cette institution désastreuse ? Comment une conscience humaine pourrait-elle se former là où il y a des hommes hors la loi, et où des êtres qui ont une âme sont asservis à l'arbitraire, et aux caprices d'autres êtres, leurs semblables ?

" La religion n'est-elle pas une dérision, une pure comédie là où le blanc s'arroge le droit de traiter l'image du Créateur comme une bête de somme, ou plutôt comme une chose ? Comment peut-il tenir une religion pour véritable et même en respecter une en général, quand il rejette en dehors des droits de l'homme une partie de l'humanité et ne la considère que comme des masses de chair et de sang faites pour être bâtonnées ? "

Philosophe à ses heures, l'empereur s'amusait à noter certaines de ses pensées. En voici quelques-unes cueillies au hasard :

" La lutte est le charme de la vie. Quand elle cesse, c'en est fait de la machine : l'esprit s'est enfui. Mais tant que l'esprit est à son poste et que le cœur bat, la lutte est perpétuelle ; et dans la lutte seulement est la vie qui se termine elle-même par le combat suprême de la mort.

" Il faut commencer par obéir et par apprendre à apprendre, pour plus tard commander et enseigner à enseigner.

" On reconnaît ceux qui sont grands à leurs ennemis ; les hommes qui n'en ont point n'ont pas plus d'amis en partage.

" Le mouvement de développement dans la vie des peuples est un courant puissant et irrésistible. Les hommes qui ont été vraiment grands ont fixé leur attention sur ce courant ; ils en ont étudié la direction et la force, et lui ont creusé un lit pour l'avenir. C'est ainsi qu'ils se sont rendus maîtres de la situation, et qu'ils ont laissé aux siècles leur empreinte. Les hommes ordinaires se tiennent assis sur le bord. Ils gémissent sur la violence et sur la rapidité du torrent. Les fous lui opposent des digues ; ils sont emportés par lui, et ils laissent après eux l'héritage d'une inondation.

" On peut faire attendre les grands, on ne doit jamais faire attendre les petits. Les grands ont de l'argent et par conséquent du temps ; pour les petits, le temps est de l'argent.

" Celui qui ne craint point la mort a fait un grand progrès dans la vie.

" Il est plaisant de voir comment les hommes ne font en réalité que se tromper mutuellement, tout en se trompant eux-mêmes. Une tromperie en efface une autre. Quant aux scrupules qu'une première tromperie soulève parfois dans la conscience, on s'en débarrasse bien vite par une seconde ingénieusement imaginée pour calmer les nerfs. Il n'y a de vérité que Dieu, mais aussi que d'illusions il dissipera au jugement dernier ! Combien de gens alors feront cette découverte amère, qu'ils se sont trompés jusqu'au jour de la mort.

" Souverains et ministres — parmi ces derniers surtout, le ministre des finances — devraient toujours posséder des biens imposables, sur lesquels ils pourraient expérimenter à merveille et par eux-mêmes toute l'échelle de l'élévation des impôts.

" Une preuve manifeste d'intelligence et d'entente de la vie est de savoir trouver un bon côté aux situations les plus désagréables.

" Dans la discussion, celui qui se passionne est perdu ; car la passion renonce aux arguments pour les affirmations violentes et brutales.

"On commence les révolutions avec de belles paroles ; on les achève avec du sang.

"L'ambition est un ballon. Jusqu'à une certaine hauteur pour l'aéronaute l'ascension est agréable : elle lui fait jouir d'une vue splendide et d'un panorama immense. Mais quand il monte plus haut, le vertige survient ; le tableau est couvert de brouillard ; il est confus ; l'air se raréfie, et finalement il risque de faire une chute et de se casser le cou.

"Les nations qui exercent l'empire n'apprennent pas les langues étrangères, mais elles forcent les nations plus faibles à apprendre la leur. C'est seulement lorsqu'une nation commence à décliner qu'elle se met à babultier des idiomes étrangers ; témoins les Romains à l'égard du grec.

"Les choses bien réussies sont celles qui, une fois faites, semblent exister ainsi depuis longtemps.

"Le corps met plus de temps à se décomposer que la mémoire du mort à s'effacer."

La note poétique et virile est la prédominante de Maximilien. Il écrit alors des pages d'un coloris chaud, enlevé, vibrant. Lisez ce qu'il dit sur les combats de taureaux :

"Je ne cherche pas à le nier, écrit-il, j'aime les anciens temps ; non pas ceux du siècle dernier, où dans le nimbe de la poudre et du fard, au milieu de folles et langoureuses idylles, à travers les prés fleuris, on s'avançait en roucoulant vers le béant abîme ; non, mais les temps de nos vieux ancêtres, où l'esprit chevaleresque se développait dans les tournois ; où les femmes étaient fortes, ne demandaient pas un flacon d'odeurs et ne feignaient pas de s'émouvoir pour une goutte de sang répandu ; où l'on chassait le sanglier et l'ours en pleine forêt, et non comme aujourd'hui derrière des barricades ! Ces temps ont enfanté une race énergique. Et nous, que nous est-il resté des divertissements virils de nos pères ? La chasse peut-être ? Hélas ! pas même la chasse ! Nous nous appelons chasseurs, mais nous ne faisons en somme autre chose que fusiller à distance respectueuse et en parfaite sécurité de pauvres bêtes apprivoisées. La guerre seule subsiste, la guerre que depuis trente ans les efforts de nos modernes philosophes n'ont pas réussi à supprimer — et avec elle ont survécu deux plaisirs chers à certaines nations. Le premier est la chasse au renard en Angleterre, où l'homme s'expose à des dangers vraiment dignes de lui, et ne redoute aucun obstacle pour arriver à son but. On a beau dire que c'est une chose vaine de mettre sa vie en péril pour un objet insignifiant ; je crains fort que ceux qui reculent devant les dangers inutiles ne retrouvent pas leur courage au moment de la nécessité. L'autre plaisir est la *corrida* espagnole, véritable fête populaire des anciens temps. Elle surexcite, il est vrai, les passions violentes et sauvages qui sont au fond de la nature humaine, mais elle développe aussi le courage et l'énergie. Celui qui prend à ce spectacle un plaisir enthousiaste ne manquera pas de cœur pour d'autres choses plus importantes, et tout au moins il ne s'énervera pas dans une mortelle apathie. Il y a encore chez ce peuple un fier et noble esprit chevaleresque ; et en dépit de ces jeux sanglants que leur ont légués leurs ancêtres, les Espagnols de nos jours sont pieux et bienfaisants. Chaque chose a son caractère, et le cachet de son époque ; la variété en ce monde est le plus grand charme de l'existence."

Causant de la force, ne disait-il pas un jour en parcourant la *Tribune* de Florence :

"Le groupe des *Lutteurs* me frappe par sa vérité, par sa vie. C'est une image fidèle et hardiment conçue de la virilité et de la beauté antiques ; elle nous reporte aux temps des jeux olympiques, vers cette jeunesse du monde où le corps ne succombait pas comme

aujourd'hui sous le débordement maladif des forces intellectuelles, où il y avait harmonie entre le physique et le moral, où l'homme n'était complet qu'à la condition d'être sain et vigoureux. On voit les athlètes se sourire aux applaudissements d'une foule enthousiaste ; la lutte est indécise, l'assistance haletante les contemple et se demande quel sera le vainqueur. Tous deux sont d'une force herculéenne ; les yeux brillent, les muscles se tendent, on dirait deux lions en un combat acharné ; un moment ils s'abattent dans le sable de l'arène ; un léger nuage de poussière les dérobe aux regards ; mais bientôt ils reparaissent. Le vaincu veut se relever ; l'autre l'a déjà saisi par l'épaule, et lui appuyant sur le flanc son genou nerveux, rend inutiles tous les efforts de son bras. Au milieu de l'enthousiasme universel, il attend ainsi triomphant la couronne du vainqueur. La Grèce tout entière a assisté au combat ; voilà sa récompense. C'est ce moment le plus émouvant de la lutte — quand le vainqueur enlace son adversaire étendu sous lui — que l'artiste a fixé dans le marbre et conservé à la postérité."

Admirateur de la vie puissante que l'art antique savait donner à la pierre, Maximilien préférait, cependant, contempler la magnificence plus sereine des couleurs. Ses études sur les grands maîtres que vous venez de lire, en font foi.

Vous avez eu la note virile : étudions maintenant la note poétique.

Nous sommes au Brésil, en pleine forêt vierge.

"Nous nous dirigeâmes vers une forêt magnifique. Un long sifflement aigu, semblable à celui qu'en entend sur les chemins de fer, se mit à retentir dans la profondeur des bois. Ce bruit singulier s'élève trois fois par jour dans les forêts de la zone tropicale, le matin, le midi, et à la chute du jour. L'auteur de ce long soupir, plein d'angoisse, est une cigale, la *cicada manifera*. On ne peut ni la voir ni la découvrir ; mais son cri donne le signal régulier et infaillible de ce bruit étrange, indescriptible, qui retentit à certains moments sous les tropiques. C'est comme un vaste concert de voix invisibles, accordées sur tous les tons, qui résonne dans l'atmosphère paisible des forêts. Vous n'apercevez rien, vous n'observez aucun mouvement ; pas une branche agitée, pas un murmure dans le feuillage. Soudain retentit ce long sifflement, tantôt tout près de vos oreilles, tantôt à une grande distance ; c'est comme l'appel du veilleur. Avant l'heure du midi tout n'était que silence ; à peine entendait-on bourdonner un insecte : ce signal annonce que le silence est arrivé à son terme. Aussitôt s'élève sur tous les tons, un chant de joie universelle pour saluer l'astre fécondant, parvenu au zénith, D'abord ce long appel est suivi de quelques accents isolés, semblables au prélude des instruments ; puis les voix se multiplient et ce sont des murmures, des cris, des tintements, des roulades ; la mesure s'introduit dans la mélodie, et le grand unisson de la vie retentit avec de pleins accords sous les voûtes de l'immense cathédrale de verdure. L'impression est souveraine. On se sentait isolé sous l'éclat sévère des plantes muettes ; on marchait en silence sous le poids de la chaleur du jour, au milieu de ces splendeurs féeriques mais inanimées ; tout à coup on se sent salué de tous côtés, par un concert invisible. Cette forêt pénétrée d'un puissant souffle de vie, cette ombre mystérieuse, sous laquelle des milliers de plantes inconnues goûtent le repos du midi, et enfin ce merveilleux concert exaltèrent en moi cette admiration enthousiaste, ces transports de joie, dont mon âme était remplie depuis mes premiers pas sur ce sol nouveau.

"En marchant sous la voûte épaisse de la forêt, je passai en revue les souvenirs de mes nombreux voyages, et j'arrivai à cette conclusion : L'homme qui a le sentiment de la

nature doit voir trois grands spectacles pour connaître ce que la terre offre de plus sublime. D'abord, une matinée dans les Alpes, sur un sommet élevé dans l'air pur, loin du mouvement du monde. Là, environné des richesses de la flore alpestre, comme d'un magnifique émail naturel, gentianes azurées, roses souriantes, pensées, myosotis, œillets et violettes, baignés dans la fraîche vapeur du matin que percent peu à peu les rayons de la lumière, il voit les étoiles s'éteindre dans le firmament argenté. Une haleine puissante semble soulever le sein de la terre qui se réveille. Les flocons de nuages se dissipent dans les vallées ; l'Orient se couvre d'une teinte de pourpre qui devient de plus en plus éclatante ; les cimes et leurs champs de neige, sous la lumière dorée, s'éclairent de plus en plus ; les sapins secouent la rosée de leurs branches. Soudain le soleil franchissant les dentelures des monts gigantesques s'élève dans tout son éclat, envoyant ses rayons comme des messagers de joie aux vertes vallées et aux lacs étincelants ; et de toutes les profondeurs montent, en signe de gratitude, le chant des oiseaux et le son harmonieux des cloches.

"Tel est le premier tableau. Le deuxième est celui du milieu du jour dans le paradis des tropiques, avec cette exubérance de parfum et de fleurs, de vie et de sons, avec ce sentiment d'allégresse qu'éveille le soleil à son apogée, — voluptés que mon cœur savourait en ce moment avec une admiration pleine de reconnaissance.

"Le troisième tableau est celui du soir dans le désert, quand le disque enflammé, voilé d'une teinte de sang, s'abaisse dans les vapeurs où se joue le mirage, au moment de disparaître à l'horizon lointain dans la mer de sable. Le firmament devient pourpre ; la vaste plaine se couvre d'une poussière d'or et d'argent ; peu à peu les couleurs s'effacent, le ciel se constelle de diamants. Les vautours planent, et semblables à de noirs fantômes, décrivent leurs cercles sur l'arrière plan, où règne une blancheur de fournaise ; le chameau comme une ombre en voyage poursuit silencieusement sa route. Les croyants prient tournés vers la Mecque, tandis que les étoiles du Couchant allument leurs flambeaux sur la voûte au sombre azur. Un souffle frais et vivifiant, qui est le baume de la nuit, passe comme une douce haleine sur le sol argenté ; la lune dans son plein, et deux fois plus grande au début de sa carrière, s'élève calme et pure du côté de l'Orient.

"Quiconque a recueilli ces trois tableaux dans son âme est un initié. Le culte de la nature non seulement lui est permis, il est pour lui obligatoire.

"Je marchais entre deux murailles de feuillage. Tout à coup un objet passa devant moi, rapide comme la pensée. Mes sens étaient tellement éveillés que rien ne m'échappait, ni un son, ni un mouvement. Je vis de nouveau cet objet passer comme l'éclair, s'élever et s'abaisser. Ce mouvement se concentra devant une liane tout près de moi ; c'était une vibration incessante, un bourdonnement, une oscillation mille fois répétée. On eût dit une pensée saisie au vol et enfermée dans un battement d'ailes, pensée flottante et suspendue dans les airs. J'étais en présence d'un colibri. Les Brésiliens l'appellent *Bejia flor*, baise-fleur. Ici la réalité dépasse toute description, toute attente. Ce petit être est insaisissable ; on ne saurait reproduire ses mouvements, ni le garder en captivité. Semblable à une image apparue en songe, il se trouve là sans être attendu, et fuit au moment le plus intéressant. Ce n'est que mort qu'il tombe entre les mains de l'homme.

"Le colibri ne se laisse pas plus analyser que l'arome des fleurs. Il est si petit, si gracieux, si rapide, qu'il se soustrait en quelque sorte à la définition commune de la subs-

tance des corps. Il semble ridicule de le classer dans les règles de la nature. C'est une mignonne créature qui bourdonne dans l'atmosphère des tropiques ; elle a la vie animale avec la forme et les couleurs d'une fleur fantastique et l'éclat étincelant de la pierre précieuse qui brille d'une lumière propre et mystérieuse. Au Brésil on prend les colibris pour des âmes d'enfants morts.

" Le nid de cet oiseau est semblable à une fleur ; ses œufs ressemblent à des perles. Les mouvements du colibri quand il navigue dans l'air et vit du parfum des fleurs ont quelque chose d'espiègle et de tout à fait original. Si quelque part une plante aromatique du monde tropical déploie son éclat, soudain le petit être ailé apparaît comme par un coup de baguette, sans qu'on sache d'où ni comment.

" Il va et vient, se balance et se précipite, scintillant de l'éclat des pierres aux rayons du soleil ; son œil perçant comme une pointe de diamant cherche la fleur qu'il va honorer de ses baisers ; et aussitôt il s'arrête devant celle qu'il a choisie. Il vibre suspendu dans l'air ; son corps étincelant paraît en repos ; il plonge sa tête dans le calice de pourpre et il en suce le miel. Vous croyez maintenant pouvoir le considérer à l'aise. Il est déjà loin ; il folâtre en bourdonnant dans l'azur, puis soudain il revient à sa fleur, et, satisfait, il s'évanouit dans la verdure où se cache son nid.

" Nous avancions dans un océan de verdure qui présentait les nuances les plus diverses ; la lumière dorée du soleil était amortie par le feuillage et ne nous donnait qu'une clarté crépusculaire et fantastique. Transporté dans des régions inconnues, loin de tout ce que j'avais vu jusqu'alors, je me sentais comme enivré, comme bercé dans un songe délicieux où la nature m'apparaissait sous l'aspect d'un jardin enchanté. Cependant quelques objets formaient comme un lien entre ce tableau et mes souvenirs antérieurs : c'était des plantes que je connaissais pour les avoir vues dans nos serres chaudes, mais comme elles étaient transfigurées ! Autour d'elles, les intervalles étaient remplis par des objets entièrement nouveaux. Les formes les plus étranges, les plus inconnues flottaient comme sur un abîme de trésors que le regard troublé ne pouvait saisir, que les sens étonnés ne pouvaient embrasser. L'âme est envahie par une sensation voluptueuse, mais l'impression est trop puissante et trop nouvelle pour qu'il soit possible de se rendre compte du détail. Quand la nature déploie son énergie primitive, et prodigue tous ses trésors sous les tropiques, l'homme se sent écrasé et ne peut que s'étonner et admirer.

" Nous savions que le soleil se couchait au loin dans les forêts de l'Ouest, mais nous ne le voyions pas. Une vapeur dorée s'élevait lentement ; de place en place, à travers le feuillage on voyait le firmament se couvrir de teintes plus éclatantes. L'ombre portée par les broussailles montait le long des tiges des arbres, les couleurs des objets brillaient encore une fois avec un reflet métallique ; les derniers rayons glissaient sur les feuilles azurées des palmiers qui se balançaient doucement ; une lumière rosée flottait comme une haleine mourante dans le branchage. Tout à coup la cigale — la *cicada manifera* — donna son long signal mélancolique ; une lueur argentée, dernier reste du jour, se répandit avec la fraîcheur sur la vaste forêt, et un moment après on put dire comme dans le récit de la Genèse :

" — Le soir se fit !

" Le soir dans le monde primitif ! Si de pareils spectacles ont partout quelque chose de sublime, ici leur gravité est saisissante, écrasante. On est pris d'un frisson religieux en se représentant cette période de la création où déjà tout germait, fleurissait, bruissait,

excepté l'homme et sa race. Loin de ses semblables, dans une forêt qui n'a jamais été profanée, qui s'étend sur le quart d'un continent, le voyageur, au moment où le jour le quitte, sent son cœur saisi d'une anxiété inexprimable ; il se trouve comme perdu, il est incertain entre le sentiment joyeux d'une liberté sans limites et une inquiétude qu'il ne saurait réprimer."

Mais trève de ces citations ; vous connaissez maintenant Maximilien aussi bien que moi. Cette plume fine, aisée, toujours prête à saisir la nature dans ce qu'elle a de plus noble, de plus grand, de plus poétique, ce penseur délicat et profond, cette âme d'élite va bientôt voir devant lui se fermer à jamais les portes d'ivoire des doux rêves, des pensées élevées. Le Mexique l'attend avec ses adulations, ses triomphes éphémères, ses trahisons terribles, ses lâches abandons. Le martyre va couronner cette vie bien remplie mais trop courte.

Maximilien a-t-il eu un pressentiment, quand, à Grenade, il contemplait dans la *Capella reale* les images de pierre de ses ancêtres, si belles dans la physionomie de la mort ?

" C'étaient de grands hommes, disait-il, qui ont fait des morceaux d'histoire, qui ont joué leur rôle sur la vaste scène du monde. Ils ont produit une race puissante et qui a règné au loin. Maintenant ils reposent délaissés dans une chapelle solitaire : vanité des vanités ! Jadis une cour somptueuse les environnait de son éclat ; aujourd'hui un sacristain misérablement vêtu prend une torche, ouvre la petite porte de fer, et me conduit par un étroit escalier dans un caveau sombre et bas, sans ornement ni parure, où la vérité se montre triste, nue, et m'accueille avec un ricanement sinistre. Là, ne pénètrent jamais le regard d'oublieux héritiers. Le cœur se serre en voyant ces couples royaux, autrefois si puissants, si fiers, emprisonnés dans leurs étroits cercueils, et l'affreux *memento mori* retentit comme un glas au fond de l'âme et nous fait frissonner."

Relisez dans *Vienne et les Viennoises*, par Victor Tissot, la description du caveau de la chapelle des capucins où dort maintenant cet empereur dans une caisse d'acajou placée dans un sarcophage en bronze, avec quatre griffons et quatre têtes d'anges déployant leurs ailes. Vous n'aurez pas une ligne à changer aux lignes que vous venez de lire.

En laissant Madère, Maximilien avait inscrit ce qui suit dans son livre de bord :

" Tenant à la main une rose cueillie au cimetière, et respirant son parfum, je quittai cette île inoubliable où, sept mois plus tard, s'éteignait une vie qui m'était chère."

Or cette personne chérie appartenait à la maison d'Autriche.

Curieux retour des choses d'ici-bas, celui qui un jour cueillait à Madère la rose du cimetière repose maintenant à côté de cette princesse, dans l'église des capucins de Vienne !

Poète, savant, philosophe, Maximilien était aussi bibliophile.

Son tact, ses patientes recherches lui avaient permis de se former, au Mexique, une riche bibliothèque.

Là, dans son château de Chapultepec se coudoyaient pêle-mêle les splendides éditions des Alde, des Estienne, des Plantin, des Elzevir, les heures de Notre-Dame aux splendides enluminures, une foule de manuscrits introuvables sur l'histoire d'Amérique, et les incunables de la typographie américaine, six volumes gothiques imprimés en 1543 et en 1547, restés complètement inconnus aux bibliophiles.

Sept mille volumes consacrés exclusivement au Mexique étaient là réunis à grands frais, et les rayons en bois de fer de la bibliothèque. Ils ployaient sous les livres de la littérature française, anglaise, espagnole, sous les travaux d'économie politique, de

théologie, d'éducation, d'histoire ecclésiastique, de droit, de géographie, de sciences exactes et physiques, de philosophie, de monographies sur l'Asie, l'Afrique, l'Amérique.

Dans sa soif de savoir, l'empereur s'abreuvait à toutes sources.

Le Canada assistait à ce rendez-vous universel, et sous les yeux du visiteur toujours bien reçu dans la bibliothèque, défilaient les *Voyages de Cartier aux terres Neufves du Canada*, *La nouvelle découverte d'un grand pays situés entre le Nouveau-Mexique et la mer Glaciale*, par Hennepin, les ouvrages du baron de la Hontan, l'*Histoire de la Nouvelle-France*, par Lescarbot, l'*Histoire du Canada et le grand voyage au pays des Hurons, situé en Amérique, vers la mer douce, ès-derniers confins de la Nouvelle-France du Canada*, par Gabriel Sagard Théodat.

Maximilien recherchait les éditions canadiennes. Dans le catalogue dressé par ses soins et sous ses yeux, figuraient la relation du P. Bressani, éditée par le P. Martin, et imprimée par Lovell, de Montréal, les biographies de Mme d'Youville et de Mlle Mance, ainsi que les *Relations des Jésuites*. Ce dernier travail, classé sous le numéro d'ordre 1982, était ainsi consigné dans le guide de la bibliothèque impériale.

Je l'ai noté moi-même.

" Relations des Jésuites, contenant ce qui s'est passé de plus remarquable dans les missions des Pères de la Compagnie de Jésus dans la Nouvelle-France, ouvrage publié sous les auspices du gouvernement canadien, 3 vols.; Québec, chez A. Côté, 1858, très-grand in-8, à 3 colonnes, demie-reliure, maroquin vert, non rayée, tête dorée."

Puis venaient les remarques du bibliophile. Il avait fait écrire dans son catalogue: " Exemplaire d'une collection importante devenue rare. C'est une réimpression de la collection in-8 en 48 vols. imprimée à Paris au commencement du XVIIe siècle et devenue introuvable."

Après la catastrophe de Queretaro, ces trésors d'érudition déposés entre les mains d'un fidèle ami de l'empereur, don José Maria Andrade, furent précipitamment arrachés du palais, emballés furtivement dans plus de deux cents caisses, chargés à dos de mulets et conduits hors de Mexico. Après un mois d'incroyables pérégrinations, ils arrivèrent heureusement à la Vera Cruz, et de là en Europe.

Cette précieuse bibliothèque, joyeuse amie de l'empereur, lorsque brillaient les beaux jours de jadis colorés par les teintes roses de l'avenir, — devenue teinte de sang le 19 juin 1867; cette collection unique, devenue plus tard sa seule et sincère confidente, lorsque sonnèrent les heures du mensonge et de la trahison, a été dispersée le 18 janvier 1869 dans la salle des ventes de Leipsic.

Avec l'adjudication du dernier volume sombrait la dernière épave du naufrage mexicain.

Qu'ajouter de plus à ce croquis imparfait où s'estompe le profil d'un homme qui sent en ce moment courir sur sa tombe le refrain frissonnant de la ballade allemande?

— *Hue! Hue! les morts vont vite!*

Vous qui me lisez, vous comprenez maintenant que devant l'empereur Maximilien nos esprits se soient échauffés; que nous nous soyons enthousiasmés; que nous ayons fait l'impossible — nous qui l'avons servi — pour lui prouver notre dévouement.

J'avais alors à peine dépassé mes vingt ans. Maximilien en avait trente-deux. Huneau, canadien-français, s'était fait tuer pour sa cause au combat de Médellin; Beaugrand, devenu plus tard maire de Montréal, servait comme maréchal de logis chef à la

contreguérille du colonel Dupin ; Arthur Taschereau — un nom qui oblige quand il s'agit d'aller de l'avant — était lieutenant de chasseur et aide de camp du général Wachter ; celui qui fait cette étude était capitaine au 2e bataillon d'infanterie légère d'Afrique.

En ces temps historiques, Maximilien nous donnait à pleines mains son savoir, son érudition. Il nous communiquait toutes les vibrations, toutes les aspirations de son cœur. Il savait aussi nous mener gaiement au combat.

Maximilien devait, en suivant le fil ordinaire de la vie, entrer dans l'histoire par la porte ouverte aux gens de lettres et aux savants.

Il y a été précipité brusquement par un peloton d'exécution, commandé par un officier de vingt-trois ans !

Un jour, causant avec son état major, Maximilien disait :

— Regardez cette maisonnette assise près du bois. J'ai été marin. Sur l'Océan, lorsqu'on voit à l'horizon s'élever un point blanc, une voile lointaine, cette vue éveille chez le navigateur un sentiment de curiosité sympathique ; notre âme se porte vers cette petite tache, vers ce point sur lequel des inconnus, nos semblables, poursuivent leurs destinées. C'est alors qu'au sein de cette mer de verdure, on regarde, comme maintenant, s'élever vers le ciel les blanches colonnes de fumée qui laissent deviner au voyageur que, là-bas, entre les vagues immenses du feuillage, une existence indépendante et ignorée lutte et se soutient à force de travail. Les yeux du passant s'attachent avec intérêt à ces manifestations silencieuses d'une vie solitaire ; et ce n'est pas sans mélancolie que l'imagination en travail se représente la manière de vivre de ces êtres qui, si loin du monde, séparés de tout ce qui leur fut cher et précieux, sont allés chercher un asile dans la vaste et impénétrable forêt. Ces colonnes de fumée sont les bornes milliaires de la civilisation, qui s'efforce de jaillir au sein de la forêt vierge ; ce sont les feux de bivouacs des avant-postes où la Providence a envoyé de vaillants pionniers. Accablés de dégoûts et de chagrins dans l'ancien monde, ils ont pris la hache du colon, pour aller servir de premiers instruments à cette civilisation même, qui s'annonce toujours à leur insu. Quand on songe aux motifs qui ont poussé tant de vaillants lutteurs dans les solitudes sauvages, le cœur se sent attristé à la vue de ces colonnes de fumée. Une sympathie secrète dirige involontairement le regard du côté de ces germes de vie. Mais dès qu'on a vu les colons, et qu'on a eu quelques rapports avec eux, cette sympathie se change en une mélancolie profonde ; et, en s'éloignant, on se retourne pour regarder longtemps, longtemps encore, ces signaux de la terre qui s'élèvent vers le ciel.

Voilà comment, un jour, l'empereur appréciait les colons d'Amérique devant ses officiers, et j'en étais.

Nous sommes descendants de pionniers aussi hardis. En de semblables circonstances nos pères vinrent créer ici la Nouvelle-France. J'ai cru être agréable à ceux qui sont fiers de cette lignée, en leur faisant connaître sous son véritable jour, mais dans l'humble limite de mes forces, Maximilien, voyageur, critique d'art, marin, poète, bibliophile, philosophe et chrétien.

D'ailleurs dans ces pages que vous venez de lire, l'empereur s'est peint lui-même. A vous maintenant de juger cet homme, à qui peuvent s'appliquer volontiers ces paroles qu'un historien allemand disait de Juan d'Autriche :

" C'est le propre de certaines âmes que de se complaire dans des désirs et des projets vagues. Quand leurs premiers desseins ont échoué, elles se livrent à des plans plus vastes

encore, comme si, sentant doublement leurs forces, elles voulaient défier la fortune. Le monde est ainsi fait. Il excite l'homme à désirer, à vouloir. Il éveille en lui toutes les espérances, lui prodigue les encouragements et les promesses, lui persuade que les destinées l'appellent, après quoi il lui ferme ses barrières et le fait mourir."

ROYAL SOCIETY OF CANADA.

TRANSACTIONS

SECTION II.

ENGLISH LITERATURE, HISTORY, ARCHÆOLOGY, ETC.

PAPERS FOR 1889.

I.—*The Study of Political Science in Canadian Universities.*

By JOHN GEORGE BOURINOT.

(Read May 25, 1889.)

In commencing this paper I cannot do better than refer you to a statement made on a recent occasion by a brilliant lecturer and essayist, Prof. Seeley of Cambridge, with reference to the important part that the universities of a country can and ought to perform in the fruitful field of Political Science. He believes that it should be among the principal objects of the great universities of England—and I commend his words to the heads of similar institutions in the Dominion—" to give coherence, connexion, and system to the thinking of the nation ;" and he looks forward to the time " when the English Universities will extend their action over the whole community by creating a vast order of high-class popular teachers, who shall lend their aid everywhere in the impartial study of great questions, political or other, and so play a part in the guidance of the national mind, such as has never been played by universities in any other country."[1]

These words are pregnant with meaning for ourselves. Among the significant changes that have been made within a few months in the educational system of some of our universities, none is likely to be fraught with more important results to Canada than the effort to give superior opportunities to students of learning the nature of our system of government, and of studying all those branches of knowledge that relate to its operation and make it more intelligible.

In a country like this, with an elaborate system of local and parliamentary government, it is a matter of growing importance that no institution of learning should keep exclusively within the old beaten paths of classical and mathematical learning, but should endeavour to bring itself as far as possible in accord with the practical aspirations of the world around it and launch boldly into the current of political and philosophic thought and study, so as to be in touch with the actual requirements of these busy and energetic times.

The study of Political Science is making rapid headway on this continent, and those of you who desire more information on the subject cannot do better than refer to the valuable series of publications published by Johns Hopkins University, which devotes especial attention to this interesting branch of knowledge. Cornell, Harvard, and Columbia Universities also give superior facilities to students for perfecting themselves in studies so important to the people of a country of popular institutions. In this respect the American universities probably offer somewhat larger advantages to the student than even Oxford and Cambridge since they give special importance to Political Science as a department of study. The names of Maine, Stephen, Seeley, Bryce, Free-

[1] Contemporary Review for July, 1888, p. 65, " The Impartial Study of Politics."

man, Dicey, and Stubbs, I need hardly tell you, stand in the foremost rank of constitutional writers and indicate the desire on the part of the great English seats of learning within recent years to strengthen this branch of higher education. It has been well observed by Mr. Andrew White, who presided for many years so ably over Cornell University, that a remarkable change has taken place in this direction on the part of Oxford and Cambridge since he first visited them thirty years ago "when the provision for instruction in political and social science, to say nothing of the natural sciences, was wretchedly inadequate."[1]

It is to France and Germany confessedly that we should look for the most perfect system of education of this class. No country in the world has more effective methods of administration, or a better instructed civil service, than the Empire of Germany — the very qualities which have made the German soldier a remarkable military machine tend to fit him for official life. The German is educated to habits of obedience and discipline in all walks of life, and has had from his youth excellent opportunities for instruction in all branches of knowledge. He is naturally plodding and industrious. He studies in universities where the opportunities for being deeply grounded in all branches of knowledge are not surpassed by institutions in any other country; for a long time they have given a special course of training suitable for political life or the work of administration. The same thing may be said of France, where the official service has been always admirably administered by servants of the state capable in every essential particular. Whatever may be the faults of the politicians of that great country, it can be truly said that the permanent public service, by the stability, capacity, and knowledge of its members, has proved a veritable bulwark against the impulsiveness and unsteadiness of the politician or demagogue at times of intense political excitement.

The College of France and the Independent School of Political Sciences in Paris have for a long time past presented a course of studies, which enable a diligent student to make himself thoroughly conversant with all those branches of history, and of Political Science which assist him to master the great problems of government and social life that are daily presenting themselves around him, and help to make him a more useful member of the commonwealth.

It is therefore eminently satisfactory to find that Canada is commencing to follow, in this particular, the example set her by the countries just mentioned. Our population and wealth are very insignificant as yet compared with the United States, or with those peoples from whom the two races that inhabit this Dominion derive their origin and institutions; but though it may not be possible for us for a while to offer the large opportunities which the rich institutions of these countries give to the student, still it is for us to make a beginning, and lay the foundation for the study of those branches of knowledge which are admitted to be essentially within the province of all seats of the higher education that wish to be *en rapport* with the times.

No course of studies is better calculated to profit the student than this, when it is fully and faithfully carried out. It is one inseparably connected with the vital interests of the whole community. Every man, woman, and child has an interest in the efficient administration of government, and in the impartial execution of the laws. These

[1] See Johns Hopkins University Studies, 5th Series, xii.

are matters which relate immediately to human happiness, and those studies which teach the principles on which all good government must rest, the respective duties, powers and privileges of the different executive, legislative and judicial authorities, and the eternal maxims of civil liberty, are studies which, when taught in the spirit of a judicious and honest historian, are well worthy of the name of a science, and should obtain a preëminence over all departments of thought and study, except the teaching of the true lessons of Christianity. In the words of the distinguished essayist from whom I quoted in commencing this lecture : "If there is a science of politics at all, it must needs be almost the most complicated of all sciences. It deals with that curious phenomenon called the State, which is a kind of organism composed of human beings. The lives of individual men, even the greatest men, are included in the life of the State ; almost everything indeed is included in it. Does not the very thought of studying such a vast comprehensive phenomenon, and of discovering the laws that govern it, give rise to a feeling of bewilderment? Does it not strike you that this study must rest upon other studies, that this science must presume the results of other sciences, therefore that it cannot be properly studied by itself? . . . Would you know what is wise and right in politics, you must consult experience. In politics, as in other departments, wisdom consists in the knowledge of the laws that govern the phenomena, and these laws can only be discovered by the observation of facts, history. If this is so, how can we avoid the conclusion that such a study of politics as you meditate cannot be separated from the study of history ?"

Canada, though a young country compared with the old civilizations of Europe, presents a very interesting field for the student in this department of study. Though not a national sovereignty like the United States, and therefore probably inferior to it in that respect as an object of contemplation and reflection for European statesmen, its political history, its fundamental law and constitution, its economic system, its social institutions and the racial characteristics of its people are worthy of the close study, not only of Canadians, but of all persons who wish to follow the gradual development of communities from a state of cramped colonial pupilage to a larger condition of political freedom which gives it many of the attributes of an independent nation, never before enjoyed by a colonial dependency.

A course of Political Science, to be in any measure complete, would mean that we should study, in the first place, the political history of our own country, from the time the French laid the foundation of their colonial government on the heights of Quebec, down to the conquest of Canada by England in 1759-60, and thence through all the political and constitutional changes which have brought about a federation of provinces under the somewhat ambitious name of "Dominion." This historical study necessarily leads us to review the political and social conditions of old France during the century and a half when Canada was under its government. We cannot fail to see how the conflict between Great Britain and France for centuries actually meant a conflict for supremacy in America, and how the development of French Canada was retarded by the ambitious designs of the French monarch in Europe, and the way consequently made easier for the triumph of the mother country on this continent.

The history of the unfortunate differences which led to the separation of the old thirteen colonies, the state of political parties in England during the days when the people of Canada, Nova Scotia and New Brunswick were contending for extended political

rights, and the causes that led English statesmen at last to change their policy towards these dependencies of the Empire, and to grant the large measure of self-government we now enjoy, are more or less of an historical as well as political nature, and clearly enter into the domain of Political Science. Indeed, history and the political sciences are so closely associated that so high an authority as the late eminent Prof. Francis Lieber, of Columbia College, in the city of New York, made these studies an independent and homogeneous department in that excellent institution. On this point Prof. Herbert Adams, of Johns Hopkins University, has said with much force: "There is a valuable and suggestive idea in Lieber's first combination of history and politics, which ought to influence all American colleges and universities in the proper coördination of these studies. If, for economic or other reasons, there must be a grouping of various subjects under one administrative head, history ought rather to be yoked with political science than with language, literature or philosophy. The nature of History and Political Science determines their intimate relation, if not their necessary coördination. *History is past politics and politics is present history.* History is, primarily, the experience of man in organized societies or so-called states. Political Science is the application of this historical experience to the existing problems of an ever progressive society. History and politics are as inseparable as past and present. This view is justified by the best historical and political opinion of our time—Ranke, Droysen, Bluntschli, Knies, Roscher, Nitzsch, Freeman, Seeley, and by the practical experience of the best American colleges and universities."[1]

Among the studies that naturally enter into the domain of Political Science we may mention the study of general and historical jurisprudence, which necessarily opens up a large field in a country like this, where one province, inhabited by a million and a quarter of people, has a system of law drawn from the civil law of France, which again rests on the principles of that famous Roman law which has entered into the institutions of so many nations of Europe, and more or less affected the civil conditions of nations who have exerted, and continue to exert, such important influences on the destinies of the world.

It is generally admitted that the common law of England itself exhibits to the careful inquirer traces of the influences of Roman law, and that the principles that govern equity jurisprudence have been largely drawn from the same remarkable source. But in studying that great system of common law, which is the basis of the jurisprudence of all the English-speaking communities of the Dominion, the student of Political Science will naturally take a philosophic survey of English history in order to obtain an accurate insight into the genius of those principles, usages, and laws of action which have from all times been applied to the government and the security of persons and property in England. The political and civil liberty which we now enjoy is the natural heritage of English communities throughout the world, and its main principles can be traced to the maxims of the common law. It illustrates the sturdy, independent spirit of the English race, and its determination to resist all the efforts of monarchs, with the assistance of servile statesmen, to establish an arbitrary power in the realm. The great principles on which our parliamentary government rests had their origin in maxims in vogue in the

[1] Study of History in American Colleges and Universities, by H. B. Adams, Ph. D., p. 67.

early times of English history. It was asserted, for instance, in all times, that representation and taxation must go together—that those who pay must vote the taxes. The Great Charter did not strictly give any new privileges to the people, but was rather an assertion of rights always claimed by the people, or of principles that lay at the foundation of English civil life, but which had fallen into disuse or been purposely evaded or infringed by the kings in the course of years. "Magna Charta," said Sidney,[1] "was not made to restrain the absolute authority, for no such thing was in being or pretended (the folly of such visions seeming to have been reserved to complete the misfortunes and ignominy of our age); but it was *to assert the natural and original liberty of our nation* by the confession of the king then being that neither he nor his successors should in any way encroach upon them."

In studying, then, the civil and common law of the two races who are labouring to build up a new England on the northern half of this continent, we must do it, not from the purely legal standpoint of a practising lawyer, but rather in the spirit of a philosophic historian desirous of following the influences of systems of law on the social customs, the usages of the people and the structure of government. As I have already shown you, the historical method can be as well applied to the study of law as to other subjects that fall within the domain of Political Science. The thoughtful student will in this way be able to trace the steady growth of principles adapted to the ever varying conditions of society.

It is well observed by an eminent writer in a recent issue of an English review that "jurisprudence itself has become a study of the living growth of human society through all its stages, but it is no longer possible for law to be dealt with as a collection of rules imposed on societies as it may be by accident, nor for the resemblances and differences of the laws of different societies to be regarded as casual."[2]

I quote this suggestive paragraph to show you the wide scope of the studies that must enter into any course such as I hope will be sooner or later carried out in connection with all our universities.

Or, consider one moment how necessary it is to study the principles of international law. It will be said that Canada is still a colony, and has no right to make treaties and enter into relations directly with foreign powers. But the time has already arrived when this study has become important.

As a result of the very liberal system of self-government granted to Canada, and in consequence of the great territorial expansion she has attained as one of the most important consequences of this self-government, the Dominion has assumed the proportions of an Empire. It has commercial relations with many countries, and our statesmen are now stimulating rapid steamship communication with Europe and Asia. The dream of La Salle, on the banks of his seigniory at Lachine, to find a shorter route to the riches of Cathay, is being realized in this dependency, not of the France he loved, but of her hereditary enemy. Or, consider the situation of Canada on the borders of a colossal republic, which constantly gives rise to questions affecting the relations of the two nations. For instance, we have seen of recent years important international questions arising out of the fishery dispute. All these matters involve negociations of a delicate

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[1] Sidney on Government, c. 3, sec. 27.

[2] "Sir H. Maine and his Work," by Sir F. Pollock, Contemporary Review, February, 1889.

character, and show how necessary it is for our statesmen and publicists to make themselves thoroughly acquainted with the rules and principles that govern communities in their dealings with one another. Though Canada is still a dependent state, yet her importance entitles her, as her recent history will show you, to be consulted and represented on every occasion when her interests are immediately affected by a proposed treaty. Consequently, every year that passes gives greater scope to the abilities and learning of her public men. The relations of Canada to other peoples, and especially to aliens who are domiciled or mere temporary residents in the country, and the necessity of observing the great moral elements that lie at the basis of international law—the duties of humanity, comity and intercourse—entail responsibilities on our people which must be enlarged with the increase of the wealth and population of the Dominion.

Some of you who now hear my words may see the relations between the parent state and its different dependencies undergo a very important change, which may give our statesmen a direct and larger influence on the destinies of the whole Empire—when a Canadian will have as potent a voice on imperial affairs as a dweller in Kent or Devon. Higher conditions of national existence must be in store for a country like Canada, which has expanded so remarkably in political greatness within a few decades. It may be that the Imperial Federalists will eventually find a solution of the great problem they are busy with in Great Britain and its dependencies, and Canadians will become citizens of the Empire in reality, and as such able to negotiate directly with foreign nations. But in any case, as things are now, Canadians must necessarily find it to their advantage, whether lawyers or politicians or ordinary citizens, to learn something of that public law which governs the relations of sovereign peoples with one another throughout the civilized world.

Political Economy is another of those useful studies which are naturally allied with others on this wide domain. Look around us, and do we not see how important it is for Canadians to understand the principles or doctrines which have been laid down by men like Adam Smith, Ricardo, Mill, Carey, and others I need not mention here, who have devoted their lives in Europe and America to a branch of science so fruitful of discussion, and so intimately connected with the industrial and commercial development and the material prosperity and social comforts of a people? Every year that passes sees questions connected with the health, and the improvement of the condition of the labouring classes demanding the consideration of our legislatures. Only last session of parliament we had laid on the table a number of bulky volumes representing the work of a commission appointed by the Dominion Government to enquire into subjects of deep interest to labour. Or, when I refer to the fact that we have a "national policy" which is practically a system of protection, I show you as Canadians how important it is to understand the principles which recommend it to so large a body of people in the Dominion, in preference to the principles of the opposing party who would have a system of indirect taxation for revenue and would give a fuller expansion to free trade with other peoples. With this study are intimately allied the questions of unrestricted reciprocity and commercial union, which are of an economic character, requiring a large knowledge of the economic conditions of Canada, and of the United States, and a thorough understanding of the sound principles which should guide us in our international relations. An accurate knowledge of statistics which are now a recognized branch of economic science,

(despite the old saying that figures can be made to prove anything) is invaluable in the consideration of questions like those I have cursorily mentioned. It is only necessary to study the pages of the works of a man like Mr. Mulhall, the eminent English statist and economist, to see how important and useful is a scientific method of handling figures and drawing from them sound deductions as to a nation's prosperity or decline.

While it is to England that we naturally look for those lessons and examples of statesmanship and political sagacity, which may assist us in laying broad and deep the foundations of our political organization and social system, the student of Political Science cannot fail at the same time to draw much valuable instruction from a close and constant study of the institutions, national, state, and municipal, of our American neighbors. They, like ourselves have borrowed largely from the parent state, to which we both owe our origin, in organizing their system of government, and it is the common law of England, we all know, that lies at the basis of their system of jurisprudence. Some among us have a practice of depreciating American institutions, thinking that this is the best, as it is certainly sometimes the easiest, way of showing the superiority of our own political and social conditions; but after an honest and assiduous study of the political systems of both countries, I must fairly come to the conclusion that each of us may learn something from the other, and that there is a great deal to admire in the sagacity, the business-like methods, and the thorough organization of many of the institutions of our neighbors.

If we should study thoroughly the comprehensive and thoughtful work on the American Commonwealth by Prof. Bryce, one of those men who do honour to the great seat of learning on the banks of the Isis, we shall see that this particular study is full of encouragement and warning to us at one and the same time; but "its chief value," to quote his exact words, and apply them to ourselves rather than to England, "lies in what may be called the laws of political biology which it reveals, in the new illustrations and enforcements it supplies of general truths in social and political science, truths, some of which were presented long ago by Plato and Aristotle, but which might have been forgotten had not America poured a stream of light upon them."

As I have just said, both Canada and the United States can trace all the valuable institutions they possess to England. Their legislative bodies have been modelled on the great parliament of the parent state. The many differences that now exist between the government of Canada and that of the United States have arisen from the differences in the political circumstances and varying conditions of the two countries. The United States for more than a century and a half had been colonies of England, enjoying a system of legal and political institutions, which was their natural heritage as Englishmen. When their independence was acknowledged and it became necessary to mature a constitution adapted to the new state of things, they proceeded to frame a government, which throughout shows that they still considered the English government superior in essential respects to all other governments in the world. In the division of legislative, judicial and executive departments which they made, they showed their desire to adhere to those important principles which evoked the admiration of Montesquieu. The president was still the king of England, though he was deprived of powers which the Americans considered fatal to their liberty. He was given the right of veto over legislative acts and of appointing his own cabinet. But the council was not made responsible to or given seats

in congress, a fact quite intelligible when we consider that the king was, as far as the old colonists saw, the controlling power in the nation, and that parliamentary government, as we know it in these times, was not understood by the Americans. The framers of the American constitution knew that among the royal prerogatives was the right of veto, although they forgot it had not been exercised for one hundred and seventy years; but they gave it to the president chiefly because they thought it would be a valuable check on the otherwise arbitrary power of congress. If I should pursue this subject still further, we would see throughout the political system of our neighbors many other evidences of their desire to reproduce British practices and rules when consistent with the system of republican liberty they were attempting to establish. Canada, on the other hand, has remained a dependency, and has necessarily kept pace with the progressive stages of parliamentary and responsible government of the parent state. Our government has always closely followed the important rules and maxims which make up the British constitution. Our statutory law is drawn in a great measure from that of England. It is then most advisable for us to consider in what respects, if any, the United States system is an improvement upon our own. Whilst it is very interesting to note the differences in the working of the two systems of government, it is still more important to observe the operation of their federal system from which that of Canada is taken in essential respects. In short, an elaborate series of lectures fully dealing with the nature and working of the political institutions of our neighbors should necessarily form a prominent feature of any course of Political Science, if it is to be made of practical and real value to the students of a university.

I might dwell at considerable length on the many subjects that naturally suggest themselves to my mind in connection with so suggestive a theme. Our own system of government itself, drawn as it is from the constitutional and political experience of England and of the United States, is replete with matter for study and reflection. Of Canada and her institutions (particularly her local government, and her federal system), it may be truly said, she "is the heir of all the ages." For instance, the federal idea is one which originated with the leagues that existed in ancient Greece, with those famous Achæan and Lycian federated nations which played so important a part in the history of the ancient world. We can trace its principles, according to the French historian, Guizot, in the working of the feudal system, and in the relations that existed between the rude communities of Europe and the feudal king or chief to whom they professed to pay a modified homage. We can see that it has been the source of security upon which the Swiss Cantons have relied for centuries, though surrounded by hostile and jealous nations. It is a system which rests on the basis of local self-government and a central authority, and it is interesting to trace its development through all times until at last it has found its most perfect realization in the United States, Canada, and the remodelled Swiss Confederation, as well as in the Empires of Germany and Austria, where the machinery is in a measure more complicated than in the American example of federation.

All these subjects to which I have very briefly referred, as immediately associated with, and indeed falling naturally under, the generic term of Political Science, are important to us inasmuch as they bear more or less directly on the development and operation of the elaborate system of federal government which we possess at last as the results of more than a century of political struggle and achievement.

The machinery which works our national (if I may so style our central government) as well as our provincial and local systems of government, is obviously of a complex character, requiring a large number of persons for administrative, judicial and municipal purposes. To those officials and legislators we must add the relatively small number of learned men who are called upon to occupy the bench, and administer the law which, with the exception of the fundamental law or constitution governing the Dominion and its various sections, is amended from time to time by the parliament and the legislatures. If we add to this official and judicial *personnel* the large number of individuals who practice the learned profession of the law, or if we add, too, the numerous persons outside the classes just mentioned who are more or less identified as citizens in the efficient working of our political system, we shall see how many men in this country are deeply interested in the accurate study of Political Science.

The study of constitutional law and of constitutional history, in fact, opens up to the lawyer an exhaustive field of research. It broadens his sphere of knowledge much more than the ordinary technical studies of his profession. Questions constantly arise which require him to make investigations into the annals of the times preceding the formation of the constitution, and to inquire by what events it was preceded, as well as to study the nature and scope of the provincial organizations previous to Confederation.

But it is not merely the lawyer, the statesman, or the publicist, who has a deep interest in the consideration of the various political and economic questions which enter into the course of which I am speaking. There is one class which, above all others, should have a deep insight into the wise solution of the many social problems which arise from time to time and demand the earnest thought of every person who looks to the happiness of the community. No one would wish to see the clergy take an active interest or participate vigorously in the purely political conflicts of the day—I mean, such an interest or participation as would weaken their influence in their proper sphere;—but no one now-a-days can keep aloof from great human interests, and occasions may arise when even clergymen may properly consider it necessary to give warning and advice, not as partisans, but as dispassionate, impartial critics, animated solely by a conscientious desire to unite and not dissever the different classes which make up the people of this Dominion, and to consider the national good as the highest and purest purpose of a Canadian's life.

Nor should I forget to refer to the important effects that a course of Political Science may have upon journalism in Canada. In a country of popular government, the press necessarily exercises a large influence which, on the whole in Canada, is directed to the promotion of the public interests. It is true that party conflict has given to the great majority of our public journals a partisan character which too often prevents the people from obtaining that impartial criticism of public men and matters of controversy which they have a right to expect from their self-constituted teachers. Partisan journalism is, however, one of the penalties we must expect to pay for party government, and the time seems yet far off when independent journalism is likely to assert itself on any large scale. No one will deny that the leading newspapers of the Dominion are edited and written with decided ability, and represent fairly the intelligence of the country at large. The tendency in Canada, as in the United States, is to publish short crisp articles in the editorial columns, instead of the elaborate, and often too heavy, articles which

are characteristic of the English and even the Australian press. When we consider the varied topics with which a newspaper writer has to deal in the course of a week's issue, and the short time he has necessarily at his disposal for thoroughly informing himself on the questions on which he has to speak authoritatively, it is certainly surprising to notice the knowledge of the subject and the insight into its salient points he exhibits. One must at times recognize evidences of superficial information, and a tendency to ignore the valuable maxim, "Always verify your facts." One would wish sometimes to see a greater sense of responsibility and a more earnest desire to elevate public opinion; but these are defects which must in the nature of things be associated with daily journalism. After all, it is well to remember that a newspaper in these days of speculation and competition is a business enterprise. No successful journal is likely to be ahead of the community in which it lives, and its daily tone must generally afford a fair criterion of the state of public opinion around it. As the population and the wealth of the country increase, it must happen that journalism will become more of a profession, offering larger emoluments to deserving men, although they are likely to be much smaller for a long time to come than the rewards open to legal and medical men of merit. As a rule, a newspaper man must be more or less to the manner born. I am hardly prepared to admit that much practical benefit can be derived from the establishmen of classes for educating men in the various departments of journalism, as is proposed, and I believe even now attempted, in one or two institutions in the United States. A reporter or editorial writer must be trained in the drudgery of a newspaper office, must work his way way up and gain practical experience before he is likely to become successful in so arduous and engrossing a profession, demanding special qualifications. But, at the same time, I can see very great advantages to be derived by journalism from the careful study of the different branches of research that should fall within the domain of Political Science. Young men, who have a desire to embrace this arduous pursuit as a profession, ought assuredly to make themselves more capable of meeting the many requirements of a vocation, which every year is making greater demands on varied knowledge. An understanding of the principles of Political Science, of the different constitutions of the two continents, and especially of the United States and England, of historical jurisprudence, of political economy and statistics, of the principles that lie at the basis of the two great systems of law that regulate the lives of the Teutonic and Latin races, must certainly strengthen the confidence of a public writer in himself, and give him a mental equipment which most newspaper men, who have not had such advantages, will fully appreciate. The responsibilities that rest upon journalists in this country are undoubtedly great, and they owe it to themselves and to the public they serve to bring to the numerous questions that come before them for review and judgment the most accurate knowledge as well as honesty of purpose.

We are now laying the foundations of a great community stretching between two oceans, and the more clearly all classes of our people can learn the principles of government, and understand the lessons which the history of our own and other countries teaches them, the more confidently we can look forward to the future, and all we trust it has in store for us. We have already achieved a great deal through the instrumentality of the courageous and astute statesmen who have so far guided this country through its political development. The institutions we now possess compare very favourably in all

essential respects with those of any other country, not even excepting the United States or England; but still there is much to learn, and it is to the young men of the present day, who are now going out into the world to fight the practical battles of life, that we must look to continue the great work of those who have preceded them.

We need not be apprehensive that these studies will educate mere theorists. It is a truism to say that theory must always precede practice. Certainly it has its valuable influences on all political systems, whatever the purely practical politician may say in his contempt for studies beyond his ken. Who ever doubts now the importance of the political ideas of Montesquieu, or the value of the lessons drawn by De Tocqueville from his study of American democracy, or the soundness of the teaching of Burke, or of Hamilton in the 'Federalist'? Or who can exaggerate the influence of the work of Adam Smith in the wide field of Political Economy, since his time so important a branch of Political Science?

But among the great works that have been written on government, there is none that affords a more striking example of the influence that one book can make upon the political institutions of the world, than "De l'Esprit des Lois," which was written in the middle of the eighteenth century. No student of institutions should fail to read carefully a work replete with learning and showing a remarkable insight into the meaning and working of the English government, and the fundamental principles of civil liberty. He may be justly considered the founder of the historical school of modern times which comprises among its teachers many of the most learned and brilliant men who have been, or are now, connected with leading universities in America and Europe. He saw intuitively that we must interpret laws by history, and interpret history by custom. The influence of his opinions can be traced throughout the 'Federalist,' that excellent series of commentaries on the American constitution, which, it has been well observed by Chancellor Kent, "is equally admirable in the depth of its wisdom, the comprehensiveness of its views, the sagacity of its reflections, and the freshness, patriotism, candour, simplicity, and eloquence with which its truths are uttered and recommended." Hamilton, Madison, and the other authors of the constitution were deeply imbued by the ideas of the French writer. History must place him among the great architects of political systems. His ideas have inspired the statesmen of France in establishing their present parliamentary system, and have had their influence on the political institutions of Germany. "Montesquieu," says an eminent French writer,[1] "has left us something more than precepts, he has left a method which enables us to develop his thought and apply it to contingencies that he could not foresee. He exercised a deep and permanent influence in his own time, and is full of teaching for ours. His name is associated with many of the most excellent reforms which this century has seen in France, and he is the representative of the French spirit in all its clearness, breadth, generosity and wisdom."

I can well remember that the discussion of the union of the British North American provinces was actually left for years to theorists in the press, or was chiefly valued because it gave opportunities for brilliant rhetorical flashes in legislative halls. But the day came when this theoretical problem had to be solved to meet the political exigencies of old Canada, and the confederation of the provinces became a reality. Indeed,

[1] Albert Sorel in his Life of Montesquieu in the series of Great French Writers, p. 179.

in a country like this, where the people are of essentially practical instincts in all matters affecting government, the man who should always remain a mere *doctrinaire* or theorist would soon become without weight or strength in the community where he lives; but whoever brings to the practical discussion of the questions of the day sound knowledge, which is based on the experience of the past, and shows he can well adapt principles drawn from the great storehouse of sound political science to the difficulties of the day, he will be found invaluable as a leader of men and the architect of institutions.

No human institutions are perfect, but "an increasing purpose" must always distinguish the development of government, and the thoughts of statesmen must be widened "with the process of the suns," by the experiences of the past as set forth in emphatic and pregnant sentences by historical and political writers.

I have thought it necessary to give these introductory remarks to show the importance that a study of Political Science ought to assume in all institutions of high standing; I hope they will be able from year to year to obtain the services of able men, ready to devote themselves to the elucidation of the various subjects to which I have referred. Lectures addressed to classes in the universities by men engaged in the practical pursuits of law and politics, by men whose opinions are valued by their countrymen for their experience and learning, should always supplement the labours of the regular professors and lecturers, who deal mainly with principles and theories of the schools.

This is the practice of the famous École des Sciences Politiques of Paris; it is much to be desired that the Canadian universities should obtain the services of the same class of men, who may be willing from time to time to give them the benefit of their knowledge and experience.

As I have endeavoured very imperfectly to show you in the course of this lecture, there is a rich field of study and research before you. We live in times of great intellectual activity, and Canadians must keep pace with the results of thought throughout the world. The facilities that are open to us for extending our knowledge of other countries and of learning valuable lessons from the rich storehouse of their experience, are very superior to those possessed by the pioneers and founders of this country. In the times of slow communication with the great outside world, in the absence of electric telegraphs and daily mails, they were at a great disadvantage compared with us, who know every day what is passing in the most distant places of the globe. With our universities, colleges and schools, affording so generous an education in all branches of necessary study, with numerous libraries established in all the principal centres of thought and activity, with scientific and literary societies starting up everywhere, with an able and enterprising newspaper press, circulating varied knowledge of matters of current and immediate interest, young men now-a-days have opportunities for becoming useful citizens which stand out in remarkable contrast with the condition of things even half a century ago. Still, in the early days of trial and struggle in this country, there were men of remarkable ability and knowledge, possessed of a thorough practical comprehension of the necessities of the times, and there was always with the mass of the people that strong common sense, so characteristic of Englishmen, which enables them to tide successfully through difficulties and crises, and without which no learning or knowledge can realize great results in a country like ours. The men who laid the foundations of our social and political structure, a goodly edifice, whatever some doubting Canadians may say, were men

who thought deeply and acted vigorously, and if they had fewer opportunities than we have, yet they made the most of what they possessed. Indeed, we must not forget that after all they had in some respects the same advantages as we have: they had the admirable teachings of Burke and Montesquieu, and the suggestive and inspiring examples of Pym, Hampden, and Russell, of all the fathers of parliamentary government in the parent state. The majority of the people, certainly in Canada, have understood the principles of British liberty, and were always faithful to them, while at the same time they recognized their obligations to the Empire, and remained faithful to the Crown at times when their patience was sorely tried, and their fortunes seemed at the lowest. The point which I should like to make here is this: that we can learn much from the examples of the men, who have preceded us, in studying the social and political development of Canada. We should do well to emulate their patience and perseverance amid what seemed at times insurmountable obstacles, as well as their insight into the safest maxims on which to rest civil liberty and local government.

Let me here utter a warning against mere shallowness. To master one good work at a time, to be able to understand its teachings, and apply them to the conditions of the present and to the exigency that may arise at any moment, should be the aim of every student of Political Science. The tendency in some universities as in the public schools, I am inclined to think, is to overburden the student with work, instead of giving him opportunities for devoting himself to those particular studies for which his inclinations and abilities fit him. I do not know that it is best for a country like this to have too many superficial Crichtons. I should therefore hope that all persons who wish to take up a course of Political Science in addition to those studies which are necessary for mental discipline and to fit them for their respective vocations, will not look upon it as a mere pastime, as quite subsidiary to other things, but will bring to it the perseverance, diligence and interest which will enable them to master its true teachings and make it an invaluable aid to them in the practical pursuits of their lives.

In no department of study is there more danger of being deceived and carried away by dangerous theories and delusive ideas than that which leads us to consider political, social and economic problems. In attempting to lay deep and firm the foundations of government and society in the Dominion—for remember we are at the basis as yet of our national structure—our rulers and thinkers must carefully study the systems of other countries, for there is always much to learn from them; and by no other country are we likely to be more influenced by reason of language and origin and neighborhood than by the remarkable nation alongside of Canada; but we must be careful not to be deluded by the glamour of republicanism or the social tendencies of purely democratic conditions, and to level those old landmarks which can best lead us in the direction of true social happiness and national greatness. It is well to have conservative tendencies—I mean "conservative" in the true sense and not in the elastic political meaning of the word—and not adopt new ideas and opinions simply because they are new. Let us, above all, remember that the Social and Political Sciences are inseparably allied, that the laws of the one influence the laws of the other; and that laxity of morals in society must tend to lower the political conditions of a country. We see in the neighboring United States the danger that is threatening the social fabric from the lax principles that prevail on the subject of marriage ties. This unhappy laxity must and indeed does sap the foundations

of social life and destroy the permanency of the family, the true basis of the happiness and security of every community that aims at real greatness. This is but one instance out of many that I could cite to prove to you how necessary it is to study thoroughly and conscientiously the social as well as the political conditions of communities, in order to accumulate those experiences which may assist us in moulding and perfecting our own institutions. There is no institution or law that we may adopt, that will not have some effect upon our social and and political development.

In conclusion, I can only say we have much to look forward to in this country if we are wise and prudent in profiting by the best experience of other peoples, and in avoiding the quicksands into which indiscreet politicians and dangerous theorists would ever and anon push Canada. Twenty-two years have passed since we entered on the new political era which Confederation has opened up to this Dominion, and we have achieved an encouraging amount of success through the sagacity, perseverance and hopefulness of our statesmen, and the industry, energy and patriotism of the people who have faith in this country and its future. We have achieved this success through the exertions of two races, different in language, in religion, and in certain institutions, but equally allied by the ties of a common interest. The one can gain much from the other: the energy, the common sense and the forbearance characteristic of Englishmen, can well be associated with the brilliancy, the ardour, and the sanguine temperament of the French race. But whatever may be their points of difference, a study of institutions will teach them both to value the great principles and maxims on which rest the foundations of English liberty, and which illustrate the pages of England's noblest history; and it is from the love of her people for home and social purity, from their assertion of free thought and free speech, and from their encouragement of political morality, above all other things, that Canadians can best gather true inspiration and sound example, which will enable them to steer the ship of state into a haven where it will rest secure from the storms that ever threaten its safety.

"——Sail on, O Ship of State?
Sail on, O Union, strong and great!
Humanity, with all its fears
With all the hopes of future years,
Is hanging breathless on thy fate.
* * * *
Fear not each sudden sound and shock,
'Tis of the wave and not the rock;
'Tis but the flapping of the sail,
And not a rent made by the gale!
In spite of rock and tempest's roar,
In spite of false lights on the shore,
Sail on, nor fear to breast the sea!
Our hearts, our hopes, our prayers, our tears,
Our faith triumphant o'er our fears,
Are all with thee,—are all with thee."

II.—*The Cartography of the Gulf of St. Lawrence, from Cartier to Champlain.*

By W. F. GANONG, A.M.

(Presented by Dr. George Stewart, May 8, 1889.)

At its meeting in May, 1887, the present writer had the honor to lay before this Society, a paper on the first voyage of Jacques Cartier to Canada. At that time the importance of the bearing of this voyage upon the subsequent cartography of the Gulf had not become evident to me, but a more careful and comprehensive study since then of this in connection with other early voyages and with early maps, has made it clear that it is of the greatest importance. The first voyage of Cartier to the Gulf quite overshadows, from a cartographical point of view, his later ones, and indeed all of those of the Sixteenth Century. Its results largely moulded the maps of this region for nearly eighty years; and the various discrepancies and errors of those maps, as well as the differences of opinion and inaccuracies of some late writers, have been due to a lack of that true interpretation of Cartier's course which is the key to the situation. So marked and important is this, that I may be pardoned for repeating with greater emphasis what is in reality the text of this paper :—*The correct interpretation of Cartier's first voyage is the key to the cartography of the Gulf for almost the subsequent century.* This statement I hope to substantiate in the following pages.

In order that we may have a connected view of the whole subject, I must ask you to briefly review Cartier's itinerary as set forth in the paper[1] referred to. In this connection it will be necessary to mention the different and sometimes inconsistent views held by several writers, since these have directed the writings on the subject.

I.

VOYAGES OF CARTIER AND CONTEMPORARIES.

A.—*Cartier's First Voyaye.*

Cartier, with two ships, left St. Malo on April 20th, 1534. He made land at Cape Bonavista, May 10th, and after spending some days in Catalina Harbor, visited Funk Islands to provision his ships with the birds there. He entered the Strait of Belle Isle early in June, and coasted along the Labrador shore as far as the present Cumberland

[1] Trans. Roy. Soc. Canada, 1887, vol. iv. sec. ii. pp. 121-136.

Harbor, to the west of Shecatica Bay,[1] visiting and naming several harbors on the way. At Cumberland Harbor he turned back and retraced his steps to the port of Brest, the present Old Fort Bay.[2] Thence, on June 15th, he crossed to Newfoundland, making land in the vicinity of the present Point Rich. From this place he coasted to the south-west, visiting and naming several bays and capes, until he reached the present Cape Anguille, which he sighted in a storm on June 24th, and named Cape St. John.

Up to this point, Cartier's narrative is so clear that there never has been any doubt, except in a few minor instances, as to the course he followed. From this point until he reached Bay Chaleur, however, there has been great difference of opinion as to his route. As traced in the present writer's former paper, it is as follows :—

Leaving Cape Anguille, he came next day to the Bird Rocks and later to Brion Island, all of which he describes fully and faithfully. Then he approached North Cape (*cap du Daulphin*) of the Magdalene Islands, and on the 27th of the month coasted along the western side of the larger of the group, until Entry Island was reached, one cape of which was named St. Peter. The present Deadman's Island, off to the west, was named Allezay. The course was now laid to the west, and he sailed forty leagues before again coming in sight of land. On the morning of June 30th, he saw to the south-west what appeared to be two islands, but what proved later to be really firm land lying S.S.E. and N.N.W., on which was a cape named Cape Orleans. He entered the mouth of a beautiful but shallow river which he named River of Boats (*ripuiere de Barcques*) and describes very fully the shores and banks of the region. The land, like two islands, was the high land near Grenville; the River of Boats was Richmond Bay; Cape Orleans was Cape Kildare; and the Cape of the Savages,[3] visited and named by him later, was the present North Cape.

After landing at the latter point, he coasted nine or ten leagues along the land, finding

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[1] All writers hitherto have considered Shecatica Bay to be the Port of Jacques Cartier, and a small inlet to the east of the mouth of the latter (*B. du Petit Pene*) to be the River of St. James. They are so marked in the excellent French and English charts of the last century, which give both Cartier's and the modern names. The reason for my view is, that Cartier describes St. James as a very large river, "bonne ripuiere plus grande." This would by no means apply to the small inlet referred to, but it would apply well to Shecatica Bay which on the charts does look like a river. Again, the Port of Jacques Cartier was clearly a harbor, not a river, and Cumberland Harbor would be more likely to be spoken of as a harbor than Shecatica Bay. See good modern charts of the coast. It is worth noticing by the way, that Kingsford, in his History of Canada (i. 3), suggests that "Shecatica" is an Indianized survival of Jacques Cartier, an improbable supposition it seems to me.

[2] There is some question as to the exact locality of Brest. Thus Hind (Labrador, ii. 352), Packard (Bull. Am. Geog. Soc. xx. 352), Rev. M. Harvey (Ency. Brit. xiv. 177) say that Brest was on Bradore Bay, a few miles from Blanc Sablon, and that it was founded in 1500 (Packard), or 1520 (Harvey). Yet Cartier's narrative is quite clear on this point. Bradore Harbor he entered and called its islands the Islettes. He mentions no town there. Brest, he says, was ten leagues from the Islettes. The conclusion must be that Cartier's Port of Brest was really Old Fort Bay, and that the town of Brest, if on Bradore Harbor (where its ruins are said to be) must either have been founded later, or else was unknown to Cartier. The latter can hardly be credited.

[3] It seems probable that this word survives, in an altered form, in Cape Tormentine on the Strait of Northumberland coast of New Brunswick. During the early part of the seventeenth century a large number of maps were published in Europe, which followed Champlain's 1612 or 1613 map, neither of which showed any trace of Prince Edward Island. Some of these retained Cartier's names, which, of course, had as a consequence to be on the mainland. Later, however, Prince Edward Island was added to them (following, no doubt, Champlain's 1632 map), but naturally the names were left where they were and not removed to the island. Hence "River of Boats," "Cape of the Savages," etc., appear on some maps on the New Brunswick coast, even with Prince Edward Island clearly shown. De Laet's map of 1632 is a conspicuous example, the name "C de Sauvages" being applied by him to Point Escumenac and "Fleue de Barques" to Baie Verte. Some maps of the last century have "C of

it the next morning, July 2nd, to be one of the shores of a large bay which he named Bay of St. Lunario. His description of the place makes it clear that this bay was the head of the present Northumberland Strait.[1] He passed near Cape Escumenac and crossed the mouth of Miramichi Bay to which he gave no name. He described the latter as a triangular bay, running deep into the land, lying north-east and ranged with shoals. Continuing along the coast, with the weather stormy, on July 3rd, he rounded Point Miscou naming it Cape of Hope (*cap d'Espérance*),[2] and entered Bay Chaleur. He crossed at once to the present Port Daniel, where his ships remained for some days.

Among the more prominent of the late writers who have considered Cartier's voyage, are Dr. J. G. Kohl and Rev. B. F. De Costa. The former, in his greatly and justly valued work, "History of the Discovery of Maine,"[3] gives a quite different account of Cartier's route after leaving Bird Islands. He confuses the narrative greatly, applying to the land coasted along immediately after leaving Brion Island, the description which Cartier gave of a land forty leagues to the westward. Yet he calls Brion Island our present Prince Edward Island, and says that Isle Allezay and Cape Orleans were names given to places thereon. He does not locate the River of Boats, but speaks of "the triangular gulf which he named Saint Lunario," the present Miramichi Bay. The answer to this confused and impossible interpretation is found in Cartier's narrative itself, and must be evident to everyone who has carefully followed the preceding pages, or has read the original narrative.

Rev. Dr. De Costa, in Winsor's "America,"[4] makes Allezay the present Prince Edward Island, entirely ignoring the fact that Cartier sailed forty leagues out of sight of land before he reached the place where was the River of Boats. Cape Orleans he places on the mainland and says, "next he found Miramichi Bay, or the Bay of Boats, which he called St. Lunario." Now nothing could be clearer than the testimony of Cartier's narrative on this point, that the River of Boats and Bay of St. Lunario were two entirely distinct places. No reader of the narrative can possibly accept such an interpretation.

Another version of this part of the course is that of Abbé Laverdière,[5] as shown on

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the Savages" altered to "C. Savage", and placed further down the coast, as on Popple's celebrated map of 1733. On others "C. Savage" or "Savage Cape" is replaced by "Stormy Cape", and on French maps is translated into "C. Tourmente" and "C. Torment." On some maps such as those by Bellin in Charlevoix's History, it is marked Cape Tourmentin, which is of course the Cape Tormentine of to-day. On the (for its time) very accurate map of 1755 in the Memorials of the English and French commissaries, both "Stormy Point" and "C. Tormentine" are given and applied apparently as synonymous, and are placed moreover in exactly the proper position. From Cartier's "Cape of the Savages", applied to North Point of Prince Edward Island, to Cape Tormentine on the New Brunswick shore there appears to be an unbroken transition. [As this paper is passing through the press, I find that Deny's map of 1672, gives "La Cap de Tourmentin." This indicates that the intermediate steps are doubtless to be found upon still earlier maps.]

[1] There is a curious use of this word by De Laet in his Histoire du Nouveau Monde of 1640. He says "La Baye de Gennes [i.e. Chignecto Bay] .... receives two rivers, one of which comes from the east, the other of which descends from the north, and is almost joined to near the Strait of S. Lunario." This seems to imply that he meant the latter name to apply to Northumberland Strait. His map, however, applies it to the Miramichi, which he places opposite Chignecto Bay.

[2] Now Cape Despair in Gaspé. Old maps show the transition. See also, the Canadian Review, no. 1, 1824, p. 85.

[3] Coll. Maine Hist. Soc. vol. i, 1869.

[4] Narrative and Critical History of America, iv. 49. This work hereinafter quoted as "America."

[5] Le Canada-Français, i. 689.

a recent map.[1] The course among the Magdalene Islands does not differ very greatly from that of the present writer,[2] but the long sail to the west is made to take Cartier to Miramichi Bay which, as usual, is called the Bay of Saint Lunario. Thence he is made to go southward to Richibucto River, which is made the River of Boats, and thence north again to Bay Chaleur. This is about the course which is given also in the Quebec Literary and Historical Society's reprint of Cartier's voyages (Vol. I, pp. 10, 11). It is remarkable how persistently he has been sent to the mainland and kept away from Prince Edward Island. This is no doubt because it has not been remembered that his directions were invariably not for the true but for the magnetic meridian. Forty leagues true west would take him to the New Brunswick shore, but forty leagues magnetic west would take him to Prince Edward Island. As to whether the interpretation of the course as given by the present writer is consistent and clear, or, in other words, the correct one, he must leave others to judge.

Cartier, leaving his ships at Port Daniel, explored in his boats to the head of Bay Chaleur, and, of course, did not find the passage to the west which he came to seek. On July 12th he left his anchorage and coasted to the east,[3] leaving so clear a narrative that he is easily followed to Gaspé Bay. On the 25th he sailed away again to the east-north-east for about twenty leagues, which brought him to Anticosti. He followed the land to the eastward, giving us a clear account of his progress. To East Cape he gave the name of Cape St. Loys (or Aluise, i.e. St. Louis), and to Fox Point that of Cap de Memorancy.[4] He kept on to opposite North Point, and named the strait between Anticosti and Labrador the Strait of St. Peter. Here the lateness of the season and other causes made him turn back and sail away for France. He followed the coast of Labrador, visiting Natashquan Point (which he named Cape Thiennot),[5] to Blanc Sablon, and, passing through the Strait of Belle Isle, reached France on September 5th.

It is rather surprising that there has been a difference of opinion as to his course

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[1] Carte de la Nouvelle France, pour servir à l'Etude de l'Histoire du Canada, etc. Par P. M. A. Genest, 1875.

[2] I had not seen this map when my former paper was written.

[3] He visited the present White Head, near Bonaventure Island, and named it Cape Pratto. This name, De Costa says, he found there (America, iii. 186), implying that Cartier did not give it on this voyage. I quote this here to illustrate the difference of opinion which has prevailed as to Cartier's or his companions' previous knowledge of the Gulf. Many names Cartier simply writes, without saying whether he gave them or not, while many others he distinctly says he gave. I believe that *all* names on the south and west of the Gulf used by him he gave himself on this and his following voyages. This was apparently Dr. Kohl's view. We have no maps, no evidence of any kind to show that this region was at all known either to him or to his companions, while his actions and language throughout are those of an entire stranger. On the east coast of Newfoundland, however, and possibly in the Strait of Belleisle, some of the names were used before his time. Bonavista and Chasteaux appear to be among these. Compare America, iv. 72, last paragraph. As to the origin of the word Pratto, De Costa states (America, iii. 186) that Albert de Prato, a priest and mathematician, was on the coast of Newfoundland with Jean Rut in 1527. He is probably the man referred to in Hakluyt (iii. 167) in the narrative of a voyage of 1527 to the east coast of Newfoundland and Cape Breton Cartier may have known him, and named the cape for him. The name must not be confounded with "Plato," "Plateau" or "Flat Island," near Point Peter, on the opposite point of Mal Bay. The latter names were given on account of its shape.

[4] Doubtless meant for Montmorency. This was the name of one of the noblest old families of France. At this time, Anne, Duke of Montmorency, a brave and illustrious man, was held in high honor in France by Francis I, and it was probably in his honor that Cartier named the cape. (See Encyclopædia Britannica, xvi 791.)

[5] Most writers consider C. Thiennot to be Mount Joli, a little to the east of Natashquan Point. Yet Cartier tells us distinctly that C. Thiennot was a "low cape." Why, then, seek to place the name on Mount Joli? It may have been just at the mouth of Natashquan River.

after leaving Gaspé, for the narrative is here perfectly clear. Yet more than one writer has claimed that instead of crossing to Anticosti he sailed up the St. Lawrence to near Point des Monts. This is the view taken by Abbé Laverdière in M. Génest's map.[1] In the latter the course, as marked, follows the curve of the north shore of the Gaspé peninsula to near the present River St. Anne, then crosses to near Seven Islands, recrosses to near Matane, then runs nearly direct to the north of Anticosti, and along the Labrador coast to the Strait of Belle Isle. This view is taken also by the very courteous author of a short review[2] of my paper on Cartier's first voyage. I cannot help believing, however, that the latter has not examined the evidence in the light of facts, but has rather based it upon supposition. The chief reason advanced by the reviewer was, practically, that Cartier would never have gone to the east along Anticosti, when the great St. Lawrence was opening to him what would seem to him to be the western passage for which he was seeking. It is not in the light of what Cartier would have done with a modern chart of the Gulf before him, but in the light of what he, with his imperfect knowledge or want of knowledge, did do, that we are to read the history of his voyage. This matter is so clear that argument is hardly needed. There are at least three distinct lines of evidence showing that he did not go up the St. Lawrence on this voyage, but to the eastward around Anticosti.

(1.) The narrative itself is quite clear on this point. It says that he sailed away to the east-north-east; that he thought he was crossing the mouth of a great bay, the coast of which he could see from his ships; that the land he approached lay south-east and north-west, and that the passage across was twenty leagues. This is all unmistakeable. The "Relation originale" reads as follows: "Le landemain, xxve jour dudit moys, le vent vynt bon et appareillasmes du hable; et nous estans hors de ladite ryuiere, fismes porter à l'Est Nordest, pour ce que depuis la terre de ladite riuiere estoit la terre rengée, faisant une baye en manière de demy cercle, dont auyons veues de toute la couste de noz nauires; Et en faisant la routte, vynmes querre ladite terre qui gisoit Suest et Nornoyst, e paraige de laquelle il pouoyt auoir de distance, depuys ladite riuiere, enuyron xx lieues." The edition of 1598 is less clear here as elsewhere, but its meaning is the same. His distances and directions from his landfall on Anticosti to East Cape, thence around and up the northern coast of Anticosti, are quite correct and clear, and leave no doubt that he reached North Cape and went but very little beyond it. Now, as to why he thought he was crossing the mouth of a bay, the whole coast of which he could see from his ship, when crossing to Anticosti, I can only suggest that he was deceived by fog-banks.[3] Why is it, I may ask, that the position of the Bay of Fundy is represented by solid land upon nearly every known map up to the time of Lescarbot? Navigators and

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[1] See antea, p. 20, note 1.

[2] See Le Canada-Français, i. 689-690.

[3] "In the same manner, in modern times, Sir James Ross, in Lancaster Sound, believed he saw mountains where there were but fogs, and depicted this sound as land-locked, whilst it has the widest open water in the whole world." J. G. Kohl, Coll. Maine Hist. Soc., vol. i, 1869. "The reports of lands seen at a distance in these waters (*i.e.*, Arctic Ocean, near Alaska) should be made with great circumspection, where clouds and fog-banks are constantly appearing on the horizon, and are so very deceiving," etc., and examples of such deceptions. W. H. Gilder, Ice-Pack and Tundra, p. 100. My friend, Dr. Benjamin Rand, of Cambridge, who has sailed in schooners in the Gulf and River St. Lawrence, tells me that the region we are considering is a famous one for its mirages.

explorers passed it, and although it was almost certainly known to the fishermen, the explorers did not see its entrance.

(2.) In his second voyage he passed between Anticosti and Labrador (as no one has ever doubted), and, rounding the western end of Anticosti, saw the mountains of Notre Dame to the south. And by the two natives whom he had taken from Gaspé the year before "we were told that it was a part of the southern coast, and that there was an island to the south of which is the way to go from Honguedo [*i.e.*, Gaspé] to Canada." This was named the Island of Assumption. Cartier clearly shows that he had no suspicion previously that this was an island, for on his first voyage he had not gone far enough beyond North Cape of Anticosti to see the land to the south. Had he gone up the river south of the island the previous year, as he was now passing along the northern side, he would not have needed to be told by the natives that the land he had sailed all around was an island. But as he had not gone up the river south of the island, but supposed it to be all land, the information that it was an island was news to him.

(3.) But the most conclusive evidence of all is that Cartier tells us, in so many words, that he did not discover the southern entrance on his first voyage. In returning towards France in May, 1536, he passed down the St. Lawrence directly to Gaspé, "which passage," he says, "had not before that time been discovered."[1] Nothing could be more conclusive upon this point.

B.—*Cartier's Second Voyage.*

In his second voyage, Cartier left St. Malo with three ships, on May 19th, 1535, and he did not succeed in reaching Newfoundland until July 7th. He visited Funk Islands, and, entering the Strait of Belle Isle, waited at Blanc Sablon until the 26th for the arrival of the two ships which had been separated from his in a storm. On the 29th he sailed to the west, and twenty leagues beyond the port of Brest (now Old Fort Bay) passed two islands which projected beyond the others into the sea. These were named St. William's Islands, and would appear, from the distance given, to be in the vicinity of what is to-day called St. Augustin Chain. Twelve leagues further he found other islands, which he named St. Martha's. Among them, to the north, was a bay with many islands and apparently good harbors. This description applies well to the islands at Great Mecatina, to the north of which is just such a bay as Cartier describes. Fifteen leagues further brought him to another group of islands, which he named St. Germain, the description and position of which would place them at the St. Mary's Islands or those at Cape Whittle. This is confirmed by the fact that his course after leaving them was along a coast which ran east and west, a point to the south-east.[2] Seventeen and a half leagues further he met with other islands, but gave them no name. Seven leagues beyond this he came to Cape Thiennot, to which he had given that name on his first voyage. This was without doubt the present Natashquan Point. Some seven leagues or more further on he entered a harbor among four islands which stretch out into the sea. This he named St. Nicholas Harbor; it appears to be the Pachachibou (or Pashasheebu) of to-day.

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[1] "Passasmes iusques a Honguedo [i.e. Gaspé], lequel passage n'auoit pas cydeuant esté descouuert." Bref Récit., p. 54, ed. 1863.

[2] The directions are magnetic and not true, of course.

On August 7th he left this port, and, to use the words of the narrative, "went to seek the land towards the Cape Rabast, which is distant from the said harbor [*i.e.*, St. Nicholas] about twenty leagues north-north-east and south-south-west. And the next day the wind was contrary; and because we found no harbors on the said land to the south, we took our way towards the north beyond the aforesaid harbour about ten leagues." This brought them to the bay which he named St. Lawrence (*Sainct Laurens*), and which few doubt was the region of the present St. Genevieve and Hunting Islands.[1] This would place Cape Rabast on Anticosti somewhere near Charleton Point of to-day. It could not have been on the mainland,[2] for he sailed twenty leagues to the south-west after leaving St. Nicholas, and then went to the north to reach St. Lawrence Bay, which itself was only ten leagues beyond St. Nicholas.

On August 14th he left St. Lawrence Bay, and went to a cape twenty-five leagues to the west, where the land lay west, a point south-west. This must have been the present North Cape of Anticosti, as distances and directions clearly show. He remarks upon the great number of whales which he saw here. Here the two natives, whom he had taken at Gaspé the previous year, told him that the land on the south was an island (the first hint he had of the fact), on the south of which was a clear passage from Honguedo (Gaspé) up to Canada. The next day, August 15th, he passed the strait and saw the high land of Notre Dame Mountains to the south, and that day he gave to Anticosti the name of Assumption. West-south-west from its western end, twenty-five leagues distant, he mentions another cape, probably the present Mount Louis.[3] He coasted along this southern shore until the next day, when, the wind coming west, he crossed to the northern shore. He now saw the river rapidly narrowing, the shores coming together, and his natives told him that he was at the beginning of the Kingdom of Saguenay, and near the mouth of a river which became fresh further on. Disappointed in the hope of finding here his western passage, he would not ascend the river until he had examined the northern coast between where he now was (near Point des Monts) and his Bay of St. Lawrence, which coast, of course, he had missed by sailing along the southern shore.

On August 18th he coasted north-easterly to the Seven Islands, which he named the Round Islands (*les ysles Rondes*). Just beyond this was a river of fresh water, in which were seen fishes which had the forms of horses; this was the present Moisie River.[4] On

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[1] De Costa, following Kohl, makes the St. Lawrence the mouth of the St. John, which it clearly was not. This is but one of the many inaccuracies in De Costa's account, which a little care would have avoided.

[2] Some maps of the seventeenth century mark C. Rabas on the mainland, though none of the sixteenth show it. They are, without exception, so far as I have found, of those which, with Champlain's topography, use many of Cartier's names. In these respects they copy Lescarbot, who, as will presently be shown, made an effort to retain every name given by Cartier, and made many mistakes in placing them. It is worth noticing that this word "Rabast" is used by Cartier in the narrative just before he uses it as a proper name, "Iusques au Cap de Thieñot qui se rabast, au Nor onaist qui est enuiron sept lieues," etc. (Bref Récit., p. 8). It is here used, apparently, in the sense of "lies" or "has the direction."

[3] Or Cape Magdalen. Allefonsce says that the cape is "a very high land," and that it was south of Seven Islands. This would apply best to Mount Louis; but north-east and west-south-west of the west end of Anticosti, as he also places it, would rather better describe Cape Magdalen.

[4] The horses were probably walruses, which, as Hind points out in his work on Labrador, were formerly abundant in this region. Hind also refers to the low lands in the vicinity of Seven Islands, as Cartier does. The river must have been either the Moisie or the Manitou, but most probably the former, which is the larger. It could not possibly have been the St. John, as they had a long sail to the eastward after leaving it before sighting Anticosti again.

the 21st he continued on to the eastward until he came in sight of Anticosti, and knew there could be no passage on that coast. Turning to the west again, he returned to Seven Islands, and on the 24th entered the mouth of the river proper. From this time until his return to the Gulf on his way to France in the spring his movements do not concern our present subject. But in May, coming down the river, he passed directly down to Gaspé by the passage which had not before that been discovered, went near Cape Pratto (the present White Head), and crossed thence to Brion Island. He appears to have coasted along the west, and afterwards the east of the Magdalens, from which he went[1] to Cape Lorraine, in Cape Breton Island. This cape was in 46.50 deg. N. lat. and three-quarters of a degree to the north he saw another cape, which he named St. Paul. He does not give us sufficient data for determining the position of these places; if Cape St. Paul be our Isle St. Paul,[2] Cape Lorraine could hardly be the present Cape St. Lawrence, but must have been some point to the south of it, perhaps at Grand Anse or Chetican.[3] On June 4th he saw the coast of Newfoundland, and entered a harbor which he named "Harbor of the Holy Spirit," which may have been La Poile Bay. Thence he went to St. Peter's Islands, and afterwards passing Cape Race (*Cap de Raze*) to Harbor Rougnoze (undoubtedly Renewse Harbor of to-day[4]), and from this place laid his course for France, where he arrived on July 6th, 1536.

C.—*Cartier's Third Voyage.*

We have but few particulars of Cartier's course on his third voyage. As given by Hakluyt, he left St. Malo May 23rd, 1540, and after a long, stormy voyage entered the Harbor of Carpunt, in Newfoundland, and on August 23rd, reached the Port of St. Croix. On September 2nd, he sent two ships back to France, but the narrative does not tell us when he himself went, nor by what route.

D.—*Roberval's Voyage.*

In the account of the voyage of Roberval, we are told that it was by way of St. John's, Newfoundland, in 1542.[5] We have a very fragmentary account of Roberval's voyage, and it contains nothing of value in connection with our present discussion.

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[1] As M. D'Avezac points out (Paris edition of 1863 of Bref Récit., p. 64) some versions read "we named this cape," instead of "we reached this cape."

[2] Dr. Kohl (Discovery of Maine, p. 349) and De Costa (America, iv. 53 and 67) consider them to be the same, but think the name was given before Cartier, as it appears in this region upon at least two maps before Cartier's voyages—that of Maiollo of 1527 and of Viegas of 1534. But on the former "C. St. Paulo" is on Newfoundland, near St. Pierre, while on Cape Breton is a "Rio de St. Paulo." On the latter "S. Paulo" is on the strait between the island marked Cape Breton and the mainland. It does not seem at all certain, then, that the "S. Paulo" of these maps was the same as the "Sainct Paul" of Cartier, and it appears likely that Cartier gave the name anew without knowledge or notice of its previous application in this region.

[3] Cartier says at Cape Lorraine: "There is low land, and seems to be the entrance to a river; but there is no harbor of any value." This may help to locate it to one familiar with the locality. According to the charts, the description might apply to either of these localities. Near the latter are two hills, 1,130 and 1,220 feet high, and no height is marked at Grand Anse.

[4] See Hakluyt, (iii. 155) where it is called "the next harbour unto the northward of Cape Rase." Also op. cit., p. 239, also Map of Avalon accompanying Murray's Geological Survey Newfoundland, London, 1881. Also Whitbourne's Discourse and Discovery of New-found-land, 1622, p. 53, where "Harbor of Renouse" is said to be six leagues north of Cape Race.

[5] Hakluyt's account is now known to be erroneous in certain particulars. Cf. De Costa, America, iv. 56, 64-66.

E.—*Allefonsce's Cosmographie.*

There is but one[1] other contemporary account of the Gulf, or of voyages to it, which throws any light upon our subject. Jean Allefonsce, who accompanied Roberval to Canada as his pilot in 1542, wrote a work on cosmography, which is preserved in manuscript in the National Library at Paris. It has never been reprinted in full, but the parts relating to this region have been translated and published by Hakluyt,[2] Murphy[3] and De Costa.[4] Hakluyt's account is prefaced by a title which reads: "Here followeth the course from Belle Isle, Carpont, and the Grand Bay in Newfoundland up the River of Canada for the space of 230 leagues, observed by Iohn Alphonsce of Xanctoigne chiefe Pilote to Monsieur Roberval, 1542." This would imply that Allefonsce actually made the voyage along the coast himself, and this receives some confirmation from the statement of Le Clercq (in his "Établissement de la Foy"), mentioned by Murphy and De Costa, that Roberval sent Allefonsce along the Labrador coast to search for a western passage. This statement is also made by Champlain.[5] He may have made the voyage, or he may not, but there is very little, if anything, in his account of the Gulf, which is not in the narratives of Cartier, and which, therefore, could not have been derived directly from Cartier himself (with whom, of course, he had acquaintance), or from Cartier's maps. He has certainly used Cartier's names almost exclusively, and if he did make a journey over the region he describes, named no places himself. The only differences between his place-names and Cartier's are as follows:—He uses the name Belle Isle for the island north of Newfoundland, still so-called, which Cartier had named St. Katherine's. He uses the name Grand Bay for the Strait of Belleisle, which Cartier had called Bay of Castles, but extends the term to include the eastern part of the Gulf also. He seems to apply the term Bay of Castles to Cartier's Port of Castles. He mentions the Isles de la Demoiselle, 36 leagues west-south-west of Blanc Sablon and 18 leagues north-east of Cape Thiennot. There are no islands exactly corresponding to this position, but the group at the present Cape Whittle, near St. Mary's Islands, seems to come nearest to them.[6] It will be remembered that in this vicinity Cartier named a group St. Germain.

Allefonsce, in speaking of Anticosti, always calls it Ascension, instead of Assumption, as Cartier named it. He uses also the names Mountains of Notre Dame and Cape of the Mountains of Notre Dame, by the latter meaning probably Mount Louis.[7] Cartier undoubtedly gave these names, for he first saw them and described them both on August 15th.[8] Allefonsce uses the name Bay of Molues or Gaspé,[9] which Cartier does

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[1] Hakluyt (iii. 168–170) gives an account of the voyage of M. Hore and others to Newfoundland and Cape Breton, in 1536. Hannay (Hist. of Acadia, p. 21) thinks they were on the west coast of Newfoundland. The account contains no geographical information.

[2] Voyages, iii. 291–294 of 1810 ed.

[3] Voyage of Verrazano, New York, 1875, pp. 38, 39.

[4] America, iv. 69, 70, 74-76.

[5] Laverdière's ed. of his works, p. 692.

[6] It is not unlikely that there is some misprint in Hakluyt here. Unfortunately there are many such, and one should never depend upon his work in matters of detail when he can have the originals before him. In the case of this part of Allefonsce's work I have been forced to use Hakluyt, as I can find no other version whatever in the libraries near Boston.

[7] See antea, p. 23.

[8] See post, p. 58.

[9] The earliest use of the word of which I can find any record.

not, applying it apparently to the present Mal Bay.[1] Cartier's Honguedo he changes to Ognedoc (on his map Unguedor),[2] and describes very faithfully under this name Gaspé Harbor. He uses the name Seven Islands, to which Cartier at first gave the name of Round Islands. But Cartier himself afterwards called them Seven Islands (*sept ysles*) in the same narrative in which he called them Round Islands. Allefonsce's description of the river does not concern us at present, and his reference to Isle St. John will be considered further on.[3] A complete list of Cartier's place-names, for use in the study of the descriptions of maps to follow, will be found at the end of this paper.

F.—*Cartier's Previous Knowledge.*

An important question connected with Cartier's voyages, especially his first, is: What previous knowledge had he of the region he was about to explore? How much of his course was real exploration, and how much merely revisiting places known to him? What maps or other records had he to aid him?

As to maps, we have no knowledge that he had any. No map is known to us which gives the topography of the Gulf in a recognizable form prior to those which show his explorations. It is quite certain, as Dr. Deane has shown,[4] that the Cabots left maps showing their explorations. It is thought that the outline of the coast in this region on La Cosa's map of 1500 was taken from them. Some writers have thought that John Cabot, in his first voyage in 1497, circumnavigated the Gulf,[5] a view which will have to be alluded to again[6]; but, if he did so, no map known to us down to 1534 shows any trace whatever of it. John Denys, of Honfleur, is said to have made a map of the Gulf in 1508, but if it ever existed at all, it produced no influence on later ones. Several maps prior to 1534 do show, however, very distinctly both entrances to the Gulf, such as those of Ruysch (1508), Maiollo (1527), Ribero (1529), Verrazano[7] (1529), and several others. It is hard to believe that Cartier was ignorant of the entrance between Cape Breton and Newfoundland[8] (we know he had previously been in Newfoundland), though he may not have known whither it led,[9] or that it was more than a shallow bay. So far as maps are concerned then, we know of none which Cartier had to help him.[10] Nor do we

[1] Abbé Laverdière, in his superb edition of Champlain's Works, p. 1084, points out that this word is an English corruption of Baie des Molues (or Morues). It is hence one of the oldest names in the Gulf.

[2] See sketches of Allefonsce's maps in America, iv. 74–77.

[3] See post, pp. 45, 46.

[4] America, iii.

[5] Mr. Stevens (Historical Notes) thinks that La Cosa's map represents the Labrador coast of the Gulf, Newfoundland being entirely absent. This is not very complimentary to the Cabots as navigators, or else to La Cosa (whose accuracy Mr. Stevens otherwise highly praises) as a map-maker.

[6] See post, p. 46, note 4.

[7] Tracings of these may be found in America respectively as follows: iii. 9, iv. 39, 38 and 37.

[8] In the narrative of his first voyage, however, he speaks as if he had not known of it. (See footnote 2 on p. 44. of this paper.) The earliest known map showing Newfoundland as an island, or rather a collection of islands, was Mercator's, of 1538. Cf. America, iv. 74.

[9] The very improbable claim of the exploration of the Gulf by Alvarez Fagundes, a Portuguese, is referred to in America, iv. 37, 74.

[10] The map of Gaspar Viegas, given by Kohl (Discovery of Maine, p. 348), shows the Gulf as a small, nearly circular bay, having no connection with the Strait of Belle Isle. But it is in MS. and bears date 1534, and we can hardly suppose Cartier knew much more than it embodies. It must be remembered also that the famous Gastaldi

know of any other records whatever that he could have possessed. If he had anything of the sort, they were probably derived from the fishermen who frequented the Newfoundland region.

It has been held by most writers[1] that Cartier himself was familiar with the Gulf. I cannot find that there is any direct evidence for this, though it is known that he visited the Newfoundland coast. His actions and language in the narrative are those of an explorer, except for the earliest part of the course. He mentions several places by name, but the first that he says he named himself was the Islets in Bradore Harbor. This region was well-known indeed to French fishermen, and doubtless Cartier would have taken among his men some such as pilots. After passing Brest on the coast of Labrador, he gave new names to all prominent places, as he did also throughout the west coast of Newfoundland. Again in the Magdalenes and on the coasts to the west, nearly every name he mentions, he says he himself gave. Would a man, familiar with the west coast of the Gulf, have gone coasting along Prince Edward Island and New Brunswick looking for a western passage, and then think he had found it when he reached Bay Chaleur? Would he not rather have skipped this part of the coast if he had known it? And if he knew the coast, would he have missed the mouth of the St. Lawrence by crossing to Anticosti as he did? Cartier very rarely tells us in his narrative why he did a thing—only that he did it. It is not worth while to speculate further on this subject, but it seems there is very little ground for supposing that he or his companions knew any part of the Gulf, except that near the Strait of Belle Isle.

II.

Influence of Cartier's Voyages on Early Cartography.

In reviewing the influence of Cartier's voyages on subsequent cartography and development of geographical knowledge, the first question which presents itself is, did Cartier leave any maps? None whatever are known, but there are three distinct lines of evidence to show that he did. (1) Upon *a priori* grounds we might infer it. The value of maps was fully recognized in those days, and it would be a part of Cartier's duty, as an official explorer, to make them, to illustrate his explorations to his master, Francis I. It is probable that these were in manuscript only. (2) We are told positively by Cartier's nephew or grand-nephew, Jacques Noel, of St. Malo, that there were such maps. In two letters[2] from the latter to his friend, John Growte, one of which is dated June 19th, 1587, and the other undated, but written only a short time later, it is said that Noel

map of 1550, (Kohl, op. cit., pp. 226 et seq., and America, iv. 86, 88) is supposed to represent ideas current as to the Gulf before Cartier. If this could be proven, it would show much greater knowledge than we have any other evidence of. Dr. Kohl expresses the belief (*op. cit*, p. 350) partly founded upon the Viegas' map, that "the Portuguese and French fishermen had circumnavigated the Gulf long before Cartier, which, indeed, is rendered probable by other reasons."

[1] Garneau, for instance, (Hist. du Canada,) says, "Dans ce premier voyage, il ne fit aucune découverte importante, les parages qu'il visita étant déjà connus en grande partie des pêcheurs, qui y avaient même donné des noms à plusieurs caps, comme le cap Royal, le cap d'Orléans, près de Miramichi, le cap de Montmorency," and Cartier distinctly says he named the former cape, and implies that he named the latter.

[2] Hakluyt, Voyages and Navigations, iii. 290, 291, ed. 1810.

had a book containing a map, "which is agreeable to the booke of Iacques Cartier," that it "is made in maner of a sea chart,"[1] and that his two sons had it with them in Canada. Again he says :—"I can write nothing else unto you of any thing that I can recover of the writings of Captain Iaques Cartier, my uncle disceased, although I have made search in all places that I could possibly in this Towne ; saving of a certain booke made in in maner of a sea Chart, which was drawne by the hand of my said uncle, which is in the possession of master Cremeur, which booke is passing well marked and drawne for all the River of Canada." Some inscriptions on the maps are also quoted. (3) Some of the maps we are presently to consider, show plainly that they did not copy their topography, one from another, but must have taken it from a common source. That source could not have been Cartier's narrations, for aside from the inaccessibility of the latter (none of them having been published until after the dates of some of the maps in question), the maps are too accurate and too much alike to have been drawn from materials which have puzzled modern historians who had accurate charts of the Gulf before them. The appearance in these maps, also of certain words which occur in Cartier's narrations not as place-names, but as used in describing places, seems to indicate that they are fragments of inscriptions taken from some other map. Such inscriptions would hardly have been placed there by any other than Cartier. There can be no reasonable doubt, in the face of this evidence, that Cartier left maps, showing his explorations.[2]

In considering the cartographical work of old explorers and map-makers, we must endeavour to place ourselves as far as possible in their mental position. Sitting in our studies, with our correct modern charts before us, we cannot, from our standpoint, see why they did many things that they did, or did not do many things they could or should have done. We are always in danger of interpreting their actions from our age rather than from theirs. It is singular how the idea we get of the topography of a place from visiting it, differs from that derived from a chart. Islands a short distance off appear joined together, and in an archipelago we seem to be land-locked. To know an island is not a peninsula, we must go around it ; that a bay is not a curved strait, we must go to the head of it ; that a passage is navigable, we must go through it. Anyone who has long studied a map of a place of complex topography before an anticipated visit, will remember how surprised he was to find how little he knew of the place, and how different it was in most respects from what he had pictured. We must remember that Cartier and his companions visited the places ; we, for the most part, study the correct maps. Then we must take into account other things which they experienced, but which the maps do not show us, mirages, fogs and misty weather, strong currents, storms. They were superstitious, badly educated, often careless in writing. Their maps were mostly made upon a very small scale, and an important place, however small in extent, had to be represented, so that small islands and rivers often appear vastly larger than they should and proper proportion is quite lost. In short, in considering these ancient narratives and charts, we must, as far as possible, place ourselves in the position of their makers and try to view things as they had to, not as we do. Then by a comparison of that standpoint with our own correct knowledge, we may gain truthful and therefore consistent results.

[1] Allefonsce may have had this or a copy to consult when he wrote his Cosmographie.

[2] Indeed, Dr. Kohl, (op. cit., p. 344) considers this so certain that he takes it for granted without discussion.

A.—*The Rotz' Map*, 1542.

The first map that I have been able to find, which shows certain traces of Cartier's voyages, is that by John Rotz, dated 1542.[1] It is also the only map known to me which shows his first voyage with no trace of the later ones. I have not been able to find any complete reproduction of this map, the original of which occurs in a "Boke of Idrography . . . by Johne Rotz," preserved in the British museum. The annexed sketch is copied from that in Winsor's "America," Vol. IV, p. 83.[2] No names are attached to this map and De Costa says[3] they are omitted on the Gulf and River St. Lawrence. Only the western portion of the gulf is given in Winsor's sketch, but Harrisse[4] says some French names are placed on the east of Newfoundland. The figures and explanations are entirely my own. I need hardly mention that one cannot follow the explanations of these maps without a good modern map of the Gulf before him.

Fig. 1.—Map of John Rotz, 1542.

I shall omit, until a little later, a discussion of localities Nos. 1, 2, 3, 4, merely saying in passing that I consider No. 1 to be Bird Islands; 2, Bryon Island; 3, the north-west coast of the largest of the Magdalenes; 4, Isle Allezay (Deadman's Island). It will be remembered that Cartier sailed from the Magdalenes to the west, i.e., magnetic west, which would be south of true west. There he entered the River of Boats (Richmond Bay), 5, to the north of which was Cape Orleans (Cape Kildare), 6, north of which again was Cape of the Savages (North Point), 7—all of these places being on Prince Edward Island.[5] He then coasted along the north-west of Prince Edward Island, and being in the head of Northumberland Strait, thought himself in a bay, 8, the Bay of St. Lunario. North of this was

[1] Harrisse (Jean et Sébastien Cabot, par Henry Harrisse, Paris, 1882), pp. 197-200, mentions a "Mappemonde Harleyenne," of about 1542, from which or from the prototype of which Rotz copied the Newfoundland coast. I have not been able to find a copy of the map (which is preserved in the British Museum in manuscript), but Harrisse's description would lead me to think it contains little that is different from that of Rotz. Harrisse considers it earlier than the latter, and says of it "cette belle carte, la plus rapprochée, ce semble, des découvertes accomplies par Jacques Cartier," and again, "Le golfe et le fleuve Saint Laurent, la péninsule Gaspésienne, la baie des Chaleurs, présentent des contours très exacts pour l'époque."

[2] For further description of this map see America, iv. 82, also Harrisse, op. cit., pp. 201-204.

[3] America, iv. 76.

[4] Jean et Sébastien Cabot, p. 203.

[5] For details see preceding pages 18, 19, or take subsequent p. 57, or the writer's paper in these Transactions, 1887, ii. 121-136.

a cape, 9, not named by him, the present Point Escumenac; 10 represents Miramichi Bay; 11, the Cap d'Espérance, the present Miscou Point, and 12, is, of course, the Bay Chaleur. At 13 is the exaggerated group of islands representing Isle Bonaventure and Percé; 14 is Gaspé Bay and Harbor. At 15 we have clearly what should be the southern entrance to the St. Lawrence, but which, it will be remembered, Cartier crossed, thinking he saw the land ranging in a semicircle all the way across; 16 would represent the point near which he reached Anticosti; 17, East Cape of Anticosti, Cartier's St. Louis; 18, Cape Montmorency and 19, St. Peter's Strait between the north of Anticosti and Labrador. Above that, the river widens out, as Cartier saw, in his first voyage, that it was beginning to do when he had to turn back. 16, 17, 18, 19 would therefore represent the eastern and northern part of Anticosti.[1]

There is nothing on this map to indicate that its maker had any knowledge of Cartier's second voyage, but it corresponds exceedingly well with the facts of the first narrative. Is it not a fair inference, that it follows, at least for the most part, Cartier's own map of his first voyage? Rotz has a second map[2] quite different from the first, though of the same year, which shows the second voyage, but it has no special interest for us here.

B.—*The Dauphin or Henri II Map*, 1546.

The next map to which I invite attention here, is one which represents Cartier's explorations better than any other of the sixteenth century. It is the so-called "Dauphin or Henri II Map," and is now known to have been made by Pierre Desceliers in 1546. The original is a map of the whole world. It is reproduced by M. Jomard in his "Monumens de la Géographie," Plate XIX, 1, and from this the sketch on p. 31 is taken.[3]

All writers unite in praising the pains-taking, accurate and truthful character of the maker, and the beauty, clearness and great value of the map itself.[4] It is considered to be a faithful picture of the geographical knowledge of Frenchmen at the time it was made. Desceliers was the contemporary and almost the neighbour of Cartier, and was undoubtedly personally familiar with Cartier's maps and records, even if he did not know Cartier himself. We proceed, then, with an expectation of finding in this map the geographical knowledge of the Gulf given to the world by Cartier, or in other words, nearly Cartier's own idea of its topography.

Let us look first at the group of islands to the west of the entrance of the Gulf, a group lying in the position of the Magdalenes. As to "ye aux margaulx," there can be no doubt; this is Cartier's own name applied to our Bird Rocks. "Ye brion" is equally

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[1] Harrisse, (op. cit. pp. 203-204) says: "Si on ne voit pas l'île d'Anticosti sur la carte de Rotz, il faut attribuer cette omission à un simple lapsus." The explanation simply is that Rotz's map shows Cartier's first voyage only, and it was not until his second that he found Anticosti to be an island.

[2] "America," iv. 83.

[3] There is also a reduced sketch in Kohl, Discovery of Maine, p. 351, and in America, iv. 85.

[4] Dr. Kohl, (op. cit. p. 351,) says of it: "The map is not only one of the most brilliant, but also one of the most exact and trustworthy pictures of the world which we have in the first part of the sixteenth century. It gives accurately all that was known of the world in 1543, especially of the ocean, and the outlines of the coasts of different countries," and again, "The author of the map must have been a well instructed, intelligent and conscientious man. Where the coasts of a country are not known to him, he so designates them. For his representation of countries recently discovered and already known, he had before him the best models and originals."

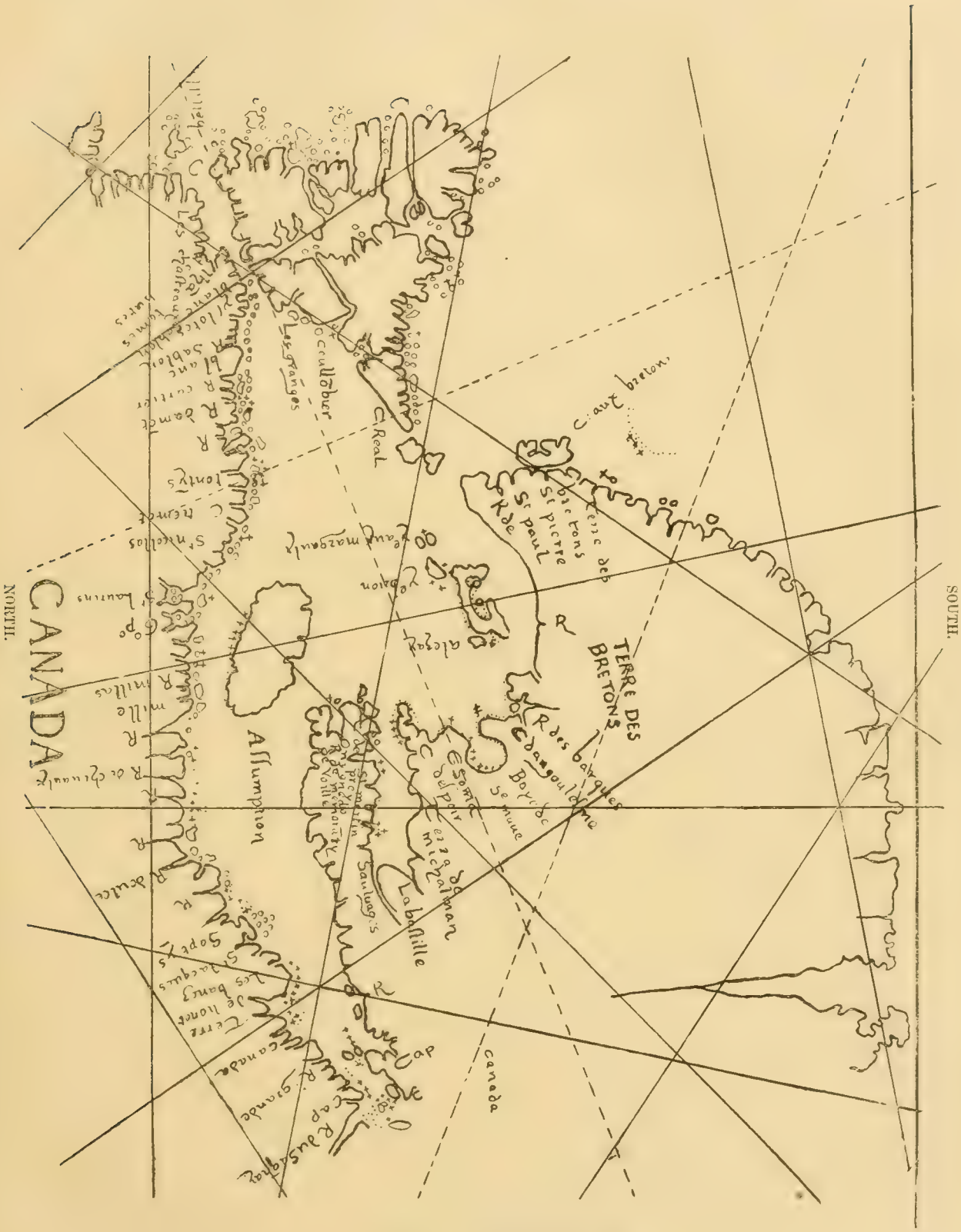

FIG. 2.—Dauphin or Henri II Map, 1546.

clear; it is the Brion Island of our charts. Alezay, I hope, has been shown to be Deadman's Island. What can be the large, unnamed island, other than the large island of the Magdalene group, to which, in his narrative, strangely enough, Cartier gives no name? Its position and shape are both exceedingly accurate for the time, and for the hasty survey Cartier was able to give it. On two or three maps subsequently to be considered, the same island is marked "ille de sablões," and "I. dareas," both Portuguese forms for "Isle of Sands,"[1] and so Cartier described it. In his own words, "semble de loing que se soinct butterolles de sables, pour ce que se sont terres-basses et araineusses," i.e. "it seemed from afar to be little hills of sand, for it is a very low and sandy land." How well this describes the great island of the Magdalenes, composed as it is of four or five distinct rocky islands, joined by long lines of sand dunes, everybody knows. Does it not seem strange in the face of these facts, that this island has been considered up to the present, to represent Prince Edward Island? Harrisse, for instance, so considers it, for in his description of another and very similar map by the same author, made in 1550, he says that what is clearly the island we are considering, represents Prince Edward Island of to-day. I call particular attention to this point, for it is connected with one of the most important parts of our present study.

Passing to the mainland, we meet with our familiar "R. des barques," and "C. dangoulesme," which stands, of course, in place of Cape Orleans. Cape of the Savages is not named, but running out to the north-east we see represented the reef, spoken of by Cartier, which ran half a league into the sea. These places of course appear to be on the mainland. It is hardly necessary to repeat that this is because Prince Edward Island was not known to be an Island, and is therefore shown as apart of the mainland. All of the topography of the Gulf in this region was given to the cartographers exclusively by Cartier, and no writer whatever has ever pretended that Cartier explored or passed through the Strait of Northumberland. The Bay of St. Lunario, really the northern end of the Strait, is clearly shown, but we have a new name for it. It seems to read "Baye de Se. maue," which I believe is a misprint, and meant to read "Se. Marie." It will be remembered[2] that Cartier found he was in his supposed bay on July 2nd, but as he had actually entered it on the 1st, he named it after the saint of that day, St. Leonarius. Now, July 2nd, is the day of the visitation of the Virgin Mary, and it seems as if this name had been substituted either by Cartier or the maker of this map, as an alternative for St. Lunario.[3]

The name "G. Soma*n*" I cannot explain.[4] Just north of it is a triangular indentation which is probably meant for Miramichi Bay, though it is separated from St. Lunario by a distance quite unusual in these old maps. "C. despoir" is perfectly clear,—Cartier's

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[1] And Harrisse describes, (op. cit. p. 231,) another map by the same author, made in 1550, in which what is clearly the same island, is called "Il. des arenes."

[2] See these Transactions, v. 131-132.

[3] An interesting possibility is suggested to us here. Cartier saw Miramichi Bay on the 2nd, and described it as a triangular bay, lying north-east, but gives it no name in his narrative. He had named so many places after saints, that we are tempted to wonder whether he did not call Miramichi Bay, Bay of St. Mary, and the name has got displaced on the map. I must say I have as yet seen no facts to substantiate this very hazy theory.

[4] I have no doubt that anyone familiar with the old French, Spanish and Portuguese, familiar with Cartier's narratives, and who will allow for the abominably bad spelling and carelessness of early cartographers, could solve all the puzzling questions about these names, left unsolved in these pages.

Cape of Hope, our Point Miscou. The name "Terre de michalman," I shall discuss upon another page. "La bastille"[1] is a word of which I can find no trace either in Cartier's narrative or in any other map whatever. The only suggestion I have to offer as to its origin, is that it was given to the region at the head of Bay Chaleur by Cartier, to signify his intense disappointment at finding his hoped-for and expected western passage closed up. He named a cape at the entrance of the Bay, Cape of Hope, because he hoped he had found the passage; when he found the broad way narrowing, his hoped-for freedom to spread his sails for the west and far Cathay changing to close imprisonment, may he not have named it, in disgust, a second Bastile?

As Cartier was on his way back from the head of the Bay, he saw natives at Tracadigash Point, a fact commemorated by the word "Sauluages" on our map. "St. martin" is clear, i.e. Cartier's name for Port Daniel; and "C. de prey" was his C. Pratto—why so corrupted I cannot say. "Onygnedo" was, of course, the Indian Honguedo of Cartier's voyages, the Indian name for Gaspé Bay or the region thereabouts. The next word, "R. de Memora*n*ty" is certainly a corruption of Cartier's "Cape de Memorancy," as will be seen by comparing it with the Mercator map of 1569, given below, and some others. It will be remembered that Cartier gave this name on his first voyage to a cape on the northeast of Anticosti, when he thought Anticosti was a part of the mainland, and on his map represented it as a projection of the Gaspé peninsula. The names Cape St. Loys, or Aluise, and Cape Memorancy would, therefore, be represented *on the mainland* in the maps of Cartier's first voyage. But curiously enough, in all the maps that I have seen, when Anticosti has been removed from the mainland, these two names have been allowed to remain.[2] This will be seen on the Mercator map given below. For the same reason St. Peter's Strait, really between Anticosti and Labrador, was thought by Cartier to be between the mainland and land to the north. But when Anticosti was found to be an island and so marked on the maps, the Strait of St. Peter was still left between the Gaspé peninsula and the land to the north of it; and so it appears in the Mercator map south of Anticosti instead of north of it. The last word on the Gaspé peninsula on our map seems to me to belong to Anticosti with St. Peter's Strait, and to have been kept on the mainland with it; "de voille," appears to indicate that here Cartier turned to sail back home.

Upon the Labrador coast many of the names are those given in his second voyage. There is none at the present Point des Monts. To the east of it we see "St. Jacques," to which "Lez bancz" may also belong, for it appears on Mercator's map as "banc S. Jaques," but there is no mention of such a place in Cartier's narrative. It seems to be one more of the places named by Cartier or marked upon his maps, but not referred to in his written descriptions.[3] "Sept ys" he did name, and the "R. doulce" he referred to

[1] The Bastile of Paris (spelled also, and originally Bastille) was used as a prison before the time of Cartier. The admiral Chabot, whose place was filled by the Dauphin for whom this map we are considering was made, was imprisoned there. Or the name may have been given to some hill or rock resembling a castle.

[2] There is in this, it is hardly necessary to say, no shadow of an argument that Cartier went up the St. Lawrence, south of Anticosti, in his first voyage. Anticosti, like Prince Edward Island at a later period, was simply *added* to the cartography of the Gulf, without affecting the nomenclature on the mainland of which the island was previously thought to be a part.

[3] Called "banc lormine" on Diego Homem's map of 1558. There is a bank at Cape des Monts, and it is not impossible that this was the one referred to. Possibly one of Cartier's ships struck upon it on St. James' Day.

as a river of fresh water. It was in this he saw fishes like horses, so that this and the "R. de chevaulx" should not be removed from each other, but should be both given to the same river, as they are in Mercator's map. "Mille R. millas," I find no direct reference to in the narrative, and the only circumstance likely to be connected with it, was his meeting at this place with great numbers of whales, "Et n'est memoire de iamais auoir tant veu de ballaynes[1] que nous vismes cette iournee." That "so many" should become "mille" and "R. millas," should be a corruption and misprint for perhaps "Balinas," seems a violent supposition at first sight, but it is no stranger a history than many geographical names are well known to have had. It receives considerable confirmation also from the fact that the Cabot map, to be referred to below, has commemorated the presence of the whales by the name "numinas salinas"[2] (or balinas), and as nearly every name on the Cabot map is on this, and as the two names under discussion are in nearly the same position on the two maps, it seems quite reasonable to suppose that they have the same origin.

"6 º pº" I do not understand. "St. Laurens," "St. nicollas," "C. tiemot," are all familiar and in place; "tonty*n*s" refers, without doubt, to the many islands he saw in this region. "R. damõt" is, probably, a corruption of "Isle of Demons," found in this region upon some maps, and explicitly placed there by Allefonsce. "R. Cartier" is clear, but I do not see why "R. blanc sablon" has been placed here in addition to "blanc sablon."

Upon the west coast of Newfoundland we have but three names given out of all the number Cartier placed there, "Les granges," "coullõbier" (Coulonbiers), "C. Real" (Cap Royal) are easily recognized. Yet even these three are far more than any other cartographer gives us up to Lescarbot. In the many maps of this region that I have examined, I have not seen another which places any names on the west coast of Newfoundland, and the three in this might readily have been supplied from narrative or hearsay. I shall return to this point again. The two islands nearly blocking up the entrance to the Gulf are, of course, a part of Newfoundland, which in earlier maps is represented as cut up into even a larger number of islands than is shown upon this. We notice "St. paul" on the north of Cape Breton.

This map, though in some details less accurate than that of Mercator, presently to be referred to, must be acknowledged to be, in general, the most accurate picture of Cartier's voyages which has descended to us from the sixteenth century. Its topography is, for that time, exceedingly accurate. Newfoundland, though broken up into many islands, has a more correct outline than in any other map of the century. The Magdalenes are proportionately too large, but want of proportion is a fault of all early maps without exception. Prince Edward Island is fused with the mainland, but so it is on all maps nearly up to Champlain's large map of 1632. Cape Breton Island is likewise fused with the mainland, as it is for a long time thereafter. Latitude and longitude are both very erroneous. These are its chief faults. Its general excellence must command our admiration.

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[1] Cartier spells very badly. It is not to be expected that his chart would be more accurate in this respect than his narrative, or *vice versâ*, or that they should always agree.

[2] The letter *c* added to "salinas" on the Cabot map (see next page) does not belong there; it is an error of transcription.

C.—*The Cabot Map*, 1544.

Contrasting strongly with it in most of these respects is the well-known map of 1544, attributed to Sebastian Cabot. This is earlier than the Henri II map it will be noticed, but there is nothing to show that the latter derived anything from it, or, indeed, that the maker of the Henri II map had any knowledge of it. That the two had the same material to draw upon seems quite probable, indeed, almost certain. But the Cabot map is less accurate in topography, gives some of Cartier's names, corrupts others, misplaces a few, omits the rest, and is in general quite unsatisfactory. Whether Sebastian Cabot did or did not make it, does not concern greatly our present purpose. It is very unworthy of him if he did. Dr. Kohl discusses this map very fully,[1] and concludes that "Cabot had no agency, either in writing the map or correcting it, or in any way superintending its publication."[2]

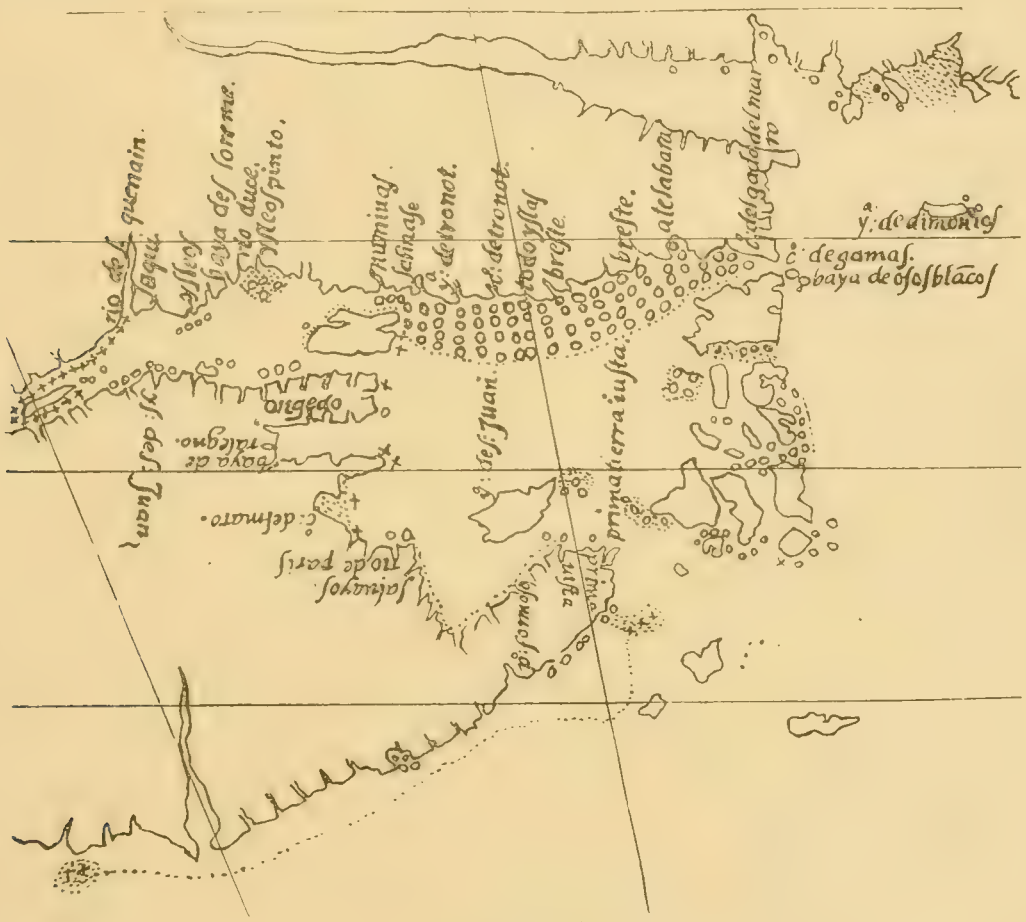

Fig. 3.—The Cabot Map, 1544.

The peninsula comprising Cape Breton is very well shown. To the north and west of it is a group of islands, the largest of which is called "I. de S. Juan." If, now, one will compare this group with that in a similar position on the Henri II map above, it is

[1] Discovery of Maine, p. 358–370.

[2] Ibid., p. 363.

impossible to resist the conclusion, allowing for the difference in topography all through the two maps, that they are the same. We see the same three small islands on the east, and the whole group is even more correctly in the position of the Magdalene Islands than it is in the Henri II map. Yet this "I. de S. Juan" has always been considered to be Prince Edward Island. I shall return to this subject later on.

Passing to the mainland we find the word "saluayos," evidently Cartier's "cap dez Sauuaiges," and "rio de paris," a Spanish corruption, appearing on many maps, of Cartier's "R. de Barcques." It will be noticed that the two are transposed on this map; the former should really be north of the latter. "C. del maro" stands in the position of St. Lunario," and is either a corruption of that word,[1] or possibly of "St. Marie" or "Se. Marie" of the source from which this and the Henri II map took it in common. The words "baya de ralegno" are probably some Spanish corruption for Bay Chaleur, and in "ongedo" we recognize Cartier's "Honguedo." On the northern shore of the Gulf we see "Rio de S. quenain," a curious form for "Saguenay." To the east of it occurs "Jaqui," which must be the "St. Jacques" and "banc St. Jacques" of the Henri II and Mercator maps; while "ylleos" may refer to Seven Islands, though those at "ysleos pinto" correspond better with them. "Baya de S loreme" would appear to be intended for "St. Laurens," but if so, it is out of position, as it belongs opposite Anticosti; but "rio duce" is quite clear, though "ysleos pinto" I do not understand.

The next name is "numinas salinas,"[2] which I think, is intended for "numinas balinas," many whales. It was near this place that Cartier speaks of having seen so many: "Et n'est memoire de iamais auoir tant veu de ballaynes que nous vismes celle iournee," etc. "Ye de tronot" seems to be a repetition, of which there are many similar ones on the map, of "Co. de tronot," Cartier's Cape Tiennot. "Todo yslas" is the "toutyns" of the Henri II map, and in "breste" to the east of it we have another meaningless repetition[3]; the most easterly "breste" is probably the "Brest" of Cartier. "Atelabara" may be a very much corrupted Spanish form for White Sand.[4] On the west coast of Newfoundland there are no names to be found. The name "prima vista" is fully discussed by Kohl, Harrisse, Deane and others. It refers merely to Cabot's supposed or real land-fall at this point.

Dr. Kohl says of names on other parts of this map that, "the Spanish terms and names are corrupted and disfigured in such an extrordinary way, that sometimes it is nearly impossible to make out what the author means;" and, again, speaking of certain names being repeated or duplicated, of which we have an instance in "breste" above, he says: "This doubling of names can be nothing else than an extraordinary blunder, or a mark of great negligence in the preparation of the map." From such errors he concludes that Cabot had nothing to do with it, but that some ignorant compiler had copied an original manuscript in a very careless manner, and had written, in bad Spanish, his construction of the language. Certainly our Gulf of St. Lawrence is very badly done. Aside from the names, the topography is poor compared with the Henri II map. Anticosti is too far up the St. Lawrence; islands are put in phalanxes along the Labrador coast;

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[1] Cartier in the Relation Originale has St. Limaire for St. Lunario.

[2] See page 34, note 2.

[3] It must be remembered that according to the 1598 ed. of Cartier's first voyage, there are two Brests on this coast one of which is an island. The more trustworthy Relation Originale, however, makes only one.

[4] See *arca blanca* on p. 38.

Newfoundland is very badly shown, and even Cartier's Bay of St. Lunario and some other places are less well drawn than in any other map of the century. Latitude, however, is rather good for that time, though the longitude is as usual far wrong.

D.—*The Vallard Map*, 1543-1547.

A map which resembles the Cabot map very closely in many respects is the Nicholas Vallard map of between 1543 and 1547. It belongs to a manuscript atlas, and the only reproduction of it that I am acquainted with is that in Kohl's "Discovery of Maine," p. 354, from which the tracing below is taken.[1] Very little is known of the map except that its maker was a Portuguese, Vallard being considered to be merely the owner of the atlas and not its maker. Kohl, it is a little surprising to see, considers this a more accurate map than the Henri II. In this I cannot agree with him.

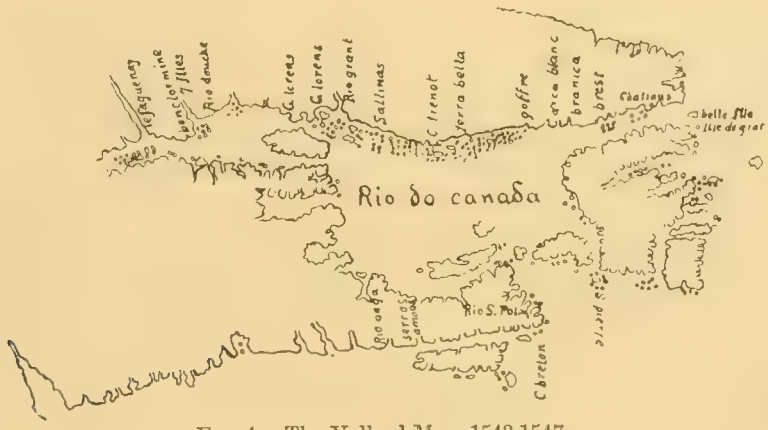

Fig. 4.—The Vallard Map, 1543-1547.

To the group of islands in the Gulf, no name is assigned. If one compares their form and position with those on other maps, he will see there is no escaping the conclusion that they represent this group, and not Prince Edward Island, as Kohl and others have supposed. The long island is too near the shore, it is true—a point that I shall consider presently. We find no names upon the mainland until we come to the north shore of the Gulf, though the topography has the usual form. Beginning at "le Saguenay" and going eastward, we meet with "banc lormine," where in other maps we have found "banc St. Jacques" and "St. Jacques." I do not know the meaning of this word, but it suggests the names of two of Cartier's ships on his second voyage, "la grande Hermine" and "la petite Hermine."[2] "7 Illes," "Rio douche," "G. lorens," are all clear. It must be remembered that this is a Portuguese map, and many of the names are to be expected to have a Portuguese form. "Rio grant" we have not met with before. Cartier does not mention a river in this region. He does speak of what he named Bay of St. Lawrence as being "une moult belle et gra*n*de baye," and this "grande" bay may have become

[1] Also copied in Winsor's America, iv. 87.

[2] French, *l'Hermine*. Portuguese, *lormine?* Compare Faillon, Histoire, i. 505. See antea, p. 33, note 3.

"grande" or "grant" (Portuguese form for "grande") river. "Sallinas" is the same word as "Sallinas" in the Cabot map. "C. trenot" is clearly "C. tiennot;" "terra bella" probably refers to the coast a few leagues (less than seven) east of Tiennot (Natashquan Point), which Cartier described in these words: "Et a la fin desdictes ysles, y a une fort belle terre basse plaine de grandz arbres & haultz."[1] The "goffre" may be a corrupted "Golfo."

"Arca blanc" would probably be *area* or *areia branca*, Portuguese for "Blanc Sablon." "Branica" I do not understand unless it be another greatly corrupted repetition; "brest" is clear and also "chatiaux." On the west coast of Newfoundland are no names, and its outline is very poor. The many islands on the Labrador coast resemble those on the Cabot map.

E.—*The Homem Map*, 1558.

We may here look at another Portuguese chart, that of Diego Homem, made in 1558. This map is contained in an atlas in the British Museum, and has been reproduced by Kohl in his "Discovery of Maine," from which work the sketch below was taken. We notice some surprising topographical innovations here. Bay Chaleur and the St. Lawrence meet to the west and communicate with a great north-western sea. To this same sea are several openings on the Labrador coast. As Kohl says,[2] "He puts down a strait in every place where Cartier in his report had said he had looked for one, even if he did not find it." The west coast of Newfoundland is left unrepresented, the land merging into the sea. As to the names, Kohl says,[3] "The whole draft of the Gulf of St. Lawrence is necessarily taken from Cartier, though our Portuguese author has badly changed and corrupted the names of his French original."

Fig. 5.—The Diego Homem Map, 1558.

The Magdalene group is represented by two islands, "briou," which, of course, should be "Brion," and "ille de sablões." The latter word, as already pointed out, was used in its French form by Cartier in describing the greater of the Magdalene Islands. There can

[1] Bref. récit, ed. of 1863, f. 7b and 8. [2] Op. cit., p. 379. [3] Op. cit. p. 379.

be no doubt, then, that these belong to that group. I do not know the meaning of "ilha de senesaus," unless this be the Portuguese name of some of the birds found by Cartier on Bird Islands. On the land to the west we have in "Ribeira de paris" the same corruption or form for "R. de barcques" that we had on the Cabot map. "Cap de bestus" stands for "C. des Sauuaiges;" "baia de lunari" is clear; "micheomai" I shall consider later, under Miramichi. "Le lac de chaleur" is plain, and in "lomgue" we have a great corruption of "Honguedo." "I. simplor" is written for "Assumption." East of "Soquenai" we have "Sep: isles" and "Mibera." I believe the latter is meant for "Ribera," and alludes to Cartier's "Rivière douce," the present Moisie. "Le beau pais" may apply to the land along the coast to the east of Seven Islands, which Cartier described as "basses terres plaines de beaux arbes."[1] "La baie de S. lorenzo" is clearly "La Baye St. Laurens" of Cartier, but "mines de cuivres" (mines of copper), which occurs in two places on this coast, is quite new. I find no justification for its use anywhere in Cartier's narratives. Does it indicate a result of some later voyage known to Homem, or was it placed on a map by some maker for purposes best known to himself? "Pais de ternate" and "Cap de ternate" stand for "Tiennot" without doubt; "Salines" is the "sallinas" of the Cabot map removed too far to the east. "Todo illes" we have seen on other maps. "Cap de illes" may be one of the several groups of islands Cartier mentions as occurring in this region. On the whole this map is not an advance on some earlier ones, but rather a retrogression so far as the Gulf of St. Lawrence is concerned.

F.—*The Freire Map*, 1546.

There is still another important Portuguese map of this period which should be noticed, that of Freire of 1546. It is in manuscript, and has been reproduced by Kunstman in his Atlas.[2] In it, however, some of the names are so corrupted as to be almost unrecognizable. At the Magdalenes we see "I. broi," "I. allesai," "I. dareas," all of which are readily recognizable. Cape of the Savages is called "C. delimargi;" Honguedo, "homgaeda;" Rivière doulce, "agoadoce;" C. Tiennot, "C. de tienoze," and so on. The west coast of Newfoundland is left undefined, shading off into the Gulf. This map illustrates the extreme of corruption of Cartier's names.

G.—*The Mercator Map*, 1569.

In the year 1569 we find a map which for completeness and correctness is rivalled only by the Henri II map. It was made by Gerard Mercator, a German, both drawn and engraved by him. It has been reproduced by Jomard in his "Monumens de la Géographie," and from that work the sketch is taken. After what has been said in the preceding pages, an explanation of its topography or names is hardly needed. Attention must, however, be given to one or two points.

The two islands nearly blocking up the entrance to the Gulf are, of course, a part of Newfoundland; and the large island to the west, the analogy of other maps will allow us

[1] Bref Récit, ed. 1863, p. 10 a.

[2] Accompanying Die Entdeckung Amerikas.

to call nothing else than the Magdalene group. The great peninsula to the south of the island is the real Cape Breton of to-day, the square island marked "C. de Breton" being only a part of it. Here we notice two names not before observed in this position, "C. real" and "C. S. Jean." Both of these belong on the coast of Newfoundland, Cape Royal (Cape Real being the form it has on the Henri II map) being the present Cape Gregory, and "C. S. Jean" the present Cape Anguille. The question as to why they are placed by Mercator down on the coast of Cape Breton is connected with the question as to why nearly all of these old maps leave unrepresented Cartier's explorations on the west coast

Fig. 6.—The Gerard Mercator Map, 1569.

of Newfoundland, a question I shall consider a little later in this paper. On the coast to the west, where, of course, Prince Edward Island is fused with the mainland, the names are all familiar, and almost exactly as Cartier gave them. The only exception is found in "C. de Stiago, alys dorleans." I do not know why "C. de Stiago" is used as an alternative for Orleans. It is worth noticing that a cape of this name appears on some early maps on Cape Breton, notably on that of Maiollo of 1527.

"Hunedo" is for Honguedo, and I have already explained the displacement of "C. de S. Aluise," "C. de Mommorancy" and "Estroict de S. Pierre" from Anticosti, where they belong. We find another "Honguedo" in the vicinity of the Saguenay. "banc S. Iaques," "7 isles" and "r. doulce" are all clear enough. "Coste du oist" is an

odd expression, meaning, probably, "coast to the west." It may be a part of some of the inscriptions which Cartier's maps probably contained. "S. Laurens," "S. Nicolas" and "C. Tienot" are clear, but "posilles" I do not understand, nor "acarty isles." I find no trace of these words in the narratives or on other maps. The other names on this coast are clear, "Isles a la demoiselle" being mentioned by Allefonsce. The west coast of Newfoundland literally shows no trace of Cartier's visit.

H.—*The Whytfliet Map*, 1597.

This map appeared in 1569. From that time until after the close of the century no better one was published. All that followed until the time of Lescarbot and Champlain were either retrogressions, or were copies of this, or combinations of it with others we have

Fig. 7.— The Whytfliet Map, 1597.

considered. As a type of the very best of the later maps of that century we take that of Whytfliet of 1597, which is contained in his "Ptolemy" of that year. It will be seen that the topography, far from improving, has become poorer, while the nomenclature is almost

precisely that of Mercator. The maps treated of in the foregoing pages are the principal ones of the century.

I.—*The Lescarbot Map*, 1609.

In many respects Lescarbot's map of 1609[1] is more nearly allied to those of this than to those of a later period. While his topography is in special points more accurate than Mercator's or the Henri II map, it is in general little, if any, better in this respect. It makes one island of Newfoundland, but its outline is far from being as correct as it is in the Henri II map. For the first time Cape Breton Island is clearly defined and the Bras d'Or lakes shown. But there is no trace at all of the large island of the Magdalenes, and none at all of Prince Edward Island. He made a strenuous effort to retain all of Cartier's names, and I believe there is hardly one of the latter that he has not worked into his map. But having no accurate charts to guide him, and, of course, not possessing Cartier's originals, he has made hopeless confusion of the whole matter. He has not even used Cartier's narratives with care. He places on Cape Breton many localities which no one now doubts were on Newfoundland. Lescarbot's opinion as to the places named by Cartier is quite valueless. He derived much of the material of his map, of course, from Champlain; he never visited the Gulf of St. Lawrence himself. We have introduced, however, for the first time, some new names, afterwards appearing on Champlain's maps, which are the beginning of our modern nomenclature. Such are Anticosti, Mesamichis (Miramichi), Tregate (Tracadie), Campseau (Canso), Ile Percée, Ile Bonaventure and others. With Lescarbot, Cartier's nomenclature as a whole disappears from all good maps. It revives occasionally upon later compilations, sometimes with Champlain's correct topography, but such are off the line of advance.

With Champlain's maps, and particularly with that of 1632, begins our modern nomenclature; we have here a long step in advance and one never to be retraced. Since then the place-names and topography of the Gulf have not changed on our maps; they have simply developed.

J.—*Cartier's Own Maps.*

It is not impossible that Cartier's own maps may yet be found, but such a desirable event is hardly probable. We have no evidence that they were ever engraved, and even as early as 1587 his papers had been lost sight of. His nephew, Jacques Noel, writing to a friend, at that date, from Paris, said: "I can write nothing else unto you of any thing that I can recover of the writings of Captaine Iaques Cartier my uncle disceased, although I have made search in all places that I could possibly in this Towne: saving of a certain booke made in maner of a sea-Chart, which was drawne by the hand of my said uncle."[2]

Yet from the data supplied by the maps we have considered we can form some idea of what those made by Cartier must have contained. These all bear evidence that, if not taken from Cartier's own, they derived their topography and names from some one or two which had been in turn really taken from Cartier's. Each map-maker copying the names, turned them into his own language as far as possible, and used his own judgment as to

[1] See reproduction in Tross' reprint.

[2] Hakluyt, iii. 290.

what ones he should adopt and what omit. It seems probable that Cartier's maps were on a much larger scale than any of the copies, and that they contained many more names than any of the latter. It is altogether likely, also, that they contained many short legends describing the character of the country, its natural productions, inhabitants, etc., and it is parts of these legends which appear on some maps as names of places which were not given by Cartier. Of this character are "numinas salinas" of the Cabot map, "le beau pais" of the Homem map, "coste du oist," "banc lormine" of the Vallard map, and many others. In nearly all cases there is some corresponding description in Cartier's narratives, applying exactly to these places. If they were not taken from legends on the maps of Cartier, it is necessary to suppose that the cartographers had access to Cartier's narratives—a highly improbable supposition, as the narratives were not published until after most of these maps were made, and we can hardly suppose his manuscripts to have been in the hands of so many map-makers.

I believe also that certain parts of the coast were left undefined on the maps showing his first voyage, which parts were filled in after the second. His first map was probably not unlike that of Rotz, given above, except that the Magdalenes and Cape Breton coast may not have been joined as in that map, but left undefined, the former on the south and the latter on the north. After the second voyage Anticosti was shown as an island, the River St. Lawrence appeared, and the Magdalenes and Cape Breton assumed distinct coast-lines. Upon these maps, doubtless, the west coast of Newfoundland was clearly laid down, though it does not so appear in any later maps of the century.

III.

Cartographical Questions Suggested.

In the preceding pages there are three questions which I left for later discussion. They were the poor representation or want of representation of the west coast of Newfoundland, the identity of the part of the map of Rotz which I think represents the Magdalene group, and the identity of Isle St. John. For the discussion of these points we need to understand our whole series of maps.

A.—*Early Cartography of the West Coast of Newfoundland.*

The Henri II is the only map which gives the west coast of Newfoundland with any approach to accuracy. Even it gives but three names to this whole coast, to which Cartier applied two or three times as many. The Cabot, Mercator and Vallard maps give a totally incorrect coast line with no names, while those of Homem and Freire give no coast line at all, but instead represent the land shading off into the sea, as in a region totally unknown. Even Champlain, as late as 1632, in his explanation of his map of that year, says that the west coast of Newfoundland "n'est bien recognuë." The only reason I can think of for this is that Cartier's map of this coast was inaccessible to all of the makers of these maps, except to the first, and possibly even to him. It may have been destroyed by accident or for business reasons unknown to us. All of these maps appear to have been

drawn from similar or the same originals. Such may have been copied directly from Cartier's own notes and draughts, and in them this west coast may have been defaced in any one of a dozen possible ways.[1]

B.—*Early Cartography of the Magdalenes and Cape Breton Island.*

I believe a somewhat similar reason is to be found at the basis of my second question, but in order to make it clear, I must introduce another map. This is the so-called Jomard map of uncertain date, but supposed to belong between 1550 and 1560. It is in manuscript and a much reduced copy, from which this sketch is taken, appears in Winsor's "Narrative and Critical History of America," Vol. IV, p. 89.

Fig. 8.—The Jomard Map, 155—(?).

No doubt it has suffered in the reduction from the original, and it has suffered in my transference from "America." But its strong resemblance to the map of Rotz given above must at once strike one. The two are identical in their topography as far as the Rotz map goes, except that the Jomard map has Anticosti separated from the mainland. Now what is the meaning of this immensely broad peninsula occupying the position of Cape Breton? And where is the group of the Magdalenes explored by Cartier on his first voyage? We may get some light on the difficulty, if we examine in connection with these our Henri II map. There we find an island marked "ye aux margaulx" corresponding to No. 1 on Rotz and 5 on Jomard, "ye brion" to 2 on Rotz and 6 on Jomard, "alezay" to 4 on Rotz and 8 on Jomard, and a northern coast on the large island corresponding with the coast, 3 on Rotz and 7 on Jomard. My idea is that here we have the Magdalene group fused with the mainland, or rather with Cape Breton, just as Prince Edward Island was throughout the century. Rotz's map shows Cartier's first voyage only, with no trace whatever of his second. Now, on his first voyage, Cartier explored this group on its northern and western sides, and he knew nothing at all about the coast of Cape Breton[2] to the south, nor about the eastern coast of the Magdalenes. I believe, therefore, that on

[1] This tends to show that these early map-makers relied chiefly upon Cartier's maps in constructing theirs and made little use of the narratives. One could more easily reconstruct his course on Newfoundland from his narrative than in any other part of the journey.

[2] This is shown by the fact that he did not even know on his first voyage of the passage between Newfoundland and Cape Breton. In the narrative he says: (Relation originale, p. 20.) "Je présume mielx que aultrement, à ce que j'ay veu, qu'il luy aict aulcun passaige entre la Terre Neuffue et la terre des Bretons. Sy ainsi estoit, se seroit une grande abreuiacion, tant pour le temps que pour le chemyn, se se treuue parfection en ce voyage." Clearly he did not know the passage and therefore he could not have known the coast inside of it. What could he do but leave that coast unrepresented?

his map of his first voyage he left the northwestern coast of Cape Breton and the eastern coast of the Magdalenes undefined, as he had not been there, perhaps representing them as standing off into the sea, as was the custom among honest cartographers to signify a coast unknown. Rotz, however, in copying the topography, extended the two indefinite coasts to meet each other, thus making the Magdalenes a part of Cape Breton. Indeed it is not impossible that this may have been Cartier's own idea. On his second voyage, Cartier again visited these islands on his way home, and also visited the north of Cape Breton, naming two capes there. This enabled him to fix the coast line in this region and thenceforward to show it clearly on his maps. The maker of the Jomard map knew of Cartier's second voyage, as the Isle of Assumption and the topography of the River St. Lawrence show, yet for some reason he copied the error as to the Magdalenes, which was not inexcusable in Rotz, but was in himself. He may indeed have taken it from Rotz, or the two may have taken it from some other source in common; certainly their topography in this region is strikingly similar.

C.—*The Name "Isle St. John."*

Now I face the most interesting question in the early cartography of the Gulf, the origin, identity and history of the name "Isle St. John." Those who have followed me through the preceding pages will before this, I trust, have foreseen whither my line of thought is to lead me.

It has been held by nearly all writers that Prince Edward Island received the name Isle St. John, which it held from the time of Champlain until 1798, from John Cabot, it being the island sighted and so named by him June 24th, 1497.[1] So far as I have been able to find, after a careful study of the question, the evidence for this rests upon the following bases :—(1) Upon the name itself; Cabot somewhere in this region discovered an island and named it St. John; Prince Edward Island was called Isle St. John from very early times; it is not unnatural in the absence of further evidence to consider them to be the same. (2) Upon some statements, presently to be noticed, of Allefonsce, Roberval's pilot. (3) Upon the evidence of the Cabot map, which places a large Isle St. John in the Gulf. The first of these is connected with the last, and will be considered along with it.

Allefonsce several times distinctly speaks of an Isle St. John in this region, but never in a way to enable us to locate it beyond doubt. Thus he says,[2] "Turning to the Isle of St. John, called Cape Breton, the outermost part of which is in the ocean in 45° from the Arctic Pole, I say Cape of St. John, called Cape Breton," etc.; again, in the printed "Voyages avantureux," a work published after his death, and which must be consulted with caution,[3] we read, "Having passed the Isle of St. Jehan, the coast turns to the west and west-southward as far as the River Norombergue" (i.e. the Penobscot). Certainly such phrases as these could not by any possibility whatever apply to our Prince Edward Island.

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[1] Yet some have said that it was because the Cape St. John of Cartier was on it, the cape named by Cartier June 24th, 1534. This statement is made by no less an authority than Rev. E. Slafter, the scholarly annotator of Otis's translation of Champlain. (Prince Soc. Ed. Boston, i. 288).

[2] From De Costa's translation contained in America, iv. 69-76.

[3] America, iv. 68.

They apply to Cape Breton fairly well, but they appear to me to refer really to the island which appears on so many old maps just to the east of Cape Breton of to-day and which has generally been taken to be Cape Breton Island itself. I have already pointed out that this island was probably intended for a part of Cape Breton only, the real Cape Breton being the large peninsula tolerably well shown upon nearly all of the old maps. Maps before Cartier nearly all show an Isle St. John on the Atlantic coast in this region, and it persists in some maps after Cartier.[1]

But again, Allefonsce says, "Passing about twenty leagues west-north-west along the coast you will find an island called St. Jean, in the centre of the district, and nearer to the Breton region than Terra Nova. This entry to the Bretons is twelve leagues wide, and in 47° 30′ north. From St. Jean's Island to Ascension [Anticosti] Island, in the Canadian sea, it is forty leagues across, north-west by west. St. Jean and Bryon and Bird Island are 47 north." The grouping of Isle St. John with Bryon and Bird Islands, together with its distance from Assumption (Anticosti) would place it where the Cabot map does, as the largest of the Magdalenes. Yet its latitude is made half a degree lower (if the MS. be translated correctly) than the entrance between Cape Breton Island and Cape Ray, when it really is on about the same parallel. Part of Prince Edward Island is south of the entrance, but in no other respect whatever does the latter correspond with Allefonsce's references to Isle St John. We get no help from Allefonsce's maps, for the name does not appear, and the only island[2] he has shown in the vicinity of Prince Edward Island is a very small one without a name. These are all of Allefonsce's references to Isle St. John. What place he meant it for does not now concern us. It is enough that his own writings and maps show that he did *not* refer to our Prince Edward Island.

Our knowledge of the discovery and naming of Isle St. John by the Cabots, rests, so far as I have been able to learn, solely upon the Latin and Spanish inscriptions on the Cabot map, and upon the presence of the island itself on that map. There is no other evidence known bearing upon the question. Dr. Deane, in his splendid essay in "America," Vol. III, on the Voyages of the Cabots, has summed up all of our knowledge of the voyages of John Cabot and his son, and in that work I find no other references to Isle St. John, coming from the Cabots themselves. Dr. Deane translates the legend as follows:— "This country was discovered by John Cabot, a Venetian, and Sebastian Cabot, his son, in the year of our Lord Jesus Christ, MCCCCXCIV.[1494] on the 24th of June, in the morning, which country they called 'primum visam'; and a large island adjacent to it, they named the island of St. John, because they discovered it on the same day." In the Latin inscription[3] the words referring to the size of the island and its position are, "insulā quandā magnā ei oppositā Insulā diui Ioannis nominarūt," and in Spanish, "prima terra vista, y a una isla grâde que esta par la dha tierra." Isle St. John then, was simply opposite or before or near the first land seen[4]; we are not told in what direction, nor how far.

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[1] "Oviedo in his description of the coast in 1537, shows no knowledge of the Gulf. He mentions an island of St. John, but this lay out in the Atlantic near Cape Breton, close to the Straits of Canso." De Costa, America, iv. 73.

[2] On fol. 181^A, America, iv. 75.

[3] Given by Dr. Deane in Proc. Amer. Antiq. Soc. for April, 1867.

[4] Several writers have maintained that the Cabots sailed into the Gulf of St. Lawrence, turned to the south, went through Northumberland Strait, turned thence towards the Strait of Belle Isle, through which they passed. Such is the opinion of J. C. Brevoort, (Historical Mag, Mar. 1868, xiii, 131-135), and Frederic Kidder, (N. E.

We get a side light on the question in the statement that the land (either the first land seen, or the island) was sterile and contained many white bears ("Es tierra muy steril, ayenella muchos orsos plancos"); but the main fact is that the island was near the first land seen. This resolves itself into the question of Cabot's Landfall, which, in turn, becomes resolved very largely into the question of the authenticity of the Cabot map.

It is well known that upon the Cabot map, the words "prima terra vista" are placed at the north of Cape Breton Island.[1] Now, two views are open to us, both of which have had their adherents; which are, that the map is genuine, and made by Sebastian Cabot, or that it is a forgery. In the latter theory Dr. Kohl was an emphatic believer. Even Dr. Deane, who accepts the map as authentic, has to admit that: "The map itself, as a work of Sebastian Cabot, is unsatisfactory, and many of the legends on its sides are also unworthy of its alleged author." Dr. Kohl points out so many discrepancies, errors and imperfections in the map, that their weight is well-nigh irresistible.[2] There is certainly this to be said—there is nothing on the map in the Gulf of St. Lawrence region, except the words "prima terra vista" and "Isle St. John," which is not fully explained by Cartier's explorations. If Sebastian Cabot visited the Gulf, his map shows no trace of it whatever, except on this one word "Isle St. John." But if the map, as we have it, is what I believe it to be, the work of a compiler, who may have used in part material from some real, but now lost, maps of the Cabots, the solution is not difficult. The compiler used Cartier's maps, for all around the Gulf are Cartier's names, and Cartier's topography; for his own reasons he placed "prima terra vista" on Cape Breton. Off in the Gulf to the west on Cartier's maps was a group of islands, one of them very large. This corresponded in position and size with "Isle St. John" of the inscriptions, and it was so named, the name being added to substantiate as it were the "prima vista."[3]

This view receives the strongest confirmation from the fact that this Cabot map, of all the large number known to us of the sixteenth century, *is the only one which marks "Isle St. John."*[4] All or nearly all others have in precisely the same position a large island or group of islands, *but without exception, when names are applied to them, they are Cartier's names applied by him to the Magdalene Islands.* An examination of the series of maps presented with this paper will, I believe, make this point quite clear.

Hist. and Genealogical Register, Oct., 1878, pp. 381-389). The latter gives a map illustrating Cabot's supposed course in the Gulf. These writers have very little basis for such a view, and it is emphatically contradicted by the La Cosa map, which, no one doubts, shows the Cabots' discoveries, and which shows no large island on the coast. What navigators the Cabots must have been to sail completely around Newfoundland, and not see it! Besides this, such an erratic course as attributed to them in the Gulf, is quite inconsistent with Cabot's purposes and aims. The whole difficulty is that Isle St. John of the Cabot map, has been assumed to be Prince Edward. The former paper takes no account of Cartier's influence on the map, indeed does not mention Cartier at all.

[1] See map, antea, p. 35.

[2] Discovery of Maine, pp. 358-377. See also Howley, Ecclesiastical History of Newfoundland, pp. 50 et seq., where some objections to the genuineness of the map appear to be very well taken.

[3] It is not a difficult feat of the imagination to picture at that time, political reasons which might make it advisable for France and Spain to wish to prove that the Cabots did not make land on Newfoundland, where the best fisheries were. Sebastian Cabot was in the service of Spain, it must be remembered, when this map was made. Harrisse suggests (*op. cit.* p. 95) that if Cabot's landfall was on Newfoundland or Labrador, Sebastian Cabot may may have placed "Prima Vista" in Cape Breton, preferring to be known as the discoverer of the land that France was trying to colonize, rather than of the barren coast to the north.

[4] That the name "Isle St. John" is copied upon no other map is very significant; it shows the estimation in which the map was held by Sebastian Cabot's contemporaries.

But the Cabot map has not been proven to be apocryphal. If it is all genuine, and the Cabots did sight Cape Breton as their land-fall, then the Island marked "Isle St. John" probably was their Isle St. John. But it is none the less true that this "Isle St. John" was not our Prince Edward; the topography of the map none can doubt is that of Cartier; if it be compared with other maps showing Cartier's influence it will be seen as before, that this is the same as on all other maps represents the Magdalene group, and Cabot's Isle St. John must have been the larger of the Magdalenes.

It has been claimed in the early part of this paper that Prince Edward Island is, in all these early maps, fused with the mainland, and in no way distinguished from it. This is the case, I believe, in every map of the century, that is, every engraved map. I have no doubt that the French fishermen had MS. maps showing, or that at all events they knew of, the existence of the island, but no official map showed it. Lescarbot's well-known map of 1609[1] shows no trace whatever of it, nor indeed does Champlain's 1612 map, unless the very small round island in the south of the Gulf marked "ille St. Jean" be intended for it. Yet Champlain knew of it as early as 1603, but by hearsay only. In "Des Sauvages" published in 1604, chapter xii, he tells us the story of the Sieur Prevert's attempt to find mines on the Bay of Fundy, by crossing overland from the Gulf, in connection with which he mentions "the Island of St. John, which is some thirty or thirty-five leagues long and some six leagues from the mainland on the south." This is the very first mention of the name "Isle St. John," as applied unquestionably to Prince Edward Island, that I have been able to find. The patent of De Monts of 1603, which names many important places in the Gulf, does not mention it. We admire the honesty of Champlain, who would not place the island from hearsay only, upon his 1612 map, but instead placed along the shore the legend, "lauteur na point encore recognu cette coste." It is, however, distinctly shown upon his 1632 map, and the latter is the first map[2] of which I have any knowledge, which shows Prince Edward Island in its proper shape and in its proper position.

That the south-western part of the Gulf, the basin in which Prince Edward Island lies, was very little known prior to 1600, is shown by documentary as well as cartographical evidence. De Laet, a writer of high repute, writing as late as 1633, in describing the Gulf, says that from St. Lunaire (which he, apparently, uses to designate Miramichi Bay or the head of Northumberland Strait), to Isle St. Lawrence (Cape Breton), "the coast is little known, and is difficult of access on account of the shallows." Champlain himself speaks of the region as being almost unknown. Still more satisfactory evidence, because coming much earlier, is found in Thevet's description of the Gulf. Though the latter's reputation for trustworthiness is none of the best, he certainly in general tells the truth, and the following passage bears on its face evidence of its own reliability. In the "Singularitez de la France antartique," published in 1558, p. 147, he says, referring to Cape Lawrence on Cape Breton:—"and going from the said cape towards the west and south-west, one coasts for about two hundred leagues, and it is nothing but sandbanks without any port or harbor." Cartier, in his narrative, speaks frequently of the shoals and sands

[1] Marcel (Cartographie de la Nouvelle France, Paris, 1885, p. 7) describes a fine manuscript map of 1607, showing Champlain's explorations.

[2] I find later that Sir William Alexander's 1624 map shows it, but gives it no name.

of the coast.[1] It is so easy for us, looking down upon good charts in our studies, to see this island, that it is difficult for us to put ourselves in the position of those who first came to it. The early navigators had little to attract them to that region. Cartier showed there was no hope of finding a western passage there; the fishing was not so good as off Newfoundland nearer home; the shoals were dangerous and good harbours few. Is it any wonder that it was avoided?

How then did Isle St. John get its name? This I cannot answer, but three possible ways occur to me:—

(1.) Champlain had the Cabot maps before him, and thought its Isle St. John must be the same as the other large island mentioned by Sieur Prevert, and hence that the latter should have the same name. This, while a possible, is an extremely improbable explanation.

(2.) The name was given *de novo* by some of the French voyagers in the latter part of the sixteenth century, or immediately preceding 1603. This seems to me highly probable; the name St. John was a favorite with early explorers.

(3.) Another explanation which receives support from the maps, will be found by comparing the Mercator map with the Molineaux Globe of 1592,[2] with Lescarbot's map of 1609, and with Champlain's of 1612. In the former, Cartier's Cape St. John, which really was on Newfoundland, has been transferred to Cape Breton, where it also appears on Lescarbot's map. Transferred still further, it has become C. S. Jean on the Molineux Globe, which stands almost exactly in the position of the little "ille St. Jean" of Champlain's 1612 map. This appears to me hardly as probable an explanation as that given above, since Champlain knew it as a large Island with this name as early as 1603.

Further material is needed to decide which of these three possible interpretations is the correct one.

IV.

Voyages between Cartier and Champlain.

After Cartier, there was no official explorer of the Gulf until Champlain; yet, that there were numerous private voyages in the interval there can be no doubt. Evidence on this point is constantly accumulating. Dr. De Costa quotes[3] Gosselin's work on the marine of Normandy, as showing that French vessels engaged in the fishery went to Newfoundland during the twenty years subsequent to Cartier's voyages, and some of these probably visited the Gulf. The only actual narratives of voyages, however, that we have, are those contained in Hakluyt. He gives a narrative of a voyage to Isle Ramea (the Magdalenes) for the capture of walruses in 1591, and another to the same place in 1597, with some others relating to the Gulf and Cape Breton. They add very little to geographical knowledge, however, as the place names used in them in most cases cannot be identified.[4] It is interesting to note, however, that the names used in these narratives

[1] There is geological evidence to show that the coast in this region is steadily sinking, and that the water must have been even shallower in its harbors in Cartier's time than it is now.

[2] America, iii. 213.

[3] Ibid., iv. 60, 62.

[4] They are considered further on p. 55.

are incorporated in the charts of Dudley's "Arcano del Mare" of 1647, but the poor topography of the latter does not help us in locating them.

All the accounts of voyages given by Hakluyt are of voyages subsequent to 1580, and it is probable they were numerous after that date, few before it. In this connection, a passage in the "Briefe and summary discourse upon the intended voyage to the hithermost parts of America, written by Captaine Carlile, in April, 1583," given by Hakluyt,[1] is of the greatest importance. It reads as follows, in connection with the voyages of Cartier:—"Thus the poore king of the Countrey, with two or three others of his chiefe companions, comming aboorde the French shippes, being required thither to a banquet, was traiterously caryed away into France, where hee lived foure yeeres. . . . . This outrage and iniurious dealing did put the whole Countrey people into such dislike with the French, as never since they would admit any conversation or familiaritie with them, vntil of late yeeres, the olde matter beginning to grow out of minde, and being the rather drawen on by gifts of many trifling things, which were of great value with them, they are as (I sayde) within these two or three yeeres content againe to admit a traffique, which two yeeres since was begunne with a small barke of thirtie tunnes, whose returne was found so profitable, as the next yeere following, being the last yeere, by those marchants, who meant to have kept the trade secret vnto themselves, from any others of their own Countrey men, there was hired a shippe of fourscore tunnes out of the Isle of Iersey. . . . . This shippe made her returne in such sorte as that this yeere they have multiplyed three shippes, to wit, one of nine score tunnes, another of an hundreth tunnes, and a third of fourscore tunnes." In Hakluyt's "Discourse on Western Planting,"[2] written in 1584, we read: "The Frenche, the Normans, the Brytons or the Duche, or some other nation, will not onely prevente us of the mightie Baye of St. Lawrence, where they have gotten the starte of us already," etc. And again, in the same, we read:—"And nowe our neighboures, the men of St. Malo, in Brytaine, in the begynnynge of Auguste laste paste, of this yere 1584, are come home with five shippes from Canada and the countries upp the Bay of St. Lawrence . . . they are preparinge tenne shippes to returne thither in January nexte." In 1587, two sons of Jacques Noel, nephew of Cartier, were in Canada, and Noel had been there himself.[3] All of these facts, together with others, show the existence of a trade in the Gulf, and Champlain's first voyage up the St. Lawrence in 1603, was to a region annually visited by traders. During these years some new names appeared in the Gulf. The patent of De Monts, of 1603, mentions, in addition to well-known places, "Bayes de Sainct-cler, de Chaleur, Ile Percée, Chischedec, Mesamichi, Lesquemin, Tadoussac,"[4] etc.

Yet, none of these voyages made any impression upon the maps of the time. Whytfliet's of 1597, shows no trace of them, nor have they produced any influence that I can see, until the map of Lescarbot, of 1609, and Lescarbot derived his knowledge from Champlain. In other words, there was no advance in a cartographical knowledge of the Gulf of St. Lawrence, given to the world, between Cartier and Champlain. We see here illustrated the fact that the cartography of a new region advances not by steps, but by leaps. It took an explorer to make or improve a map. Cartographers, in their studies in

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[1] Hakluyt, iii. p. 233.

[2] Maine Hist. Soc. Coll. Documentary History, 1877, ii. 102.

[3] Hakluyt, iii. 291.

[4] Lescarbot. Identity of these places is considered in the Appendix.

Europe, had few or no data other than these given them by Cartier. They could but alter and confuse his topography and nomenclature, they could not improve them. So the errors and imperfections of Cartier's first surveys remained until they were corrected or improved by Champlain. In view of these facts then, it does not seem too much to say that Cartier's voyages, and particularly his first, are the key to the cartography of the Gulf for the remainder of the century.

APPENDIX I.

The History of Certain Geographical Names.

The following geographical names, occurring in the Gulf of St. Lawrence, are connected with the foregoing subject:—

Canada.—A bibliography of the discussion on the origin of this name is given in Winsor's "America," Vol. IV, p. 67, and some additional references in Taylor's "Names and Places" p. 400. There cannot be much doubt that the interpretation usually given is the correct one. It is worthy of note that the name appears on the Henri II map (given before, p. 31) in three distinct places.

Cape Breton.—Undoubtedly the oldest French name on the Canadian east coast. It appears on maps anterior to Cartier's voyage, both as Cape Breton, applied to a single cape on the island, and as *Land of the Bretons*, placed on the mainland. The island itself was not clearly distinguished until the time of Champlain.[1] It has borne the names of *Bacculau, Isle St. Lawrence* and *Isle Royale.*

Anticosti.—The history of this word is given by Rev. E. Slafter, in a note in Otis's "Translation of Champlain" (Prince Society, Boston), Vol. I, p. 233, and by Dr. N. E. Dionne, in his "Etudes Historiques" (Quebec, 1880), pp. 69 and 70. Rev. Eugene Vetromile, in "The Abnakis" (New York, 1866), says the name means "open fields, that is, opened by being burned," but this writer's statements must be taken with great caution. Thevet said, in 1586, that the savages called it *Naticousti.* This was corrupted to *Antiscoty* on one of Champlain's maps, and thence to Anticosti. De Laet, in 1640, called it *Natiscotec.* Ferland in his "Canada," and Dionne in "Etudes Historiques," state that the Montagnais call it *Natashkoueh* or *Nataskoueh*, which means, "lieu où l'on va chercher l'ours." Cartier called it *Assumption*, so naming it on August 15th, 1535. Allefonsce calls it, by mistake, *Ascention.*

Cape Ray.—It seems quite probable that this name is a corrupted survival of Cartier's *Cape Royal*, the present Cape Gregory. Its Spanish equivalent is *Cape Real*, and in this form it appears upon many early maps. In the Henri II map, for instance, the only map of the sixteenth century

[1] Captain Southack, who made a survey of the north and east American coast at the end of the seventeenth or early part of the eighteenth century, claims in an inscription on his map, published about 1730-33, that he was the first white man who ever went through the Strait of Canso. This is clearly an error, as the strait is distinctly shown on Lescarbot's map of 1609 and all later ones. It may have been put in on the authority of the Indians, but such is quite unlikely.

which shows the west coast of Newfoundland at all well, Cape Real is placed nearly in the position of Cape Ray. On later maps, until the time of Lescarbot, it is either moved out of place to Cape Breton, or omitted altogether. It is especially significant that the only map showing the west coast of Newfoundland should place it nearly in the proper position. Some maps, after Lescarbot and apparently independent of the latter, have *Cape Rey.* Lescarbot himself has *C. de Raye.* Still, this is but a possibility; there is little positive evidence to sustain it. Mr. Reade (Trans. Roy. Soc. Can., VI. ii. 22) states that it is said to be derived from the Basque "arraico," pursuit or approach. I have seen no maps whatever which support this.

Notre Dame Mountains.—There can hardly be any question as to this name. Cartier gave it on August 15th, 1535. See antea, p. 23.

Chischedec.—Not now used, but frequently found in maps of about the time of Champlain. It appears in DeMonts' Patent of 1603. It was applied, according to Hind (Labrador, II., 26) to Seven Islands. Others have said it applied to the mouth of the St. John River.

Lesquemain.—This words appears in old documents. According to Laverdière, (Champlain, p. 1090,) it is equivalent to "Les Escoumins," the present Esquamine in the St. Lawrence.

Labrador.—This word is not used in Cartier's narratives, though it appears in the title of the 1598 edition of his first narrative. It is supposed to have been added by the translator. There are, at least, six theories as to the origin of this word.

(1) The generally accepted and altogether probable one, that given by Dr. Bourinot, in 'Canadian Monthly,' April, 1875, and by other writers, that it was originally "Terra Laboratoris," land of the laborer, because Cortereal brought fifty men thence to Europe, who were described as well fitted for slaves. This is sustained by all the evidence of old maps.

(2) A tradition which says that Bradore Bay took its name from La Bradore, a Basque whaler, who entered it before the sixteenth century, and that from the bay (called Bradore to-day) the name rapidly extended to the whole country. Cartier did not use Bradore for the bay, though he entered it and gave a name to its islands; nor so far as I know does the name appear on any map of the sixteenth century. Labrador, applied to the whole country, does appear, however, very early. There is no cartographical evidence to sustain this theory.

(3) That given by M. Jules Marcou in his "Sur L'Origine du Nom D'Amérique" (Bull. Soc. Géo., 1888, p. 57 of the reprint), attributes to it an Indian origin. "Ce beau nom *Brador* ou *Bradaur*, sonore et admirablement approprié, est un mot des Indiens des bords du golfe Saint-Laurent; il signifie 'baie étroite et profonde', s'avançant dans les terres et il correspond exactement au nom norvégien de *fiord.*" M. Marcou, however, does not give us any authority for his statement.

(4) The latter writer mentions that some have thought the name was given in irony, because of the sterility of the land,—a land of labor should be fertile, and here the name was given in derision.

(5) Another interpretation, which seems to have escaped notice, is hinted at by John Ogilby, in his "History of America" (1671). He says: "The denomination of *Terra de Laborador* or *Laboratoris* seems probably enough conjectured to be from the cultivability (if one may so term it) of the soil, or its aptness for Cultivation or Tillage; that is because, by the painful Hand of the Labourer or Husband-man, it may be rendered so fertile as to yield all sorts of Grain and Fruits; haply in Allusion to the fruitful Countrey of *Campania* in *Italy*, vulgarly known by the name of *Terra di Lavoro.*" A very old Portuguese map of 1520, one of the earliest on which the name appears (given by Kohl, "Discovery of Maine," p. 179), gives some authority for such a suggestion as Ogilby's, for the region is there called *Do Lavrador.* Otherwise, there seems no ground for this theory.

(6) That given by Mr. Reade, in these Transactions, VI. ii. 22. "Labrador is claimed to be a remembrancer of the Labourde district which gives a distinctive name to a dialect of the Basque language." I have seen nothing on old maps to substantiate this.

GASPÉ.—There are two explanations of this word. Sir William Dawson (Canadian Naturalist, III., p. 323), calls it a Micmac word, meaning "as nearly as possible, the 'land's end,'" and suggests that it may be identical with the termination "gash" in names of points in New Brunswick and Nova Scotia. Vetromile (The Abnakies, p. 46) derives it from "Gachepè or Kech'pi (the end)," very appropriately, to signify the extreme end of Micmac territory and the last promontory between St. Lawrence and Bay of Chaleurs. De Mont's commission of 1603 has *Gachepé*, and Champlain and De Laet use both *Gachepé* and *Gaspé*. On the other hand, Abbé Laverdière (Œuvres de Champlain, p. 1085) derives it from "Katsepioui, qui est séparément," referring to a rock known as Le Forillon, just off Cape Gaspé. In Howley's "Ecclesiastical History of Newfoundland" (p. 99) it is said to be from the Abenaquis word "*Katespi*, which means *separately*, or that which is separated from the mainland," thus agreeing in the main with that given by Laverdière.

The very earliest use of the word that I know of is by Allefonsce in his Cosmographie of 1542. As translated by Hakluyt, it is spelled *Gaspay*. If it be an Indian word, either Allefonsce or Cartier must have obtained it from the Indians. Now, it seems highly probable that at the time of the visits of Cartier, the Indians resident there were neither Micmacs nor Montagnais, but Hurons (see N. E. Dionne, "Etudes Historiques," Quebec, 1880, pp. 57–60, and Trans. Roy. Soc. Canada, II. ii. 77, 80, Faillon, Histoire, I, 524). If this be so, it is rather to the Huron tongue that we are to look for the meaning of the word, not to the Micmac, and both of the interpretations given above may fail in the light of new evidence.

NEWFOUNDLAND.—Probably the very oldest geographical name given by Europeans on the American continent, which has survived to the present time. It probably dates back to the first voyage of the Cabots in 1497. Cartier does not appear to use the word for the island itself, though he speaks of the coast of Labrador as *Terre Neuffue*. He was the first, so far as we know, to prove that Newfoundland was an island; before his time the name had to appear on the mainland. On the map of Ruysch, of 1508, *Terra Nova* appears on a peninsula certainly meant for Newfoundland. On that of Cosa, of 1500, it appears as *Tierra Nueva*, but, as no peninsula or island is shown, it covers a considerable tract on the mainland. Cosa's map in this region is supposed to have been derived from the Cabots' maps. The name also appears in other records, as mentioned by Kohl (Discovery of Maine, p. 186), the most interesting of which is the entry in the privy-purse accounts of Henry VII in 1497 of "10 pounds to him that found the new isle." Other later entries speak of the *New Islande*, *New Isle*, and one in 1503 of the *Newfound island*. It appears, then, that our word "Newfoundland" is a direct descendant of the name given to this region by the Cabots. It was used in its present form at least as long ago as the time of Champlain.

ISLE ST. JOHN (See antea, p. 45).—It bore this name until 1798, when it was changed to Prince Edward Island, in honor of the father of our Queen, by an Act of the Provincial Legislature, which was confirmed by the King in 1799. The name "Northumberland Strait" is, however, much older.

ST. LAWRENCE.—This name rapidly extended to the whole Gulf, and later to the river. Early names for the former, or parts of it, were *Grand Baie*, *Golfo Quadrado*. The river was called *River of Canada*, *River of Hochelaga*. Purchas states (Pilgrimage, p. 869) that the river was also called the *Strait of the Three Brothers*, though the statement does not appear to occur elsewhere.

GRAND BAIE.—This name was very clearly applied to the north eastern part of the Gulf by Allefonsce and other early writers. Yet some have supposed it applied to the Bay of Fundy. (A. L. Adams, Field and Forest, Rambles, p. 15, N. Y. Hind, Rep. Geology, N.B., p. 18.)

ISLE OF DEMONS.—An uncertain, almost mythical locality, based chiefly upon the imagination of Thevet. The legend is given by Parkman (Pioneers of France), and has been made the subject of one of Canada's best narrative poems, viz. "Marguerite or the Isle of Demons" by Mr. George

Martin (Marguerite and Other Poems, 1887.) Bourinot (Canadian Monthly, April, 1875), makes the Isle of Demons and the *Isles de Demoiselle* the same. Allefonsce, as pointed out, places the latter in the Gulf on the Labrador coast (p. 25), though old maps place the former in the region of Belle Isle. The legend is interesting and, Parkman points out, may have an historical basis, but these localities cannot be certainly identified.

Miramichi.—This is popularly supposed to be a Micmac word, meaning "happy retreat," such being the interpretation given by Cooney, Gesner and others in their histories of this region. Another idea is that it comes from "Miggumaghee" or "Megumaage," which means Micmac-Land. On the other hand, Dr. Silas Rand, our greatest Micmac scholar, does not know its meaning or origin, nor does Mr. Edward Jack, who is familiar with the language of the Milicete Indians. One of the most intelligent Indians of the Milicete tribe, Newell Paul, has told me that the word is not Indian at all. Mr. Jack writes that there is no such word in the Abenaki language to his knowledge, and that the Indians call the Miramichi *Les-ta-goo-chic*, or Little Restigouche. Dr. Rand, in his Micmac Reader, gives it the same name, *Lŭstegoocheechk*. Were the word "Miramichi" used by either Micmacs or Milicetes, these two men would certainly know of it.

The word has had a most interesting history, but so far I have not been able to reach a satisfactory conclusion as to its origin. On maps of the last century, the river is usually called *Ristigouchi*, which is clearly the same word as Dr. Rand and Mr. Jack give, with the *r* softened to *l*, as it always is in the language of these Indians. Passing back to the seventeenth century, the *r* disappears and is replaced by *s*, so that it reads *Misamichi*, *Missamichi*, etc., though occasionally the *r* does appear. Lescarbot has *Misamichis*, De Laet *Mesamichi*, Champlain *Misamichy*. DeMont's commission of 1603 has *Mesamichi*. Moreover the word in all of these cases is applied not to the river, but to a place or port; Lescarbot speaks of it as a port where the French were accustomed to dry fish, and he also tells us that it is an Indian word.

So much is certain: but I believe the word can be traced still further back. On a map, dated 1594 in the "Histoire de la Navigatione de Icau Hugues de Linscot," and on another dated 1596, in De Bry's "America," we find the name *Machanuce* (which may be misprinted of course,) and indeed in the latter might almost be read *Machamice*, occurring in the position of our present Miramichi. Moreover, its position is made certain on both maps by the presence of the little circle and tower used conventionally on both to indicate a town, settlement or port, and this circle is placed on what is clearly very near or exactly on the present Miramichi River. I have not seen it again on any earlier map until that of Homem of 1558 (given antea, p.), where it appears exactly in its proper position[1] in the form *Micheomai*. The same forms appears also upon Freire's map of 1546, though it might possibly be read there *pucheomai*. Lastly in the Henry II map (given antea, p. 38) we find a name *Terre de Michalman*, placed not at the Miramichi, but in what is now Restigouche County. Considering the great differences in spelling in these early maps, their corrupting of names, and changes from one language to another, together with the fact that an entirely new name very rarely appears, it seems not unreasonable to suppose that these are all the same word.

As it appears on the Henri II map, which so faithfully mirrors the explorations of Cartier, it would look as if the name had been given by him, or, at all events, was in some way connected with his voyages. Yet we search his narratives in vain for any trace of it, or anything that can be connected with it. No modern word either in French, Spanish or Portuguese, which at all resembles any of these forms throws any light upon it. Both Portuguese maps have *Micheomai*; the French map has *Michalman*. Some student who thoroughly understands these languages might help us here, or the Kohl collection of maps at Washington might give other forms of the name, or intermediate steps which would throw light on the question.

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[1] The little bay at the right of the name is meant for Miramichi Bay, the "Baia de lunari" just below being the head of Northumberland Strait.

An explanation which suggests itself is that the Indians whom Cartier met in different parts of Bay Chaleur, told him that the land to the south was *Megumaghee* Micmac-land, and Cartier, writing from memory, or not understanding their peculiarities of pronunciation, wrote it on his maps *Terra de Michalman* or something similar. This might afterwards be corrupted into a very different form by later map-makers. The objection to this view is that the word Micmac does not appear to be an aboriginal Indian word. It is usually given a French origin, being supposed to be the word "micmac," meaning jugglery and applied to them because of the number if their "autmoins" or medecine-men. No writer previous to 1696, so far as I can find, has ever used it, the word "Souriquois" being universally applied to this people. Dr. Silas Rand writes me that the Indians use it themselves, but know nothing of its origin. Such writers as Lescarbot and Champlain would have heard it had it been used in those times by the Indians themselves. It is not impossible, after all, that Miramichi is a greatly corrupted French or Spanish word, and not Indian at all.

It is well known that the Miramichi was called also *River of the Cross* or *River of the Holy Cross* in the seventeenth century. This was because of the veneration which the Indians were said to have had for the cross, something which they claimed was very ancient. In this, some writers see the influence of Christian Norsemen. Cartier however did not notice this (a statement in Standard Natural History, VI, 149, to the contrary notwithstanding). He had too little communication with the Indians at Miramichi.

Magdalene Islands.—The name Magdalene does not appear to have been used at all before the time of Champlain, and is not mentioned by him until the 1632 edition of his works and his map of the same date. For half a century before this, and perhaps longer, they had been known as *Isles Ramées*, or *Ramea*. Champlain himself applied the name *La Magdelene* only to the present Amherst Island, as did Denys in 1672, applying the names *Isles Ramées* to the remainder of the group. There appears to be nothing in Champlain's works to show where he obtained, or why he gave the name. In reading his works we notice two or three occasions upon which he might possibly have been at Amherst Island on the July 22nd, day of St. Mary Magdalene. In 1613 for instance, he left Tadoussac July 8th, and reached St. Malo on August 26th, and it may have happened that, on the 22nd, he was at this place or in sight of it and honored this conspicuous island by the name of the saint of the day.

Cartier gave no name to the group as a whole, and the name *Ramea* appears first, so far as I know, in the accounts of voyages to them between 1590 and 1597, given by Hakluyt. In these accounts are introduced a number of new names, none of which have survived, and none of which are, with certainty, identifiable. *Isle Blanche* and *Isle Duoron* appear to be the same, and to represent the modern Entry Island. Cape du Chapt, Isle Hupp, Harbor of Halabolina, are others that appear. It is worth noticing that the names all appear on the charts in Dudley's "Arcano del Mare," of 1647, though they are there certainly not applied as in the narratives given by Hakluyt. A group of small islands on the south coast of Newfoundland at present bears the name "Ramea Isles," and this may have been transferred from the Magdalenes to them.

APPENDIX II.

A Table of the Place-names Mentioned or Given by Cartier in the Gulf of St. Lawrence.

Cartier's Name.	Date.	Why Given.	Present Name.	Remarks.
	1534.			
Blanc Sablon	June 9th	Probably from presence of banks of sand	Blanc Sablon	Perhaps not given by Cartier. Has persisted until the present.
Les Islettes	" 9th	Evident	The islands in Bradore Harbor.	
Brest.	" 10th	Probably from Brest in France.	On Old Fort Bay	Probably not given by Cartier.
Toutes Isles	" 11th	From their great number	Islands beyond Old Fort Bay.	
Hable . . . Saint Anthoine.	" 12th	For the festival of St. Anthony, which falls on the 13th.	Rocky Bay.	
Hable . . . Sainct Seruan	" 12th		Lobster Bay.	
La ripuiere Sainct Jacques	" 12th		Shecatica Bay	See different opinion on this point, antea, p. 18, note 1.
Hable Jacques Cartier	" 12th	From Cartier himself	Cumberland Harbor	" " " " "
Cap Double.	" 15th	From its appearance, a double cape	Point Rich	Properly the Highlands of St. John near Point Rich.
Les monts de Granches	" 16th	Probably from his wife Catharine des Granches.	Portland Mountain and the range of which it is a part	There is here a play upon words, the hills like a grange (Granche) suggesting the name of his wife.
Cap Pointu	" 16th	From its shape	Cow Head.	
Les Coulonbiers	" 18th	From the shape of the small rocky islands.	Rocky Harbor near Bonne Bay.	
La baye Sainct Jullian	" 18th	Doubtless for the day of St. Juliana Falconeria, which falls on the 19th.	Bonne Bay in the vicinity of Roche or Rocky Harbor.	
Cap Royal	" 18th		Cape Gregory	Perhaps survives in Cape Ray. See antea, p. 51.
Cap Delatte	" 18th	Probably from some whiteness which it presents.	South Head	May possibly have been Guernsey Island, as it had a low island to the north of it.
Le cap Sainct Jehan	" 24th	Sighted on the day of the nativity of Saint John.	Cape Anguille	The last land seen in Newfoundland.
Isles de Margaulx	" 26th	Abundance of birds called *Margaulx*	Bird Islands	
L'ille de Bryon	" 26th	From Admiral Brion	Brion	Name has persisted until the present.

Cap du Daulphin	June 26th	No doubt a compliment to the Dauphin, afterwards Henri II.	North Cape	"Because it was the beginning of good lands."
[Isles of Sand]	" 27th	Most appropriate, as they are in great part of sand.	Magdalenes	Not specially named by Cartier, though he speaks of their hills of sand. See antea, p. 32.
Le Cap St. Pierre	" 28th	For the day of St. Peter, the 29th	On Entry Island	There is a possibility that it may have been on Amherst Island.
Allezay	" 28th		Deadman's Island.	
Cap d'Orléans	" 30th	Probably in compliment to the reigning family of France.	Cape Kildare.	
Ripuiere de Barcques	" 30th	From canoes full of natives which he saw there.	Richmond Bay.	
Le Cap dez Sauuaiges	July 1st	From a native whom he saw there	North Point	May survive in "Cape Tormentine." See p. 18, note 3.
La baye Sainct Limaire [should be Lunaire, see these Trans., V, p. 122-123].	" 2nd	The day of St. Leonarius is July 1st, on which day they had entered it.	Head of Northumberland Strait, between a line from C. Wolfe to Richibucto and one from North Point to Cape Escumenac.	See these Trans., V, pp. 131-132.
[Triangular Bay]	" 2nd		Miramichi Bay	Not specially named by Cartier, but referred to by him as "a bay, in the fashion of a triangle."
Cap d'Espérance	" 3rd	From his hope of finding a western passage.	Point Miscou or North Point	Has been corrupted and moved to Gaspé, where it is now Cape Despair.
La couche Sainct Martin	" 4th	Day of St. Martin	Port Daniel.	
La baye de Chaleur	" 10th	From the great heat experienced	Bay Chaleur	The name has persisted until the present.
Cap de Pratto	" 12th	Perhaps for Albert de Prato, priest and mathematician.	White Head	See antea, p. 20, note 3.
Le Cap St. Loys	" 28th	The day of the festival of St. Louis	Heath Point (or east Cape?).	
Cap de Memorancy	" 29th	Probably in honor of Duke of Montmorency.	Fox Point	See antea, p. 20, note 4.
Le destroyt Saint Pierre	Aug. 5th	Because *entered* on the day of St. Peter, Aug. 1st.	Strait between Anticosti and Labrador.	
Le Cap Thiennot	" 5th or 6th	After the Chief of a band of Indians seen there.	Natashquan Point	See antea, p. 20, note 5.

APPENDIX II.—*Continued.*

A Table of the Place-names Mentioned or Given by Cartier in the Gulf of St. Lawrence.

Cartier's Name.	Date.	Why Given.	Present Name.	Remarks.
	1535.			
Les ysles Sainct Guillaume....	July 29th	.....	St. Augustin chain (?).	
Les ysles Saincte Marthe.....	" 30th	For the day of St. Martha, July 29th.....	Great Mecatina Island (?).	
Les ysles Sainct Germain.....	" 30th	For the day of St. Germain, July 31st.....	St. Mary's Islands (?).	
Le haure Sainct Nicolas.....	Aug. 1st	.....	Pachachibou.	
Le Cap de Rabast.....	" 7th	Perhaps from its position	Charleton Point (?).	See antea, p. 23, and footnote 2.
La baye Sainct Laurens.....	" 8th	For the day of St. Lawrence, Aug. 10th....	The vicinity of St. Genevieve and Hunting Islands.	
L'ysle de l'Assumption.....	" 15th	Assumption of the Blessed Virgin Mary...	Anticosti.	
[Mountains of Notre Dame]...	" 15th	Because sighted on "Our Lady day of August."	Notre Dame Mountains.....	The name has persisted until to-day.
Les ysles Rondes.....	" 19th	Without doubt from their high and rounded hil	Seven Islands.....	Cartier also used the name "the seven islands" later in his narrative, so that he really gave the name by which they are still known.
[Riuiere d'eaue doulce.].....	" 20th	Evident. See antea, p. 23.....	Moisie River.....	Appears on old maps both as "fresh river" and "river of horses." See p. 23.
	1536.			
Honguedo	May 21st	Given to him, no doubt, by the Indians...	Gaspé.	
Les Araynes	" 27th	From their sandy character	Magdalene Islands.....	Used as a proper name to signify the low sandy islands.
Cap de Lorraine.....	" 27th	Doubtless from Lorraine in France	Possibly Cape St. Lawrence...	May possibly survive, corrupted, in the present Cape St. Lawrence.
Le Cap de Sainct Paul.....	" 27th	Possibly the name found there by Cartier..	Probably the present St. Paul's Islands.	See antea, p. 24, and note 2.

Note.—In naming important places, when not actually discovered on a particular saint's day, Cartier frequently gave to them the name of the Saint whose festival or day was nearest. Days of St. Anthony, St. Julien, St. Lawrence and others are examples of this.

III.—*Trade and Commerce in the Stone Age.*

By SIR DANIEL WILSON, LL.D., F.R.S.E., President of the University of Toronto.

(Read May 8, 1889.)

The term "Stone Period" or "Stone Age" was suggested in the early years of the present century by the antiquaries of Denmark as the fitting designation of that primitive era in western Europe—with its corresponding stage among diverse peoples in widely severed regions and ages,—when the use of metals was unknown. That there was a period in the history of the human race, before its Tubalcains, Vulcans, Vœlands, or other Smith-gods appeared, when man depended on stone, bone, ivory, shells, and wood, for the raw material out of which to manufacture his implements and weapons, is now universally admitted; and is confirmed by the abundant disclosures of the drift and the caves. The simple, yet highly suggestive classification, due to Thomsen of Copenhagen, was the first scientific recognition of the fact, now established by evidence derived from periods of vastly greater antiquity than the Neolithic age of Denmark. The accumulated experience of many generations was required before men mastered the useful service of fire in the smelting of ores, and the casting of metals. Nevertheless it seems probable that the knowledge of fire, and its useful service on the domestic hearth, are coëval with the existence of man as a rational being. The evidence of its practical application to the requirements for warmth and cooking carry us back to the age of cave implements, including some among the earliest known examples of man's tool-making industry. In connection with this subject, Mr. John Evans draws attention to some curious indications of the antiquity of the use of flint by the fire-producer.[1] He refers to the ingenious derivation of the word *silex* as given by Vincent of Beauvais, in the "Speculum Naturæ," "Silex est lapis durus, sic dictus eo quod ex eo ignis exsiliat," and he recalls a more remarkable reminiscence of the evoking of fire in the Neolithic, if not in the Palæolithic period. Pliny informs us (lib. vii. cap. 56), that it was Pyrodes, the son of Cilix, who first devised the way to strike fire out of flint; "a myth," says Mr. Evans, "which seems to point to the use of silex and pyrites (from πῦρ) rather than of steel." In reality the flint and pyrites lie together in the same lower strata of the chalk. As the ancient flint-miners sunk their pits in search of the levels where the flint abounds they would meet with frequent nodules of pyrites. In the use of these as hammer-stones to break up the larger flints, the first grand discovery of the fire-producer may have been made.

But whatever was the source of this all-important discovery, it dates among the earliest manifestations of human intelligence. Nodules of iron pyrites have been found

[1] Ancient Stone Implements, p. 14.

in the caves of France and Belgium, among remains pertaining to the Palæolithic age; and are among the most interesting disclosures of the greatly more modern, though still prehistoric age of the barrows and cairns of the Allophylian period of Britain, and of western Europe generally. Sir R. C. Hoare records the finding, among the contents of a cinerary urn, in a Wiltshire barrow, "chipped flints prepared for arrow heads, a long piece of flint, and a *pyrites*, both evidently smoothed by usage." [1] More recent explorers, apprised of the significance of such discoveries, have noted the presence of nodules of pyrites, accompanying the personal ornaments and weapons occurring in graves of the same age—deposited there either as tokens of regard, or more probably with a vague idea of their utility to the dead in the life beyond the grave. In a communication to the Society of Antiquaries of Scotland on a group of stone cists disclosed, in 1879, on the farm of Teinside, Teviotdale, Lord Rosehill thus describes part of the contents of one of them. "It was filled with dark-coloured earth, mixed with charcoal; and closely intermingled in every part with fragments of bones which had been exposed to the action of fire." A broken urn lay about ten inches from the top. "Close to the urn was a rounded piece of metallic-looking substance, which appears to be 'radiated iron pyrites,' and which," adds Lord Rosehill, "I have myself discovered in several interments." [2] More recently, in 1883, Major Colin Mackenzie reported to the same Society the discovery of a cist and urn in the Black Isle, Ross-shire. He thus proceeds: "Whilst gathering together the broken pieces of the urn, a round-nosed flint-flake or scraper, chipped at the edges, was found amongst the debris, and proved to have a bluish tinge, as if it had been subjected to the action of fire. Close beside it there was found a round piece of iron pyrites, flat on one side, in shape somewhat like the half of an egg, divided lengthways, only smaller. Dr. Joseph Anderson at once recognized this as forming, along with the solitary flint, nothing less than a prehistoric 'strike-light' apparatus." [3] No flint is procurable in the locality; and after the closest search, no other flint implement or flake was found on the site. In communicating this interesting discovery to the Society of Antiquaries of Scotland, Major Mackenzie reviewed the disclosures of this class in Great Britain, so far as they had been noted by Hoare, Borlase, Bateman, Greenwell and Evans, furnishing a tabulated statement of eleven examples, chiefly found in barrows, and ranging over an area extending from Cornwall to Ross-shire. He draws attention to their occurrence in localities which produce neither pyrites nor flint. But with the former, at least, this need not surprise us. The prized and easily transported pyrites may be looked for in any ancient barrow or sepulchral deposit; and has probably in many cases passed unnoted before its significance was understood. Now that this is fully appreciated, it is seen to have been in use from the early dawn of primitive art; and doubtless the pyrites and flint found in localities remote from those where they occur as natural products are in most cases due to primitive barter.

The old Promethean myth represents the fire-bringer interposing on behalf of a degraded race of beings whose helpless lot had been preceded by the Hesiodic Golden, Silver and Bronze ages, as well as by an Heroic age of such demigods as the Titan son of

[1] Hoare's South Wilts., p. 195.

[2] Proceedings of the Society of Antiquaries of Scotland, viii. 137.

[3] Proc. of Soc. Antiq. Scot., N. S., vii. 356.

Iapetus. By a reverse process of evolution from the lower to higher stages, the anthropoid, or Caliban of archæological science, becomes the tool-maker, the tool-user, and in the same primitive stage, the fire-maker. But the service of fire is required by man under the most varied conditions of life. The stone lamp with its moss wick, and the stone kettle, are important implements in the snow-hut of the Eskimo. On those he depends, not only for cooking, but for his supply of water from melted snow ; and without the lighted taper of his stone lamp the indoor life of the long, unbroken arctic night would be passed in a rayless dungeon. He has inherited the knowledge of the palæolithic fire-maker, from whom, indeed, some have claimed for him direct genealogical descent; and he generally treasures among his most useful appliances a piece of quartz, and a nodule of pyrites, which constitute his flint and steel. At the remote extreme of the southern continent the same precious bequest is in use by the Fuegians and Patagonians of Terra del Fuego, the name of which is a memorial of its fire-using savages. The Fuegian makes a hearth of clay in the bottom of his rudely constructed bark canoe, on which he habitually keeps a fire burning. He prepares a tinder of dried moss or fungus, which is readily ignited by the spark struck from a flinty stone by means of a pyrites. The invaluable discovery is shared by the lowest races. The Australian, the Andaman Islander, and other rudest tribes of the Old and the New World, possess the same great secret, and turn it to useful account.

The tradition may have been perpetuated from generation to generation from the remotest dawn of human reason ; or it may have been re-discovered independently among diverse races. But wherever the value of the pyrites in evoking the latent spark of the flint was known, it would be a coveted prize, and a valuable object of barter. The story of the old fire-makers is recorded still in the charcoal ashes of many an ancient hearth ; for charcoal is one of the most indestructible of substances when buried. In the famous Kent's Hole limestone cavern at Torbay, Devonshire, explorers have systematically pursued research backward from the specifically dated stalagmitic record of " Robert Hodges, of Ireland, Feb. 20, 1688," through Saxon, Roman, British, and Neolithic strata, to the deposit where human remains lay embedded alongside of those of the woolly rhinoceros, the mammoth, the fossil horse, the hyena and cave bear. There also lay, not only the finished implements, but the flakes and flint cores that revealed the workshop of the primitive tool-maker, and the charcoal that preserved the traces of his ancient fire. So, too, in the Cromagnon rock-shelter of the Perigord, in an upper valley of the Garonne, repeated layers of charcoal, interspersed with broken bones and other culinary remains of the ancient cave-dwellers, tell of the knowledge and use of fire by palæolithic man, in western Europe's Reindeer and Mammoth ages. Compared with such disclosures of the arts and knowledge of primeval man, the discoveries on which the Danish archæologists based their systematising of prehistoric remains belong, geologically speaking, to modern eras. Denmark is underlaid essentially by Upper Cretaceous rocks, the Etage Danien of most French writers, and the Faxoe Kelke of German geologists. Drift clays and gravels overlie the cretaceous rocks in many places, with more recent deposits of sands, gravels, etc. These latter are of Neolithic age, containing bones only of existing mammals. Palæolithic deposits, with bones of extinct species, do not appear to have been recognized in Denmark ; nor is there any trace of the presence of palæolithic man. Hence the field alike of Danish antiquarian research and archæological speculation was

greatly circumscribed. But thus precluded from the study of primitive arts in that vague Palæolithic dawn which lies outside of the speculations of the historian, and from any resort to classical authorities for evidence in the interpretation of local disclosures, the Danish antiquary escaped the temptation to many misleading assumptions which long perplexed the archæologists of France and England; and so his limited range has tended to facilitate the investigations into subsequent disclosures relative to the antiquity of man and his arts.

Within the old Roman provinces of western Europe, the Latin conquerors were not only accredited with whatever showed any trace of Hellenic or Roman art, but with the sole skill in working in iron. The Dane and Northman were assumed to have followed in their wake with bronze, as with runes and other essentially non-classical products; though still the beautiful leaf-shaped sword and other choicest relics of the Bronze age were not infrequently ascribed to the Romans. But philologists had not yet assigned a place to the Celtic in the Aryan family of languages. The Celt was not only assumed to be the barbarous precursor, alike of Roman and Dane, but to be the primeval man of western Europe. Hence when the first hoards of palæolithic flint implements were accidentally discovered in Sussex and Kent, their Celtic or British origin was assumed without question. But the known historic position of the Northman on Scandinavian soil prevented the crude application of the term "Danish" to every bronze relic found there; and as no Roman conqueror had trodden the soil of Denmark, the ethnology as well as the archæology of the region was left unaffected by complexities resulting from the presence of the Romans in Gaul and Britain. The absence of remains of palæolithic man still further simplified the problem; while the geology of the Danish peninsula favoured the neolithic tool-maker. Flint abounds there in amorphous nodules or blocks, and the nuclei, or cores, from which a succession of flakes have been struck, are of frequent occurrence among the relics of the Danish Stone age. Flint is no less abundant throughout the regions of France and England, on either side of the English Channel; and there, accordingly, alike in the caves and the river-drift, the rude, massive flint implements of the Palæolithic era abound.

The natural cleavage of flint, as also of the obsidian found in certain localities in the Old and New World, so readily adapts both materials to the manufacture of knives, lances, and arrow-heads, that they appear to have been turned to account by the tool-maker from the dawn of rudest art. But it must not be overlooked that obsidian is limited to volcanic regions, and flint is no more universally available than bronze or iron. In some countries it is rare; in still more it is entirely wanting; and yet its peculiar aptitude for tool-making appears to have been recognized at the earliest period; so that implements and weapons of flint, alike of the Palæolithic and the Neolithic age, abound in many localities where the raw material of the tool-maker is unknown.

It was only natural that the systematic study and classification of the manufactures of the ancient workers in flint should be first carried out in regions such as the Danish peninsula, geologically related to the Cretaceous period, and abounding in the material which most readily adapts itself to the requirements of an implement-maker ignorant of the arts of metallurgy. But the same inexhaustible store of raw material was available to the "Flint-folk" whose implements have become so familiar by reason of more recent disclosures of France and England belonging to a period when the climate, the physical

geography, and the whole animal life of western Europe, contrasted in every respect with anything we have knowledge of in remotest historic times. Those rude examples of primitive art lie alongside of the unwrought flint in such profusion that the examples of them already accumulated in the museums of Europe and America, amount to many thousands. But now that attention has been thus widely drawn to their character and significance, it is found that implements of the same class not only abound in regions geologically favorable to their production, but they occur in nearly every country in Europe, and on widely scattered localities in Asia and Africa, where no such natural resources were available for their manufacture.

The earliest known type of primitive flint implements, illustrative of a class now very familiar to archæologists, was accidentally recovered from the Quaternary gravel beds of the Thames valley, in the heart of Old London, before the close of the seventeenth century. It is a well made spear-pointed implement, with an unusually tapering point, while the butt-end is broad and roughly fashioned so that it could be used in the hand as a spade or hoe without any haft. The deposit in which it lay would now be accepted as unquestionable evidence of its Palæocosmic age; but at the date of its discovery, the Celtic era was regarded as that to which all oldest traces of European man pertained. This interesting relic is accordingly described in the Sloane Catalogue of the British Museum as "a British weapon, found with elephant's tooth, opposite to Black Mary's, near Gray's Inn Lane." In 1797, another and highly interesting discovery of the same class was communicated to the Society of Antiquaries of London by one of its members, Mr. John Frere.[1] In this case a large number of palæoliths were found lying at a depth of twelve feet from the surface, in a gravelly soil containing fresh-water shells and bones of great size. Subsequent excavations in the same locality, at Hoxne, Suffolk, confirm the presence there of the bones of the mammoth, as well as of the fossil horse and the deer. Mr. Frere was so strongly impressed with the evidence of antiquity supplied that he inclined to assign the implements to a remote age, "even beyond that of the present world." By this, however, he probably meant no more than M. Boucher de Perthes, when, so recently as 1847, he entitled his volume devoted to the corresponding discoveries in the valley of the Somme, "Antiquités Celtiques et Antédiluviennes." The antiquity of man, as now understood, was then unthought of; and the word "antediluvian" sufficed as a vague expression of remote indefinite antiquity for which pre-Celtic would then have been accepted as an equivalent. Mr. Frere speaks of the flint implements as "evidently weapons of war fabricated and used by a people who had not the use of metals." He further adds: "The manner in which they lie would lead to the persuasion that it was a place of their manufacture, and not of their accidental deposit; and the numbers of them were so great that the man who carried on the brick-work told me that before he was aware of their being objects of curiosity he had emptied baskets full of them into the ruts of the adjoining road."[2]

When, in December, 1886, Mr. J. Allan Brown communicated to the same Society an analogous discovery near Ealing, Middlesex, English archæologists had become so familiar with the idea of the antiquity of palæolithic man, and the arts of his epoch, that the existence of pre-Celtic races in Britain was accepted as a mere truism. It was not, therefore,

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[1] Archæologia, xiii. 204.

[2] Ibid., xiii. 224, 225; pl. xiv, xv.

any matter of surprise to be told of the discovery of a palæolithic workshop-floor of the Drift period, near Ealing. It lay about a hundred feet above the present bed of the Thames; and here, six feet below the surface, on an ancient sloping bank of the river, an area of about forty feet square disclosed nearly six hundred unabraded worked flints, including neatly finished spear heads from five to six inches long. Along side of these lay roughly wrought axes, chipped on one or both sides to a cutting edge, and some of them unfinished. There were also flint flakes, some with serrated edges, and well-finished knives, borers, drills, chisels, etc. Waste flakes and chippings, as well as cores, or partially worked blocks of flint, were also observed in sufficient numbers to leave no doubt that here, in the place of their manufacture, lay buried beneath the accumulations of unnumbered centuries industrial products of the skilled artizans of the British Islands contemporary with the long-extinct Quaternary fauna.[1]

The types of flint implements, found at Hoxne in 1797, correspond to other palæoliths recovered from rolled gravel and clay of the glacial drift in the valleys of the Thames, the Somme and the Seine. In their massive and artless rudeness they seem to realize for us some fit ideal of the primitive fabricator in his first efforts at tool-making. But the Ealing find accords with the more extended discoveries of this class. In reality, the manufactures of palæolithic man, as a whole, are less artless than many examples of modern Indian flint-work. Not a few of the stone axes have had their shape determined by that of the water-worn stones out of which they were fashioned, and so required much less skill than was necessarily expended in chipping the flint nodule into the rudest of pointed implements. Any close-grained rock, admitting of grinding and polish, was available for fashioning the larger weapons and domestic implements, alike among the men of the Neolithic age and the native races of the American continent in modern centuries. For many of the simpler requirements of the tool-user, any apt stone chip or water-worn pebble sufficed; and scarcely anything can be conceived of more rude or artless than some of the stone weapons and implements in use among savage tribes at the presen day. Prof. Joseph Leidy describes a scraper employed by the Shoshone Indians in dressing buffalo skins, consisting of a thin segment of quartzite, so devoid of manipulative skill that, he says, had he noticed it among the strata of indurated clays and sandstone, instead of seeing it in actual use, he would have regarded it as an accidental spawl.[2] Dr. Charles C. Abbott, in his "Primitive Industry of the Native Races," furnishes illustrations of pointed flakes, or arrow tips, triangular arrow heads, spear heads, and other stone implements, only a little less rude and shapeless.[3] Of a similar character is the blade of a war-club in use among the Indians of the Rio Frio, in Texas.[4] Nothing so rude has been ascribed to artificial origin among the disclosures of the drift, though corresponding implements may have escaped notice; for were it not that the chipped piece of trachyte of the Texas war-club is inserted in a wooden haft of unmistakable human workmanship, the blade would scarcely suggest the idea of artificial origin. Mere rudeness, therefore, is no certain evidence of the first artless efforts of man to furnish himself with tools.

Until we arrive at the period of neolithic art, with its perforated hammers, grooved

[1] Athenæum, Dec. 18, 1886.

[2] U. S Geological Survey, 1872, p. 652.

[3] Primitive Industry, figs. 241, 254, 292, 295, &c.

[4] Evans' Stone Implements, fig. 94.

axes, net-sinkers, gouges, adzes, and numerous other ground and polished implements, fashioned of granite, diorite, trap, and other igneous rocks, the forms of implements are few and simple, dependent to a large extent on the natural cleavage of the flint. The commoner examples of neolithic art, recovered in thousands from ancient Scandinavian, Gaulish and British graves, from the lake-dwellings of Switzerland, the Danish and British shell mounds, the peat mosses of Denmark and Ireland, and from numerous other depositories of prehistoric industrial art, are scarcely distinguishable from the flint knives, scrapers, spears and arrow heads, or the chisels and axes, manufactured by the Indians of this continent at the present day. The material available in certain localities, such as the claystone of the Haida and Babeen Indians, and the argillite of the old implement-makers of New Jersey, the obsidian of Mexico, or the quartz, jasper, and greenstone of many Canadian centres, give a specific character to the implements of the various regions; but, on the whole, the arts of the Stone period of the most diverse races and eras present striking analogies, scarcely less suggestive of the operation of a tool-making instinct than the work of the nest-builders, or the ingenious art of the beaver. But the massive and extremely rude implements of the river drift and caves present essentially different types, controlled indeed, like the productions of later artificers by the natural cleavage and other essential properties of the material in which the flint-worker wrought; but with some characteristic differences, suggestive of habits and conditions of life in which the artificer of the Mammoth or Reindeer period differed from the tool-maker of Europe's Neolithic age, or the Indian savage of modern centuries.

The tool-bearing drift-gravel of France and England presents its relics of primitive art intermingled with countless amorphous unwrought flints. Both have been subjected to the violent action of floods, to which the present condition of such geological deposits is due; and many contents of the caves, though subjected to less violence, are the results of similar causes. But, along with numerous implements of the rude drift type, the sheltered recesses of the caves have preserved, not only the smaller and more delicate flint implements, but carefully wrought tools and weapons of bone, horn and ivory. Some, at least, of these undoubtedly belong to the Palæolithic age; and therefore tend to verify conclusions, not only as to the mechanical ingenuity, but also as to the intellectual capacity of the earliest tool-makers. The large almond and tongue-shaped flint implements are so massive as to have effectually resisted the violence to which they, along with other contents of the rolled gravels in which they occur, were subjected; whereas it is only in the favoring shelter of the caves, or in rare primitive sepulchral deposits, that delicate trimmed flakes and the more perishable implements of bone and ivory, or horn, have escaped destruction.

The palæolithic implements to which Boucher de Perthes directed attention so early as 1840, were recovered from drift gravel beds, where amorphous flint nodules, both whole and fractured, abound in countless numbers; and this tended to suggest very reasonable doubts as to the artificial origin of the rude implements lying in close proximity to them. Nor was this incredulity lessened by the significance assigned by him to other contents of the same drift gravel. For so far is Boucher de Perthes from overlooking the endless variety of fractured pieces of flint recoverable from the drift beds, that his narrative is supplemented by a series of plates of "L'Industrie primitive," the larger number of which present chipped flints so obviously the mere products of accidental fracture or of

weathering, that they contributed in no slight degree to discredit the book on its first appearance. Others of them, however, show true flakes, scrapers, and fragments probably referable to smaller implements of the same class, such as would be recognized without hesitation to be of artificial origin if found alongside of undoubted flint implements in a cave deposit, or in any barrow, cist, or sepulchral urn. In so far as they belong to the true Drift, and not to the Neolithic or the Gallo-Roman period, they tend to confirm the idea that the large almond and tongue-shaped implements are not the sole relics of palæolithic art.

But now that adequate attention has been given to the stone implements of the Drift-folk, or the men of the Mammoth and Reindeer ages it becomes apparent that they are by no means limited to such localities. On the contrary, sites of native manufactories of flint implements, with abundant remains of the fractured debris of the ancient tool-makers' workshop, some of which are described on a later page, have been discovered remote from any locality where the raw material could be procured. Until the gun flint was superseded by the percussion cap, the material for its manufacture was procured by sinking shafts through the chalk until the beds of flint suited for the purpose were reached. In this the modern flint worker only repeated the practice of the primitive tool-maker. A group of ancient flint pits at Cissbury, near Worthing, has been made very familiar by the systematic explorations of Colonel A. Lane Fox. They occur in and around one of the aboriginal hill-forts of Sussex, the name of which has been connected with Cissa, the son of Ella, who is referred to by Camden as "Saxon king of those parts." But any occupation of the old hill-fort as a Saxon stronghold belongs to very recent times when compared with that of the flint workers, whose pits have attracted the notice of modern explorers. Colonel Lane Fox describes Cissbury Hill Fort as a great flint arsenal. Here within its earthen ramparts the workmen who fashioned the arms of the Stone age excavated for the beds of native flint in the underlying chalk, and industriously worked it into every variety of weapon. "In one place a collection of large flakes might be seen, where evidently the first rough outline of a flint implement had been formed. In another place, a quantity of small flakes showed where a celt had been brought to perfection by minute and careful chipping."[1] In other excavations the pounders, or stone hammers, were found, with a smooth rounded end by which they were held in the hand, and the other bruised and fractured in the manufacture of the flint implements that abound on the same site.[2] Twenty-five pits were explored; and from these, hundreds of worked flints were recovered in every stage of workmanship—chips, flakes, cores, balls, and finished knives; drills, scrapers, spear heads and axes or celts. In fact, Col. Lane Fox sums up his general statement of details with the remark that "Cissbury has produced specimens of nearly every type known to have been found among flint implements, from the Drift and Cave up to the Surface period,"[3] But this "Woolwich" of the flint age occupied an altogether exceptional position, with the raw material immediately underlying the military enclosure, not improbably constructed on purpose to defend the primitive arsenal and workshop, and so render its garrison independent of all foreign supplies.

Other flint pits point to the labours of the industrious miner, and the probable transport of the raw material to distant localities where the prized flint could only be procured

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[1] Archæologia, xlii. 72. [2] Ibid., p. 68. [3] Ibid., p. 68.

from traders, who bartered it for other needful supplies. An interesting group of flint pits of this latter class has been subjected to careful exploration by the Rev. Canon Greenwell; and in a former paper read to this Section, attention was drawn to the ingenious inference of the traces of a left-handed workman among the flint-miners of the Neolithic age. This was based on facts noted in reference to two picks fashioned from the antlers of the red deer, corresponding to others of the ancient miners' tools found scattered through the long-deserted shafts and galleries of the flint pits.

The shallow depressions on the surface, which guide the explorer to those shafts of the ancient workmen, are analogous to others that reveal the funnel-shaped excavations hereafter described, on Flint Ridge, the sites of ancient flint pits of the American arrowmakers. In France, Germany and Switzerland, as well as Great Britain, many localities are no less familiar, on which the refuse flakes, and chippings of flint and other available material, show where they have been systematically fashioned into implements. The museum of the Society of Antiquaries of Scotland has acquired numerous interesting additions to its collections of objects of this class by encouraging systematic research. From the sands at Colvin and Findhorn, Morayshire; Little Ferry, Sutherlandshire; and from Burghhead, Drainie and Culbin sands, Elginshire, nearly seven thousand specimens have been recovered, consisting chiefly of flint flakes and chippings; but also including several hundred arrow-heads, knives, and scrapers, many of them unfinished or broken.

Thus, in various localities, remote from native sources of flint, a systematic manufacture of implements appears to have been carried on. There can, therefore, be scarcely any hesitation in inferring, from the evidence adduced, first a trade in the raw material brought from the distant localities of the flint mines; and then a local traffic in the manufactured implements, as was undoubtedly the case among the American aborigines at no remote date; if, indeed, it is not still practiced on this continent. This aspect of primitive interchange, both of the raw material and the products of industrial skill, in so far as it is illustrated in the practice of the Indian tribes of this continent, merits the most careful study, as a help to the interpretation of the archæological evidence pertaining to prehistoric times. To the superficial observer, stone is of universal occurrence; and it seems, therefore, needless to inquire where the implement-maker of any Stone age procured the rough block out of which he fashioned his weapon or tool. Only when copper, bronze, and iron superseded the crude material of the Stone age is it supposed to be needful to determine the sources of supply. But this is a hasty and wholly incorrect surmise. The untutored savage is indeed greatly limited in his choice of materials. We are familiar with the shell workers of the Caribbees and the Pacific Islands, and the horn and ivory workers of the Arctic regions; but where the resources of an ample range could be turned to account, the primitive workman learned at a very early date to select by preference such stones as break with a conchoidal fracture. Only where such could not be had, the most available chance-fractured chip or the apt water-worn stone was turned to account. Rude implements are accordingly met with fashioned of trap, sienite, diorite, granite, and other igneous rocks; as well as from quartzite, agate, jasper, serpentine and slate. Some of those materials were specially favored by the neolithic workmen for certain classes of their carefully finished weapons and implements, such as perforated hammers, large axes, gouges and chisels. But the natural cleavage of the flint, and the sharp edge exposed by

every fracture, adapt it for fashioning the smaller knives, lance and arrow heads, in a way no other material except obsidian equals. Hence flint appears to have been no less in request among the ancient tool-makers than copper, tin, and iron in the later periods of metallurgic art.

The fact that tin is a metal of rare occurrence, though found in nearly inexhaustible quantities in some regions, has given a peculiar significance to certain historical researches, apart from the special interest involved in the processes of the primitive metallurgist, and the widely diffused traces of workers in bronze. The comparative rarity of flint, and its total absence in many localities, suggest a like enquiry into the probable sources of its supply in regions remote from its native deposits. The flint lance or arrow-head, thrown by an enemy, or wrested from the grasp of a vanquished foe, would, as in the case of improved weapons of war in many a later age, first introduce the prized material to the notice of less favoured tribes. As the primitive tool-maker learned by experience the greater adaptability of flint than of most other stones for the manufacture of his weapons and implements, it may be assumed that it became an object of barter in localities remote from those where it abounds; and thus, by its diffusion, it may have constituted a recognized form of *pecunia* ages before the barter of pastoral tribes gave rise to the peculiar significance attached to that term.

One piece of confirmatory evidence of trade in unwrought flint is the frequent occurrence of numerous flint flakes among the prized gifts deposited with the dead. Canon Greenwell describes, among the contents of a Yorkshire barrow in the parish of Ganton, a deposit of flint flakes and chippings numbering one hundred and eighteen, along with a few finished scrapers and arrow-heads;[1] and smaller deposits of like kind are repeatedly noted by him. Still more, he describes their occurrence under circumstances which suggest the probability of the scattering of flint flakes, like an offering of current coin, by the mourners, as the primitive grave was covered in and the memorial mound piled over the sacred spot. Flints and potsherds, he says, occur more constantly, and even more abundantly than bones; and this presents to his mind a difficult problem, in considering which he refers to an analogous practice of a very diverse age. The maimed rites at poor Ophelia's grave are familiar to the reader of "Hamlet." The priest replies to the demand of Laertes for more ample ceremony at his sister's burial:—

> "... But that great command o'ersways the order
> She should in ground unsanctified have lodged
> 'Till the last trumpet; for charitable prayers,
> Shards, flints, and pebbles should be thrown on her."

The flints and potsherds, Canon Greenwell remarks, "occur at times in very large quantities, the flints generally in the shape of mere chippings and waste pieces, but often as manufactured articles, such as arrow points, knives, saws, drills and scrapers, etc." He further notes that they are found distributed throughout the sepulchral mound, "in some instances in such quantities as to suggest the idea that the persons who were engaged in throwing up the barrow, scattered them from time to time during the process." Assuredly whatever motive actuated those who contributed such objects while the sepulchral mound

[1] British Barrows, p. 166.

was in progress of erection, they were not designed as any slight to the manes of the dead. In districts remote from those where the flint abounds, flakes and chips of the prized material must have been in constant demand to replenish the sheaf of arrows, and replace the lost or broken lance, knife, and scraper. The trader would barter the raw material for furs and other equivalents; or the industrious miner would carry off an adequate supply for his own future use. Such small objects, possessing a universally appreciable value, would be as available for current change as the African cowrie, the Ioqua shells of the Pacific coast, or the wampum-beads of the tribes to the east of the Rocky Mountains. If this assumption be correct, the scattering of flint flakes, while the mound was being piled over the grave, was a form of largess not less significant than any later tribute of reverence to the dead.

The sources whence such supplies of raw material of the old flint-worker were derived, have been sufficiently explored to furnish confirmatory evidence of some, at least, of the deductions suggested by other indications thus far noted. The archæologists of Europe are now familiar with many localities which have been the quarries and workshops, as well as the settled abodes, of palæolithic and neolithic man; nor are such unknown to us in the New World, though research has to be greatly extended before definite conclusions can be accepted relative to the earliest presence of man on the American continent. Flint and stone implements of every variety of form, and nearly every degree of rudeness, abound in the soil of the New World. But in estimating the true significance of such evidence, it has to be borne in remembrance that its indigenous population has not even now abandoned the arts of their Stone period. Implements have already been referred to still in use among the Shoshone, Texas, and other living tribes, ruder than any yet recovered from the river-drift of France or England; whilst others, more nearly resembling the palæolithic types, have been met with on this continent, some of them imbedded in the ancient rolled gravels, or glacial drift, and associated with the bones of the mastodon and other fossil mammals But the evidence as to their antiquity or palæolithic origin has been, at best, doubtful. An imperfect flint knife, now in the museum of the University of Toronto, was recovered from a depth of upwards of fourteen feet, among rolled gravel and gold-bearing quartz of the Grinnel Leads in Kansas Territory. Flint implements from the auriferous gravel of California were produced at the Paris Exposition of 1855. According to the Geological Survey of Illinois for 1866, stone axes and flint spear-heads were obtained from a bed of local drift near Alton, underlying the loess, and at the same depth as bones of the mastodon. Similar discoveries have been repeatedly noted in Southern States. The river Chattahoochee, in Georgia, in its course down the Nacoochee valley, flows through a rich auriferous region. Explorers in search for gold have made extensive cuttings through the underlying drift-gravel, down to the slate rock upon which it rests; and during one of these excavations, at a depth of nine feet, intermingled with the gravel and boulders of the drift, three large implements were found, nearly resembling the rude flint hatchets of the drift type. Such examples, however, though repeatedly noted, have, thus far, been too isolated to admit of their use for any such comprehensive inductions as the disclosures of the glacial drift of north-western Europe have justified. The evidence hitherto adduced, when the implements of this class have been of flint, has failed to establish their palæolithic age, notwithstanding their recovery from ancient gravels. Implements of flint occur in great abundance throughout vast

areas of this continent. With the fact before us that even now the Stone period of its aborigines has not wholly passed away, careful observation is required in determining the probable age of stray specimens buried even at considerable depths.

But disclosures of an actual American implement-bearing drift appear at length to have been met with in the valley of the Delaware. These show the primitive tool-maker resorting to a granular argillite, the cleavage of which adapted itself to the requirements of his rude art. Prof. Shaler, in a report on the age of the Delaware gravel beds, describes this formation as occurring from Virginia northward to Labrador, though it is only in New Jersey and Delaware that the accompanying evidences of human art have been thus far recovered. The New Jersey drift is made up of transported material, including boulders and smaller fragments of granitic, hypogene, sandstone. and limestone rocks, along with water-worn pebbles of the same granular argillite as the characteristic stone implements recovered from it, to which, from their peculiar shape, the name of "turtle-back celts" has been given. There is little true clay in the deposit to give coherence to the mass. The type of pebble is subovate, or discoidal, suggesting its form to be due to the action of running water; and it seems probable that the stone was not quarried out of the living rock, but that the pebbles thus reduced to a convenient form were turned to account by the tool-maker. The researches of Dr. Abbott have been rewarded by the discovery in the drift-gravel of numerous examples of this peculiar type of implement, for which the one material appears to have been used, notwithstanding the varied contents of the drift-gravel in which they occur. As in the case of the French and English river drift, the fractured material is found in every stage of disintegration. Prof. Shaler says: "Along with the perfect-looking implements figured by Dr. Abbott, which are apparently as clearly artificial as the well-known remains of the valley of the Somme, there are all grades of imperfect fragments, down to the pebbles that are without a trace of chipping." But more recent discoveries in the Delaware valley point to palæolithic remains of a still earlier age. The disclosures of Dr. Abbott naturally attracted attention to the region; for there, for the first time, the American archæologist saw the promise of disclosures corresponding in character to those of the European drift-gravels. A systematic and prolonged series of investigations have accordingly been carried out by Mr. Hilborne T. Cresson, under the direction of the Peabody Museum, resulting in fresh disclosures of early American man. The Naaman's Creek rock-shelter carefully explored by him, is situated in the State of Delaware, immediately to the south of Mason and Dixon's line. There in underlying deposits, claimed to be of Post-Glacial age, rudely chipped points and other implements, all of argillite, were found; and at a higher level, others of argillite, but intermingled with bone implements, and fragments of rude pottery, and alongside of these implements fashioned of quartzite and jasper. The antiquity assigned to the Delaware implements, as determined by the age of the tool-bearing gravel is much greater than that of the Trenton gravels previously referred to; but though remains of fifteen different species of animals, including fragments of a human skull, were recovered from the cave or rock-shelter, they include none but existing fauna. But the evidence of antiquity is based most confidently on the discovery of palæoliths in situ in the true Philadelphia red-gravel. Prof. G. F. Wright remarks, in discussing the relative ages of the Trenton and Philadelphia red gravel, that both he and Prof. Lewis came to the same conclusion; assigning the deposition of

the red gravel to a period when the ice had its greatest extension, and when there was considerable local depression of the land. "During this period of greatest ice-extension and depression, the Philadelphia Red Gravel and Brick Clay were deposited by the ice-laden floods which annually poured down the valley in the summer season. As the ice retreated towards the headwaters of the valley, the period was marked also by a reëlevation of the land to about its present height, when the later deposits of gravel at Trenton took place. Dr. Abbott's discoveries at Trenton prove the presence of man on the continent at that stage of the Glacial epoch. Mr. Cresson's discoveries prove the presence of man at a far earlier stage. How much earlier will depend upon our interpretation of the general facts bearing on the question of the duality of the Glacial epoch"[1]—a branch of the enquiry which it is not necessary to discuss here. It is sufficient to note that this argillite—an altogether inferior material to the flint, or hornstone of later tool-makers;—appears, thus far, to be a characteristic feature of American palæolithic art. The locality of the native rock is still undetermined; but implements fashioned of it have been found in great numbers along the escarpments facing the river Delaware. Prof. Shaler describes the material as a curious granular argillite, the like of which, he says, "I do not know in place." Should the native rock be hereafter identified, with traces of the manufactured celts in its vicinity, it may help to throw light on the age and history of the primitive American implement-makers.

The flint of the cretaceous deposits does not occur in America. True chalk is all but unknown among the cretaceous strata of this continent, although it has been found in the form of a somewhat extensive bed in Western Kansas. In Texas, the cretaceous limestones contain in places hornstone nodules distributed through them, like the flint nodules in the upper chalk beds of Europe. But though, so far, differing in origin, the hornstone and flint are practically identical; and the chert, or hornstone, which abounds in the chert-layers of the corniferous formation, of common occurrence in Canada, is simply a variety of flint, consisting essentially, like the substance to which that name is specifically applied, of amorphous silica, and with a similar cleavage. This Devonian formation is made up chiefly of limestone strata, parted in many places by layers of chert which vary in thickness from half an inch to three or four inches. The limestones are more or less bituminous, and frequently contain chert nodules. Most of their fossils are silicified. The formation underlies a considerable portion of south-western Ontario. Outcrops occur at Port Dover, Port Colborne, Kincardine, Woodstock, St. Mary's and other localities. At a point which I have explored more than once near Port Dover, implements occur in considerable numbers, along with fractured or imperfect specimens, mingled with flakes and chippings, evidently indicative of a spot where their manufacture was carried on. At this, and some others of the localities here named, Canadian flint pits may be looked for. Among other objects illustrative of primitive native arts in the museum of the University of Toronto, is a block of flint or brown chert, from which flakes have been struck off for the use of the native arrow-maker. This flint-core was found in a field on Paisley Block, in Guelph Township, along with a large flake, a scraper, and fourteen arrow-heads of various sizes, all made from the same material. Alongside of them lay a flint hammer-stone bearing marks of long use. All of those objects are now in the Toronto museum,

[1] Palæolithic Man in Eastern and Central North America, pp. 152, 153.

and appear to indicate the site of an aboriginal workshop, with one of the tools of the ancient arrow-maker, who here fashioned his implements and weapons, and traded with them to supply the need of the old Huron or Petun Indians of western Canada. The Spider Islands in Lake Winnipeg, near the outlet, have been noted by Dr. Robert Bell, as a favourite resort of the old workers in flint, where they could trade the products of their industry with parties of Indians passing in their canoes. "I have found," he says, "a considerable number of new flint implements, all of one pattern, in a grave near one of those sites of an old factory;" the body of a man—presumably the old arrow-maker—had been buried there in a sitting position, surrounded with the latest products of his industrious skill.

In 1875 I devoted several weeks to a careful study of some of the principal groups of ancient earthworks in the Ohio valley, and visited Flint Ridge to examine the native flint pits in the country of the Shawnees. They were formerly a numerous and powerful tribe of Indians. But they took part, in 1763, in the conspiracy of Pontiac, and were nearly exterminated in a battle fought in the vicinity of their old quarries. From these it is probable that not only the Shawnees, but the older race of Mound-Builders of the Ohio valley, procured the material from which they manufactured many of their implements, including some of those used by the latter, in the construction of their great earthworks.

Flint Ridge, as the locality is called, a siliceous deposit of the Carboniferous age, extends through the state of Ohio, from Newark to New Lexington. It has been worked at various points in search of the prized material; and the ancient pits can still be recognized over an extensive area by the funnel-shaped hollows, or slighter depressions where the accumulated vegetable mould of many winters has nearly effaced the traces of the old miners. The chert, or hornstone, of this locality accords with that from which the implements recovered from the mounds appear to have been chiefly made. One fact which such disclosures place beyond doubt, viz., that the so-called Mound-Builders had not advanced beyond the stage of flint or stone implements, is of great significance. Their numbers are proved by the extent of their earthworks in many localities in the Ohio valley; and the consequent supply of implements needed by them as builders must have involved a constant demand for the flint-miners and tool-makers. The great earthworks at Newark are among the most extensive structures of this class, covering an area of several miles, and characterized by the perplexing element of elaborate geometrical figures, executed on a gigantic scale by a people still in the primitive stage of stone implements; and yet giving proof of skill fully equalling, in the execution of their geometrical designs, that of the scientific land-surveyor. On this special aspect of the question, it may be well to revert to notes written immediately after a careful survey of the Newark earthworks, so as to suggest more clearly their extent and the consequent number of workmen and of tools in demand for their execution. The sacred enclosures have to be classed apart from the military works of the Mound-Builders. Their elaborate fortifications occupy isolated heights specially adapted for defence; whereas the broad river terraces have been selected for their religious works. There, on the great unbroken levels, they form groups of symmetrical enclosures, square, circular, elliptical, and octagonal, connected by long parallel avenues, suggesting analogies with the British Avebury, the Breton Carnac, or even with the temples and sphinx-avenues of the Egyptian Karnak and

Luxor: but all wrought of earth, with the simple tools made from quartzite, chert or hornstone, derived from quarries and flint-pits, such as those of Flint Ridge, the localities of which have been identified.

For a time the tendency among American archæologists was to exaggerate the antiquity of those works, and to over-estimate the artistic skill of their builders. But it now appears that some vague memories of the race have been perpetuated. The traditions of the Delawares preserved the remembrance of the Talligew or Tallegewi, a powerful nation whose western borders extended to the Mississippi, over whom they, in conjunction with the fierce warrior race of Wyandots or Iroquois, triumphed. The old name of the Mound-Builders is believed to survive, in modified form, in that of the Alleghany Mountains and River; and the Chatta Muskogee tribes, including the Choctaws, Chickosaws, the Natchez, and other southern Indians of the same stock, are supposed to represent the ancient race. The Natchez claimed that, in their more prosperous days, they had five hundred villages, and their borders extended to the Ohio. With such assignment of an affinity to known Indian nations, the vague idea of some strange prehistoric American race of unknown antiquity vanishes; and the latter tendency has been rather to underestimate their distinctive peculiarities. Some of these seem to separate them from any Indian tribe of which definite accounts have been preserved. Special features significant of such difference are worthy of note; and foremost among these is the evidence of comprehensive design, and of scientific skill in the construction of their sacred enclosures. The predominant impression suggested by the great military earthworks of the Mound-Builders is that of a people coöperating under the guidance of approved leaders, with a view to the defence of large communities. Elaborate fortifications are erected on well-chosen hills or bluffs, and strengthened by ditches, mounds, and complicated approaches; but the lines of earthwork are everywhere adapted to the natural features of the site. The sacred enclosures are, on the contrary, constructed on the level river-terraces with elaborate artificiality of design, but on a scale of magnitude not less imposing than that of the largest hill-forts. On first entering the great circle at Newark, and looking across its broad trench at the lofty embankment overshadowed with full-grown forest trees, my thoughts reverted to the Antonine vallum, which by like evidence still records the presence of the Roman masters of the world in North Britain sixteen hundred years ago. But after driving over a circuit of several miles, embracing the remarkable earthworks of which that is only a single feature; and satisfying myself by personal observation of the existence of parallel avenues which have been traced for nearly two miles; and of the grand oval, circles, and octagon, the smallest of which measures upwards of half-a-mile in circumference: all idea of mere combined labour is lost in the higher conviction of manifest skill, and even science. The octagon indeed is not a perfect figure. Its angles are not coincident, but the sides are very nearly equal; and the enclosure approaches so closely to an accurate figure that its error is only demonstrated by actual survey. Connected with it by parallel embankments 350 feet long, is a true circle, measuring 2,880 feet in circumference; and distant nearly a mile from this, but connected with it by an elaborate series of earthworks, is the great circular structure previously referred to. Its actual form is an ellipse; the different diameters of which are 1,250 feet and 1,150 feet, respectively; and it encloses an area of upwards of thirty acres. At the entrance, the enclosing embankment curves outward on either side for a distance of 100 feet, leaving a

level way between the ditches, eighty feet wide, and at this point it measures about thirty feet from the bottom of the ditch to the summit. The area of the enclosure is almost perfectly level, so that during rain-floods the water stands at a uniform height nearly to the edge of the ditch.

The skulls, both of the Palæolithic and Neolithic periods of Europe, have been successfully appealed to for indications of the intellectual capacity of the ancient races; and similar evidence has been employed to test that of the Mound-Builders. But ancient mounds and earthworks were habitually resorted to at long subsequent dates as favourite places of interment; so that skulls derived from modern graves are not infrequently ascribed to the ancient race; and much difficulty has been found in agreeing on a typical mound skull. Even after eliminating those derived from superficial interments, a very noticeable diversity is found in the comparatively few undoubtedly genuine mound skulls, which, as I long since suggested, may be due to the actual presence of two essentially distinct races among the ancient settlers in the Ohio valley.[1] It seems to accord with the unmistakable traces of intellectual progress of a kind foreign to the attainments of any known race of the North American continent, thus found in association with other arts and methods of work not greatly in advance of those of the Indian savage. The only satisfactory solution of the problem seems to present itself in the assumption of the existence among them of a theocratic order, like the priests of ancient Egypt, the Brahmins of India, or the Incas of Peru, under whom the vanished race of the Ohio valley—Tallegewi, Natchez, Alleghans, or other American aborigines—executed their vast geometrical earthworks with such mathematical accuracy.

The contents of the earthworks of the Ohio and Mississippi valleys show that the copper, found in a pure metallic condition at various points around Lake Superior, was not unknown to their constructors. But in this they had little advantage over the Iroquois and Algonkin tribes, in whose grave-mounds copper axes and spear-heads occasionally occur. It is even possible that working parties were despatched from time to time to the ancient copper mines on the Kewenaw peninsula, to bring back supplies of the prized malleable rock, which could be bent and hammered into a shape that no other stone was susceptible of. But the labours of the native miners were inadequate to provide supplies that could in any degree suffice to displace the flint or quartzite of the implement maker. One use, however, has been suggested for the copper, in relation to the labours of the flint-workers. Mr. George Ercol Sellers, whose researches among the workshops of the ancient tool-makers have thrown much light on their processes, was led, from careful observation of some of their unfinished work, to the opinion that copper was in special request in the operations of the flint-flakers. After referring to the well-known use of horn or bone-flakers, he thus proceeds: "From the narrowness of the cuts in some of the specimens, and the thickness of the stone where they terminate, I have inclined to the belief that, at the period they were made, the Aborigines had something stronger than bone to operate with, as I have never been able to imitate some of their deep heavy cuts with it; but I have succeeded by using a copper point, which possesses all the properties of the bone, in holding to its work without slipping, and has the strength for direct thrust required."[2] No copper tool, however, was recovered by him

[1] Prehistoric Man, 3rd Ed. ii. 132.

[2] Smithsonian Reports, part i., 1885, p. 880.

among the vast accumulations of implements and waste chips, hereafter described, on the sites of the ancient workers' industrious operations, though some of those found elsewhere may have been used for such a purpose.

The evidence that the ancient dwellers in the Ohio valley were still in their stone age is indisputable. But to a people apparently under the guidance of an order or cast far in advance of themselves in some important branches of knowledge, and by whom the utility of the metals was beginning to be discerned—though they had not yet mastered the first step in metallurgy by the use of fire,—their speedy advance beyond the neolithic stage was inevitable. But an open valley, accessible on all sides, was peculiarly unfavourable for the first transitional stage of a people just emerging from barbarism. Their numbers, it is obvious, were considerable; and agriculture must have been carried out on a large scale to furnish the means of subsistence for a settled community. They had entered on a course which, if unimpeded, would inevitably tend to develop the higher elements of social life and political organization. But their duration as a settled community appears to have been brief. Some faint tradition of the irruption of the northern barbarians of the New World survives. The Iroquois, that indomitable race of savage warriors, swept through the valley with desolating fury; the dawn of civilization on the northern continent of America was abruptly arrested; and the present name of the great river along the banks and on the tributaries of which their memorials abound, is one conferred on it by their supplanters, who were equally successful in thwarting the aims of France to introduce the higher forms of European civilization there.

Some singularly interesting information relative to the traces of the ancient flint-workers in the Ohio valley, is furnished in the paper of Mr. Sellers, already referred to. His observations were made when that region still remained, to a large extent, undisturbed by civilized intruders on the deserted Indian settlements. He notes many places along the banks of the Ohio and its tributaries, at an elevation above the spring floods except at rare intervals of violent freshets, where the flaking process of the old flint-workers had been extensively carried on, and where cores and waste chips abound. "At one of those places, on the Kentucky side of the river," he says, "I found a number of chert blocks, as when first brought from the quarry, from which no regular flakes had been split; some had a single corner broken off as a starting point. On the sharp right-angled edge of several I found the indentations left by small flakes having been knocked off, evidently by blows, as a preparation for seating the flaking tool. Most of the localities referred to are now under cultivation. Before being cleared of the timber and subjected to the plow, no surface relics were found, but on the caving and wearing away of the river banks, many spear and arrow heads and other stone relics were left on the shore. After the land had been cleared, and the plough had loosened the soil, one of the great floods that occur at intervals of some fifteen or twenty years, would wash away the loose soil, leaving the great flint workshops exposed." There, accordingly, he notes among the materials thus brought to light, the cores or nuclei thrown aside, caches stored with finished and unfinished implements and flakes, the tools and wastage, vast accumulations of splinters, etc., all serving to illustrate the processes of the ancient flint-workers.

The depth at which some accumulations occur, overlaid by the growth of the so-called primeval forest, points to them as contemporary with, if not in some cases much older than, the earthworks of the Mound-Builders. The extent, indeed, to which some

are overlaid by subsequent accumulations suggests a remote era. In 1853 Mr. Sellers first visited the site of one of those ancient work yards, on the northern bank of the Saline River, about three miles above its junction with the Ohio. The region was then covered with dense forest, with the exception of a narrow strip along the bank of the river, which had been cleared in connection with recently opened coal works. But at a later date, in sinking a cistern, about two hundred yards from the river bank, the excavation was made through a mass of flint chips. Subsequently heavy rains, after ploughing, exposed some spears and arrow points. "But it was not until the great flood of the winter of 1862 and 1863 that overflowed this ridge three or four feet with a rapid current, that the portion under cultivation on the river bank was denuded, exposing over six acres of what at first appeared to be a mass of chips or stone rubbish, but amongst it were found many hammerstones, celts, grooved axes, cores, flakes, almost innumerable scrapers and other implements, and many tynes from the buck or stag, all of which bore evidence of having been scraped to a point. On exposure to the air they fell to pieces." The actual site of the quarry appears to have been subsequently identified. "The greater number of cores, scattered flakes, finished and unfinished implements, are of the chert, from a depression in a ridge three miles to the south-east, where there are abundant indications of large quantities having been quarried." But the same great work-yard of the ancient Mound-Builders furnished evidence of other sources of supply. Mr. Sellers noted the finding "a few cores of the white chert from Missouri, and the red and yellow jasper of Kentucky and Tennessee," but he adds, "the flakes of these have mostly been found in nests or small caches, many of which have been exposed; and in every case the flakes they contained were more or less worked on their edges; whereas the flakes from the neighboring chert preserved their sharp edges as when split from the mass. These cache specimens with their worked serrated edges would, if found singly, be classed as saws or cutting implements. But here where found in mass, evidently brought from a distance, to a place where harder chert of a much better character for cutting implements abounds, they tell a different story." The material was better adapted for the manufucture of certain classes of small implements much in demand, and the serrated edge is simply the natural result of the mode of working of this species of chert and of the jasper.

The fine-grained quartzite was also in request, especially for the manufacture of the largest class of implements, including the hoes and spades, equally needed by the primitive agriculturist, and by the navvies to whose industrious toil the vast earthworks of the Ohio valley are due. The site of the old quartzite quarry appears to be about eight miles from the banks of Saline River; but there are many other localities scattered over the region extending from southern Illinois to the Mississippi, where the same substitute for chert or hornstone occurs. Some of the quartzite hoes or spades measure sixteen inches in length, with a breath of from six to seven inches, and evince a remarkable amount of dexterity and skill in their manufacture. Here, accordingly, it becomes apparent that there was a time in the history of this continent, before its existence was revealed to the race that now peoples the Ohio valley, when that region was the scene of busy native industry, and its manufacturers quarried and wrought the chert, jasper, and quartzite, and traded the products of their skill over an extensive region. But the germs of an incipient native civilization were trodden out by the inroads of savage warriors from the north; and the towns and villages of the industrious community were replaced

by what appeared to La Salle, the discoverer and first explorer of Ohio River, as the primeval forest.

It throws an interesting light on the industrial processes of the ancient flint-workers to learn that, even in a region where the useful chert abounded, they went far afield in search of other materials specially adapted for some classes of implements. They were unquestionably a settled community, in a higher stage than any of the tribes found in occupation of that or any neighbouring region when first visited by Europeans. But many tribes, both of the Northern and Southern States, habitually travelled far distances to the sea coast, where still the ancient shell mounds attest their presence. The routes thus annually pursued by the Indians of the interior of Pennsylvania, for example, were familiar to the early surveyors, and some of their trails undoubtedly marked the foot-prints of many generations. In traversing those routes, as well as in their autumnal encampments on the coast, opportunities were afforded of selecting suitable materials for their stone implements from localities remote from their homes. The lines of those old trails have accordingly yielded numerous examples of the wayfarers' weapons and tools, as well as of unfinished implements. We are apt to think of a people in their Stone period as merely turning to account materials lying as accessible to all as the loose stones employed as missiles by the vagrant school-boy. But such an idea is manifestly inapplicable, not only to the arts of communities like those by whom the earthworks of the Ohio valley were constructed, but to many far older workers in flint or stone. The Indian arrow-maker and the pipe-maker, it is manifest, often travelled to great distances for the material best suited to their manufactures; and the use of flint or hornstone for slingstones, lance and arrow heads, as well as for knives, scrapers, axes and other domestic and agricultural tools, must have involved a constant demand for fresh supplies. It might be assumed, therefore, apart from all direct evidence, that a regular system of quarrying for the raw material both of the pipe and the implement-maker was pursued; and that by trade or barter the pipestone of divers qualities, and the chert or hornstone, the quartzite, jasper and other useful minerals, were thus furnished to tribes whose homesteads and hunting grounds yielded no such needful supplies. But the same region which abounds in such remarkable evidences of the ingenious arts of a vanished race, also furnishes to us the traces of the old miners, by whose industry the flint was quarried and roughly chipped into available forms for transport to distant localities, or for barter among the Mound-Builders in the region traversed by the great river. At various points on Flint Ridge, Ohio, and localities far beyond the limits of that state, as at Leavenworth, three hundred miles south of Cincinnati, where the grey flint abounds, evidences of systematic quarrying illustrate the character and extent of this primitive commerce. Funnel-shaped pits occur there, in many cases filled up with the accumulated vegetable mould of centuries, or only traceable by a slight depression in the surface of the ground. When cleared out, they extend to a depth of, from four or five, to nearly twenty feet. On removing the mould, the sloping sides of the pit are found to be covered with pieces of fractured flint, intermingled with unfinished or broken implements, and with others partially reduced to shape. The largest hoes and spades hitherto noted appear to have been fashioned of quartzite, but those of most common occurrence in Ohio and Kentucky are made of the grey flint or chert, which abounds in the Flint Ridge pits in blocks amply sufficing for the manufacture of tools upwards of a foot in length, such as may be assumed

to have been employed in the construction of the great earthworks. But the transportation of the unwrought blocks of hornstone to the workyards in the valley would have involved great labour in the construction of roads, as well as of sledges or waggons suited to such traffic. In lieu of this, the accumulated waste chips in the quarries show the amount of labour that was expended there in order to facilitate the transport of the useful material. Suitable flakes and chips were no doubt also carried off to be turned to account for scrapers, knives and other small implements. Partially shaped disks and other pieces of all sizes abound in the pits, but the finer manipulation, by means of which small arrow-heads, lances, drills, scrapers, etc., were fashioned, was reserved for leisure hours at home, and for the patient labour of the skilled tool-maker, for whose use the raw material was chiefly quarried.

In the tool-bearing drift of France and England the large characteristic flint implements occur in beds of gravel and clay abounding in flakes and chips in every stage of accidental fracture, to some of which M. Boucher de Perthes assigned an artificial origin, and very fanciful significance. But if the palæolithic flint-worker in any case quarried for his material before the latest geological reconstruction of the beds of rolled gravel, the fractured flints may include traces of primeval quarrying, as well as of the tool-maker's labours; for the rolled-gravel beds occur in river valleys best adapted to the habitat of post-glacial man.

In a report furnished to the Peabody Museum of Archæology, by Mr. Paul Schumacher, he contributes some interesting evidence relative to the quarrying and manufactures of the stone-workers of Southern California. The Indians of the Pacific coast, south of San Francisco, not only furnished themselves with chisels, axes, and the like class of implements, but with pots for culinary purposes, made of steatite, usually of a greenish grey colour. In 1876, Mr. Schumacher discovered various quarries of the old pot-manufacturers, with their tools and unfinished articles lying there. The softer stone had been used for pots, while the close-grained darker serpentine, was chiefly employed in making the weights for digging sticks, cups, pipes, and ornaments. "I was struck," he says, "on examining the locality through a field-glass, by the discovery of so many silverhued mounds, the debris of pits, the rock quarries and open-air workshops, so that I believed I had found the main factory of the ollas of the California aborigines."[1] He also discovered the slate quarry, where the rock had been broken off in irregular blocks, from which the pieces best adapted for chisels were selected and fashioned into the forms specially useful in making the steatite pots. A venerable Spanish lady told Mr. Schumacher that she recollected her mother telling her how the Indians had brought *ollas* in canoe-loads from the islands in Santa Barbara Channel to the mainland, and there exchanged them for such necessities as the islanders were in need of. This tradition was subsequently confirmed by an old Mexican guide. Similar evidence of systematic industry with the accompanying trade, or barter, meets the explorer at many points from the Gulf of Mexico northward to beyond the Canadian lakes. The pyrulæ from the Mexican Gulf are of frequent occurrence in Northern ossuaries and grave mounds, while corresponding southern sepulchral deposits disclose the catlinite of the Couteau des Prairies and the native copper of the Lake Superior mines. Obsidian is another prized material

[1] Report of the Peabody Museum, ii. 262.

only to be found in situ in volcanic regions, but met with in manufactured forms in many diverse regions, remote from the obsidian quarries. Dr. G. M. Dawson informs me that, in 1875 and 1876, while travelling along various Indian trails and routes in British Columbia, west of Fraser River, and between lats. 52° and 54°, chips and flakes of obsidian were not unfrequently observed. The Tinné Indians stated that the material was obtained from a mountain near the headwaters of the Salmon River (about long. 125° 40′, lat. 52° 40′), which was formerly resorted to for the purpose of procuring this prized material.[1] The Indian name of this mountain is *Bece*, and Dr. Dawson further notes the suggestive fact that this word is the same with the Mexican (Aztec?) name for 'knife.' Mr. T. C. Weston, of the Geological Survey, also noted, in 1883, the finding of a flake of obsidian in connection with a layer of buffalo bones, occurring in alluvium, and evidently of considerable antiquity, near Fort McLeod, Alberta. The nearest source of such a material is the Yellowstone Park region.

Copper was procured by the tribes on the Pacific coast from some still undetermined region accessible to them. The native copper of the Lake Superior mines, as is well known, was worked extensively by its ancient miners, and undoubtedly formed a valuable object of traffic throughout the region watered by the Mississippi and its tributaries, and along the whole eastern routes to the seaboard. But, with the imperfect resources of the native miners, it was a costly rarity, procurable only in small quantities by barter with the tribes settled on the shores of Lake Superior. Axe-blades, spear-heads, knives, gorgets, armlets, tubes and beads, all fashioned out of the native copper solely with the hammer, have been recovered from ancient grave-mounds and ossuaries in the valleys of the St. Lawrence, the Hudson, the Ohio, the Mississippi, and their tributaries; and to the west of the Rocky Mountains, copper implements again occur manufactured from metal derived from some native source on the Pacific slope. The copper was, no doubt, recognized as a malleable rock, differing from all others in its ductility, and consequent reducability, with the aid of a hammer-stone, to any desired form. The ancient miners of Lake Superior acquired the art of fashioning it into the most suitable tools for their mining operations, and were probably the manufacturers of most of the widely diffused copper implements. But for general purposes, both of industry and war, American man had to be content with the more abundant chert, hornstone, and quartzite. These were, therefore, in universal demand, and must have been industriously collected in those localities where they abound, and disposed of by a regular system of exchange for furs, wampum, or other objects of barter. Mr. W. H. Dall, in his report on "The Tribes of the Extreme North-West," notes the absence in the Aleutian Islands of any stone, such as serpentine, fit for making such celts or adzes, as he recovered from the shell-mounds. "They were," he says, "probably imported from the continental Innuit at great cost, and very highly valued;" and on a subsequent page he adds: "The intertribal traffic I have referred to is universal among the Innuit."

The occurrence of well-stored caches in some of the ancient mounds of the Ohio valley, as well as their repeated discovery in other localities, accords with the idea of systematised industrial labour, and the storing away of the needful supplies for agricultural and domestic operations, and for war. Messrs. Squier and Davis, in their

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[1] Report of Progress Geol. Surv. Can., 1876-77, p. 79. [2] Tribes of the Extreme North-West, pp. 81, 82.

"Ancient Monuments of the Mississippi Valley," describe one of the mounds opened by them within the great earthwork on the North Fork of Point Creek, in which, according to their estimate, about four thousand hornstone discs were disposed in regular order, in successive rows overlapping each other. In 1864, I had an opportunity of examining some specimens retained in the possession of Dr. Davis. They were mostly discs measuring about six inches long and four wide, more or less oval, or broad spear-shaped, and fashioned out of a fine gray flint with considerable uniformity of character. Mr. Squier assumed that the deposit was a religious offering; but subsequent disclosures of a like character confirm the probability that it was a hoard of material stored for the tool-maker.[1]

In other, though rarer cases, the cache has been found containing finished implements. In digging a cellar at Trenton, New Jersey, a deposit of one hundred and twenty finished stone axes was brought to light, at a depth of about three feet below the surface. Another discovery of a like character was made when digging for the construction of a receiving vault of the Riverview Cemetery, near Taunton; and similar deposits are recorded as repeatedly occurring in the same State.[2] In two instances all the specimens were grooved axes. In another, fifty porphyry celts were found deposited in systematic order. Mr. Charles Rau has given the subject special attention, and in a paper entitled "Ancient Aboriginal Trade in North America," he furnishes evidence of addiction to certain manufactures, such as arrow-heads, hoes, and other digging tools, spear-heads, chisels, etc., by skilled native craftsmen.[3] Deposits closely corresponding to the one reported by Mr. Squier as the sole contents of one of the mounds, in "Clark's Work," Ohio, have been subsequently discovered in Illinois, Wisconsin, and Kentucky. One of the Illinois deposits contained about fifteen hundred leaf-shaped or rounded discs of flint arranged in five horizontal layers. Another, said to have contained three thousand five hundred specimens, was discovered at Fredericksburg, in the same State. A smaller, but a more interesting hoard was accidentally brought to light in 1868, when some labourers in opening up a new street, at East St. Louis, in the same State of Illinois, came upon a collection of large flint tools all of the hoe and shovel type. There were about fifty of the former and twenty of the latter, made of a yellowish-brown flint, and betraying no traces of their having been used. Near by them lay several large unworked blocks of flint and green-stone, and many chippings, fragments of flint.[4] Deposits of a like character, but varying both in the number and diversity of their contents, and, in general, showing no traces of use, have been discovered in other States to the east of the Mississippi. In the Smithsonian Report for 1877, Mr. Rau prints a curious account of "The Stock in Trade of an Aboriginal Lapidary." In the spring of the previous year Mr. Keenan presented to the the National Museum at Washington a collection of jasper ornaments, mostly unfinished, which had been found in Lawrence County, Mississippi. They were brought to light in ploughing a cotton field, where a deposit was exposed, lying about two and a half feet below the natural surface. It included four hundred and sixty-nine objects, of which twenty-two were unwrought jasper pebbles; one hundred and one were beads of an elongated cylindrical shape, and a few of them partially perforated. Others were ornaments of various forms, including two animal-shaped objects. The whole were made of jasper of

[1] Smithsonian Contributions to Knowledge, 158.
[2] Abbott's Primitive Industry, p. 33.
[3] Smithsonian Report, 1872.
[4] Smithsonian Report, 1868, p. 402.

a red or reddish colour, occasionally variegated with spots or streaks of pale yellow; but nearly all were in an unfinished state, and so fully bore out the idea of their being the stock in trade of some old native workman, who finished them in sufficient numbers to meet the demands of his customers.[1]

From time to time fresh disclosures prove the extent to which such systematic industry was carried on. The collections thus brought to light were unquestionably the result of prolonged labour, and were, for the most part, undoubtedly stored for purposes of trade. In some cases they were probably accumulated in the arsenal of the tribe in readiness for war. But whether we recognize in such discoveries the store of the trader, or the arsenal of the tribe, they indicate ideas of provident foresight altogether distinct from the desultory labours of the Indian savage in the preparation of his own indispensable supply of implements for the chase or for war.

But there were also, no doubt, the home-made weapons and implements, fashioned with patient industry out of the large rolled serpentine, chalcedony, jasper and agate pebbles, gathered from the sea-coast and river beds, or picked up wherever they chanced to occur. When camping out on Nepigon River, with Indian guides from the Saskatchewan, I observed them carefully collecting pieces of a metamorphic rock, underlying the syenite cliffs, which, I learned from one of them, was specially adapted for pipes. This they would carry a distance of fully eight hundred miles before reaching their lodges on the prairie. Dr. Robert Bell described to me a pipe made of fine green serpentine which he saw in the possession of an Indian on Nelson River. Its owner resisted all attempts to induce him to part with it; assigning as a reason of its special value that it had been brought from Reindeer Lake distant several hundred miles north of Frog Portage, on Churchill River. The pipe was of a favorite Chippewayan patern. The diverse forms in which various tribes shape the tobacco pipe are highly characteristic. In some cases this is partly due to the texture and degrees of hardness of the material employed; but the recovery of pipes of nearly all the very diverse tribal patterns, made from the beautiful catlinite, or red pipe-stone of the Couteau des Prairies, leaves little room for doubt that the stone was transported in rough blocks and bartered by its quarriers to distant tribes. This flesh-colored rock has suggested the Sioux legend of its origin in the flesh of the antediluvian red men, who perished there in the great deluge. It is soft, of fine texture, and easily wrought into minutely varied forms of Indian art, and so was coveted by the pipe-makers of widely severed tribes. Hence red pipe-stone pipes of many ingenious forms of sculpture have been recovered from grave-mounds down the Mississippi, eastward to the Atlantic seaboard, and westward beyond the Rocky Mountains. This prized material appears to have circulated among all the Plain tribes. Pipes made of it were to be found in recent years preserved as cherished possessions among both the Sioux and the Blackfoot tribes. Dr. George M. Dawson found in 1874 part of an ancient catlinite pipe on Pyramid Creek, about lat. 49°, long. 105°.

A very different material was in use among the Assiniboin Indians, limiting the art of the pipe-sculptor to the simplest forms. It is a fine marble, much too hard to admit of minute carving, but susceptible of a high polish. This is cut into pipes of graceful form, and made so extremely thin, as to be nearly transparent; so that when lighted the

[1] Smithsonian Report, 1877, p. 293.

glowing tobacco presents a singular appearance in a dark lodge. Another favourite stone is a coarse species of jasper, also too hard for any elaborate ornamentation. But the choice of materials is by no means limited to those of the locality of the tribe. I have already referred to my Indian guides carrying away with them pieces of the pipe-stone rock on Neepigon river; and Paul Kane, the artist, during his travels, when on Athabaska River, near its source in the Rocky Mountains, observed his Assiniboin guides select a favourite bluish jasper from among the water-worn stones in the bed of the river, to carry home for the purpose of pipe manufacture, although they were then fully five hundred miles from their lodges.

The favourite material of the Chippewas was a dark, close-grained schist obtained at some points on Lake Huron. It is easily carved, and many of their pipes are decorated with groups of human figures and animals, executed with much spirit. Pabahmesad, an old Chippewa pipe-maker of unusual skill, pursued his craft on Great Manitoulin Island, on Lake Huron, in comparatively recent years. The peculiar style of his ingenious carvings may be detected on pipes recovered from widely scattered localities, for his fame as a pipe-sculptor was great. He was generally known among his people as *Pwahguneka*, the pipe-maker. He obtained his materials from the favourite resorts of different tribes, using the black pipestone of Lake Huron, the white pipestone procured on St. Joseph's Island, and the catlinite or red pipestone of the Couteau des Prairies. But the most varied and elaborate in device of all the peculiar native types of pipe sculpture are those executed by the Chimpseyan or Babeen and the Clalam Indians, of Vancouver Island and the neighbouring shores along Charlotte Sound. They are carved out of a soft blue claystone or slate, from which also bowls, platters, and other utensils are made, decorated with native legendary symbols and other devices. But the most elaborate carving is reserved for their pipes, which are not less varied and fanciful in design than the details of Norman ecclesiastical sculpture. The same easily carved claystone is in great request among the Haida Indians of the Queen Charlotte Islands for their idols, and for ornamental gorgets and utensils of various kinds. Thus the available materials of different localities are seen to modify the forms alike of implements, weapons, and articles designed for personal ornament or domestic use; and were sought for and transported to many distant points, with the same object as the tin and copper which played so important a part in the commercial exchanges of nations at the dawn of civilization.

In regions where flint or hornstone is not available, the quartzite appears to have been most commonly resorted to. I have in my possession some spear heads measuring from seven to nine inches long, which were dug up on an old Indian trail at Point Oken, lying to the north of Lake St. John, Quebec; and implements of the like material are common throughout eastern Canada. The same widely diffused material was no less freely resorted to by the tribes on the Pacific coast. The arrow-heads found throughout the Salish country of southern British Columbia are chiefly formed of quartzite, though chert is also used. The quartzite occurs in so many localities that it is difficult to trace its special source. But near the east end of Marble Cañon, and at the Big Rock Slide, about six miles above Spence's Bridge, on Thompson River, chips occur in considerable quantities, suggestive of one of the chosen localities resorted to for quarrying and manufacture. Dr. Dawson informs me, as the result of his own personal observations, that trade between the coast and interior tribes of British Columbia was formerly chiefly

carried on along the following routes:—Fraser River Valley; Bella Coola Valley, from head of Bentinck Arm; Skeena River; Sticking River; and Chilkoot Pass, from the head of Lynn Canal. By the second of the above routes oolacten oil was carried far into the interior; and the old trail leading from Bella Coola and Fraser River is still known to the inland Indians as the "Great trail." Dr. Dawson adds: "All the coast tribes of British Columbia are born traders, and possess in a high degree the mental characteristics generally attributed to the Jews. Those holding possession of the above routes regarded trade with the neighboring inland tribes as a valuable monopoly, and were ready to fight for it. They also traded among themselves, and certain localities were well-known as the source of commodities. Thus the Haida regularly purchased oolacten oil from the Tshimsians, who caught the oolacten at the mouth of the Nass and Stiking, taking in exchange cedar canoes, for the manufacture of which the Haida were celebrated. Through the agency of the Tshimsians they procured the large mountain sheep horns from the inland Indians. Cumshewa, in Queen Charlotte Islands, was, again, noted for Indian tobacco, an undetermined native plant, which was an article of trade all along the coast."[1]

The old arrow-makers evidently derived pleasure from the selection of attractive materials for some of their choicest specimens of handiwork. The true crystalline quartz was prized for small arrow-heads, some of which are equally pleasing in material, form, and delicacy of finish. But the material most usually employed in eastern Canada, as well as that previously referred to as in request by the old workers of the Ohio valley for their largest implements, is a gneissoid rock of comparatively common occurrence, which chips off with a broad facet when sharply struck, and leaves an acute edge and point. In Mr. Sellers's valuable paper on the ancient workshops of Ohio and Pennsylvania, along with an account of his own experience relative to the flaking and chipping of such implements, he records some reminiscences of conversations on the subject,[2] with Catlin, the artist and traveller. In this communication he remarks: "Most of the arrow-points found within my reach in Philadelphia, Delaware, and Chester Counties, Pennsylvania, were chipped from massive quartz, from the opaque white to semi-transparent, and occasionally transparent." He further describes his first chance discovery of one of the native work-places. He was in company with two scientific mineralogists, when, as he writes, "we came to a place where (judging from the quantities of flakes and chips) arrow-points had been made. After much diligent search, only one perfect point was found. There were many broken ones, showing the difficulty in working the material. Mr. Lukins, a scientific mineralogist, collected a quantity of the best flakes to experiment with, and, by the strokes of a light hammer, roughed out one or two very rude imitations." Major J. H. Long traversed the continent westward to the Rocky Mountains, as head of the United States Military Topographical Department; and from him Mr. Sellers derived information of the habits of the rude western tribes long before they had been brought into direct contact with any civilized settlers. "He said that flakes prepared for points and other implements seemed to be an object of trade or commerce among the Indian tribes that he came in contact with; that there were but few places where chert or quartzite was found of sufficient hardness, and close and even grain, to flake well, and at those places there were men very expert at flaking."[3]

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[1] Geological Survey. 1878-79, pp. 114 B, 152 B.

[2] Smithsonian Report, part i., 1885, p. 871.

[3] Smithsonian Report, 1885, part i., p. 873.

Mr. Sellers had known Catlin in his youth, while he was still an expert worker in wood and ivory in the service of the elder Catlin, a musical instrument maker in Philadelphia, and from him he learned much relative to the modes of operation and the sources of material of the Indian workers in stone. "He considered making flakes much more of an art than the shaping them into arrow or spear-points, for a thorough knowledge of the nature of the stone to be flaked was essential; as a slight difference in its quality necessitated a totally different mode of treatment. The principal source of supply for what he termed home-made flakes was the coarse gravel bars of the rivers, where large pebbles are found. Those most easily worked into flakes for small arrow-points were chalcedony, jasper and agate. Most of the tribes had men who were expert at flaking, and who could decide at sight the best mode of working. Some of these pebbles would split into tolerably good flakes by quick and sharp blows, striking on the same point. Others would break by a cross fracture into two or more pieces. These were preferred, as good flakes could be split from their clean fractured surface, by what Mr. Catlin called 'impulsive pressure,' the tool used being a shaft or stick of between two and three inches in diameter, varying in length from thirty inches to four feet, according to the manner of using them. These were pointed with bone or buckhorn." It is thus apparent that among rude tribes of modern centuries, as in the prehistoric dawn, exceptional aptitude and skill found recognition as readily as in any civilized community. There were the quarriers and the skilled workmen, on whose joint labors the whole community largely depended for the indispensable supply of all needful tools.

In the summer of 1854, when civilization had made very slight inroads on the western wilderness, I visited a group of Chippewa lodges on the south-west shore of Lake Superior, where they still maintained many of their genuine habits. Their aged chief, Buffalo, was a fine specimen of the uncorrupted savage, dressed in native attire, and wearing the collar of grizzly bear's claws as proof of his triumph over the fiercest object of the chase. Their weapons were partly of iron, derived from the traders. But they had also their stone-tipped arrows; and one Indian was an object of an interest to a group of Indian boys as he busied himself in fashioning a water-worn pebble into an edged tool. He held an oval pebble between the finger and thumb, and used it with quick strokes as a hammer. But he was only engaged on the first rough process, and I did not see the completion of his work. No doubt, the leisure of all was turned more or less to account in supplying themselves with their ordinary weapons and missiles. But Catlin's free intercourse with the wild western tribes familiarized him with the regular sources of general supply. "The best flakes," he said, "outside of the home-made, were a subject of commerce, and came from certain localities where the chert of the best quality was quarried in sheets or blocks, as it occurs in almost continuous seams in the intercalated limestones of the coal measures. These seams are mostly cracked or broken into blocks that show the nature of the cross fracture, which is taken advantage of by the operators, who seemed to have reduced the art of flaking to almost an absolute science, with division of labour; one set of men being expert in quarrying and selecting the stone, others in preparing the blocks for the flakers."[1] But suitable and specially prized material were sometimes sought on

[1] Smithsonian Report, part i., 1885, p. 874.

different sites, and disseminated from them by the primitive trader. Along eastern Labrador and in Newfoundland arrow-heads are mostly fashioned out of a peculiar light-grey translucent quartzite. Dr. Bell informs me that near Chimo, south of Ungava Bay, is a spot resorted to by the Indians from time immemorial for this favorite material; and arrows made of it are not uncommon even in Nova Scotia. Among the tribes remote from the sea coast, where no exposed rock furnished available material for the manufacture of their stone implements, the chief source of supply was the larger pebbles of the river beds. From these the most suitable stones were carefully selected, and often carried great distances. These most easily worked into flakes for small arrow-heads are chalcedony, jasper, agate and quartz; and the finer specimens of such weapons are now greatly prized by collectors. The coast tribes both of the Atlantic and the Pacific found similar sources of supply of the stones best suited for their implements in the rolled gravel of the beach, and this appears to have been the most frequent resort of the Micmaks and other tribes of the Canadian Maritime Provinces.

I have already referred to information derived from Dr. G. M. Dawson and Dr. Robert Bell, to both of whom I have been indebted for interesting results of their own personal observations as members of the Canadian Geological Survey. Collectors are familiar with the elongated flat stones, with two or more holes bored through them, variously styled gorgets, implements for fashioning sinew into cord, etc. They are made of a grayish green clay slate, with dark streaks; and the same material is used in the manufacture of personal ornaments, ceremonial objects, and occasionally for smooth spear heads and knives. Relics fashioned of this peculiar clay slate are found throughout Ontario, from Lakes Huron and Erie to the Ottawa valley. A somewhat similar stone occurs in situ at various points, but Dr. Bell believes he has satisfactorily identified the ancient quarry at the outlet of Lake Temagamic, nearly one hundred miles north of Lake Nipissing. No clay slate procured from any other locality corresponds so exactly to the favourite material. The site is accessible by more than one canoe route; and quantities of the rock from different beds lie broken up in blocks of a size ready for transportation. Dr. Bell found on the shore of Lake Temissaming a large unfinished spear head, chipped out of this clay-slate, and ready for grinding. When the region is settled and the land cleared, sites will probably be discovered where the aboriginal exporters reduced the rough blocks to form for convenient transport.

Dr. Bell has described to me specimens of narrow and somewhat long spear points, of local manufacture, made from smoky chert found on or near Athabaska, in Mackenzie River basin; and an arrow head of brown flint from the mouth of Churchill River, Hudson Bay. The flint implements of Rainy River and Lake of the Woods are of brownish flint and chert such as are found in the drift all over the region to the south-westward of Hudson Bay; and are mostly derived from the Devonian rocks. Worn pebbles of this kind occur in the drift as far south as Lake Superior. A branch of Kinogami River, is called by the Indians Flint River (*Pewona sipi*) from the abundance of the favourite material they find in the river gravel and shingle. The finest flint implements of Canada are those of the north shore of Lake Huron, made from material correspoding to a very fine grained quartzite, approximating to chalcedony, found among the Huronian rocks of that region. Dr. Bell has referred to this in his report for 1875.

Along the western coast of the Province of Nova Scotia a high ridge of trap rock

extends, with slight interruption, from Briar Island to Cape Blomidon. Here the strong tidal rush of the sea undermines the cliff, and the winter frosts split it up, so that every year the shore is strewn with broken fragments from the cliff, exposing a variety of crystalline minerals, such as jasper, agate, etc. The beach gravel is also interspersed with numerous rounded pebbles derived originally from the same source. I am indebted to Mr. George Patterson, of New Glasgow, N.S., for some interesting notes on this subject. The pebbles of this beach seem to have been one of the chief sources of supply for the Indian implement-makers of Nova Scotia. Few localities have hitherto been noticed in the Maritime Provinces marked by any such large accumulation of chips as would suggest the probability of manufacture for the purpose of trade; though chips and finished implements occasionally occur together on the sites of Indian villages or encampments, suggestive of individual industry and home manufacture. But Mr. Patterson informs me that he has found one place at Bauchman's Beach, in the County of Lunenburg, which furnishes abundant traces of an old native workshop. There, until recently, could be gathered agate, jasper, and other varieties of the fine-grained crystalline minerals from the trap, sometimes in nodules, rounded and worn, as they occur at the base of the ocean-washed cliffs. At times they showed partial traces of working; but more frequently they were split and broken, bearing the unmistakable marks of the hammer. Along with those were cores and large quantities of flakes, or chips, with arrow-heads, more or less perfectly formed. At one time, according to Mr. Patterson's account, they might have been gathered in bushels; but recent inroads of the sea have swept away much of the old beach, and strewed the products of the Indian stone-workers where they may be stored for the wonder of men of other centuries. It is curious, indeed, to reflect on the strange memorials of the life of ages, so diverse from those with which the palæontologist now deals, that are accumulating in the submarine strata in process of formation for the instruction of coming generations, should our earth last so long. The world will, doubtless, have grown wiser before that epoch is reached. But it will require some discrimition, even in so enlightened an age, to read aright the significance of this mingling of relics of rudest barbarism with all the products of modern civilization that are being strewn along the great ocean highways between the Old and the New World.

A curious illustration of the possible confusion of evidence is shown by the discovery in 1884, of a large stone lance-head of the Eskimo type, deeply imbedded in the tissues of a whale taken at the whaling station on Ballast Point, near the harbour of San Diego, California.[1] In the museum of the University of Edinburgh is the skeleton of a whale, stranded in the ancient estuary of the Forth in a prehistoric age, when the ocean tides reached the site which had been elevated into dry land long ages before the Roman invaders of Caledonia made their way over it. Alongside of the buried whale lay a rude deerhorn implement of the old Caledonian whaler; and had the San Diego whale sunk in deep waters off the Pacific coast, it would have perpetuated a similar memorial of rudest savage life, in close proximity, doubtless, to evidences of modern civilization. Such, though in less striking form, is the process of intermingling the arts of the American Stone age with products of modern skill and refinement, that is now in progress off the Lunenburg coast of Nova Scotia. The inroads of the sea have not, however, even now

[1] Science, iii. 342.

effaced all traces of the old arrow-makers of Bauchman's Beach. Specimens of their handiwork may still be gathered along the shore. To this locality it is obvious that the inland tribes resorted from remote Indian villages for some of their most indispensable supplies. Implements of the same materials also occur at sites on the northern coast; but the larger number found there are made of quartzite, felsite, or of hard, slaty rocks, such as occur in the metamorphic rocks of the mountain ranges in the interior of the Province.

From what has thus been set forth, some general inferences of a comprehensive character are suggested. It is scarcely open to doubt that at a very early stage in the development of primitive mechanical art, the exceptional aptitude of skilled workmen was recognized and brought into use for the general benefit. Coöperation and some division of labour in the industrial arts, necessary to meet the universal demand for tools and weapons, appear also to have been recognized from a very remote period in the social life of the race. There were the quarriers for the flint, the obsidian, the shale, the pipe-stones, the favourite minerals, and the close-grained igneous rocks adapted for the variety of implements in general use. There were also the traders, by whom the raw material was transported to regions where it could only be procured by barter; as appears to be demonstrated by the repeated discovery, not only of flint and stone implements, alike in stray examples, and in well-furnished caches; but also of work places, remote from any flint-producing formation, strewn with the chips, flakes, and imperfect or unfinished implements of the tool-makers. It thus becomes obvious that the men of the earliest Stone age transported suitable material for their simple arts from many remote localities; and purchased the services of the skilled workman, with the produce of the chase, or whatever other equivalent they could offer in exchange. The further archæological search is extended, the evidence of social of social coöperation and systematized industry among the men of the Palæolithic era, as well as among those of later periods prior to the dawn of metallurgic skill, becomes more apparent. Nor is it less interesting to note these was no more equality among the men of those primitive ages, than in the later civilized stage. Diversities in capacity and consequent moral force asserted themselves in the skilled handicraftsmen of the Palæolithic dawn, much as they do in the most artificial states of modern society. As a natural concomitant to this, and an invaluable element of social coöperation, the prized flint flakes appear to have furnished a primitive medium of exchange, more generally available as a currency of recognized value than any other substitute for coined money. The principles on which the wealth of nations and the whole social fabric of human society depend, were thus already in operation ages before the merchants of Tyre, or the traders of Massala, had learned of the mineral resources of the Cassiterides; or that vaguer and still more remote era before the ancient Atlantis had vanished from the ken of the civilized dwellers around the Mediterranean Sea.

IV.—*Expeditions to the Pacific. With a brief reference to the Voyages of Discovery in seas contiguous to Canada, in connection with a Western Passage from Europe to Asia.* By SANDFORD FLEMING.

(Read May 8, 1889.)

INTRODUCTORY.

The establishment of railway communication from the Atlantic to the Pacific across the territory of Canada, suggests an enquiry into the several maritime and overland expeditions, undertaken from time to time, between the two oceans. It is accordingly proposed briefly to review (1) the maritime expeditions undertaken with the desire of obtaining a western passage from Europe to Asia, in seas conterminous to the Dominion, and (2) the several overland expeditions from the eastern parts of Canada to the shores of the Pacific, from the earliest date.

Six centuries have elapsed, since the most illustrious traveller of the Middle Ages found his way from Europe across the whole extent of Asia, to the limits of the then known habitable world. After an absence of twenty years, Marco Polo returned to his home on the shores of the Adriatic, to bewilder the Venetians with wondrous accounts of the magnificence of Cathay, the splendours of Zipangu, and the vastness of the Orient. He was the first European who looked upon the hitherto unknown Pacific Ocean, which he had reached after tedious journeys through many strange lands, and after traversing the spacious empire of Kublai the Great Kaan.

Polo and his companions were the pioneers of commercial intercourse between Europe and Cathay. Other European travellers followed the Venetian noble, who with him bore testimony to the extent, power and wealth of the marvellous old civilizations of Asia; and as a consequence, the enterprise and commerce of the Middle Ages became directed towards the East.

The populous and wealthy kingdoms of Asia could only be approached by long and perilous overland journeys, through countries inhabited by warlike races, given to hostility and plunder. The route lay by Turcomania, Armenia, Persia, Upper India, Cashmere and across the mountains and deserts of Tibet. Notwithstanding the immense distance to be passed over by caravans, and the dangers and difficulties of the journey, European traders flocked to the remote East. So far as it was possible under the conditions which existed in the fourteenth and fifteenth centuries, commerce flourished over an extended overland route stretching from Genoa, Florence and Venice, to the great marts of eastern Asia.

It was the possibility of facilitating and increasing the interchange of trade between Europe and Asia which powerfully attracted the imagination of men like Columbus and Cabot. It is not therefore surprising, that an ardent desire was awakened for the discovery of a new and safer route to the East, than the one then followed.

I.—MARITIME EXPEDITIONS.

(1) *Early Voyages of Discovery in the North Atlantic.*

Columbus had formed the belief that the earth had less dimension than it really possesses, and that the continent of Asia extended farther to the eastward. This opinion was the ground of his being confident of reaching Cathay by a western voyage. So firmly was this belief held, that when Columbus set sail in 1492, he was the bearer of a letter from the Spanish court to the Great Kaan of the mighty oriental empire.

More than one European nation was stimulated to activity by the prospects of profitable trade with Asia. As Cathay was the aim of Columbus, so likewise it became the goal of Cabot, who induced Henry VII of England to enter the field of maritime enterprise. The expedition fitted out under the command of Cabot obtained for him the fame of preceding Columbus in the first actual discovery of the new continent. John Cabot sighted the coast of Labrador June 24th, 1497, thirteen months before Columbus beheld any part of the mainland. It was not until August 1st, 1498, on his third voyage, that Columbus for the first time looked upon the shores he had long sought.[1]

Columbus discovered the Bahamas in 1492, and the other West Indian Islands in subsequent years, believing them to be outlying islands of Asia. The Archipelago received the name it still bears under the belief that it was within the limits of the Indian Ocean. The great captain did not live to know that another continent, and another ocean, the broadest expanse of water on the surface of the globe, intervened between the West Indies and the shores visited by Marco Polo two centuries earlier. To the day of his death, Columbus was firm in the conviction that the islands and lands, he had discovered, were in proximity to the domain of the Great Kaan.

The two Cabots, John and Sebastian, equally with Columbus, were imbued with the idea, that the shores of Asia were washed by the waters of the Atlantic and they each displayed great activity in pursuing the object of their search. They were each distinguished by lofty enthusiasm, extraordinary courage, and indomitable perseverance, in the work of discovery which they had undertaken.

While it cannot be doubted that Columbus was the first who conceived the idea of a western route to the East, it is certain that he was not the first who discovered the new continent. Christopher Columbus, the Genoese, kindled the flame of western maritime adventure, and the result of his first voyage filled Europe with wonder and admiration; it was, however, John Cabot the Venetian and Sebastian, his English-born son, who discovered America. The record shows that the great Columbus never beheld any portion of the North American continent, and that he did not come within sight of South America, until the year in which Sebastian Cabot had made a voyage of discovery along the whole coast between Virginia and the entrance to Hudson Strait. In that year, 1498, Sebastian Cabot, with a fleet of five ships under the English flag, bent upon the effort to find an

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[1] Columbus landed on an island named by the Indians Guanahani, October 12, 1492, believed to be San Salvador, one of the Bahamas. The first view he had of the mainland was at the mouth of the Orinoco in South America on August 1, 1498. He died May 20, 1506.

open seaway to Asia, followed the land as high as latitude 67° 30′, and as far south as latitude 38 ; thus he discovered during this voyage 1,800 miles of the North American coast.

(2) *Attempts in the Sixteenth Century to find a Passage from Europe to Asia.*

In 1500, Portugal, then the greatest maritime nation, sent out Gaspar Cortereal with two ships. The expedition left Lisbon with the view of following up the discoveries of Cabot; it reached Labrador, coasted its shores some six hundred miles, and returned. In 1501 sailed proceeded on a second voyage of discovery; after entering a strait, probably Hudson Strait, the ships were separated by a tempest and that of the commander was lost with all on board.

In 1508, Thomas Aubert left Dieppe for the American coast to make similar explorations, and it is recorded that he entered the Gulf of St. Lawrence and ascended the river some eighty leagues.

In 1517, a small squadron was sent out from England by Henry VIII, in command of Sir Thomas Pert and Sebastian Cabot; the object was to continue the former discoveries made by Cabot in the north-west. The ships appear to have entered Hudson Strait, but owing in part to the mutiny of the crew, the expedition proved a failure.

In 1524, Francis I of France entered the field of discovery; he sent out four ships under the command of Giovanni Verrazzano who coasted from latitude 34° to 50°, embracing nearly the whole Atlantic coast of the United States and part of Canada. Spain likewise in this year made an attempt to find a shorter passage by the north-west, to the islands of the Indian Ocean. An expedition was sent out under commander Gomez. He failed in making any important discoveries and returned to Spain after an absence of ten months.

In 1527, Henry VIII sent out another expedition consisting of two ships, under command of John Rut. In his efforts to proceed westward off the Labrador coast, his ships were beset with ice and one of them foundered in a storm.

In 1534, France again entered the field. An expedition of two ships was fitted out at St. Malo, and Jacques Cartier was placed in charge. He entered the Strait of Belle Isle, reached a large gulf which he named the St. Lawrence, explored its coasts, discovered Prince Edward Island, Mirimachi Bay, Bay Chaleurs and Anticosti. The following year, Cartier's commission was renewed by the French king, and he set out from France with three ships, again with the view of finding an open passage to Asia. He ascended the St. Lawrence as far as the Indian settlement of Hochelaga, now Montreal. After spending the winter at Stadacona, now Quebec, he returned in the spring of 1536 to St. Malo. Jacques Cartier made a third voyage five years later with five ships. He wintered above Quebec, and returned finally to France in the spring of 1542. Roberval, having been commissioned by the French monarch to command the enterprise, met Cartier on his homeward voyage on the coast of Newfoundland. Roberval did no more than confirm the discoveries of Cartier and then followed him to France.

In 1536, another expedition consisting of two ships left England. It was promoted by many gentlemen of London, the chief of whom was, named Hore, who was skilled in

cosmography. Great privation was experienced, and but for the timely appearence and assistance of a French vessel the whole crew would have perished miserably.

In 1553, an expedition of which the then aged Sebastian Cabot was the chief promoter, sailed under Sir Hugh Willoughby and Richard Chancellor, to end in disaster. The three ships followed an easterly course, and overtaken by winter Willoughby and all his men perished by famine and cold. Three years later another vessel was sent out in a north-easterly direction under the command of Stephen Burroughs. In midsummer, the ship was beset on all sides by masses of ice, and was in danger of being annihilated, so that all efforts to proceed were unavailing.

(3) *Efforts in the Sixteenth Century to discover a North-west Passage.*

Vasco da Gama doubled the Cape of Good Hope, in the year 1498, and established the possibility of reaching Asia by sea; but the navigators of European nations remained in their belief of a western passage to what was then designated the "East." Having this discovery in view, examinations were made on behalf of Portugal, Spain, France, Holland and England, in every parallel of latitude between Darien and the extreme north.

Cathay continued to be the object of many adventurous voyages. The discoveries of Columbus and his Spanish followers, the expeditions of Cabot, Cartier and others, having established the existence of a large continent extending north, on the eastern coast, as high as latitude 67° 30, it was plain that the much desired navigable route to Asia must be sought northward of this limit. It is at this stage in the history of maritime discovery that there began a series of expeditions, having generally in view the discovery of a "North-west Passage," which were continued with but short intermission over a period of more than three centuries. Great enthusiasm long continued to be felt for the establishment of trade directly with the marts of India and China; and voyages were undertaken by the most celebrated mariners of the age mainly with this end in view.

Influenced by national considerations, Martin Frobisher one of England's heroes, who afterwards took part in the defeat of the Invincible Armada, embarked in a series of expeditions. In 1576, he set sail with three ships, and in 1577 and 1578, other expeditions followed under the same commander. In 1578, he sailed with fifteen vessels. Frobisher was followed by John Davis, who made three successive voyages in the same direction in the years 1585, 1586 and 1587. Davis Strait received the name of this commander.

(4) *Attempts to find a North-west Passage in the Seventeenth Century.*

In 1602, the enterprise was renewed by some patriotic merchants of London and by the Muscovy Company; two ships were fitted out under the command of George Waymouth, who made for Greenland; after reaching a high latitude they encountered such obstructions from ice and dense fogs, that the crew apprehensive of safety mutinied. The ships returned without adding to previous discoveries. In 1605, the King of Denmark caused three vessels to be despatched under command of John Cunningham. They coasted Greenland and reached latitude 66° 30′; but the seamen refused to proceed further. A smaller expedition went out the following year in command of John Knight, with no better result.

The great navigator Henry Hudson was engaged by the Muscovy Company. This commander made voyages in 1607, 1608 and 1609. In the latter year, when exploring the coast of North America for the Dutch East India Company, he ascended the river Hudson. In 1610 he discovered the great inland sea which bears his name; it may well be imagined that on entering on its vast expanse, he felt satisfied that the Pacific Ocean lay before him, and that the problem of a western passage, which had baffled so many, had at length been solved. The illustrious captain never left Hudson Bay. After wintering there he perished miserably on July 22nd, 1611, at the hands of his mutinous crew.

In 1612, the Merchant Adventurers of London sent out Sir Thomas Button in command of two ships, to follow up the discoveries of Hudson; during the following year he continued the examination of the new-found inland sea

In 1614, Captain Gibbon was despatched on a similar expedition of discovery, but with unimportant results. In 1615 and 1616, Robert Bytot and William Baffin continued the explorations, examining the coasts of Hudson Strait and of the great channel which has since been known as Baffin Bay.

In 1619, Denmark again entered the field of discovery. In that year Christian IV sent out two well equipped ships commanded by Jens Munk. Munk traversed Davis Strait, but failing to find the desired opening to the west, he struck southward to Hudson Strait and Hudson Bay. He wintered at Chesterfield Inlet, the crew enduring great suffering, so that, when summer returned, out of sixty-five souls, only three survived to make a perilous voyage homeward.

Two expeditions left England in 1631, under Luke Fox and Captain James; the latter wintered in the ice, near Charlton Island, in the southern extremity of James Bay, and returned to England in the October following. Neither of these expeditions discovered a single indication that the desired passage to the west was obtainable.

In 1670, the Hudson's Bay Company was incorporated and undertook various voyages having in view the discovery of the north-west passage to the Pacific Ocean. The first was undertaken in 1718 by Mr. Knight, governor at Nelson River; the two ships engaged were lost and the crews perished. A search was sent out for the missing ships. The officer in charge, Mr. John Scroggs, upon his return, reported confidently that a passage to the Pacific could be found.

(5) *Expeditions of Discovery in the Eighteenth Century.*

In 1742, the British Government having obtained from the officers of the Hudson's Bay Company information which was regarded as furnishing decisive proofs of the existence of a north-west passage, a naval expedition was despatched in command of Captain Middleton. Middleton's two ships wintered in Churchill River. This expedition was followed in 1746 by that of Captain W. Moor, who was sent out to prosecute the same work of discovery.

In 1769, under instruction from the Hudson's Bay Company, Samuel Hearne was sent out to explore Coppermine River, but without result. In 1770, the exploration was renewed; he conducted the expedition by land, having arrived at the river during the winter. He followed the Coppermine to its mouth, which he reached in July 1771.

(6) *Geographical Discoveries in the Pacific.*

It was not until nearly seven years after the death of Columbus that the Pacific Ocean was seen by Europeans from the newly discovered continent. Vasco Nuñez de Balbao crossed the Isthmus of Darien and was the first to behold the great ocean. This took place upon September 25th, 1513. Six years later, Ferdinand of Magellan emerged from the strait which bears his name, and crossed the ocean to the Philippine Islands. The first Englishman to navigate the Pacific was Sir Francis Drake, who was also the first of his countrymen to circumnavigate the globe. In 1579, Drake, in the hope of finding a shorter way home from the Pacific than by doubling Cape Horn, explored the Pacific coast of North America as far north as latitude 48° N., and it was Drake who gave the name of "New Albion" to the western portion of North America, now known as Oregon and Washington Territories. The coast, at a lower latitude, had been visited by Spanish navigators; by Ferrelo in 1543, by Francisco de Gali in 1584, and by Vizcaino and Aguilar in 1603.

For more than two centuries after Drake's discoveries, no European navigators have claimed to reach a higher latitude on the Pacific coast, if we except Juan de Fuca, whose voyage by most historians is considered apocryphal.

(7) *Fictitious Discoveries of Waterways through the Continent.*

The efforts, above described, to find a navigable passage between Europe and Asia through north-western America, were undertaken from the Atlantic side of the continent. If less activity prevailed on the Pacific side, it cannot be said that any attempt from the western coast was looked upon as inexpedient; indeed at this date a remarkable phase in the history of geography may be noticed. The imagination of navigators, as it were, was allowed to run riot; if the actual explorations were limited, in number and extent, theorizing went on, and several curious fictions were propagated, some of which have been placed on record. Among those which gained currency, one may here be alluded to, as typical of other similar narrations, and for the further reason that the memory of its author has been perpetuated in the strait bearing his name.

A mariner of Greek birth, Juan de Fuca, claimed to have discovered in 1592 a navigable strait connecting the two oceans. He represented that it was to be found on the western coast, in latitude 47° or 48°, and that it had its outlet in the North Sea, through channels not far from Hudson Bay. He described the Pacific inlet of the strait to be thirty or forty leagues wide, increasing in width inland to a much broader expanse of water, through which, after twenty-six days sailing north and north-east he got into the North Sea.

There was a general idea among navigators that there ought to be such a passage, and consequently the fiction, as it subsequently proved, of Juan de Fuca, with other spurious narratives gained ready credence. The wish evidently assisted the belief, for there remained a firm impression on the minds of cartographers, up to a date later than the middle of the Eighteenth Century, that the continent of North America in its northern part was intersected by channels, inland seas, and water passages in such a manner as would admit of ships passing from one ocean to the other. In illustration of this

common belief, two maps are reproduced, one by the French geographer, De L'Isle, published in 1752, the second by Thomas Jeffrey, geographer to the King of England, published in 1768. For these documents the writer is indebted to the work of Mr. Hubert Howe Bancroft (Vol. XXVII, pp. 128 and 131.)[1]

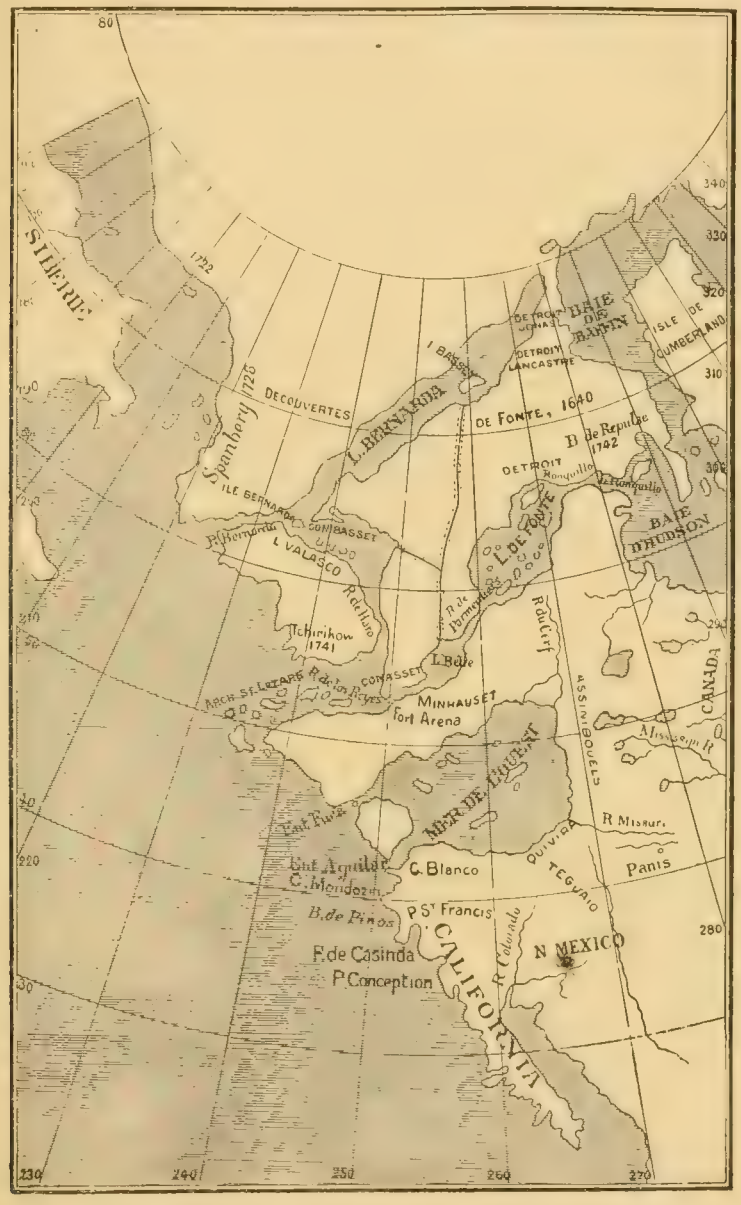

Fig. 1.—De L'Isle's Map, 1752.

[1] In the Parliamentary Library, Ottawa, may be seen a map published in London in 1776 by Thomas Jeffrey, geographer to the King, on which is engraved this note "In latitude 53 'tis pretended that in 1740 Admiral de Fonte entered and sailed by lakes and rivers till he found a ship (as is supposed in Hudson's Bay) from Boston in New England."

(8) *Explorations on the North Pacific coast.*

In 1778, the illustrious Captain James Cook received instructions, on his last voyage, to make an examination of the western coast of America in search of the desired passage to Europe; but he found no inlet such as was described by Juan de Fuca. Singularly enough, however, Captain Barclay, after whom Barclay Sound in Vancouver Island is named, discovered, in 1787, a strait about the latitude mentioned by Juan de Fuca, which strait had escaped the observation of Captain Cook. This now well-known inlet then received, and has since borne, the name of the Greek mariner who claimed to have discovered a navigable passage from the Pacific to the Atlantic two hundred years earlier. In 1788, the inlet of Juan de Fuca was explored by Captain Duffin, and again in 1790 by Captain

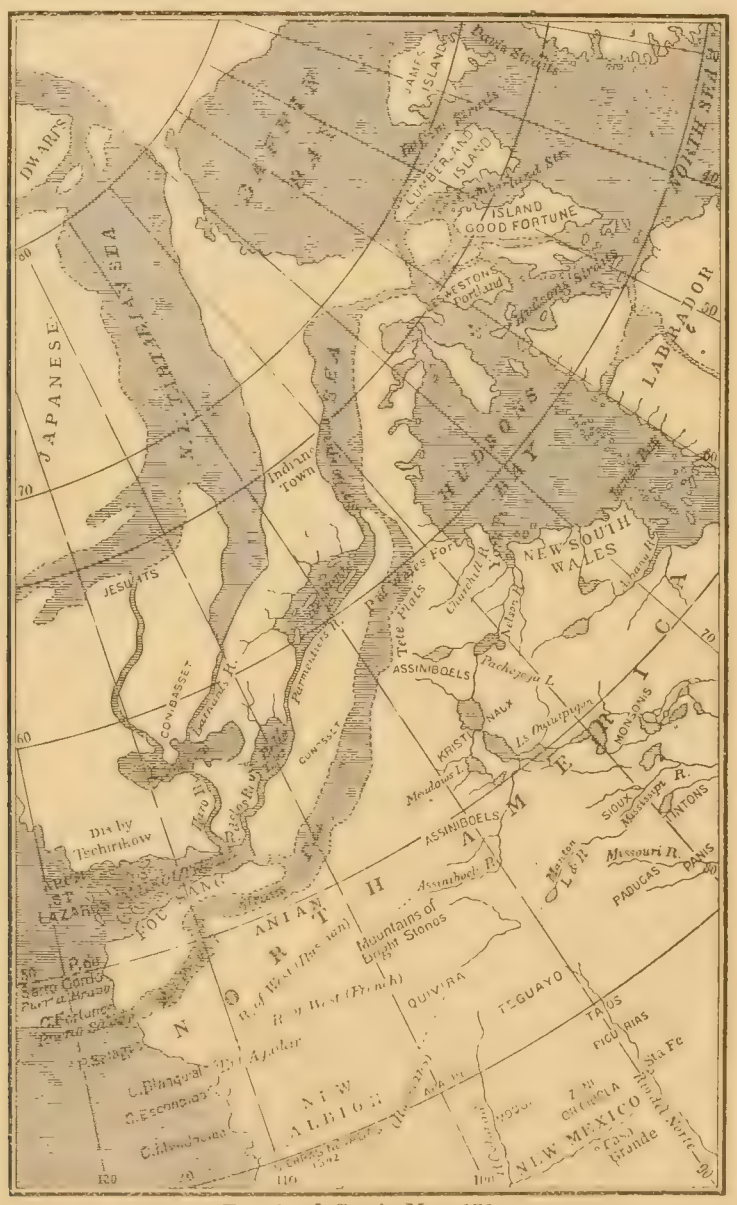

FIG. 2.—Jeffrey's Map, 1768.

Quimper. It need scarcely be added, that beyond the geographical position of the entrance, it has no resemblance to the imaginary passage between the two oceans which Juan de Fuca declared he had discovered.

In 1728, a Russian expedition under Behring discovered the strait named after the commander, who on this occasion explored part of the North-west coast. In 1741, Behring was again employed, and coasted as far south as Mount St. Elias, which he named. Behring and his crew were rendered helpless by scurvy; he expired in a miserable condition during the winter on an island in the strait, which commemorates his name.

In 1791, Vancouver was sent out from England in charge of an expedition. The special objects were to ascertain whether the inlet of Juan de Fuca really formed a strait; and to explore the coast from latitude 30° N. as far north as Cook's Inlet with a view to the discovery of an eastward passage. Those familiar with the peculiar character of the Pacific coast, embraced within the limits of British Columbia and southern Alaska, will understand the necessity of an minute survey; for the passage might have so narrow an entrance as to elude the search made for it. Vancouver examined the coast with great care, surveying all inlets up to latitude 52° and left for England in 1794.

The thorough examination of the coast by Vancouver, together with the discoveries made by Behring, and the overland travels of Alexander Mackenzie to the mouth of the river Mackenzie in 1789 and across the Rocky Mountain chain, in 1793, together with the expedition of Hearne, twenty years earlier, to the mouth of Coppermine River, swept away all belief in the existence of a navigable passage through the continent. It was now established beyond all doubt, that the continent extends unbroken from the Gulf of Mexico to latitude 69°, the mouth of the great river which bears the name of the celebrated traveller.

(9) *Eighteenth Century Attempts to find a passage to Asia across the Polar Sea.*

Every effort to find a navigable channel between the eastern and western coasts of America, having so far resulted in complete failure, the idea of a passage from Europe to Asia across the polar sea, attracted great attention towards the close of the last century. A mass of evidence with regard to its feasibility was laid before the Royal Society whose president Earl Sandwich, was also at the head of the admiralty. The project of an expedition across the pole received the favorable consideration of the king who commissioned two ships for the service. They was placed in command of Captain John Phipps and Captain Lutwidge. Horatio Nelson joined the expedition as a midshipman.

The expedition left England in June 1773, proceeded almost due north to Spitzbergen, and finally reached latitude 80° 37′ when the ships were incompassed by ice and remained in a perilous conditions for some time. Having with difficulty escaped destruction, the ships returned home.

Forty-three years later, the British Government again sent out a similar expedition with a corresponding result.

(10) *Efforts to find a North-west Passage in the Nineteenth Century.*

Notwithstanding so many discouragements, navigators continued to believe in the existence of a North-western passage connecting the Pacific by Behring Strait, to be reached

by some unknown inlet approachable from the Atlantic between the northern coast of Labrador and Greenland. Influenced by these views, the British Government, being extremely desirous of securing a new route to India, at the close of the war with France, renewed the efforts of discovery by offering a reward of £20,000 to any one, or any body of men who would satisfactorily establish its existence. A north-west passage thus having become a national object, two expeditions were sent out in the year 1818, one under Captain David Buchan and Lieutenant John Franklin, the second under the command of Captain John Ross and Lieutenant Edward Parry.

These efforts although unvailing did not establish the non-existence of the long sought passage: they rather made the question more interesting and increased the determination to obtain its solution. New expeditions were therefore decided on. In 1819, Captain Parry sailed in command of two ships which after wintering in the north seas returned in 1820. In 1821 he again commanded an expedition which after passing two winters among the Eskimo returned in 1823.

It was in 1819, that Lieutenant Franklin was despatched by land to the northern coast, in order to survey to the west of Coppermine River. Hitherto the coast had only been visited at two points; by Hearne at the mouth of the Coppermine in 1771, and by Alexander Mackenzie at the mouth of the river which bears his name, in 1789. Franklin was accompanied by Dr. Richardson, Messrs. George Back and Hood. On the return journey the expedition experienced great suffering from cold and starvation, and Hood and many of the men perished.

In 1824 a combined attempt by four expeditions was organized; under Parry and Lyon from the east; under Beechey from the west entering by Behring Strait; and under Franklin by Mackenzie River. These several expeditions returned in 1826. In 1827, Captain Parry undertook the last of the series of unsuccessful attempts made under his command.

In 1829, a wealthy gentleman, Sir Felix Booth, undertook to defray the cost of a private expedition, and placed it under the command of Captain Sir John Ross and his nephew James. On this occasion the ships became winter-bound, and were unable to return until 1833, the expedition having passed four winters in the frozen region. The anxiety felt for their safety induced the authorities to send out a land expedition under Sir George Back and Dr. Richard King. These explorers set out in 1833 and travelled by Great Slave Lake and Great Fish River to the arctic seaboard; they returned in 1834.

In 1836, Sir George Back was placed in command of a naval expedition, to prosecute north-western discoveries. He was obliged to winter in the pack ice and returned to England the following year.

In 1837, Simpson and Dease, sent out at the instance of the Hudson's Bay Company, reached the mouth of the river Mackenzie. The object of this examination was to connect by actual survey the several points on the northern coast which had been visited by previous explorers. They were engaged in this service until 1839.

In 1845, a fresh attempt to discover the north-west passage was undertaken by Sir John Franklin and Captain Richard Crozier in charge of a naval expedition with 135 officers and men. The unfortunate end of the expedition is well known. The ships "Erebus" and "Terror" sailed on May 19th, 1845. They were last seen by a whaler, on the following July 26th, in Baffin Bay. After years of anxiety and uncertainty, and

many efforts to obtain tidings of the missing ships, all that could be learned regarding them was comprised in the few relics found by search parties, proving that they had all perished. The memory of these brave men must ever live in the hearts of their countrymen.

In 1846, Dr. John Rae was entrusted with the work of completing the examination of the coast. He wintered within the arctic circle and remained there until the summer of 1847.

(11) *Expeditions in Search of Franklin.*

Franklin had been away three years when the British Government considered that the time had arrived, when search should be made for the missing ships. It was therefore determined, early in 1848, to send out three several expeditions. The first, consisting of two ships under command of Captains Moore and Kellett, was to proceed by way of Behring Strait. The second under Sir John Richardson and Dr. John Rae was to go by land, descending Mackenzie River to its mouth, and to follow the coast as far as the Coppermine River. The third, being two vessels commanded by Captain Sir James Ross and Captain E J. Bird, well supplied with stores of every kind, was to proceed by Davis Strait, and to follow Lancaster Sound westward. These relief expeditions left nothing undone to attain the object they had in view; but up to 1850 no traces of the lost ships had been found and renewed efforts became necessary.

In 1850, expeditions proceeded by Behring Strait under Captains Collinson and McClure; another by Barrow Strait under Captain Austin; a third, by the same route was sent out by Lady Franklin in command of Captain Penny.

In 1851, Lady Franklin sent out a ship under Captain Kennedy, with Lieutenant Bellot of the French navy as second in command. They wintered in the ice, and made long sledging journeys, adding to geographical knowledge, but without accomplishing the main object of the expedition. They returned to England in 1852.

In 1852, another expedition was sent out by the British Government, consisting of a number of vessels, in command of Sir Edward Belcher, Captains Osborne, Richards, Kellett and McClintock. Among the officers were Terry, Hamilton, Mecham, Nares, Pim and other well known names connected with the naval service.

In 1853, Dr. Rae again undertook a land expedition; he completed the coast examination of the previous years, and connected the discoveries of former travellers. Dr. Rae was the first to bring back tidings, of Franklin; the news of the fate of the expedition, thus obtained, reached London, October 22nd, 1854. Dr. Rae brought home with him relics of the heroic commander, which are now deposited in Greenwich Hospital. Other relics were subsequently recovered by the McClintoch and Hall expedition.

Between the years 1848 and 1854 some fifteen expeditions were sent out, mainly in consequence of the anxiety felt regarding Sir John Franklin and those who accompanied him. Unwearied exertions were made by Lady Franklin herself; she exhausted her own private means in sending out auxiliary ships to continue the search, while her appeals for aid aroused the sympathy of the civilized world.

The search was continued from year to year, winter as well as summer. The ships which entered by Behring Strait in 1850 remained in the ice for more than one winter.

The "Enterprise" under Captain Collinson returned to England in 1854 by the Pacific. The "Investigator," under Captain McClure, never returned. In the second year she reached a palæocrystic region where she became hopelessly embedded in the ice never to move again. In the third year, her perilous position having been discovered by a sledge party under Captain Pim on a relief expedition, the ship was abandoned, and Captain McClure his officers and crew to find safety marched over the ice to the "Resolute" of Sir Edward Belcher's expedition which they reached on June 17th, 1853, after a journey of two weeks. But they did not reach England until the following year. The "Resolute" was caught in the pack ice and there remained during the winter of 1853-54. This vessel was eventually abandoned, on May 14th, 1854,[1] to be recovered in 1855, after drifting in the pack nearly a thousand miles. Meanwhile McClure and his men reached England by a relief ship in the autumn of 1854.

(12) *General Results of the Maritime Expeditions.*

Thus terminated the voyages of discovery for a western passage for ships from Europe to Asia. Since Cabot sailed from Bristol in 1497 under the auspices of Henry VII, up to the day, when the return of Franklin was for ever despaired of, there have been almost ceaseless efforts to obtain it. In the numberless attempts to find a north-west passage, England has risked the lives of many of her adventurous sons. It is a story of heroic struggles year after year in ice-encumbered regions, and of daring and unsuccessful attempts for three and a half centuries. The single instance of partial success is that of McClure, who traversed the route from the Pacific to the Atlantic with his ship's crew. His ship was, however, left behind, and a second ship in which he found refuge was abandoned, the voyagers reaching England on board of a third ship after an absence of nearly five years. McClure was honoured and rewarded by the British Parliament; he had demonstrated the possibility of passing between the two oceans, but with the condition that for several degrees of longitude the passage is across an impenetrable region of palæocrystic ice. We had thus a negative solution to the problem which has tried the skill and daring of navigators ever since America was first discovered, and on which the lives of many hundreds of brave men and many millions of money had been expended. The obstacles to navigation around the northern extremity of the continent have been proved to be insuperable. It had been established beyond all question, that the climatic conditions of the Arctic Ocean render the passage of no commercial value whatever, and that nature has imposed an adamantine barrier beyond the power of man to remove.

II.—DISCOVERIES BY LAND.

(1) *Explorations by the French Pioneers.*

If the maritime efforts extending over three and a half centuries, and of which the above is only a faint outline, were, in view of the object sought, completely barren of fruit, the overland journeys must be regarded in a different light.

[1] The Resolute was found by a whaler from the United States, she was brought into port, and eventually presented to the British Government by the Government of the United States.

Up to the commencement of this century, no explorations were undertaken by the Government or by any citizen of the United States, beyond the valley of the Missouri. It is to the northern part of the continent that we have to look for the seat of adventure and enterprise. It is mainly within the territory now known as the Dominion of Canada that the earliest and more important results were obtained.

The French pioneers displayed remarkable enterprise and activity. As early as 1615, Champlain ascended the Ottawa, and discovered Lakes Huron and Ontario. In 1640, Fathers Jogues and Raymbault were at Sault St. Mary, the discharge of Lake Superior. In 1669, the French discoveries extended to Lake Michigan. In 1673, Jolliet and Marquette penetrated to the Mississipi, and descended its waters as far as Arkansas. In 1682 La Salle descended the Mississipi to its mouth. As early as 1671, an overland expedition from Quebec under father Charles Albanel, reached Hudson Bay, and in 1686 a trader, Noyon, had found his way to the Lake of the Woods.

A great impulse was given to these discoveries early in the following century. La Verendrye the elder, between 1731 and 1739, established various trading posts on Lake Winnipeg and its tributaries, Red River, the Assiniboine and the Saskatchewan. His son, Chevalier La Verendrye, undertook more distant expeditions to the west and south. This adventurous traveller places on record his arrival at some mountains which were probably the outlying highlands or foot-hills which, south of the 49th parallel, extend some degrees of longitude to the east of the Rocky Mountains zone. Under Niverville, the ascent of the river Saskatchewan was made for some considerable distance and the narrative states that the Rocky Mountains were seen.

(2) *First overland Journey to the Pacific Ocean.*

In the second half of the century, Canada having passed under British rule, expeditions of discovery were made at the instance of the English trading companies. In 1771, Hearne, under the instructions of the Hudson's Bay Company, which then had been in existence a hundred years, followed the river Coppermine to its mouth on the Arctic Ocean. In 1783, the North-West Fur Company was formed, with its headquarters in Montreal. By the year 1787, its trading posts had reached the river Athabasca, and the following year a post was established on Peace River. In 1789, an officer of the company, Alexander Mackenzie, discovered the great river of the north which bears his name, which he descended to its outlet in the Arctic Ocean. Three years later he arrived at the Pacific coast in latitude about 53°. This intrepid traveller made the first overland journey to the Pacific, north of the Gulf of Mexico.

(3) *United States overland Expeditions.*

Twelve years after Mackenzie had traversed the continent in the interest of a Canadian fur company, the attempt to reach the Pacific Ocean, was repeated by Lewis and Clark, under the authority of the government of the United States. Up to this period the central region of North America, within the limits of the United States was unknown. Canadian merchants had established trading posts from the St. Lawrence to the Rocky

Mountains and from Hudson Bay to Peace River; they had extended their explorations from Lake Superior to the Arctic Ocean, at a time when the whole region from the Missouri to the Pacific had been untrodden by white men.

Captain Lewis and Lieutenant Clarke, with a strong and well equipped expedition, left the Atlantic coast in June 1803, and reached the mouth of the Columbia in December, 1805. Returning, the expedition arrived at Washington in February, 1807. Their official journal was not published until 1814. Notes were however given to the public in 1808.

With the exception of a private expedition, sent from New York three years after the return of Lewis and Clarke, the moving spirit of which was John Jacob Astor, and which ended in failure, there was no intercourse between the United States and the Pacific coast by land until the second quarter of the present century.

After the failure of Astor's Company, the first successful attempt in the United States to form a connection with the west was in 1825, when Jedediah Smith led a party across Utah and Nevada to California. The second was in 1832, when Nathaniel J. Wyeth and some twenty others proceeded overland from Massachusets to Oregon. These were the pioneer waves of the tide of immigration which followed in after years.

(4) *Explorations under the great Fur Companies.*

The agents and officers of the Canadian fur companies penetrated the country beyond the Rocky Mountains in all directions. They established trading posts throughout New Caledonia, now British Columbia, (1) in 1805 on McLeod Lake, (2) in 1806 on Stuart Lake, (3) in 1807 on the Jackanut (now the Fraser) at Fort George, and in 1808, an expedition started from the latter point to trace the Jackanut to the sea. They discovered Thompson River in 1808; they traversed the river Columbia from its extreme northern bend at Boat Encampment to its mouth in 1811; and their agents were the first Europeans to exercise control in the extensive region now known as Oregon, Washington Territory, and British Columbia. Throughout that vast region early in the century, the Canadian fur companies founded many trading establishments, and gained a dominant influence amongst the native tribes.

Early in the century the several fur companies were reduced to two, the "North-West" and the "Hudson's Bay." In 1821, the rivals became consolidated to form a single organization, henceforth to be known by the name of the "Hudson's Bay Company." The authority of this company was now undisputed, and its influence was supreme, as well throughout the region bounded on the west by the Pacific coast, as to the east of the mountains. In 1839, the company entered into an arrangement with Russia for the lease of Alaska; and its trading posts were established at all eligible points from Behring Strait on the north, to San Francisco to the south. For the time being, the northern Pacific coast was virtually in possession of the Hudson's Bay Company.

In this condition of affairs the river Columbia proved of paramount importance as the means of intercourse between east and west. For half a century after David Thompson's first descent in 1811, it became the great highway between Canada and the Pacific. There was no natural line of communication more accessible or more available; and at the date when the Oregon Treaty went into force, few travellers attempted to enter

British Columbia by any other route. It is obvious therefore that we are warranted in including in the list of Canadian overland expeditions, the journeys by the river Columbia, up to the period when the Hudson's Bay Company's forts on its banks were evacuated.

The Hudson's Bay Company, as the inheritor and representative of all previous fur companies, has played an important part in the early history of the western territory within the limits of the Dominion. The extended trade and influence of this vast commercial concern furnishes evidence of extraordinary energy and perseverance. The adventurers and explorers in the service of the company undertook the most fatiguing journeys, and evinced the greatest fortitude in exposing themselves to hardship, privation and danger. It was they who took possession of the territory on both sides of the Rocky Mountains and on both sides of the 49th parallel. They were for many years the only civilized occupants of both banks of the Columbia from its sources to its mouth, and it was not their fault that this region is not now part of the Dominion. They held their ground in Oregon and Washington Territory under the British flag until they were compelled to relinquish their hold by the treaty of 1846. But for the discoveries made under the authority of this fur company, New Caledonia or British Columbia would never have existed, and Canada to-day would be shut out from access to the Pacific.

It was out of the tangle of diplomacy that the treaty which terminated the authority of the Hudson's Bay Company over the region watered by the Columbia was evolved. But the Oregon Treaty did not at once suspend all the company's operations south of the 49th parallel; it gave certain rights of possession and of navigating the river, subject to the regulations which the Government of the United States might impose. For some years the trading posts were retained, but owing to the conditions of the treaty it became necessary to give up to the United States authorities all the forts of the company south of Puget Sound. In 1860, the Hudson's Bay Company abandoned its various establishments in Oregon and Washington Territory, and the moveable property not disposed of was transferred to Fort Victoria on Vancouver Island, the point at which, as headquarters, the operations of the company, west of the mountains, have since been centred and carried on.

In the following brief outline of the expeditions undertaken between Canada and the Pacific, no attempt will be made to relate the frequent overland voyages of the brigades of fur-trading canoes, except such of them as have been specially recorded. Intercourse was regularly maintained by the company across the continent during the half century which preceded the abandonment of Oregon. During that period, the route generally travelled on the western side of the mountains was by the Columbia; on the eastern side of the range, the chain of rivers and lakes leading to York Factory were followed.

III.—CANADIAN OVERLAND EXPEDITIONS.

The earliest overland journey to the Pacific was made in 1793. In the ninety-two years which intervened between that date and the completion of the Canadian Pacific Railway not less than forty such journeys are on record. They may be divided into three classes, chronologically separated into three periods.

Period I.—From first Overland Journey in 1793 to Oregon Treaty in 1846.

In the first period, the Hudson's Bay Company and its associated traders appear as the active agents. During these fifty-three years we have a record of thirteen expeditions, which, with one exception, that of Mr. David Douglas, the naturalist, were undertaken by the company's officers who explored the western territory, and planted trading posts over a primeval country, thousands of miles in extent. Geographical knowledge was not the main object of these explorers; but their energy and enterprise enabled them to make discoveries which had the remarkable consequence of establishing rights national in their character, and of gaining information of much general importance and scientific value.

(1) *Expeditions of Sir Alexander Mackenzie*, 1789-1793.

Among those who have distinguished themselves by their explorations on this continent, no name is more illustrious than that of Sir Alexander Mackenzie. He ranks the first on the list of overland discoverers. He was the first white man from Canada to reach the Arctic Ocean, the first European to pass through the Rocky Mountains, the first overland traveller north of the Gulf of Mexico to arrive at the shores of the Pacific.

Alexander Mackenzie was born at Inverness, Scotland, it is said, in 1760. It is not known when he arrived in Canada; we, however, learn from himself that in 1785 he was admitted a partner into the fur-trade operations in the west. He had then been five years employed in the office of Mr. Gregory, so that he must have been twenty years of age when he began. His first venture was with some goods to Detroit, at that date little more than a trading post. Thence he proceeded to the Grand Portage, north of Lake Superior, where he commenced his remarkable career. He informs us of his ambitious hopes in the following words: "I not only contemplated the practicability of penetrating across the continent of America, but was confident in the qualifications, as I was animated by the desire, to undertake the perilous enterprise."

For some years a severe struggle had been going on between several rival establishments, and, independently of the natural difficulties of the trader's life, the greatest opposition was encountered from the common foe, the Hudson's Bay Company. The result was that a union of their several interests was effected; and, in the year 1787, the North-West Company was organized on a solid basis for the purpose of vigorously carrying on the fur trade.

Mackenzie became connected with the new company, and we find him in 1789 at Fort Chipewyan, on the Lake of the Hills (Lake Athabasca). On June 3rd, of the same year, he set out on his journey to the north, where he discovered the river which bears his name, reaching its mouth which lies within the Arctic circle. This geographical discovery was of the highest importance, inasmuch as it swept away all dubious conjectures which had been formed as to the existence of a strait or passage for ships through the interior of the North American continent. He returned to Fort Chipewyan on September 12th, 1789.

We learn from Mackenzie, that on his voyage down the river he had felt himself deficient in the knowledge of astronomy and navigation. He unhesitatingly, therefore,

undertook a journey to England, in order to educate himself in these sciences and procure books and instruments for his future use It was in this way that he prepared himself for the expedition to the Pacific.

Once more Mackenzie found his way to Fort Chipewyan, and, on October 10th, 1792, having made every necessary preparation, he left on a journey of further discovery. Ascending Peace River until his progress was impeded by ice, the party remained for the winter at the place where the delay was experienced.

On May 9th, 1793, when the river opened, the voyage was resumed. He ascended Peace River to the Forks; one branch of which has been named the Finlay, the other the Parsnip. Mackenzie's party followed the latter to near its source, when he crossed to the great river called Tacoutche by the Indians, cutting a passage through the woods so that he could carry his canoe with him. Mackenzie formed the opinion that the river on which he then embarked was the Columbia: a belief generally entertained until 1808, when Simon Fraser followed its waters to the Strait of Georgia. The travellers floated down the Tacoutche five days, meeting Indians with whom some difficulty was experienced. They learned from the Indians that the river they were following was of great length and full of perils. His men becoming mutinous, he decided to abandon the attempt to descend to the mouth of the Columbia, and determined to reach the sea by another route. In order to gain the path to the west used by the Indians, the explorer had to turn back. Fort Alexandria was established twenty-eight years afterwards, at the precise spot where he reversed his course, and was so named in honor of the first explorer.

It proved fortunate that he so determined; the route described by the Indians led to the sea in sixteen days after leaving the main river. His party had adventures with different Indian tribes; they were placed on short allowance, and underwent hardships, but Mackenzie at last attained his long cherished object. On July 22nd, 1793, he reached the sea overland from Canada, and floated on the tide-water of the Pacific. The point reached is near the Indian village of Bella Coola, on the North Bentick Arm, about latitude 52° 30′. The explorer returned approximately by the same route, reaching on August 24th, the point on Peace River where the party had passed the winter, and from which they had started west on May 9th. They arrived at Fort Chipewyan after an absence of eleven months, during which period they had encountered many dangers and undergone privation. Mackenzie had the unqualified satisfaction of feeling that the work of exploration and discovery he had undertaken, with all its toils and solicitudes, had been crowned with complete success.

Sir Alexander Mackenzie's portrait is given in the edition of his works of 1801, after the picture by Lawrence. There is almost a feminine delicacy in the features, but accompanied by a dauntlessness of expression, with a mouth round the lines of which can be read firmness and determination. He describes himself as of an inquisitive mind and enterprising spirit, and as possessing a constitution and frame of body equal to the most arduous undertakings. It was his pride to think that he had added new regions to the realm of British commerce. Mackenzie died in 1820.

(2) *Travels and Discoveries of Mr. Simon Fraser*, 1805—1808.

The explorations of Mr. Simon Fraser were in every sense remarkable, and they have exercised no little influence on the history of British Columbia. He entered the service of the North-West Company, in 1792, at the age of nineteen ; ten years later he became a partner. In 1805 a conference was held at Fort William, to discuss the advisability of extending the operations of the company beyond the Rocky Mountains, for the purpose of occupying the territory. The desire was to anticipate the United States explorers and traders, who might establish a claim to its ownership by right of discovery and occupation. It was decided that trading posts should be established in the then unknown territory, and possession by this means taken of it. The duty of carrying out the project was assigned to Mr. Fraser. He soon afterwards left Fort William, made his way to Lake Athabasca, and ascended Peace River in the mountains, where he established a trading post, which he named the Rocky Mountain Portage.

Placing men in charge, he continued his journey to McLeod Lake, which he discovered, and there also left some traders. In 1806 he portaged to Fraser River, at that date regarded as the main stream of the Columbia, or one of its principal affluents. He left the Fraser, and followed a tributary flowing from the westward, now known as Stuart River, and so named from a companion in the service, Mr. John Stuart. He traced this stream to Stuart Lake ; he here established a trading post, the present Fort St. James. He penetrated to Fraser Lake, another of his discoveries, and there also he established a trading station. He gave the name of New Caledonia to the whole territory. In 1807, two canoes with goods, under the charge of Messrs. Quesnel and Farries, reached him ; at the same time he received letters urging him to carry on his explorations to the ocean, by the river flowing through the country to the south, in anticipation of parties from the United States, who were displaying some activity at this date ; Lewis and Clark having been sent out by the United States Government to the Pacific coast. This year Mr. Fraser established another post, Fort George, on the main stream.

In the spring of 1808, Mr. Fraser, with Messrs. John Stuart, Jules Maurice Quesnel, and a crew of nineteen men, and two Indians, embarked in four well-furnished canoes to explore the unknown waters which were regarded as the main affluent of the Columbia. They left Fort George on May 28th, where the river is described as 300 yards wide with a strong current. They reached its mouth on July 1st, and found the latitude to be about 49°, establishing that the river was a separate and distinct stream, and not the Columbia, the latitude at the mouth of which was then known to be 46° 20′.

For a few days after leaving Fort George, the expedition made rapid progress. Sir Alexander Mackenzie fifteen years earlier, had passed over some extent of the distance to the point where, on the advice of the Indians, he turned back, to follow a trail westward to the sea. The Indians whom Mr. Fraser met were friendly, and gave him similar advice ; they informed him that the descent of the river was extremely dangerous, that he could not go on, and that the whole party would meet destruction if they made the attempt. The object of the undertaking being to follow the river to the mouth, Fraser declined to turn back. The verification of the Indian description of the navigation was not long delayed, for in a short time appalling difficulties were encountered. A striking narrative of this descent is given in the Journal of Simon Fraser in the work of Senator Masson, recently issued, "Le Bourgeois de la Compagnie de Nord-Ouest."

On June 1st, five days after they started, the river narrowed to a canyon, possibly the least dangerous of a long series which lay before them. In the first canyon they lost one of their three canoes. On the 5th, the river contracted to a width of not over thirty yards between precipices, the water "turbulent noisy and awful to behold." They made a portage of a mile over most difficult ground, leaving the men harassed by fatigue. On the 6th, finding a cascade and whirlpool, hemmed in by huge rocks, to avoid portaging, they lightened the canoes and ran the rapids. On the 9th "the channel contracts to about forty yards, and is enclosed by two precipices of immense height, which, bending towards each other, make it narrower above than below. The water which rolls down this extraordinary passage in tumultuous waves, and with great velocity, had a frightful appearance. However, it being absolutely impossible to carry the canoes by land, all hands without hesitation embarked as it were a *corps perdu* upon the mercy of the awful tide. . . . . Skimming along as fast as lightning, the crews, cool and determined, followed each other in awful silence, and when we arrived at the end, we stood gazing at each other in silent congratulation on our narrow escape from total destruction."

Again on the same day, the journal reads: "This afternoon the rapids were very bad; two in particular were worse, if possible, than any we had hitherto met with, being a continual series of cascades, intercepted with rocks and bounded by precipices and mountains that seemed at times to have no end." At last they found the navigation wholly impracticable, while the precipitous river sides had a most forbidding aspect. Even men of their nerve could proceed no further on the foaming stream. On the 10th they were compelled to abandon the canoes and many articles not absolutely required. They started to travel the rugged banks on foot, each with a load of eighty pounds. To describe the walking would baffle description: only those who know the river can imagine what these travellers endured, passing along the declivity of mountains, ascending and descending rugged rocks, crossing ravines and climbing precipices. On the 19th, they reached a large rapid river flowing from the east, which Mr. Fraser named the Thompson, after his friend and colleague in the work of discovery, Mr. David Thompson.

On the 20th, they reached what is now known as the Jackass Mountain. "The ascent was dangerous; stones and fragments of rock were continually giving way from our feet and rolling off in succession." Again, on the 25th, we read, "the ascent was perfectly perpendicular; one of the Indians climbed to the summit and, by means of a long pole, drew us up one after the other. This work took three hours; then we continued our course, up and down hills and along the steep declivities of mountains, where hanging rocks and projecting cliffs, at the edge of the bank of the river, made the passage so small as to render it at times difficult for one person to pass sideways."

On the 26th they came to Spuzzum, and on the 29th they emerged from the canyon, and were fortunate enough to obtain a canoe from the Indians in the neighborhood, by means of which they reached tide water on July 1st. The Indians on the coast were exceedingly troublesome, and Fraser was obliged to hasten his departure. His party started on July 3rd, returning by the route they came, and reached their starting point, Fort George, on August 6th.

That portion of the Fraser from the confluence of the Thompson downwards, is now traversed by the Canadian Pacific Railway. It is possible from the passing train to look upon some of the ground over which the men of Fraser's party struggled, by which some

idea may be formed of the difficulties the foot-sore travellers overcame. The journey itself was hazardous from first to last; it required the greatest nerve and courage. The travellers, for part of the way, were dependent on the Indians for food, which consisted of dried fish, berries and roots. Except on the upper section of the river, previously visited by Mackenzie, none of the tribes on the route had ever before seen the face of a white man, and caution and prudence were necessary to avoid awakening Indian enmity. The undertaking was bravely and successfully accomplished; and it is no little owing to Simon Fraser and his associate discoverers, Messrs. Stuart and Quesnel, of the North-West Company, that the country north of the 49th parallel is at this date British territory.

Mr. Fraser remained in the service of the company for some years after the discovery of the river which has been named in his honor. On his retirement from his position, he was offered a knighthood, but the honour was declined, owing to his narrow circumstances. He died at St. Andrews, above Montreal, at the age of eighty-nine, very poor, and leaving no provision for his family.[1] Such was the fate of this daring explorer, who was so largely instrumental in securing the British foothold on the Pacific coast, without which the Dominion of Canada would have been shut in on the west by the Rocky Mountains.

(3) *Travels and Discoveries of Mr. David Thompson*, 1790–1811.

David Thompson, whose explorations were undertaken early in the century, was a Welshman; he was born in 1770, and educated at the grey coat school, London. He entered the service of the Hudson's Bay Company in 1789; and proceeded to Fort Churchill, where he remained five years. For the succeeding nine years of his life on this continent he was engaged making surveys of the rivers Nelson, Churchill, Saskatchewan and their tributaries, frequently visiting York Factory during that period. Having completed his engagement with the Hudson's Bay Company, he joined the North-West Company, in 1797, when he went to the Grand Portage near Lake Superior. Following his duties as astronomer and geographer to the company, for a number of years he was present with the Mandan Indians in Missouri, at Lac La Biche, Lake Athabasca, the Rocky Mountains and nearly all the stations of the company throughout the vast territory.

In 1800, Mr. Thompson entered the Rocky Mountains in latitude 51°, probably in the vicinity of the same pass as that followed by the Canadian Pacific Railway. He descended one of the northern branches of the Columbia, which he called McGillivray River. He was, however, driven back by Indians, and compelled to recross the mountains.

In 1807, Mr. Thompson was again in the Rocky Mountains and was the first to go through what is known as Howes Pass, by which route he reached the Columbia. He ascended that river to the Columbia Lakes and built Fort Kootenay. In 1808, he descended River Kootenay to Kootenay Lake where he entered into trade relations with the Flathead Indians. He returned by another route to Fort Kootenay, descended the Columbia to Blackberry River, and recrossed the mountains by the Howes Pass. He then

[1] Three descendants of Simon Fraser survive: his daughter, Miss Catherine Harriet Fraser, who resides in Cornwall, and her two brothers, William, who lives in Hamilton, and Roderick, at present in St. Andrews, County of Stormont.

travelled eastward with the furs he had obtained in trade to Rainy Lake House, which he reached on August 2nd. Much suffering was experienced by his party on this expedition.

On August 4th, he again started for the west and arrived at the Columbia on October 3rd. In his notes he speaks of the Rapid River, now known as the Kicking-horse River. He continued at Fort Kootenay, trading with the Indians and making explorations in the neighbourhood. There is some confusion in the account of Thompson's travels, but it is clear that for several successive years he crossed the mountains many times by various routes. It would appear that late in the autumn of 1810, he ascended Athabasca River to its source, and crossed the mountains by what is now known as the Athabasca pass to the Columbia, where he arrived early in January. He spent the remainder of the winter at the mouth of Canoe River, and in the spring of 1811 he left for the mouth of the Columbia. But he did not follow the stream on this occasion; he ascended the Columbia to its source, crossed McGillivray Portage, and descended Kootenay River, thence by Pend d'Oreille and Spokane Rivers. On June 19th he reached the falls of the Columbia known by the Indians as Ilth-koy-Ape (Fort Colville), and thence followed the main river to the Pacific coast, where he arrived on July 15th, 1811. He was kindly received by the officers of the Pacific Fur Company, who had arrived a few weeks earlier and were then establishing Fort Astoria. Mr. Thompson remained here a few days and returned as he came to Fort Colville, thence by Arrow Lakes and the Columbia to the mouth of Canoe River, whence he had started a few months previously to ascend the stream. Mr. Thompson was thus the first civilized man to traverse the main stream of the Columbia, certainly that portion of it above Fort Colville, to its source.

In 1799, Mr. Thompson married Miss Charlotte Small, aged 15. The ceremony took place at Ile à la Croix, Buffalo Lake. He lived to be eighty-seven, dying at Longueuil, opposite Montreal, on February 16th, 1857, it is sad to write, in extreme poverty. His widow followed him to the grave in a few weeks. Bancroft says of David Thompson: "No man performed more valuable services or estimated his achievements more modestly." He was well educated; and his meteorological and astronomical observations to this day command respect. His map of the Northwest Territories, 1792-1812, "embraces the region between latitudes 45° and 56° and longitudes 84° and 124°," and was made for the North-West Company in 1813-1814. It is in the possession of the Crown Land Department of Ontario.[1]

(4) *Journeys of Mr Alexander Henry*, 1811–1814.

Alexander Henry started from Montreal in July, 1799, by the river Ottawa. He followed the ordinary route *via* Lake Nipissing, French River, and Sault St. Mary to Lake Superior, and the canoe route to Lake Winnipeg. Engaged as a fur trader he spent

[1] Some of the facts above given are from MSS., now in the possession of Mr. Charles Lindsey of Toronto, giving an account of Mr. Thompson's travels. It is well worthy of publication. An outline of some of the journeys of Mr. Thompson was submitted to the Canadian Institute, Toronto, by Mr. J. B. Tyrell, March 3, 1888. Three daughters of David Thompson survive: Mrs. G. E. Shaw, of Peterborough, Ont., Mrs. R. Scott, Evansville, Indiana, and Miss Thompson, Ivanhoe, Ohio.

ten years in the neighbourhood of Red River, visiting from time to time the posts at Pembina, Assiniboine and Missouri. He made almost annual visits to Fort William on Lake Superior until 1809, when he started for the Saskatchewan, and in 1810, passed up that river to Rocky Mountain House. In May, 1811, he set out to reach the water flowing westerly to the Pacific. He reached one of the sources of the Columbia, and returned to Rocky Mountain House. From 1811 to 1813, the journal of Mr. Henry is wanting. It may, however, be said that during this period he proceeded in 1812 to Fort Vermilion, and it is inferred that he spent the following year at Henry House near the junction of the Myette and the Athabasca. In 1813, he crossed the Rocky Mountains a second time, on this occasion following the river Columbia to its mouth.

On December 13th, 1813, Mr. Henry was present at Fort Astoria, when the Captain and crew of H. M. S. "Racoon" landed in uniform, and with some ceremony broke a bottle of Madeira on the large flag staff carrying the Union Jack. They took possession of the country in the name of His Britannic Majesty and named the establishment, which was then owned by the North-West Company, "Fort George." Mr. Henry remarks in his journal, "the officers of the *Racoon* are famous fellows for grog." The year following, he was drowned in a heavy storm when about two miles out in the stream of the river Columbia, near the fort. The last entry in his journal, which is preserved in MS. in the Parliamentary Library, Ottawa, is dated Saturday, May 21st, 1814. Mr. Alexander Ross refers to the incident in his narrative of the "The Fur Hunter," (I, p. 38.) "On May 22nd, some time after the arrival of the *Isaac Todd*, a boat containing Messrs. Donald McTavish and Alexander Henry, two partners of long standing and high reputation in the service, with six men, was swamped, all hands perishing, in crossing the river, with the exception of one man. Although the accident took place in broad daylight, and in front of the fort, the circumstance was not perceived or known, for some hours after, when John Little, the man who was saved, arrived at the fort, and communicated the intelligence."

(5) *Journey of Mr. Gabriel Franchère*, 1814.

The ship "Tonquin" crossed the bar at the mouth of the river Columbia, March 25th, 1811. She had on board thirty-three passengers, thirty of whom were British subjects, and of these twenty-eight were from Canada. They had passed round Cape Horn from New York; their object was to carry on the fur trade on the Pacific coast, under the name of the "Pacific Fur Company"; of which company, Mr. John Jacob Astor, a German by birth, residing in New York, was the principal promoter. The Canadian partners had among them some of the traders who at one time had been in the service of the North-West Company, including Alexander McKay, who had accompanied Sir Alexander Mackenzie, on his overland travels. On April 12th they selected a site for a building in which the business of the company could be carried on, The establishment broke up two years afterwards, and on October 16th, 1813, the Canadian North-West Company purchased the effects and accepted the transfer of Fort Astoria. Some of the clerks who had been engaged by the Pacific Fur Company were reëngaged during the winter by the new company. The others returned to Canada, among whom Gabriel Franchère started overland the spring following, and described the journey in a narrative published on his return.[1]

[1] Narrative of a voyage to the North-West Coast of America in the year 1812-13-14, by Gabriel Franchère.

Mr. Franchère left Fort George, as Fort Astoria was then called, on April 4th, 1814, in company with some of his companions who had doubled Cape Horn three years earlier, and who were deprived of employment by the turn of affairs on the Columbia. They embarked as passengers with a North-West Company brigade consisting of ten canoes—each with a crew of seven men, in all ninety persons, some of whom were going to posts in the interior. They were all well armed in order to protect themselves against hostile tribes along the river. They ascended the Columbia to the Great Bend, which they reached on May 4th. On Canoe River, they noticed the spot where David Thompson and his party had wintered in 1810-11. Tracing their way across the Rocky Mountains, they reached the upper waters of Athabasca River, which they followed to Little Slave Lake. Their route from this point carried them to Fort Cumberland, Lake Winnipeg and Fort William, where they arrived on July 14th ; Mr. Franchère reached his home in Montreal on September 1st.

(6) *Travels of Mr. Ross Cox*, 1812—1817.

A second ship, the "Beaver," sent from New York by the Pacific Fur Company, arrived at the mouth of the Columbia on May 9th, 1812. Among the passengers was Mr. Ross Cox, who, having obtained a clerkship in the service of the company, had proceeded to Astoria, to assume his duties. In 1831 Mr. Cox published a narrative of his adventures on the Pacific coast, and described his journey overland to Montreal. In these volumes he refers to the arrival on July 15th, 1811, of Mr. David Thompson, astronomer to the North-West Company, in a canoe with nine men. Mr. Thompson had descended the Columbia on an expedition of discovery, preparatory to his company's forming a settlement on that river. Mr. Cox, during the summer of 1812, left for the interior to trade with the Spokane tribe of Indians. The following year, on June 11th, he returned to Astoria, to find a total revolution. The Pacific Fur Company had met with a series of misfortunes. Mr. John George McTavish and Joseph La Rocque, with sixteen men of the North-West Company had arrived and had entered into an agreement to purchase all the effects of the Pacific Fur Company at a valuation, and to give such of the company's servants as desired to return, a free passage home, by Cape Horn or overland. Mr. Cox was one of those who joined the new administration. He left Astoria October 28th to spend the winter in trading with the Flathead Indians in the interior. The following year he returned to headquarters then named Fort George, where he passed two months. He left for Spokane House on August 5th. Between 1815 and 1817 he was in charge of Fort Okanagan, and in the spring of the latter year he was again at Fort George.

Mr. Cox took his departure from Fort George on April 16th, 1817, with a party consisting of eighty-six souls, which embarked in two barges and nine canoes. The brigade ascended the Columbia to Canoe River; the party thence crossed the mountains, and by the usual route reached Lesser Slave Lake, Ile à la Crosse and finally Cumberland House. They descended the Saskatchewan, passed through Lake Winnipeg, Lake of the Woods, and Rainy Lake, arriving at Fort William on August 16th. At that date Captain Miles Macdonnell, formerly of the Queen's Rangers, then connected with the expedition of Lord Selkirk, and others were at the fort. There was here encamped a

motley gathering of *voyageurs*, soldiers, Indians and half-breeds. The De Meuron soldiers represented nearly every country in Europe. Besides natives of Canada and the United States, Mr. Cox saw men from the Sandwich Islands, two negroes and an East Indian from Bengal. Proceeding by Sault St. Mary, French River and the Ottawa, Mr. Cox reached Montreal on September 19th, five months and three days from the date of leaving the Pacific coast.

(7) *Travels of Mr. D. W. Harmon*, 1800—1819.

Mr. Daniel William Harmon left Lachine on April 29th, 1800, in company with several other officers, under an engagement of seven years service with the North-West Company. They passed Sault St. Mary on May 30th, reached Grand Portage on June 13th, and Lake Winnipeg on August 10th. In November he was at Swan River post; on October 23rd, 1801, he mentions having met Mr. William Henry at this place. From 1802 to 1807, Mr. Harmon was stationed at Fort Alexandria, Lac la Biche, Qu'Appelle, Dauphin, Swan River, Rainy Lake, Bird Mountain and Cumberland House. In 1807 he made a journey to Fort Duncan, on the north shore of Lake Nepigon, where he spent the winter. In 1808 he set out for the far west, reached Lake Winnipeg on August 1st, Cumberland House on August 12th, and Fort Chipewyan on September 7th. He here met Simon Fraser, on his return from the Pacific coast. The same year he reached Dunvegan on Peace River. From 1809 to 1819, Mr. Harmon was engaged at various points in the Peace River region and in New Caledonia to the west of the Rocky Mountains. In 1810 we find him at Rocky Mountain Portage Fort; in 1811, at Stuart Lake; in 1813, at McLeod Lake; in 1814, at Fraser Lake. It does not appear that Mr. Harmon ever reached the Pacific coast; he however passed eight and a-half years on the western side of the Rocky Mountains. The description of his travels and experience accords with the other expeditions related in this paper.

Mr. Harmon finally left McLeod Lake on May 8th, 1819, and arrived at Fort William, Lake Superior, on August 18th, the same year, *en route* for Montreal.

Harmon's Journal, published in 1820, furnishes an interesting narrative of a fur trader's life in these early days. He gives a full and entertaining account of the Indian tribes with which he came in contact on both sides of the Rocky Mountains.

(8) *The Travels of Mr. Alexander Ross*, 1811—1825.

Mr. Alexander Ross, one of the twenty-eight Canadians who landed at the mouth of the Columbia in 1811, has related his adventures during the fifteen years he remained on the Pacific coast, and given a narrative of his expedition across the continent. Mr. Ross was in Upper Canada when he was invited by Mr. Alexander McKay, the senior partner, to join the Pacific Fur Company, then being organized by Mr. Astor. He proceeded with several Canadians to New York, and there embarked for the mouth of the Columbia, with thirty-three different persons, all but three of whom were British subjects. Mr. Ross was present when Astoria was established, and when David Thompson, of the North-West Company, arrived there a few weeks later. He describes the circumstances which led, in the following summer, to the breaking up of the Pacific Fur Company, and the transfer of the

stores, merchandise and buildings to the North-West Company. He informs us, that after Astoria had remained in possession of the latter company for about four weeks, it was taken possession of by the officer in command of H. M. S. "Racoon," in the King's name, and changed from Astoria to Fort George. Four months later Mr. Ross entered the service of the North-West Company, and proceeded to the duties assigned him in the interior. He spent the following twelve years trading with the Indian tribes, amongst whom he had many adventures, and not a few hair-breadth escapes. In the spring of 1825, in company with Sir George Simpson, he set out to cross the mountains. They followed the Columbia to the Great Bend, known as "Boat Encampment;" they ascended by the Athabasca pass to a small lake to which the name of the "Committee's Punch Bowl," was given. On reaching the main source of the Athabasca, they followed the current of that river to Fort Assiniboine; here they changed canoes for horses, and struck south-easterly across the country for Edmonton. At this post they remained two weeks, during their stay a grand ball was given in honor of Governor Simpson. The party left by a brigade of boats to float down the swift Saskatchewan. They halted at Fort Carleton and Cumberland House. At the latter place they found the Franklin advance party; further down the river they met Captain Franklin and Dr. Richardson on their overland Arctic expedition. The travellers reached Lake Winnipeg and visited Norway House, then a place of considerable business and activity. At this place the traders, on their return from the posts of the company, from Lake Superior on the south, the Rocky Mountains on the west, and Mackenzie River on the north, annually collected the fruits of their labour, to be dispatched to York Factory on Hudson Bay. After remaining two weeks at Norway House, Mr. Ross made the passage of Lake Winnipeg, and early in July, 1825, reached the Red River settlement where after a varied and eventful life he established himself. In 1849 he published a volume describing the career of the Pacific Fur Company, its operations, reverses and final discomfiture; and in 1855 a second narrative of his adventures among the Indian tribes west of the Rocky Mountains.

(9) *Travels of Mr. John McLeod*, 1822—1826.

After the union of the Hudson's Bay Company with the North-West Company, in 1821, Mr. John McLeod was the first officer to cross the Rocky Mountains from the east.

Mr. McLeod entered the service of the old Hudson's Bay Company in 1811, and for the ten years previously to the union of the two, he was a zealous participant in the contest with the North-West Company. He was detailed to accompany and assist Lord Selkirk's first brigade of colonists from York Factory to Red River, and he established trading posts at a number of places in the prairie region, to intercept the trade of the rival company. Mr. McLeod, when selected by the united companies to proceed to the west side of the Rocky Mountains, was stationed at Green Lake, about 200 miles north of Fort Carlton. He set out in 1822, with his wife and two young children. He reached Athabasca River, and crossed the mountains by the Athabasca pass to the Columbia, and descended the river to its mouth. In the following years he was engaged at different posts in trade operations; during this time he left Kamloops, followed the Thompson, and descended the Fraser to the Strait of Georgia. Mr. McLeod was in the Columbia district when it was decided to change the headquarters of the company. Fort

George was open to some objections, and another site was finally selected on the northern bank of the river, about a hundred miles from the mouth. At this point a new central post was established, in 1825, on a large and permanent scale, called in honour of the famous navigator, Fort Vancouver. The new headquarters of the company were placed on the northern bank of the river, in order that it might be indisputably on British soil; there was no probability at that date of the international boundary being established to the north of the Columbia.

In March, 1826, Mr. McLeod left Fort Vancouver to proceed eastward. He was accompanied by Mr. Edward Ermatinger and Mr. Douglas, the distinguished botanist. The crew consisted of sixteen men, two of whom were Sandwich Islanders. Their route took them to Okanagan and Spokane. They ascended the Columbia to Boat Encampment, the river at the time being much obstructed by ice. The mountains were crossed by the Athabasca pass, then covered with deep snow, and, with much difficulty and some danger, the party reached Jaspar House on May 5th. Here he was detained owing to the confinement of his wife, which had taken place in February, the family having proceeded thither the previous October. On horses being sent forward from Edmonton, they continued their journey, and reached that station on May 17th. From Edmonton they embarked in the spring brigade of boats to follow the river Saskatchewan and the chain of waters to Hudson Bay. They reached York Factory in July, having crossed the continent in three months and twenty days. Mr. McLeod was in the service of the Hudson's Bay Company when he died, in 1849, at the age of sixty-one.

(10) *Expedition of Sir George Simpson*, 1828.

The expedition of Sir George Simpson, in 1828, is remarkable in every point of view. As resident governor of the Hudson's Bay Company he made frequent visits to the territory of Rupert's Land and the Northwest, in order to examine into the condition of the several posts, and superintend the affairs of the company over which he presided. On this occasion he resolved to travel from Hudson Bay to the Strait of Georgia.

Leaving York Factory, he ascended Hayes River, passing through what was known as the boat route to Lake Winnipeg, at the northern end of which is Norway House. Skirting the north shore of the lake, he passed to the Saskatchewan, which he ascended to Cumberland House. From this point he went northward through the chain of lakes and streams until he reached Churchill River, which he followed to the height of land, Methye Portage. By Clearwater River, he entered the Athabasca, following its waters to Athabasca Lake and Peace River. He ascended Peace River, passing through the main Rocky Mountain chain and, with the aid of horses, he crossed the plateau, a distance of eighty-three miles, to Fort St. James, on the east of Stuart Lake. Sir George Simpson was careful on all occasions to enter the forts he visited with his men, clean and dressed in their best. He carried with him a piper, who also acted as his servant. In this instance the same ceremony was observed; a gun was fired, the bugle sounded, and the piper led the march. There was a meeting to be held here of the chief officers, among whom Mr., afterwards Sir, James Douglas, the first Governor of British Columbia, was present, and, amid a discharge of small arms, Mr. Douglas went out to meet Sir George. Mr. Conolly, the chief factor of the Pacific department, was also expected. He had not arrived. Shortly,

however, after the arrival of the governor, a canoe appeared on the lake, and in twenty minutes, amid a salute of firearms, Mr. Connolly entered the fort.

Sir George Simpson left Hudson Bay on July 12th; Mr. Connolly, the Pacific on July 12th. A singular coincidence, says Chief Factor Archibald McDonald, who in his journal records the meeting.[1]

Sir George Simpson passed from the lake to Stuart River and the Fraser, which he descended to Fort Alexandria. Horses were taken at this place and the country crossed to Kamloops, a distance of 215 miles.

At Kamloops, water navigation was resumed, and the start was made in a canoe with twelve paddles. After passing through Lake Kamloops to its outlet, they entered the Lower Thompson, which they descended to its junction with the Fraser. From this point they reached tide water by the same route as that followed by Simon Fraser twenty years earlier. They left Kamloops early on October 6th, and reached Fort Langley, on the Fraser, about twenty-five miles from its mouth, on the 10th, the distance being 264 miles.

The whole journey from York Factory took ninety days, of which sixteen were passed at the trading posts; consequently the whole time *en route* was seventy-four days. One remarkable feature of this journey was the short time in which it was made. Sir George was well-known for his rapidity of movement. Ninety miles a day was no uncommon occurrence with him. The canoes would start at 2 in the morning, with rests for breakfast, dinner and supper. The men paddled until a late hour, which the long days of the northern latitudes permitted, sometimes until 8 or 10 at night. The average distance made was fifty miles a day. In some instances seventy-five, eighty, and even ninety miles were covered. The journey recorded was made across the continent from tide-water of the Atlantic to the Pacific. It was carried out without any of the accessories of modern locomotion, in so short a time that, if the facts were not sustained by indisputable evidence, the record might be considered an exaggeration.

Sir George Simpson was a man of great force of character, with much administrative ability. He was indefatigable in the discharge of his duties, and his frame was one capable of enduring great fatigue.

(11) *Travels of Mr. David Douglas*, 1825—1834.

The distinguished botanist and traveller, Mr. David Douglas, spent a number of years in the country on the Pacific coast, extending from Oregon northward. In 1824 he started from England by sea, and reached Fort Vancouver on the Columbia, in April, 1825. Mr. Douglas is mentioned by Chief Trader John McLeod, as a fellow-traveller up the Columbia in 1826. In that year he crossed the Rocky Mountains; reached Hudson Bay, where he met Sir John Franklin, and returned with him to England.

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[1] This journey, under the title, Peace River; a Canoe Voyage from Hudson Bay to the Pacific, in 1828, was published in Ottawa in 1872. The work is edited by Mr. Malcolm McLeod, son of the Chief Trader John McLeod above referred to. He passed many years of his youth in the Northwest, and crossed the mountains twice with his father before he reached the age of six. Mr. McLeod has added many valuable notes describing the customs and habits of the *voyageurs;* his information, regarding the geography of much of this still but partially known region, is equally important and interesting.

In the autumn of 1829, Mr. Douglas again sailed from England for the Pacific coast of North America. Between the date of his arrival and 1834, his explorations extended generally through the country drained by the Columbia and the Fraser. The two last years of his life were devoted to scientific examinations in British Columbia.

In his travels through the country he obtained the knowledge of many plants, birds and mammals hitherto unknown; his discoveries include the "Douglas fir," which will always bear his name.

David Douglas was born at Scone, Perthshire, in 1798. His end is much to be deplored; he was gored to death by a wild bull in the Sandwich Islands, July 12th, 1834.

(12) *Explorations and Travels of Mr. Robert Campbell*, 1830—1843.

Among the adventurous men sent out by the Hudson's Bay Company, to explore the country beyond the Rocky Mountains, Mr. Robert Campbell takes a prominent place. The field of his operations was mainly in the territory to the north of British Columbia, still only imperfectly known.

Mr. Campbell was born at Glenlyon, in Scotland; he left home on June 1st, 1830, under an engagement with the Hudson's Bay Company. He landed at York Factory, and proceeded to Fort Garry. He was variously employed until the spring of 1834, when he was transferred to the Mackenzie River district. In 1838 he established a trading post at Dease Lake, one of the sources of the river Liard, an important tributary of Mackenzie River. On this occasion he passed over to Stikeen River, which flows into the Pacific near Fort Wrangle, now well known in connection with the "Cassiar" gold fields of British Columbia. In 1840, Campbell travelled up the northern branch of the Liard. Leaving Fort Halkett on the latter river in May, with seven men he ascended the branch several hundred miles into the mountains to a lake which he named Lake Francis; and some distance further, to a second lake, in about latitude 62° N. longitude 130° W., which he called Lake Finlayson. From this point he passed to the western slope, and in two days' travel he discovered a wide stream which he styled the river Pelly. In 1841 a trading post was established on Lake Francis. In 1843, Mr. Campbell left Lake Francis, recrossed the mountain to Pelly River, which he descended for some distance. This river discovered by him proved to be identical with the Yukon which flows into the Pacific far north. Three hundred miles from the sources of the Pelly, Fort Selkirk was established, and the river was explored by Campbell 700 miles to Fort Yukon, established in 1846 by J. Bell of the Hudson's Bay Company, 150 miles within the Alaska boundary. From Fort Yukon, situated almost directly on the Arctic circle and about 145° W. longitude, Mr. Campbell ascended the river Porcupine to its eastern sources, crossed the height of land to Peel River, a small tributary of the Mackenzie, not far from its outlet in the Arctic Ocean. Following the tributary to the main stream, he ascended Mackenzie River to Fort Simpson, his starting point at the mouth of the Liard.

In 1852-53 Mr. Campbell made a remarkable journey from the Yukon territory to England. He left White River, near the Alaskan boundary, on September 6th, ascended the Pelly to one of its sources, crossed the mountains to a branch of the Liard, which he followed to Fort Simpson, at which place he arrived on October 21st. Winter having set in, he started on snowshoes to make a journey to Crow Wing, on the Mississippi, extending

over sixteen degrees of latitude and twenty-seven degrees of longitude. He had with him three men and a train of dogs ; these were changed at the Hudson's Bay posts on his route as he arrived at them. His course lay by Great Slave Lake, Lake Athabasca, Ile à la Crosse, Carlton House, Fort Pelly, Fort Garry and Pembina. On March 13th, Mr. Campbell reached Crow Wing, where he obtained horses for the journey to Chicago. From Chicago he started eastward and arrived at Montreal on April the 1st, and such was his dispatch that he was enabled to report himself in London at the Hudson's Bay House on the 18th of that month. From his starting point on the Pelly-Yukon, Mr. Campbell had made a continuous journey of 9,700 miles, nearly half of which was through an uninhabited wilderness, and of this distance some 3,000 miles were passed over in the dead of winter and much of it walked on snowshoes. In the annals of the Hudson's Bay Company's service, long winter journeys under circumstances similar to the one described are not uncommon. Possibly the long tramps of the intrepid Dr. Rae in 1851, and of Admiral Sir Leopold, then Commander, McClintock, in 1853, both in connection with the Franklin Search expeditions are to some extent comparable with them.

Mr. Campbell, the discoverer of the Pelly-Yukon, the largest river flowing into the Pacific from the American continent, is still living, and enjoys excellent health, on his ranch in Manitoba. He is one of the last representatives of the great explorers of the Hudson's Bay Company under the old regime. His name comes close to the end in the long list of active and undaunted men who, from the days of Mackenzie, traversed the mountains, and unknown wilds ; it would be difficult to find their peers in courage and endurance in any service.

In 1887-88 the field of Mr. Campbell's discoveries was visited by Dr. G. M. Dawson, of the Geological Survey. Dr. Dawson entered the interior from the Pacific coast by the river Stikeen, passed over to the Liard, and thence to the Pelly-Yukon. He returned by the river Lewis to the Lynn canal on the coast. The journey proved exceedingly fatiguing and not a little perilous. His associates, Messrs. McConnell and Ogilvie remained in the district to carry on astronomical observations and field explorations during the following winter and summer.

(13) *Sir George Simpson's Journey round the World,* 1841.

Sir George Simpson having resolved to travel round the world, left England on March 3rd, 1841, and landed at Boston, whence he made his way to Montreal. His outfit was completed at Lachine, the headquarters of the Hudson's Bay Company in Canada. The expedition started from that village on 4th May ; on the 16th of the month the party arrived at Sault St. Mary. After some detention by ice on Lake Superior, Sir George reached Thunder Bay ; and ascended by the Kaministiqua to the height of land. He traversed the chain of lakes and rivers to Lake of the Woods, and arrived at Fort Alexander, near the mouth of the river Winnipeg on June 8th. On the third day following, Sir George Simpson was at Fort Garry, having accomplished the journey of 2,000 miles in thirty-eight days.

There was an ordinary trail from Fort Garry to Edmonton. It passed from point to point across the prairie, and was used by the Red River carts for the transportation of merchandise. It was not always in good condition, but was easily followed along the

banks of the Assiniboine to Fort Ellice, thence to Fort Carlton, Fort Pitt and Edmonton. On July 23rd, Sir George left Edmonton, taking a south-western course. He crossed Battle River and Red Deer River and two branches of Bow River. Ascending by a tributary of the latter, he gained the height of land at the Kananaskis pass in about 50° 30′ latitude. Descending a tributary of the Kootenay to the main river of that name, the party directed its course to Kulispelm Lake, the source of Pend d'Oreille River which was followed to the Columbia.

At no great distance, south of the present boundary line, the then Hudson's Bay post of Fort Colville was situated. "Here then," writes Sir George, "terminated a long and laborious journey of nearly two thousand miles on horseback, across plains, mountains, rivers and forests. For six weeks and five days we had been constantly riding, or at least as constantly as the strength of our horses would allow, from early dawn to sunset, and we had, on an average, been in the saddle about eleven hours and a half a day. From Red River to Edmonton, one day's work with another amounted to about fifty miles, but from Edmonton to Colville, we more generally than otherwise fell short of forty."

From Fort Colville, the Columbia was descended by canoe. The travellers passed the Company's post of Okanagan and reached Fort Vancouver. From Fort Vancouver, Sir George crossed to Puget Sound, where, on September 6th, he embarked on board the company's steamer the "Beaver," and passed up the Strait of Georgia on a tour of inspection to the various trading ports. He proceeded as far north as Sitka, and reached the quarters of the Russian America Company at New Archangel. He left on September 30th, and returned to Fort Vancouver, whence he travelled to San Francisco, Monterey and St. Barbara. The latter place he left on January 27th, to visit the Sandwich Islands. He returned to Sitka, whence he took ship to continue his remarkable journey. In the voyage he skirted Kamschatka to reach a more western point on the Asiatic coast. He traversed Siberia to gain western Russia, and at St. Petersburg embarked for England. This portion of his journey has no bearing upon his passage across the American continent, but it is worthy of mention as indicating the energy of character and tenacity of purpose which characterized the man.

Period II.—From Oregon Treaty in 1846 to Confederation in 1867.

The Oregon Treaty of 1846, with the United States, and the passage of the Imperial Act, establishing the Dominion of Canada, form epochs of great importance in the history of the northern half of North America.

The first for ever settled an international dispute which had existed for a quarter of a century, and had awakened feelings on both sides of bitter hostility. It was a turning point in the career of the Hudson's Bay Company; the commencement of a series of events owing to the influence of which the old regime was to pass away. The second was the genesis of a new order of things. It gave birth to Canada as a Dominion, with a national status and with a territory of semi-continental magnitude.

The time which intervened between the Oregon Treaty and the establishment of the Dominion by the British North America Act may be considered as a period of transition. During these twenty-one years we have records of at least eight expeditions from the

St. Lawrence to the western side of the Rocky Mountains. These expeditions, and the objects in view, no longer partook of the character which distinguished the explorations and journeys undertaken during the preceding half century. The Hudson's Bay Company and its officers ceased to be exclusively and actively connected with them.

(1) *Mr. Paul Kane's Travels*, 1846—1848.

Mr. Paul Kane, of Toronto, had studied art in Europe, and returned to Canada with the determination to devote his time and talents to the completion of a series of paintings illustrative of Indian life and character.

Mr. Kane obtained an interview with the governor of the Hudson's Bay Company, Sir George Simpson, who entered cordially into the project, and gave directions to the company's officers to facilitate the artist's movements in every way. He set out from Toronto in May, 1846, his design being, whenever an opportunity offered, to make portraits of the principal chiefs in their native dress, and characteristically to represent on canvas the Indian tribes and the scenery of the almost unknown country.

Mr. Kane was enabled to travel to the Northwest with a brigade of canoes of the Hudson's Bay Company, which he joined on Lake Superior. About midsummer he reached Red River; he passed northerly by Lake Winnipeg to the Saskatchewan, which river he ascended to Edmonton. Early in October he left Edmonton, passing by way of Fort Assiniboine, on the Athabasca, to Jaspar House; thence he crossed the mountains by the Athabasca Pass to Columbia River, down which stream he made a rapid descent of fifteen days to Fort Vancouver, reaching that place on December 8th.

Fort Vancouver, on his visit, contained two chief factors, ten clerks, and two hundred *voyageurs*. The fort was further enlivened by the presence of the officers of H.M.S. "Modeste," which had been on the station for two years.

The artist remained at Fort Vancouver until the beginning of January, when he proceeded southward some distance up the river Willamette. He then found his way northward to Puget Sound and Vancouver Island. Here, among various Indian tribes, he spent the summer of 1847. In the autumn he returned to the Columbia, and by the ascent of that river, the route usually followed, he reached Edmonton in December, meeting with hardships and suffering on the journey owing to the lateness of the season. The following spring Mr. Kane passed down the Saskatchewan. At Cumberland House, on June 12th, he met Sir John Richardson and Dr. Rae on their way to Mackenzie River in search of Sir John Franklin. He reached Toronto early in October, 1848.

A full account of Mr. Kane's journey and experience is graphically given in a volume published in 1859, "Wanderings of an Artist among the Indians of North America, from Canada to Vancouver Island and Oregon." Some of Mr. Kane's pictures are to be seen at the Speakers' residence, in the House of Commons, Ottawa; the greater number of them are in the private collection of Senator Allan, Moss Park, Toronto.

(2) *Travels of Earl of Southesk*, 1859-1860.

In the spring of 1859, the Earl of Southesk accompanied Sir George Simpson by way of St. Paul, Minnesota, to Red River. He left Fort Garry in June on an expedition to the

mountains; the route followed was the trail to Edmonton. From Edmonton he proceeded westward to the river McLeod, which he ascended into the heart of the mountains. In gaining the height of land, he followed the eastern slope of the mountains to the sources of Bow River, which he descended until he met the Edmonton trail which Sir George Simpson passed over in 1841, and which Lord Southesk followed. Returning by way of the North Saskatchewan, Forts Carlton and Pelly, he reached Fort Garry in January, 1860. From Fort Garry he passed by way of Minnesota to New York and took passage for England. In 1875 a volume was published with a narrative of Lord Southesk's travels and adventures.

(3) *Explorations of Captain Palliser and his Associates*, 1857—1860.

The explorations of Captain Palliser took place in 1857–60, under instructions from the Imperial Government. He ascended the St. Lawrence, and traversed the lakes to Fort William, where his examination may be said to have commenced. He was assisted by several well known scientific men, among whom may be named Dr. Hector and Lieutenant Blakiston, Mr. John W. Sullivan and M. Bourgeau. The examinations made by the expedition extended from Lake Superior to the Okanagan Lakes in British Columbia, and from the frontier of the United States northward to the sources of the chief rivers which flow to the Arctic Ocean.

In the summer of 1857, the attention of Captain Palliser was directed to that portion of the country lying between Lake Superior and the prairies. The examination was continued up Red River to Pembina, up the Assiniboine to Fort Ellice, and up the Qu'Appelle to the elbow of the South Saskatchewan thence across the country to Fort Carlton on the North Saskatchewan. The members of the expedition arrived at this place in October, and their winter quarters were established here. From Fort Carlton, Captain Palliser started for Fort Garry, the United States and Canada, to return the following spring. Dr. Hector made a winter journey from Fort Carlton up the North Saskatchewan to Fort Pitt, Edmonton and Rocky Mountain House. He also penetrated the first range of mountains.

At the commencement of the summer of 1858, the various branches of the expedition set out from Carlton to examine the Eagle Hills, Battle River, Red Deer River and Bow River districts. The latter stream was followed to the mountains along the route on which the Pacific Railway is to-day constructed. The Vermilion and Kananaskis passes were examined and the sources of Kootenay River reached. Dr. Hector returned by Kicking Horse River, and explored in the general direction of the mountains to the Brazeau range, and from the sources of the North Saskatchewan he followed the course of that river to Edmonton. Traces of the wearisome journeys, made by him in this and the following years, are everywhere to be met by the railway traveller in the names of mountains and rivers between Calgary and the Columbia. Captain Palliser extended his journey to the boundary of the United States, and returning northerly reached Edmonton in September. Dr. Hector reached that post in October.

In January, 1859, Dr. Hector left Edmonton on a journey to the mountains. He made his way by the usual means of travelling in winter to Jaspar House, thence to the Athabasca pass. Returning to Edmonton in April, he immediately left for Fort Pitt. Captain

Palliser started in May for the forks of the South Saskatchewan and Red Deer River, and thence to the district near the United States boundary. He crossed the mountains by the Kootenay pass, followed Kootenay River to Fort Shepherd and Fort Colville; and from Fort Shepherd he made excursions to the westward. On reaching Fort Colville, Dr. Hector descended the Columbia to the sea.

The reports of the Palliser expedition, presented to the Imperial Parliament in 1863, furnish detailed narratives of the explorations undertaken by the several branches of the survey, with maps showing the routes followed from Lake Superior to the mountains and likewise through the mountains. These documents contain much scientific and general information respecting the central prairie regions, and they throw light on an immense territory previously but little known. The information furnished by this expedition gives indication of the great agricultural and industrial possibilities of vast areas of the interior of British North America. Captain Palliser's report is also remarkable for his adverse recommendation to the British Government in respect to opening up the country for settlement,[1] and for the positive opinion given by him as to the impracticability of constructing a railway through British America to the Pacific. He considered that the whole prairie region north of the 49th parallel was completely isolated and practically unapproachable both from east and west.[2]

(4) *Journey of Mr. M. Lawrin*, 1860.

Mr. M. Lawrin, an old miner, left the forks of Quesnelle, in the Cariboo country, on August 15th, 1860, to cross the mountains to the east. His party consisted of four persons besides himself, and they carried away with them $1,600 in value of the precious metal from the Cariboo "diggings." The little party ascended Fraser River by canoe to its source at Yellow Head Lake. Abandoning the canoe as it could be of no further service, they crossed the Rocky Mountain "divide" at the Yellow Head pass, to the rivers Myette and Athabasca, following the latter to Jaspar House; proceeding by the trail they found their way to Edmonton and Fort Garry, and finally reached St. Paul, on the Mississippi.

(5) *Journey of Dr. A. P. Reid and others*, 1861.

So far, we have had no record of any party or person, other than the officials and explorers of the Hudson's Bay Company entering British Columbia by the Yellow Head or Athabasca passes. Immigrants, attracted by the gold discoveries, generally reached the

[1] "I therefore cannot recommend the Imperial Government to countenance or lend support to any scheme for constructing or, it may be said, forcing a thoroughfare by this line of route either by land or water, as there would be no immediate advantage commensurate with the required sacrifice of capital; nor can I advise such heavy expenditure as would necessarily attend the construction of any exclusively British line of road between Canada and Red River settlement." Palliser's Report, p. 6.

[2] "Still the knowledge of the country, on the whole, would never lead me to advocate a line of communication from Canada across the continent to the Pacific, exclusively through British territory. The time has now for ever gone by for effecting such an object, and the unfortunate choice of an astronomical boundary line has completely isolated the Central American possessions of Great Britain from Canada in the east, and also almost debarred them from any eligible access from the Pacific coast on the west." *Ibid.* p. 6.

famed Fraser River by the sea. The few who went overland from the east, struck away from the Saskatchewan to the southward of the international boundary, and entered either by Fort Colville and Portland, or by Fort Colville and Similkameen. Dr. A. P. Reid and five others started to find their way by one of these routes. They left Fort Garry on June 13th, 1861; they travelled by way of Fort Ellice, Carlton, Fort Pitt and Edmonton; turning southward, they crossed Bow River and, by a southern pass, reached Kootenay River. They were weak in numbers and had only an imperfect idea of the difficulties of the route; in consequence, they suffered much hardship, fell short of food, and reached Fort Colville in great distress on November 26th.

(6) *Migration of a large party of Canadians*, 1862.

The discovery of gold on the Fraser exercised a powerful influence on the history of British Columbia; so that in 1860 a considerable population had assembled within the province, all, or nearly all of whom, was engaged in mining. The first rush to the gold mines was in 1858; the rich discoveries made in 1861 on William's Creek, caused a second immigration. The excitement resulting from the bountiful presence of the precious metal extended in all directions, so that men gathered from every quarter. In 1862 it influenced many adventurous natures in Ontario to visit the scene of the discovery, in the hope of bettering their fortunes. Many hundreds went round by Panama. A large company was formed to find its way overland; it consisted of 193 men, made up of detachments from Queenstown, St. Thomas, Huntington, Ottawa, Toronto, London, Montreal, Huron and a few from Ogdensburg. They left their homes during the month of April, to rendezvous at St. Paul, Minnesota. From St. Paul they proceeded, by Burbank's stages, to Red River, which they descended, by the steamer "International," to Fort Garry.

At Fort Garry they completed their organization for the journey. Their number was increased to two hundred by the addition of seven persons from the Red River settlement, among whom were Mr. and Mrs. Schubert and three small children. The expedition left Fort Garry on June 2nd; it formed a train consisting of about ninety Red River carts, each drawn by an ox. There were also about fifty saddle horses with the party. The journey across the plains was necessarily slow, and they only came in sight of Fort Edmonton on July 21st, having accomplished some 900 miles of their journey from Fort Garry, without any serious hardships having been encountered.

At Fort Edmonton they exchanged the carts for pack saddles, and left for the mountains on July 29th. Their route was by the ordinary trail, imperfectly defined, through forest and swamp to Jaspar House, and thence up the valleys of the Athabasca and Myette to the Yellow Head pass, where the river Fraser takes its rise; following which they reached Tête-Jaune-Cache on August 28th. Here those constituting the party were unable to decide as to the route they should follow. It was finally agreed to divide into two parties, each division to act independently of the other and follow the direction it might select. Both of them left Tête-Jaune-Cache on the same day, September 2nd. The larger number made rafts by which they descended the Fraser, which at this point flows north-westerly. Those who trusted to the river had many mishaps and underwent suffering, but they arrived at the mouth of the Quesnel on September 11th. They lost

three men by drowning, Robertson, Carpenter and Leader; another died, a young Englishman named Patterson, who succumbed to exposure, and was buried at Fort George.

The second division of the party, about sixty in number, endeavoured to cross the mountains in a westerly direction to Cariboo, but they were deterred by the immense labour experienced in forcing a passage across the mountains and the difficulty of penetrating through the heavy timber in the valleys. They turned in a southerly direction, and succeeded in reaching the North Thompson. They here constructed large rafts to descend the stream. They killed some of their horses, and "jagged" the meat, cutting it in strips and drying it. The remainder of the horses, about forty or fifty, they abandoned, and putting all their effects on the rafts, they proceeded to descend the swift current of the river. As they approached what is called the Grand Rapid, at the head of the fifteen-mile canyon of the Thompson, the leading raft was engulfed in the torrent before those navigating it were aware of the danger; and two men were drawn within the rapids and drowned. The rafts which followed avoided the fate of that before them: by great effort those on board reached the shore in safety, and, with labour and difficulty, forced their way up the precipitous banks. They managed to clamber along the cliffs to the lower end of the canyon, where they formed a second set of rafts and proceeded to shoot the lower rapids; they arrived eventually in great distress at Kamloops on October 11th. On the following morning, Mrs. Schubert, who accompanied this branch of the expedition, gave birth to a daughter.[1] The two men drowned in the Thompson were Wm. Strachan, of London, Ontario, and Frank Penwarden, of St. Thomas.

Of the 193 who left Ontario in 1862, the survivors now resident in British Columbia, as far as known, are J. A. Mara, Mr. and Mrs. Schubert, A. McNaughton, John Bowron, W. Fletcher, D. Simpson, Robert Heron, R. B. McMicking, W. H. Thompson, W. McKenzie, W. Halpenny, Geo. C. Tunstall, D. McQuarrie, R. H. Alexander, Capt. Redgrave, A. McConnell, J. B. McQueen, W. Fortune and J. Fannin, curator of the Provincial Museum at Victoria. The four last named, with Mr. and Mrs. Schubert, came down by the Thompson. The writer is chiefly indebted for information to Mr. Fannin.

There is a record of a third party which, late in the autumn of 1862, arrived at the Yellow Head Pass. It consisted of three brothers named Rennie and two men named Helstone and Wright. They obtained canoes from the Shuswap Indians to descend the Fraser. The canoes being found bottom upwards with the effects of the men strewn along the banks, led to the belief that they had been drowned. The terrible fate of three of the men became afterwards known. In the descent of the river the men had lashed the canoes together for safety, but they were swamped in a rapid; two of the Rennies gained the shore, the other three men succeeded in reaching a rock. An attempt was made during two days to rescue them. Finally they were hauled ashore, prostrate with fatigue and hunger, and from the frost which prevailed at night, they were so frost-bitten as to be unable to proceed. The two who retained their strength, cut a large quantity of firewood, and, leaving as much of the provisions as they could spare to their comrades, who were to remain behind, they started to obtain help at Fort George, which they imagined to be nearer than was the case. It was not until the twenty-eighth day that they arrived at the fort, frost-bitten, half-dead with hunger and fatigue. Some Indians were at once

[1] The child born on this occasion is now the wife of a well known settler in British Columbia.

despatched to rescue the unhappy men left behind. They returned in a few days, explaining that, owing to the depth of the snow, they were unable to proceed. The writer will leave Dr. Cheadle to relate the conclusion of this painful narrative.

"Other Indians, however, discovered the party some time afterwards. Helstone and Wright were still alive, but, maddened by hunger, had killed Rennie. When they were found they had eaten all but his legs, which they held in their hands at the time. They were covered with blood, being engaged in tearing the raw flesh from the bones with their teeth. The Indians attempted to light a fire for them, when the two cannibals drew their revolvers, and looked so wild and savage that the Indians fled and left them to their fate, not daring to return. The following spring a party of miners, on their way to Peace River, were guided by Indians to the place where these men were seen by them. The bones of two were found piled in a heap, one scull had been split open by an axe, and many of the other bones showed the marks of teeth. The third was missing, but was afterwards discovered a few hundred yards from the camp. The skull had been cloven by an axe, and the clothes stripped from the body, which was little decomposed. The interpretation of these signs could hardly be mistaken. The last survivor had killed his fellow-murderer and eaten him, as shown by the gnawed bones, so carefully piled in a heap. He had in turn probably been murdered by Indians, for the principal part of the dead man's property was found in their possession" (p. 322).

(7) *Travels of Lord Milton and Dr. Cheadle*, 1862—1863.

No Pacific expedition has attracted greater attention than that of Lord Milton and Dr. Cheadle; that such was the case may be attributed to the literary ability with which the narrative was written. The travellers arrived at Quebec in the spring of 1862, and made their way, without loss of time, to Red River, but not without some of the unpleasant incidents of such a journey, common enough a quarter of a century back. They narrowly escaped being involved in the massacre, by the Sioux, of the settlers in Minnesota, through which State they passed; and in their canoe voyage down Red River they had to undergo serious privation and incur danger.

They left Red River to proceed to Edmonton, but the season being late, they decided to winter at White Fish Lake, eighty miles beyond Carleton. They reached Edmonton in May, 1863. Here they were advised against following the route by the Yellow Head pass, but the Canadian party, the preceding year, having travelled by it, they determined to follow the trail which so large a party must have left the traces.

They started from Edmonton on June 8th, 1863. They had with them an Indian, known in the narrative as "the Assiniboine"; he was accompanied by his wife and their son, a boy of thirteen. The Assiniboine had but one hand; nevertheless he was an excellent hunter, of undaunted courage and unfailing resource. The guide, Baptiste, whom they had engaged, with a "Mr. O'B.," completed the party, which thus consisted of seven persons. The latter individual had drifted westward to Edmonton, possibly with the Canadian party. He was a Cambridge man, with a good knowledge of classics, but the most shiftless and useless of human beings. No one could have been more out of his element, on such a journey. Mention of him threw doubt upon the narrative, but the

writer of this paper, from information obtained at Edmonton and British Columbia in 1872, can testify that Mr. O'B. was not a creation of fancy, but that he existed in the flesh.

At the elbow of McLeod River, Baptiste deserted, but the journey was persevered in. The travellers experienced great difficulties, and suffered the hardships incident to a journey through that rugged country; possibly the obstacles would not have been found so trying to men experienced in backwoods life. They continued on the trail of the travellers of the previous year, and on June 29th reached Jaspar House. On July 17th they were at the Yellow Head pass. Occasionally they lost the trail, but the intelligence of the Assiniboine invariably regained it.

They had no definite objective point in British Columbia, and had considered it advisable to follow the route taken by the Canadians, as the trace of it was not wholly obliterated. At Tête-Jaune-Cache it led them to the southward, where the timber became heavier, the obstruction greater, and the route more difficult to follow. Finally they arrived at the spot where the Canadians had made rafts to descend the Thompson, and from this point they were compelled to proceed over untrodden ground.

They could not retreat or leave the deep valley they had entered, so they continued to follow the river. Their hardships and great privations now really commenced, and except for the indomitable spirit which sustained them, and the resources of the Assiniboine, they must have succumbed. Those familiar with their published narrative, may remember their account of the headless Indian sitting upright as a mummy, with a tattered blanket, by the dead ashes of a fire, with the bones of a horse and a few utensils beside him.[1] The sight came upon them all as a painful warning of what might be their own fate, a slow death by starvation. They were, however, sustained by the hope that they would ultimately reach some settlement. Soon afterwards they were disheartened by the one hand of the Assiniboine becoming disabled. The woman took her husband's place in cutting out the way. They passed the first three weeks of August in the struggle to advance, worn out with fatigue, weak from want of food, and with the prospect before them of death by hunger. They killed their two horses one after the other to supply their want. Pressing forward day by day, on August 18th they came on the traces of human beings. Some bushes had recently been cut, a few "blazed" trees succeeded, and they met some Indians who gave them food. Their prowess in eating astonished even the Indians, who are not given to surprise at feats of this description.

Finally they reached Kamloops, and for some days the whole party could think of nothing but eating. From Kamloops they found their way to New Westminster and Victoria. They returned to the mainland and passed up to Lilloet, Quesnel and Richfield, to visit the Cariboo gold-diggings.

Lord Milton and Dr. Cheadle returned to England by the way of California, Panama and New York. A narrative of their adventures appeared in 1865, "The North-West Passage by Land," which has passed through several editions.

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[1] The reader is referred to Dr. Grant's book, Ocean to Ocean, p. 275, where the record is made of the burial of these remains, June 5th, 1872. The head was found 150 yards up the bank of the river. The skull was brought to Ottawa, and was lost in the fire of the Canadian Pacific Railway offices in the following year.

(8) *Journey of Dr. John Rae*, 1864.

The year following the expedition of Milton and Cheadle, Dr. John Rae, already distinguished as an Arctic trveller, undertook an overland journey to the Pacific. From the east he found his way to Fort Garry, arriving there on June 16th, 1864, and leaving on the 26th he took the route by Fort Pelly to Edmonton. On August 7th he reached the river McLeod, whence he passed to the Athabasca. Following the route taken by Milton and Cheadle, through the Yellow Head pass, he arrived at Tête-Jaune-Cache on August 23rd. Here his Indian guides, having heard of the extremely dangerous character of the rapids, refused to descend the Fraser.

Dr. Rae resolved to proceed without the Indians. He succeeded in purchasing two small dug-out canoes from the Shuswaps, a few of whom he met at this place, and accompanied by Richard Turner, Henry Mackenzie and a third man, he left Tête-Jaune-Cache on August 27th. On the fourth day of their descent they reached a dangerous rapid at which there are two portages of considerable length. It was known that disasters had occurred on this part of the river, but all the members of the party were experienced canoe men, and Mackenzie, with great courage, led the way in the smallest canoe. On the 31st, they ran another dangerous rapid many miles long, in which several men had been drowned in previous years. On September 1st they reached Fort George. From the ill-omened reputation of the section of the river above that station, their safe arrival caused astonishment to the chief trader, Mr. Charles; for it had been thought that, owing to the intricate and dangerous navigation, no stranger unaccompanied by a guide could successfully make the descent.

On September 3rd, Dr. Rae left Fort George, taking with him an Indian guide and one white man. They made the descent to Quesnel, nearly a hundred miles, in one day. On the 4th, accompanied by one man, he paddled down to Alexandria, a distance of thirty-five miles, in less than five hours. From Alexandria, he followed the road to Richfield, the centre of the mining district. Returning to Alexandria, he obtained horses, and rode to Yale, where he took the steamer to New Westminster.

Period III.—From Confederation to completion of Canadian Pacific Railway in 1885.

An important change in the annals of Canada begins with the British North America Act. By the Imperial statute, the several British Provinces eastward of Lake Superior were united to form one confederation, and at the same time provision was made for the occupation of the Northwest Territory and the entrance of British Columbia into the Dominion. The union of the Pacific province with the provinces in the eastern part of the continent, necessitated the establishment of a line of communication between them, and the construction of the Canadian Pacific Railway was the consequence. The act of union passed the Imperial Parliament and came into force in 1867; British Columbia entered the Confederation in 1871. Between these dates the Government of Canada purchased the territorial rights of the Hudson's Bay Company. In consequence of the policy adopted to carry out the conditions of the union, there has been a succession of expeditions to the

new province on the Pacific. Within a period of fourteen years from the entrance of British Columbia into the Dominion, we have a record of eighteen overland journeys, most of which were undertaken in connection with the establishment of the national railway.

(1) *Sir Hector Langevin's visit to British Columbia*, 1871.

A journey was made to British Columbia by Sir Hector Langevin. It does not strictly come within the list of Canadian overland expeditions, inasmuch as it was made by railway through the United States to San Francisco, thence by steamboat to Victoria. It is chiefly remarkable as the first journey undertaken by a Canadian minister to the newly acquired western province of the Dominion. In the summer of 1871 the Minister of Public Works, visited the Pacific coast on behalf of the Government, with the view of acquiring some information concerning the new province, especially in relation to the Pacific Railway and its western terminus. His duty was to enquire into the requirements of the western province, and personally to ascertain what public works were imperative. To fulfil the mission assigned him, he visited Victoria, New Westminster, and extended his observations by proceeding to Yale, Lytton, Cariboo, and other localities in the interior of the country. He also made an examination of Bule Inlet, Burrard Inlet, Barclay Sound, Nanaimo, and other points on the coast. Sir Hector Langevin on his return to Ottawa, issued a volume containing an account of his journey and obserservations, in which was included much valuable statistical information.

(2) *Expedition of Mr. Sandford Fleming*, 1872.

Early in 1871 the writer of this paper was appointed engineer-in-chief of the Canadian Pacific Railway. At that time but limited knowledge had been obtained of the immense extent of territory to be explored; and the opinions, which were current regarding it, were not in favor of the possibility of constructing a railway. In 1863 the Home Government presented to Parliament "the journals, detailed reports, and observations relative to the explorations by Captain Palliser of that portion of British North America which lies between Lake Superior and the Pacific Ocean, during the years 1857, '58, '59 and '60." In these documents the opinion had been strongly expressed that the impediments to railway construction were insuperable.[1]

On January 24th, 1871, the Legislative Council of British Columbia unanimously passed an address to the Queen, praying Her Majesty to admit British Columbia into the Dominion of Canada upon the terms previously arranged. One of the essential conditions was the establishment of a railway "to connect the sea-board of

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[1] Report of the Minister of Public Works to the Canadian Parliament, 1873, p. 53. "It is but ten years since that Captain Palliser, in his report to the Imperial Government, declared the utter impossibility of finding any communication through Canadian territory. . . . . This deliberate and forcibly expressed opinion, the result of four years labour in the field, of a man of eminence, aided by assistants of equal culture, ability and energy, may, with propriety, be quoted to show the formidable difficulties to be overcome in the Pacific Railway line. Difficulties which, until the last three years, have been held to be insuperable, and the solution of which calls for unremitting labour and thought."

British Columbia with the railway system of Canada." The Canadian Government accordingly considered it advisable that the whole distance should be carefully explored, and the writer was instructed to make the necessary organization to carry out the work. The examination was commenced in the summer of 1871 and was continued during the following winter. A large number of surveying parties were engaged between the valley of the Ottawa and the Pacific coast, and in 1872 it became necessary to undertake a general reconnaisance and tour of inspection across the continent.

Previous to starting on the expedition, the writer, as chief engineer of the Intercolonial Railway, then under construction, had to make an examination of that line; this duty necessitated his presence in Nova Scotia. Accordingly his western journey commenced at Halifax.

Great interest being felt with regard to the surveys, it was considered advisable to make known to the public as far as was expedient, the information obtained, so that the problem which the Dominion had undertaken to solve could be the better understood. The writer had the good fortune to induce the Rev. G. M. Grant, of Halifax (now Principal Grant, of Queen's College, Kingston), to accompany the expedition as secretary, with the view of publishing a narrative of the journey.

Leaving Halifax on July 1st, 1872, the party arrived at Thunder Bay, Lake Superior, on July 22nd, and Fort Garry, on July 31st. The plains were crossed to Edmonton, which place was reached on August 27th. At Edmonton a detachment consisting of Messrs. Horetsky and Macoun, was despatched by way of Peace River to the Pacific coast. The main party proceeded to Jaspar House, crossed the mountains by the Yellow Head Pass to Tête-Jaune Cache, and passed southerly by way of the North Thompson to Kamloops, where they arrived on September 28th. From Kamloops they followed the government road to Yale, the head of navigation, and by steamboat reached New Westminster.

After crossing the mountains by the Peace River pass, Mr. Macoun passed down the Fraser to its mouth. Mr. Horetsky found his way to the river Skeena, and arrived at Port Simpson, on January 23rd, 1873.

The writer extended his examination to various points in British Columbia, and returned to Ottawa by way of San Francisco. Full details are given in the Canadian Pacific Railway Report submitted to Parliament. A narrative of the journey by Dr. Grant[1] was published the following year.

(3) *Expedition of Adjutant-General P. Robertson Ross*, 1872.

In July, 1872, Colonel P. Robertson Ross, Adjutant-General of Militia, left Ottawa for the Northwest Territory. His route was by Toronto, Collingwood, and the lakes to Port Arthur. Following the old canoe route to Lake of the Woods, he reached the road to Fort Garry, then lately opened. After visiting Pembina he proceeded to Fort Ellice, Carlton, Victoria to Edmonton and Rocky Mountain House. From this point he passed southward to the Blackfeet country and crossed the Rocky Mountains by the North Kootenay Pass. In his narrative, published in the Militia Report for 1872, he gives

[1] Ocean to Ocean. Sandford Fleming's Expedition through Canada in 1872. By the Rev. George M. Grant.

his views as to the number and character of the Indians in the country traversed. Colonel Robertson Ross reached Wild Horse Creek, on the west side of the main range of mountains, and proceeded southerly *via* Mooyais River, Lake Pend d'Oreille, the Spokane and Snake Rivers to Walla Walla and Walula, in Washington Territory, U. S. The portion of the journey across the mountains was tedious and fatiguing. From Walula he descended the Columbia to Portland, and thence passed northward *via* Olympia and Puget Sound to Victoria, in Vancouver Island, where he arrived on October 28th. Remaining about two weeks in British Columbia, he returned through the United States by way of San Francisco, and by railway to Chicago and Ottawa.

(4) *Travels of General Sir W. F. Butler*, 1872–1873.

General, then Captain, W. F. Butler left England in 1872, and travelled by way of Minnesota to Red River. He found the village of Fort Garry, afterwards to be known as the city of Winnipeg, under the excitement of an election, the first which had taken place. On October 4th he left for the Northwest. Reaching the forks of the Saskatchewan his intention being to make this place a central point from which the buffalo could be hunted, he remained in this neighbourhood until February, when with a dog-train he started for the west and reached Fort Carleton. On the 11th of that month he left Fort Carleton and passed by the way of Methye portage, the river Athabasca and Athabasca Lake to Peace River. He ascended the Peace River valley, followed the Finlay or North Branch to Ominica, and ascended a western tributary to Germansen. From Germansen he passed overland to Fort St. James. Leaving this point on May 25th he travelled southerly to Quesnel on the Fraser, where he arrived on June 3rd. At Quesnel he came within reach of the appliances of civilization to carry him to New Westminster. On his return to England, General Butler published an account of his travels entitled "The Wild North Land, being the story of a winter journey with dogs across Northern North America."

(5) *Expedition of the Boundary Commission*, 1872-1874.

The boundary between British North America and the United States, as described in the Treaties of 1818 and 1846, had been in previous years defined and traced from the Atlantic westward to Lake of the Woods, and from the Pacific eastward to the crest of the Rocky Mountains. There remained to be marked out the intervening distance. In 1872 the British and United States Governments appointed a joint commission to trace the line from Lake of the Woods to the summit of the mountains. The British commissioner was Major-General, then Major, D. R. Cameron, R. A. Mr. Archibald Campbell acted in that capacity for the United States. A staff of scientific officers of both nations with mounted escorts were detailed for the service.

The field operations were begun at Lake of the Woods in the autumn of 1872 and prosecuted to completion during the two following years. A topographical survey was made of the belts of country five miles wide on each side of the line. Iron monuments were planted from longitude 96° to 99° at intervals of a mile; west of the latter point the line was marked by stone pyramids or otherwise at approximate intervals of three

miles, to the summit of the Rocky Mountains, where the line joined that which had been established from the Pacific coast by a similar commission thirteen years earlier.

The boundary line for the greater part of the distance passed through open ground; where forest land was encountered the trees were cut down and a continuous open passage formed. Dr. G. M. Dawson accompanied the expedition as geologist and naturalist. On the completion of the field work, at the end of 1874, he reported the results obtained. The published volume consists of 379 printed pages, replete with information respecting the resources of the entire distance surveyed.

(6) *Journey of Messrs. Jarvis and Hannington*, 1874–1875.

The overland exploration of Messrs. Jarvis and Hannington is worthy of record. They had been engaged in 1874 on a section of the survey of the Canadian Pacific Railway in British Columbia. It being deemed advisable to gain information respecting the Smoky River pass, Mr. E. W. Jarvis was selected for the duty, and at the beginning of winter he received instructions to begin exploration. On December 9th, 1874, with his assistant Mr. Hannington, he left Quesnel on the Fraser for Fort George, to complete his arrangements and obtain an outfit. So soon as the ice was frozen on the rivers, the party, consisting of eight men and six dog trains, started on the hazardous journey across the mountains. They left the Fraser above the Giscome portage, following the North Branch until it terminated in a *cul de sac*. They returned to ascend a second branch and finally reached the continental "divide" on February 25th. After leaving the summit, the dogs became unserviceable from frostbites and exhaustion, so that each man was compelled to carry on his back a share of the necessary supplies, leaving behind everything not absolutely required. They were also placed on short rations. The party crossed an extremely broken mountainous region intersected by tributaries of the Smoky and Athabasca Rivers. The snow was deep, the temperature low and the weather unusually stormy in the elevated region they passed over. They were on the verge of starvation and every member of the party suffered greatly from fatigue and exposure. Nevertheless they succeeded eventually in reaching Jaspar House on March 5th to find it unoccupied. They, however, in their exhausted condition were fortunate in meeting in the neighbourhood a band of Indians who supplied them with some provisions—all they could spare from their meagre store. The weary travellers continued their journey eastward over 200 miles to St. Anne, which they reached in twelve days. Here they found rest and food under the hospitable roof of a Hudson's Bay Company's establishment. From St. Anne they drove to Edmonton, thence to Fort Pitt and Carlton and arrived at Winnipeg on May 21st.

The journey from Fort George to Winnipeg occupied 116 days, the distance being 1887 miles, of which 932 miles were traversed on snow-shoes. The temperature was at times exceedingly low. For twenty consecutive days in January the thermometer averaged 37 degrees below zero. Mr. Jarvis' narrative of the journey is included in the Canadian Pacific Railway Report of 1877. Mr. Hannington's diary is given in the report of Canadian Archives for 1887 (pp. cx, cxxxii.)

(7) *Expedition of Major-General Sir Selby Smyth*, 1875.

In July, 1875, Major-General Sir Selby Smyth, commanding the militia, made an official trip through the Northwest Territory. On the 2nd of the month he left Sarnia by steamboat for Duluth, Lake Superior, and proceeded to Fort Garry by Moorhead and Red River. He travelled on wheels to Shoal Lake, where he was met by a division of the Mounted Police, under the escort of which he went to Swan River and to Carlton. The party followed the trail to Fort Pitt, Victoria and Edmonton, thence to Battle River and Red Deer River. At Bow River General Smyth had a conference with the Blackfeet Indians. He passed to Fort McLeod and Old Man's River, a tributary of Bow River. When in this locality, he crossed the frontier to pay his respects to the general officer of the United States commanding in Montana, who was stationed at Fort Shaw. Returning to Fort McLeod he proceeded westward through the Kootenay pass to "Joseph Prairie," where, parting from the Mounted Police, he travelled southward to Walla Walla. He was here met by General Howard of the United States army, hospitably entertained, and escorted for several days down the valley of the Columbia. His journey was continued to the city of Portland, and through Washington Territory to Puget Sound, where he took the steamer for Victoria, Vancouver Island.

(8) *Travels of the Marquis of Dufferin*, 1876—1877.

On July 31st, 1876, the Marquis of Dufferin and Ava, then Governor-General of Canada, accompanied by the Marchioness, proceeded by the Central Pacific Railway to San Francisco. They were there met by H.M.S. "Amethyst," and steamed to Victoria. Lord Dufferin was everywhere received with the respect due to his character and station. He visited Nanaimo, and after inspecting the coal mines, travelled northward to Bute Inlet, Skeena River, Queen Charlotte Islands, and arrived at Port Simpson. He returned south to Burrard Inlet. On September 6th he started up the stream of the Fraser; he reached Yale, and continued his journey to Kamloops. Returning to New Westminster, he again crossed the Strait of Georgia to Victoria, and performed the ceremony of driving the first pile of the Esquimault graving dock. Lord Dufferin left by the "Amethyst" for San Francisco, and returned to Ottawa.[1]

The following year Lord Dufferin proceeded, by the way of St. Paul, to Winnipeg, where he received addresses, and where festivities were interchanged. On September 29th he addressed a large assembly at the banquet given him. During his stay in Manitoba, Lord Dufferin went as far as the Mennonite settlement on Rat River. He also visited the Icelandic settlement, and proceeded up Lake Winnipeg in the steamer "Colville" to the mouth of the river Saskatchewan.

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[1] Although political digressions in no way come within the objects of this paper, the writer takes upon himself to refer the reader to Dr. Stewart's work on the administration of Lord Dufferin, in which his speeches on the occasion of this visit to British Columbia are preserved. The time was one of great excitement, and Lord Dufferin's political ability was never more apparent.

(9) *Journey of Mr. Marcus Smith*, 1877.

Mr. Marcus Smith, crossed the continent in 1877, on a tour of inspection of the Canadian Pacific Railway surveys. He had been engaged for some years in extended explorations in British Columbia, but on each of his former expeditions he travelled by San Francisco and the Union Pacific Railway. On this occasion he left Ottawa on May 24th, passed by the lakes to Port Arthur, thence by steamboat and railway, by St. Paul, to Winnipeg. On July 2nd he started from Winnipeg to cross the plains, by way of Fort Ellice. On the 26th he reached Fort Carleton; making a detour to Lac la Biche, he arrived at Edmonton on August 13th. Mr. Smith with his party followed the recently improved trail to Jaspar House and Yellow Head pass, which point he reached on September 7th. Two days later he writes at Tête-Jaune-Cache, "Just as we were arriving, a man, W. Roxburgh, came running wildly towards us; he had been nearly two years in charge of that depot all alone, seldom having seen a human being, even an Indian, during that time. He had read all the books in his possession over and over again; had caught fish till he hated the sight of one; had tried gold-mining with a little success; had shot bears, one of which he only lamed and seeing it crawling around the depot, he took pity on it and fed it; it came regularly, and at last grew so tame that it became his only friend and companion." Mr. Smith continued his journey southward, by the rivers Albreda and North Thompson, to Kamloops. From this station he followed the ordinary route to Yale, where he arrived on September 23rd, the fourth month from the day he left Ottawa. From Yale he took the steamer for New Westminster, and returned home by way of San Francisco and the Union Pacific Railway.

(10) *Expeditions in connection with the Geological Survey*, 1871-1879.

Since British Columbia became part of the Dominion no year has passed without explorations being carried on in the Pacific Province by the officers of the Geological Survey. The chief director, Dr. Selwyn, has frequently made examinations in the territory and has crossed and re-crossed the Rocky Mountains. In 1871, having reached Victoria by way of Chicago and San Francisco, he left in July for the mainland. He followed the valley of the Fraser to Lytton, passed on to Kamloops, and by the North Thompson and the Albreda travelled to Tête-Jaune-Cache. He reached Yellow Head pass on October 21st. Returning by the same route he arrived at Victoria on November 29th, and Montreal on December 26th. For the four years 1871 to 1874 Mr. Richardson was engaged in the geological examination of Vancouver and Queen Charlotte Islands. In 1873 Dr. Selwyn crossed the plains from Red River to the Rocky Mountains and returned by the North Saskatchewan. In 1873 Dr. Bell examined the country between Red River and the South Saskatchewan, and in 1874 the district between Lakes Manitoba and Winnipegoosis.

In 1875 Dr. Selwyn made an extended exploration of that part of the country formerly known as New Caledonia. He followed the trail to Fort Fraser on Stuart Lake, thence he proceeded across to Fort McLeod near the source of Peace River. On July 3rd he left Fort McLeod and descended Peace River. On July 11th, after passing the mouth of Finlay River, Dr. Selwyn ascended a mountain 4,590 feet above his camp, and 6,220 above the

sea. He passed up Pine River, following the stream as far as his canoe would float. He returned to Fort St. John and descended Peace River to Dunvegan; proceeding down stream to the forks, he ascended and partially explored Smoky River. This proved the limit of Dr. Selwyn's expedition, and he returned by the route he had followed. The result of his labours is embodied in the Geological Report of 1875-76.

Prof. Macoun, who accompanied Dr. Selwyn, continued the exploration from the mouth of Smoky River to Lake Athabasca; thence he proceeded eastward by the Methye portage and along the ordinary route of the Hudson's Bay Company to Carleton, and returned to Ottawa by way of Winnipeg. The result of Prof. Macoun's exploration is given in "Geological and Geographical notes" for the year 1875.

In 1875 Dr. G. M. Dawson commenced his labours in British Columbia by making an examination east of the lower part of the river Fraser. The following year he made explorations in the basin of the Blackwater, Salmon, Nechacco Rivers and Francois Lake. The same season Mr. Richardson continued the examination of the coal fields of Nanaimo and Comox.

In 1877 Dr. Dawson devoted his time to an extended geological survey of southern British Columbia, and the following season to an examination of Queen Charlotte Island. Dr. Bell spent the summer of 1878 in the country bordering on the Churchill and Nelson Rivers, and three years later he made examinations in the Athabasca and Mackenzie Rivers regions. In 1879 Dr. Dawson accompanied Messrs. Cambie, McLeod and Gordon from Port Simpson, on the Pacific, through northern British Columbia and the Peace River country to Edmonton. From Edmonton, crossing the plains to Winnipeg, he reached Ottawa.

The services performed by the geological staff have been highly important, and deserve the most respectful mention. The volumes which have annually appeared relate in detail the results of the several explorations, and fully establish the value of the examinations which have been carried on, equally in the interest of general science and in making known the economic materials which are found in the territory.

(11) *Travels of the Marquis of Lorne and the Princess Louise*, 1881–1882.

In the summer of 1881, the Marquis of Lorne, then Governor-General of Canada, started on a journey through the Northwest Territory. Part of the Canadian Pacific Railway between Lake Superior and Winnipeg was then under construction, and the rails were laid from both ends, leaving an intervening gap at that date of about seventy miles. Lord Lorne reached Port Arthur by steamer, passed over the railway some 230 miles by a construction train to the end of the track. From this spot the journey was chiefly by canoe through a series of lakes and water channels until he reached the completed railway, by which he travelled to Winnipeg.

From Winnipeg, Lord Lorne travelled westward 115 miles by rail to a point where other means of locomotion became necessary. Here he was met by an escort of the Mounted Police under Major Crozier, and thus attended in his further journey, he proceeded over the plains on horseback to the North Saskatchewan, thence to Red Deer district, Calgary and Bow River. Lord Lorne crossed the frontier east of the mountains, and passed into the United States as far as Fort Shaw in Montana. He

reached this point in September, and returning eastward through Dacota, he revisited Winnipeg on his way to Ottawa, where he arrived after an extended journey of seven weeks in the Northwest, most of the time being at night under canvas.

The following year (1882), with H. R. H. the Princess Louise, he visited British Columbia. Lord Lorne and Her Royal Highness travelled by Niagara and Chicago to San Francisco, arriving on September 13th. They embarked on H. M. S. "Comus" for Victoria, where they landed on the 20th. After a week of ceremonial observances, Lord Lorne and the Princess left for New Westminster on the 29th. Princess Louise returned to Victoria, while Lord Lorne ascended the Fraser to Yale by steamer, thence he proceeded by the old Cariboo road to Kamloops in the interior, returning by the same route.

On October 7th, the Vice-regal party reëmbarked on the "Comus" for San Francisco. While on the Pacific coast they visited St. Barbara and St. Angelo; after which they returned to Ottawa.

(12) *Second Journey of Mr. Sandford Fleming*, 1883.

In the summer of 1883, the writer of this paper was induced to undertake an examination of the route, which has since been located through the Rocky Mountains, for the Canadian Pacific Railway, and on which the line has been constructed. Being at the time in England, he crossed the Atlantic and on his arrival at Halifax proceeded to Lake Superior. At this date the railway was completed from Lake Superior as far west as Calgary; consequently only a few days were required to arrive at the base of the mountains. When at Winnipeg the writer had the good fortune to meet his old travelling companion, Principal Grant, whom he had invited to accompany him. At Calgary, horses were obtained to cross the mountains as far as any trail could be found. The party followed Bow River to the continental "divide" where the waters flow eastward and westward to the Atlantic and the Pacific. They descended by Kicking Horse valley to the Columbia, and after following that river for about thirty miles, ascended the Selkirk range of mountains by the valley of Beaver River and descended on the western slope by the valley of the Ille-celle-waet to the second crossing of the Columbia. The journey was continued across the Eagle pass to the Shuswap Lakes. In many portions of the route the trail was difficult to follow, until finally, in the Selkirks, all vestige of a trail ceased. The horses were consequently unable to be taken further, and the party was compelled to go onwards without them. Like other travellers, similarly situated, those who made this journey experienced difficulty and anxiety; they however succeeded in reaching Kamloops and proceeded in the usual way to New Westminster. It is worthy of note that this was the first connected expedition through the mountains, in fact the first continuous journey on the actual route of the railway as established from Lake Superior to the Pacific coast. Dr. Grant wrote several papers in the Toronto 'Week' describing it. The writer's experience was embodied in a volume published the year following.[1]

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[1] England and Canada, a summer tour between Old and New Westminster, 1884.

(13) *Explorations in connection with the Canadian Pacific Railway*, 1871-1884.

Early in 1871, the negotiations for the admission of British Columbia into the Canadian confederation took such a form that the successful termination of them was foreseen. The construction of the Pacific Railway was a prominent condition in the articles of union, and in consequence preparations for explorations on a comprehensive scale were commenced. Surveying parties were organized, so as to take the field on the opening of the lakes and rivers. On July 20th of that year the admission of the western province into the Canadian Dominion was consummated; on that day the first detachment of engineers left Victoria, Vancouver Island, to commence explorations between the coast and the Rocky Mountains. The vast territory intervening between the valley of the Ottawa and the Pacific coast, which now became the field of survey, extended within its extreme limits over fifty-four degrees of longitude and ten degrees of latitude. The chief obstacle to be overcome lay in the mountain region to the west and the woodland region to the east, and it became necessary to explore long stretches of trackless and uninhabited territory, portions of which so far as we have any record to show, had never been penetrated by civilized man.

During the season of 1871 twenty-one surveying parties were placed in the field, and their operations were continued from year to year. The examinations were much interrupted during the winter, although as far as practicable the work of exploration was carried on both in winter and summer. It would not be possible within the limits of this paper to give even a faint outline of the detail of these years of labour. The results are fully embodied in the several volumes of engineers' reports annually submitted to Parliament. As a rule the work of each party in the field was confined to a particular district and rarely partook of the character of a "through" expedition. The engineering corps engaged in the mountain region usually made their way to British Columbia by railway to San Francisco and thence by steamer, returning to Ottawa by the same route. Some individual members of the service who passed overland through the Dominion have been specially mentioned; the following may likewise be referred to.

In 1879 Messrs. Cambie and McLeod, accompanied by Dr. G. M. Dawson and Rev. D. M. Gordon, left Ottawa by way of San Francisco, for the northern parts of British Columbia. By steamer they arrived at Port Essington, at the mouth of the Skeena, on June 6th, and immediately commenced the ascent of the river by canoe. In two weeks they reached the forks of the Skeena. Leaving the river, they crossed to Babine Lake, which they followed to its southern end, and thence passed over to Fort St. James, on Stewart Lake, where they arrived on July 8th. Thence by land they followed the trail to Fort McLeod on the Parsnip, a tributary of Peace River. At Fort McLeod, the party was divided. Dr. Dawson proceeded across the mountains by Pine River pass, while the main party descended the Parsnip and Peace Rivers. Explorations were continued on the two routes until the end of August, when the two divisions of the party rejoined at Dunvegan, on Peace River east of the mountains. In September they again divided. Mr. Cambie recrossed the mountains by Pine River Pass, and reached the Pacific coast by way of the valley of the Fraser. The remaining members of the expedition followed different routes to Edmonton, and thence across the prairies to Winnipeg. All arrived at Ottawa at the end of the season. Reports from the several

members of this expedition are fully given in the Pacific Railway Engineer Report for 1880.[1]

Up to 1880 the construction of the Canadian Pacific Railway was directly carried on by the Government; at that period the completion of eight hundred miles, embracing some of the heaviest and most difficult sections of the line, had been assured. In that year it became the policy of Parliament to transfer the whole work to private enterprise, and thus the Canadian Pacific Railway Company came into being. The Company has since, with extraordinary energy, carried the work to completion.

The railway, as constructed through a portion of the mountain region, follows a different route to that previously adopted by the Government. As the directors of the company considered it wise to change the line to a more southern direction, it became indispensable to seek for another pass. For this purpose Major A. B. Rogers with much labour and determination explored the Selkirk Range, and found the pass through which the railway has been constructed.[2]

(14) *Journey of Mr. W. C. Van Horne*, 1884.

In the year 1884, Mr. W. C. Van Horne, at that time general manager and vice-president of the Canadian Pacific Railway, accompanied by Mr. S. B. Reed, C.E., reached British Columbia by way of San Francisco, with the object of inspecting the line of the railway and examining the works in progress in the mountains. On August 9th they left Victoria for New Westminster and Burrard Inlet; they proceeded up the valley of the Fraser to Kamloops; on the 11th they took their departure for Shuswap Lake and the mountains. On the 15th they entered the Eagle pass and reached the Columbia; having crossed that river they passed over the Selkirks by the valleys of the Ille-celle-waet and Beaver. Again reaching the Columbia at its eastern crossing they ascended that river to Kicking Horse River, the valley of which they followed to the summit. Between the Eagle pass and the source of Kicking Horse River, the journey was made partly on horseback and on foot; much of it was exceedingly tedious and fatiguing. On the 21st, they reached the end of track, which had then been laid to the summit in the Rocky Mountains and by train they travelled to Winnipeg. The railway journey was continued by St. Paul to Montreal, and the travellers arrived at that city on August 29th, twenty days after leaving Victoria.

(15) *Journey of Mr. Collingwood Schreiber*, 1884.

As Mr. Van Horne's party emerged from the mountains, Mr. Collingwood Schreiber, Chief Engineer of the Canadian Government Railways, started on the overland journey. He was accompanied by Mr. Pottinger, General Superintendent, and Mr. Archibald, Engineer of the Intercolonial Railway. They proceeded by railway to Oregon, and thence

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[1] See also Mountain and Prairie; a Journey from Victoria to Winnipeg, *via* Peace River Pass, by the Rev. Daniel M. Gordon, B.D., Ottawa, 1880.

[2] The circumstances which led to the discovery of the pass through which the railway is established are alluded to in the work of the writer, England and Canada, pp. 267 and 409.

by rail and steamboat to Victoria, British Columbia. Crossing the Strait of Georgia to New Westminster, they ascended the Fraser to Yale, and proceeding along the line of railway, examining the works under construction, they reached Eagle pass. Thence crossing the Selkirk and Rocky Mountains ranges on the route, already described as followed by Mr. Van Horne the previous month, Mr. Schreiber reached the end of the track at the "divide" between the Kicking Horse River and Bow River valleys; continuing his journey eastward by railway, he returned to Ottawa on September 29th.

(16) *Visit of the British Association to the Rocky Mountains*, 1884.

In August, 1884, the meeting of the British Association was held in Montreal; on the termination of the session the majority of the members who had crossed the Atlantic visited Toronto and Niagara. Of the number, from eighty to a hundred, including some ladies, accepted an invitation to extend their tour to the Rocky Mountains.

They left Toronto on September 6th, and by steamboat passed through Lakes Huron and Superior to Port Arthur, where they took the train for the west. The rails were then laid a few miles over the Rocky Mountain summit, so the travellers proceeded to the end of the track and remained some few hours in the neighbourhood. They actually passed the period of their halt in British Columbia—the crest of the Rocky Mountains being the eastern boundary of that province.

On their return they arrived at Regina on Sunday the 14th. Divine worship was held on this day, the Bishop of Ontario and the Rev. Harry Jones, a member of the British Association from England, officiating. The visitors remained some hours at Gleichen, where they had an opportunity of meeting a large number of Blackfeet Indians. They also made a halt at Winnipeg, where a reception was given them at Government House. They arrived at Toronto on September 19th, after an absence of thirteen days, expressing great satisfaction with the trip. The party included a number of distinguished men. Among them was Dr. Cheadle, who must have contrasted the ease and comfort with which the journey had been made, with his painful experience in crossing the mountains with Lord Milton twenty-one years earlier.

(17) *Journey of Sir Charles Tupper*, 1885.

Sir Charles Tupper, High Commissioner in London, arrived in Canada on August 7th, 1885. After remaining three weeks in the eastern provinces, he left by the Northern Pacific Railway for Portland, Oregon, and thence went to Victoria, British Columbia. His party consisted of Mr. Collingwood Schreiber, Mr. Stewart Tupper, the late Mr. Andrew Robertson, of Montreal, and Mr. Townshend, M.P. After visiting Nanaimo, they crossed to New Westminster and Yale. On October 3rd they left Yale by the recently constructed railway and by train reached the end of the track in the Eagle pass where there remained a gap of forty-seven miles unfinished. Proceeding over the gap on horseback, they met, on September 4th, Lord Lansdowne passing in the opposite direction. On gaining the track laid from the eastward, they took the train for Winnipeg, and by way of Chicago reached Ottawa on October 20th.

(18) *Journey of the Marquis of Lansdowne*, 1885.

The Governor-General, the Marquis of Lansdowne, accompanied by his staff, Lord Melgund and Mr. Anson, left Ottawa on September 24th by the Canadian Pacific Railway, then uninterruptedly available for traffic by the north shore of Lake Superior. At Dunmore, the point of junction of the narrow-gauge coal-railway, His Excellency proceeded to the mines at Lethbridge. From Lethbridge he travelled on horseback to Fort McLeod, and thence to Calgary, where he rejoined the main line of railway. From Calgary, Lord Lansdowne passed by train to the end of the track then at a point in the Selkirks, eighteen miles east of the second crossing of the Columbia. At this point commenced the gap of forty-seven miles of unfinished work referred to. Two days were taken to ride over this section, on the last stage of which he met, as previously stated, the party of Sir Charles Tupper travelling eastward. When the railway track from the west was reached, Lord Lansdowne and his party took the train and followed it to the then terminus, Port Moody, on Burrard Inlet. Crossing the Strait of Georgia to Victoria on October 6th, he was received with every mark of respect, and in his address at the banquet given him, he remarked that until the present occasion no other governor-general had been able to make the journey entirely through Canadian territory. Remaining some few days at Victoria, the party visited the coal mines at Nanaimo; they left on the 14th for New Westminster. The following day they took the train at Port Hammond, and remained over a short time at Yale, Lytton, Drynock, and other points. The party reached the end of the track on the morning of the 17th. They here again resumed the saddle, but in the interval of the thirteen days since they passed westward, the gap had been reduced to twenty-eight miles; this distance was accomplished in one day. The train took the party to Winnipeg, where His Excellency was received by the authorities, and entertained at a banquet. In the speech made by him, like each of his two immediate predecessors on similar occasions, he gave a narrative of what he had seen, and spoke of the bright future, which he confidently anticipated. He reached Ottawa by way of Chicago, on October 26th, having made the double journey in little more than a month. Lord Lansdowne's trip was the first occasion on which the new railway route had been followed in both directions across the mountains on the same overland journey.

(19) *First through train by the Canadian Pacific Railway*, 1885.

The writer has thus described the several overland journeys to the Pacific, undertaken previously to the completion of the Canadian national railway. He has endeavored to make the catalogue complete, and has included every through Canadian journey of which he could find any account. The important epoch is now reached when the necessity for all such expeditions has for ever passed away.

It has been stated that when Lord Lansdowne passed through the mountains on his way homewards, there remained twenty-eight miles of rail track to be laid, to complete the connection through the mountains. Nine days later, on October 26th, the Governor-General arrived at Ottawa.

On the evening of October 27th, when the regular Winnipeg train left Montreal, a

private car, the "Saskatchewan," was attached with the design of proceeding to Port Moody, at that date the terminus—the new city, Vancouver, having no existence. This car, contained seven persons: five came the whole way from Montreal, one of them joined at Ottawa, and one on their way to Port Arthur. A delay of two days took place at Winnipeg; finally the party left Winnipeg on Monday, November 2nd, 1885. The train beyond Calgary became "special;" it reached the western crossing of the Columbia in fifty-six hours after leaving Winnipeg. The gap, however, was not closed; the work having been retarded by incessant rains, so the train could not proceed further. Early on the morning of the 7th the junction was verging to completion, and at 9 o'clock the last rail was laid in its place. All that remained to finish the work was to drive home one spike.

By common consent, the duty of performing the task was assigned to one of the four directors present—the senior in years and influence, whose high character placed him in prominence—Sir Donald Alexander Smith. No one could on such an occasion more worthily represent the company or more appropriately give the finishing blows which, in a material sense, were to complete the gigantic undertaking.[1]

Sir Donald Smith braced himself to the task, and he wielded the by no means light spike hammer with as good a will as the professional track-layer. The work was carried on in silence. Nothing was heard but the reverberations of the blows struck by him. It was no ordinary occasion; the scene was in every respect noteworthy, from the groups which composed it and the circumstances which had brought together so many human beings in this spot in the heart of the mountains, until recently an untracked solitude. Most of the engineers with hundreds of workmen of all nationalities who had been engaged in the mountains were present. Every one appeared to be deeply impressed by what was taking place. The central figure in the group was something more than the representative of the railway company which had achieved the triumph he was consummating. His presence recalled memories of the Mackenzies and McTavishs, the Stuarts and MacGillivrays, the Frasers, Finlaysons, McLeods, McLoughlins, and their contemporaries who first penetrated the surrounding territory. From his youth he had been connected with the company, which for so long had carried on its operations successfully from Labrador to the Pacific, and from California to Alaska. To-day he was the chief representative of that vast organization which, before the close of the last century, had sent out pioneers to map out and occupy the unknown wilderness, and which as a trading association is in the third century of its existence.

All present were more or less affected by a formality which was the crowning effort of years of labour, intermingled with doubts and fears, and of oft-renewed energy to overcome what at times appeared unsurmountable obstacles. Moreover, was it not the triumphal termination of numberless failures, the successful solution of the frequently repeated attempts of the British people, ever since America has been discovered, to find a new route to Asia? To what extent the thoughts of those present were turned to the past must with that undemonstrative group remain a secret with each individual person. This much may be said: to all, the scene was deeply impressive, and especially to the many hundreds of workmen who, from an early hour up to the

[1] The other directors present were Messrs. Van Horne, Harris and the writer.

last moment, had struggled to do their part, and who were now mute lookers on at the single individual actively engaged—at one who in his own person united the past with the present, the most prominent member of the ancient company of "Adventurers of England," as he was the representative of the great Canadian Railway Company.

The blows on the spike were repeated, until it was driven home The silence however continued unbroken, and it must be said that many a more solemn ceremony has been witnessed with less solemnity. It seemed as if the act now performed had worked a spell on all present. Each one appeared absorbed in his own reflections. The abstraction of mind, or silent emotion, or whatever it might be, was however of short duration. Suddenly a cheer spontanously burst forth, and it was no ordinary cheer. The subdued enthusiasm, the pent up feelings of men familiar with hard work, now found vent. Cheer upon cheer followed as if it was difficult to satisfy the spirit which had been aroused. Such a scene is conceivable on the field of a hard fought battle at the moment when victory is assured.

Not unfrequently some matter of fact remark forms the termination of the display of great emotion. As the shouts subsided, and the exchange of congratulations were being given a voice was heard, in the most prosaic tone as of constant daily occurrence, "All aboard for the Pacific." The notice was quickly acted upon: in a few minutes the train was in motion. It passed over the newly laid rail, and amid renewed cheers sped on its way westward.

On the same night a telegram was sent to Ottawa and published in the eastern Canadian newspapers. It ran:—

"The first through train from Montreal is approaching Yale, within a few hours of the Pacific coast. The last spike was driven this morning by Hon. Donald A. Smith at Craigellachie in Eagle pass, three hundred and forty miles from Port Moody; on reaching the coast, our running time from Montreal exclusive of stoppages will be five days, averaging twenty four miles per hour. Before long, passenger trains may run over the railway from Montreal to Vancouver in four days and it will be quite possible to travel on special occasions from Liverpool to the Pacific coast by the Canadian transcontinental line in ten days. All are greatly pleased with the work done. It is impossible fully to realize that enormous physical and other difficulties have been overcome with such marvellous rapidity, and with results so satisfactory."

The train arrived at Port Moody the following morning, November 8th. On the succeeding morning the principal newspapers in England published the substance of the above telegram, with the additional important fact that the first through train from Montreal had actually arrived at the coast.

The party embarked in a steamer to cross to Victoria. They touched near the mouth of Burrard Inlet, the site of the city of Vancouver, then an unbroken forest. In a few hours the vessel entered the Strait of Juan de Fuca; the name of the channel recalled the memory of the Greek adventurer of three hundred years ago, and with it the painful record of the more honest seamen, whose names will for ever be associated with the heroic yet fruitless efforts to discover a new route, in the northern hemisphere, to hold in possession the commerce of Cathay.

It is difficult to believe that to-day the efforts to obtain this result have been crowned with success. It is quite true that the passage for ships, sought for in vain by every

commander from Cabot in the fifteenth to Franklin in the nineteenth century, has not been found; but if it be not possible for a ship to pass from the Atlantic to the Pacific within the limits of the northern hemisphere, the means are now provided for speedily transporting the cargoes of any number of ships from one ocean to the other. The railway journey described from a shipping port on the St. Lawrence to Pacific tide-water, testifies to the fact that the long desired communication is at length established; and if further evidence be needed, it may be found in the circumstance that a consignment of naval stores follows by the next train from the dockyard at Halifax for the use of the Pacific fleet at Esquimault. It would indeed have astonished the illustrious navigators, Drake, Cook and Vancouver, when in this part of the world, to have been told that the time would come when ships on the Pacific coast could have their stores replenished from a naval station on the north Atlantic within a few days interval from the hour of making the requisition.

The members of the party who had made the transcontinental journey remained in Victoria a few days. They left on the return trip on November 12th, and reached Winnipeg on the 15th; after a short delay, they continued the journey to Montreal.

The narrative of the passage of the first train from Montreal to the Pacific completes the record of the expeditions which the writer has endeavoured to describe. It would have exceeded the scope of the enquiry to have referred at any length to the travels of the pioneers who in the early days of French rule were the first to penetrate the unknown western wilderness. A long list of illustrious names in connection with these explorations and adventures will ever be associated with the history of North America; but the briefest outline of their travels would have carried the narrative far beyond the limits of this paper. The writer's object, especially in the second part of the paper, has been to place side by side the several complete journeys which have been made overland between the waters of the two oceans. He ventures to affirm that few more important events are recorded in our history than the first and last of these journeys, between which there is an interval of nearly a century.

On the roll of famous travellers there is no grander figure than the intrepid Scotchman who was the first to cross the continent north of the Gulf of Mexico. Can there be a more fitting subject for an historical painting for the National Gallery of the Dominion, than the incident of his mixing some vermilion with melted grease, and inscribing on the face of the rock on which he had slept his first sleep by the shores of the Pacific, this brief memorial: "Alexander Mackenzie, from Canada by land, the twenty-second of July, one thousand seven hundred and ninety-three"?

Equally appropriate for a painting to hang by its side, is the scene at Craigellachie on the morning of November 7th, 1885, when Sir Donald Smith, spike hammer in hand, is giving the last blow to finish the work of the railway. It marked the close of a long series of events interwoven with the annals of the northern portion of the continent. Can we doubt that the future historian will regard the occurrence, as a turning point in the history of the Dominion, as the beginning of a new page in the life and destiny of the British colonial empire?

Map of North America, on Mercator's projection, to illustrate "Expeditions to the Pacific," by Sandford Fleming.

ROYAL SOCIETY OF CANADA.

TRANSACTIONS

SECTION III.

MATHEMATICAL, PHYSICAL AND CHEMICAL SCIENCES.

PAPERS FOR 1889.

I.—*The Maximum Shear and Bending Moment produced by a Live Load at different points of Horizontal Girder* AB *of span* l. By Prof. H. T. BOVEY, McGill University.

(Read May 31, 1889.)

At any given instant let the load consist of a number of weights

$$w_1, w_2, w_3, \quad . \quad . \quad . \quad . \quad . \quad . \quad w_n,$$

concentrated at points distant

$$a_1, a_2, a_3, \quad . \quad . \quad . \quad . \quad . \quad . \quad a_n,$$

respectively, from B.

Let W_r be the sum of the first r weights.

" W_n " " n weights.

The reaction R_1 at A is given by the equation

$$R_1 l = w_1 a_1 + w_2 a_2 + w_3 a_3 + \quad . \quad . \quad . \quad . \quad . \quad . \quad + w_n a_n,$$

and the shear S_1 at any point P between the rth and the $(r+1)^{th}$ weights, by the equation

$$S_1 = R_1 - (w_1 + w_2 + \quad . \quad . \quad . \quad . \quad . \quad . \quad w_n) = R_1 - W_r.$$

Let all the weights now move towards A through a distance x, and suppose that the first p weights move off the girder, that q of the weights are transferred from one side of P to the other, and that s new weights advance upon the girder.

Denote these new weights by

$$w_{n+1}, w_{n+2}, \quad . \quad . \quad . \quad . \quad . \quad . \quad w_{n+s},$$

and let their distances from B be

$$a_{n+1}, a_{n+2}, \quad . \quad . \quad . \quad . \quad . \quad . \quad a_{n+s},$$

respectively.

Let W_p be the sum of the first p weights.
" T " total weight transferred from one side of P to the other.
" $R_p.l = w_1.a_1 + w_2.a_2 + \quad . \quad . \quad . \quad . \quad . \quad . \quad + w_p.a_p.$
" $R_q.l = w_{r+1}.a_{r+1} + w_{r+2}.a_{r+2} + \quad . \quad . \quad . \quad . \quad . \quad . \quad + w_{r+q}.a_{r+q}.$
" $R_s.l = w_{n+1}.a_{n+1} + w_{n+2}.a_{n+2} + \quad . \quad . \quad . \quad . \quad . \quad . \quad + w_{n+s}.a_{n+s}.$

The reaction R_2 at A with the new distribution of weights is given by the equation,

$$R_2.l = w_{p+1}.(a_{p+1}+x)+w_{p+2}.(a_{p+2}+x)+ \quad . \quad . \quad . \quad +w_n.(a_n+x)+w_{n+1}.a_{n+1}+ \quad . \quad . \quad . \quad w_{n+s}.a_{n+s}$$

$$= (R_1-R_p).l+x.(W_n-W_p)+R_s.l$$

$$\therefore (R_1-R_2).l = (R_p-R_s).l-x(W_n-W_p).$$

The shear S_2, at the same point P as before, is given by the equation,

$$S_2 = R_2-(w_{p+1}+w_{p+2}+ \quad . \quad . \quad . \quad . \quad w_r+w_{r+1}+w_{r+2}+ \quad . \quad . \quad . \quad . \quad +w_{r+q})$$

$$= R_2-(W_r-W_p+T).$$

Hence the shear at P with the first distribution of load is greater or less than the shear at the same point with the second distribution, according as $S_1 >< S_2$

$$\text{or } R_1-W_r >< R_2-(W_r-W_p+T)$$

$$\text{or } R_1-R_2 >< W_p-T$$

$$\text{or } R_p-R_s-\frac{x}{l}(W_n-W_p) >< W_p-T$$

$$\text{or } R_p-R_s-W_p+T >< \frac{x}{l}(W_n-W_p).$$

Corollary.—If no weights advance upon or leave the girder, R_p, R_s, and W_p become severally *nil*, and the last relation reduces to the simple form,

$$\frac{T}{x} >< \frac{W_n}{l}$$

A.—In words, the shear at P with the *first* distribution will be greater or less than the shear at the same point with the *second* distribution, according as the weight transferred, divided by the distance of transfer, is greater or less than the total weight divided by the span.

Again, the bending moment M_1 at P with the first distribution is given by the equation,

$$M_1 = R_1(l-z)-w_1(a_1-z)-w_2(a_2-z)- \quad . \quad . \quad . \quad . \quad -w_r(a_r-z)$$

$$= R_1(l-z)-R_r.l+z.W,$$

z being the distance of P from B.

The bending moment M_2 at the same point P with the second distribution is given by the equation,

$$M_2 = R_2(l-z) - w_{p+1}(a_{p+1}+x-z) - \quad . \quad . \quad . \quad -w_r(a_r+x-z) - w_{r+1}(a_{r+1}+x-z) - \quad . \quad . \quad . \quad -w_{r+q}(a_{r+q}+x-z)$$

$$= R_2(l-z) - R_r - R_p + R_q).l - (x-z)(W_r - W_p + T)$$

Hence,

$$M_1 >< M_2$$

according as

$$R_1(l-z) - R_r.l + z.W_r >< R_2(l-z) - (R_r - R_p + R_q).l - (x-z)(W_r - W_p + T)$$

$$\text{or } (R_1 - R_2)l >< (R_p - R_q).l - x.W_r - (z-x)(W_p - T)$$

$$\text{or } (l-z)(R_p - R_s - \frac{x}{l} \cdot \overline{W_n - W_p}) >< l\left\{ R_p - R_q - \frac{x}{l} W_r - \frac{z-x}{l}(W_p - T) \right\}$$

Corollary.—If no weights advance upon or leave the girder, R_s, R_p, and W_p become severally *nil*, and the last relation reduces to

$$-(l-z).\frac{x}{l}.W_n >< l(-R_q - \frac{x}{l}.W_r + \frac{z-x}{l}.T)$$

Let the rth weight be at the point P in the *first* distribution, and let the distance of transfer be equal to that between the rth and $(r+1)^{th}$ weights.

$$\therefore z = a_r, \qquad x = a_r - a_{r+1}, \qquad T = w_{r+1}, \qquad \text{and } R_q.lw_{r+1}.a_{r+1}.$$

Hence M_1 will be $>< M_1$ according as

$$\text{or } -(l-a_r).\frac{x}{l}.W_n >< l\left(\frac{a_{r+1}}{l}.w_{r+1} - \frac{x}{l}W_r + \frac{a_{r+1}}{l}.w_{r+1}\right)$$

$$\frac{W_r}{l-a_r} \quad \frac{W_n}{l}.$$

B.—In words, the bending moment with the first distribution will be greater or less than that with the second distribution, according as the sum of the first r weights, divided by the corresponding segment, is greater or less than the total weight divided by the span.

NOTE.—Results A and B will be found very useful in determining the maximum shears and bending moments at the panel points of a truss with horizontal chords, subjected to an arbitrarily distributed live load, e.g., a passing train. In such a case,

assuming that the weights are collected at the panel points, and that the distance of transfer is a panel length,

$$\therefore \frac{l-a_r}{l} = \frac{\text{first } r \text{ panels}}{\text{total number of panels.}}$$

Similar results may be obtained when the chords are not horizontal. For example, consider a diagonal between the rth and the $(r+1)^{\text{th}}$ weights, in the case of a truss AB, in which only the lower chord is horizontal.

Let the corresponding panel length of the upper chord produced meet the lower chord produced in the point C.

Let $CA = h$.
" p be the perpendicular from C upon the diagonal in question.
" R_1, R_2, be the reactions at A due to the *first* and *second* distributions, respectively.
" D_1, D_2, be the corresponding diagonal stresses.

Suppose, for simplicity, that no weights either leave or advance upon the girder.

$$\therefore R_1 l = w_1 a_1 + \ldots\ldots + w_n a_n.$$
$$D_1 p = R_1 h - w_1(h+l-a) - \ldots\ldots - w_r(h+l-a_r).$$
$$R_2 p = w_1(a_1+x) + \ldots\ldots w_n(a_n+x).$$
$$D_2 p = R_2 h - w_1(h+l-a_1-x) - \ldots - w_r(h+l-\bar{a}_r-x) \ldots - w_{r+1}(h+l-a_{r+1}-x)$$
$$\ldots - w_{r+q}(h+l-a_{r+q}-x).$$

Hence, $D_1 >< D_2$, according as

$$x(w_1+w_2+\ldots+w_r+w_{r+1}+\ldots w_{r+q})+w_{r+1}(h+l-a_{r+1})+\ldots+w_{r+q}(h+l-a_{r+q})$$
$$>< (R_2-R_1)\cdot h,$$

$$\text{or } x(W_r+T)+R'_q(l+h) >< W_n \cdot x\frac{h}{l},$$

$R'_q(l+h)$ being the algebraic sum of the moments of the weights transferred with respect to C.

If no weights are transferred, this relation reduces to

$$\frac{W_r}{h} >< \frac{W_n}{l}.$$

II.—*Notes on Mathematical Physics.*

By Prof. J. LOUDON, M.A., University of Toronto.

(Read May 7, 1889.)

I.

The relations between the sum of the moments (G) and the virial (V) of a set of co-planar forces may be established as follows :—

The line for which $V = \Sigma(Xx + Yy)$ vanishes may be obtained from the fact that V is equal to the sum of the moments of the forces round the origin when each is turned through a right angle.

Hence if a set of co-planar forces be reduced to a resultant force R at O and a couple G, the line for which the sum of the moments vanishes is, as we know, at a distance $OO' = \frac{G}{R}$ from the plane GOR, whilst the line for which the virial vanishes is parallel to OO' at a distance $OO'' = \frac{V}{R}$. The coördinates of C, the intersection of these two lines, are, therefore, immediately seen to be

$$\frac{VX + GY}{R^2}, \quad \frac{VY - GX}{R^2},$$

where X, Y are the components of R.

Let now C be taken as origin and CO', CO'' as axes. Then C is an astatic centre ; for, on turning each force through any angle θ, the sum of the moments round C becomes

$$\begin{aligned}\Sigma.Pr \sin(\theta + \alpha) &= \operatorname{Cos}\theta\, \Sigma.Pr \sin\alpha + \sin\theta\, \Sigma.Pr \cos\alpha \\ &= 0,\end{aligned}$$

where r is the distance of the point of application of P, and α the inclination of P to r.

C may also be shown to be the astatic centre by compounding the original forces with their equimultiples each turned through a right angle, for which equimultiples the

sum of the moments round C evidently vanishes. Hence the sum also vanishes for the original forces when each is turned through any angle.

Retaining C as origin, the sum of the moments G of the given forces round the point $P(a, b)$ is evidently bR, whilst the virial V is $-aR$. If therefore each force be turned through an angle θ, these quantities become

$$G' = Rb' = R(b \cos \theta - a \sin \theta) = V \sin \theta + G \cos \theta,$$
$$V' = -Ra' = -R(a \cos \theta + b \sin \theta) = V \cos \theta - G \sin \theta,$$

where $(a', b',)$ are the coördinates of P referred to the lines of zero moments and virial for the new forces.

Hence also $G'^2 + V'^2 = G^2 + V^2 \quad R^2(a^2 + b^2)$ varies as CP^2.

II.

When any set of forces are reduced to a single force R at O and a couple G, they may, as is well known, be still further reduced to two forces acting along lines which are perpendicular to each other. This reduction can be readily effected by referring R and G to ordinary polar coördinates, as in the accompanying figure, and by resolving the force and couple into two forces and two couples in such a way that each component force shall be perpendicular to the axis of a component couple.

Thus R at O and G are equivalent to $R \cos \varphi$, $R \sin \varphi$, at O, and the couples

$$L = G \sin \theta \cos \varphi, \quad L' = \sqrt{\cos^2 \theta + \sin^2 \theta \sin^2 \varphi},$$

the axes of which are perpendicular to the forces.

Now $R \sin \varphi$ and L are equivalent to $R \sin \varphi$, parallel to Oy, at a distance from LOy, equal to

$$\frac{L}{R \sin \varphi} = \frac{G \sin \theta}{R \tan \varphi};$$

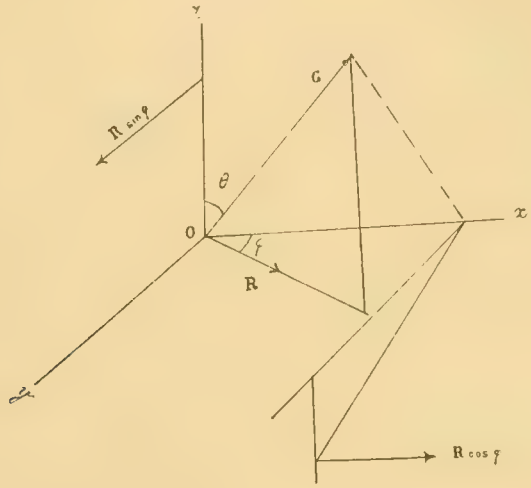
whilst $R \cos \varphi$ and L' are equivalent to $R \cos \varphi$, parallel to Ox, at a distance from $L'xO$, equal to

$$\frac{G \sin \theta}{R \cot \varphi}.$$

Hence the distance between these reciprocal lines of force is

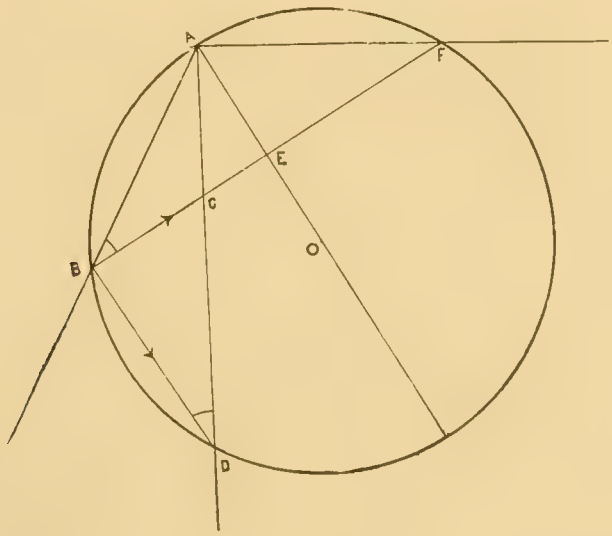
$$\frac{G \sin \theta}{R}(\cot \varphi + \tan \varphi) = \frac{2G \sin \theta}{R \sin 2\varphi}.$$

Evidently the quantities $\frac{G \sin \theta}{R \tan \varphi}$, $\frac{G \sin \theta}{R \cot \varphi}$ also represent the distances of the reciprocal lines from the central axis.



III.

The extreme points of emergence for rays refracted through a prism in a principal plane may be exhibited as in the accompanying figure, where BAD represents the prism, B is the point of incidence, ABC the complement of the critical angle $BAE = EAF$, and the circle is described around BAF. The angles marked at B and D being equal, BD is the last ray which emerges. Thus as the angle of the prism is increased, one point of emergence will always lie on the circle, whilst the other will be the intersection of BC with the second side of the prism; and when the angle of the prism becomes equal to twice the critical angle C and D coincide at F.



III.—*A National Standard of Pitch.*

By Prof. J. LOUDON, University of Toronto.

(Read May 7, 1889.)

When one considers the slow progress of the movement for introducing the metrical system into England and America, it may seem idle to propose the adoption of an international standard of musical pitch. So far as securing government legislation on the subject is concerned, the proposition is doubtless somewhat chimerical; but as the matter chiefly concerns a comparatively small number of persons, the desired end may be attained for all practical purposes by their concerted action. With the hope therefore that such action will ere long be taken by our musicians, instrument makers, and physicists, I beg to present a few facts and suggestions bearing on the subject.

(1.) The first important fact to bear in mind is that the musical standard recently adopted at the Vienna Congress differs from the scientific standard which has been employed so long by acousticians. The former is none other than the French standard of 1859, and is defined as the *A* whose pitch is determined by 870 single vibrations per second at 15° C. This is now accordingly the musical standard for France, and the countries represented at the Vienna Congress of 1885, namely, Austria, Hungary, Italy, Prussia, Saxony, Wurtemburg, Russia and Sweden. Although this adoption of the French standard by so many countries is likely to lead to its being accepted by others, it does not follow that its permanence as an invariable standard is secured. Former conferences have fixed other standards, and it is not improbable that future conferences will recommend some departure from the present standard. Indeed a slight departure has already been taken by Italy. When in Paris two years ago, I learned from Dr. Koenig, the acoustician, to whom I am indebted for a mass of valuable information on this subject, that the normal temperature selected for the Italian standard was 20° C, as he recommended, instead of 15° C—a change which would render the pitch slightly lower (say $\frac{1}{10}$th of a vibration per second). The same course has also been followed in the case of the standard constructed for the Physical Institute, Berlin.

(2.) With regard to the present acoustical standard there have been no conferences. First, suggested by Sauveur in the last century, it has been in use since the days of Chladni, and possesses advantages from a scientific point of view which should secure its permanent adoption by physicists. As established in its most perfect form by Koenig ten years ago, it is defined as ut_3, or the *C* whose pitch is determined by 512 single vibrations per second at 20° C. Its special claim to be recognized as the scientific standard rests on the fact, (1) that it is derived directly from the beat of the second's pendulum by proceeding by octaves, (2) that the octave is the only interval which remains unchanged in all systems of scales, and (3) that *C* is the fundamental note on which musical scales

are based. Accordingly whilst with this standard, the *C*'s of the different systems agree, with the musical standard (*A*) the *C*'s are different. Thus if *A* is 870, the *C* of the natural scale is 522, whilst the *C* of the equally tempered scale is 517·3. These considerations go to show the importance of retaining unchanged the time-honoured acoustical standard. The existence of two standards is not a source of inconvenience, inasmuch as they are used for entirely different purposes; and so long as the designations of notes by musicians and acousticians practically agree, no difficulty can arise.

(3.) With regard to the realization of absolutely correct standards, there were insurmountable difficulties until 1878, when Koenig solved the problem by his device of the clock-fork comparator. By this contrivance an auxiliary standard of low pitch is established, and the actual standard determined by the usual optical method. Thus, for the musical standard, the auxiliary fork is regulated to give 145 single vibrations per second at the normal temperature, and the actual standard (870) is correct when the optical test for 1 : 6 is satisfied. Standards have so far been constructed on this plan for Austria and Italy, and the Physical Institute, Berlin; whilst the original French standard, which was constructed under the superintendence of Lissajous, has been shown to be in error by $\frac{7}{10}$ths of a vibration.[1] In the same way the acoustical standard (512) is determined when the optical test for 1 : 4 is satisfied, the auxiliary fork making 128 vibrations per second at 20° C. This method of establishing a standard possesses accordingly the great merit that the accuracy of the standard may be tested at any time by the aid of the auxiliary comparator.

(4.) From the foregoing facts and comments on the two standards the considerations which should guide us in the selection of a musical standard will be evident. Whilst the standard note should be *C*, as it is in the acoustical system, it should agree with that which is already so largely in use by musicians and instrument makers abroad. As the standard *A* corresponding to 870 gives a *C* of 517·3, the agreement may be secured for all practical purposes by selecting a *C* of 517 or 518. Accordingly it is proposed that the musical standard be the *C* which corresponds to 517 or 518 single vibrations per second at 20° C, whilst the acoustical standard shall remain intact. It is to be hoped that Canadian musicians and physicists will take some action in this matter, and by their coöperation help on a movement which is calculated to put an end to confusion in the musical world, and to secure the important advantages to be derived from adopting a truly universal standard of musical pitch.

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[1] Koenig's Quelques expériences d'acoustique, p. 190.

IV.—*Notes on some Unexplained Anomalies in the Flame Reactions of certain Minerals and Chemical Bodies.* By E. J. CHAPMAN, Ph.D., LL.D.

(Read May 9, 1889.)

The brief notes embodied in this communication refer to some anomalous points in the flame reactions and spectra of certain mineral bodies, at present of doubtful explanation or which remain altogether unexplained. Attention is called to these anomalies in the hope of eliciting a clue to their satisfactory interpretation.

(1.) AXINITE AND TOURMALINE.—Substances in which boracic anhydride is present, commonly impart, it is well known, a green colour to the outer envelope of the Bunsen or blowpipe flame. In the case of Axinite, a silicate containing between 5 and 6 per cent. of B^2O^3, the green flame-coloration is always manifested; but in that of Tourmaline, a silicate in which the amount of B^2O^3 exceeds 9 or 10 per cent., no trace of colour is imparted to the flame unless the mineral be treated with special reagents. There does not seem to be any ready explanation of this anomaly. The amount of silica in each species is comparatively low, and not far from coincident. Axinite, it is true, is an alumino-calcareous, and Tourmaline an alumino-magnesian silicate; but the presence of lime in one case, and its absence in the other, hardly seems sufficient to account for the phenomenon. In the calcarous species Datolite, the coloration of the flame is strongly marked; but it is equally well displayed in the magnesian Boracite. All the later analyses of Tourmaline show a small amount of fluorine, averaging 0·65 to 0·70 per cent., and this should assist in bringing out the flame reaction. In the analyses of Axinite, fluorine has not yet been recorded, but I have recently found distinct indications of its presence in the decomposition of the glass obtained by fusion.

(2.) APOPHYLLITE AND ORTHOCLASE.—These two potassic silicates are here placed in juxtaposition, in order to show the influence of fluorine in flame reactions. Apophyllite contains, or rather yields to analysis, between 5 and 6 per cent. of potash; whilst Orthoclase contains practically 17 per cent. of that component. When moistened, in powder, with hydro-chloric acid, Apophyllite shows in the spectroscope the red line of the potassium spectrum very distinctly and persistently; whereas Orthoclase, with more than three times the amount of potash in its composition, does not under this treatment reveal the slightest indication of potassium. The apparent anomaly may perhaps be explained by the assumption that the potassium in Apophyllite is not in an oxidized condition, but in combination with the 2·9 per cent. of fluorine present in the mineral, forming 6·40 per cent. KF. This view of the composition of Apophyllite is not adopted, however, by all mineralogists. The small amount of fluorine is regarded by some as apparently replacing oxygen, or is looked upon as of little practical moment. In the third edition of Tschermak's "Mineralogie," issued within the present year (1889), for example, the chemical

composition of Apophyllite is said "to agree very nearly with the formula $2H_2O$. CaO. SiO_2, in which a small part of the hydrogen may be assumed to be replaced by potassium." Irrespective however of the part actually fulfilled by its H^2O, the composition of Apophyllite, as confirmed by the spectroscope reaction which forms the subject of the present note, would appear to be more correctly indicated by the formula 4 (CaO, $2SiO^2$, $2H^2O$) +KF.

(3.) The Red Line in the Spectrum of Potassium.—The detection of potassium in the presence of sodium and other bodies by the examination of the flame reaction through a blue glass or a solution of indigo—as indicated by Cartmell, many years ago—whilst effective in the main, does not in all cases give absolutely satisfactory results. But if the flame spectrum of potassium compounds be examined in this manner, no erroneous or indefinite conclusion can by any possibility occur. The red line of this spectrum, when viewed through a deep blue glass, remains altogether unaffected, or stands out in full relief, whilst the yellow line (or double line) of sodium, the orange and red lines of strontium, the red calcium line, and the vivid red line of the lithium spectrum, assuming these bodies to be present also in the substance under examination, are entirely cut off and obliterated. Minerals may thus be conveniently examined for potassium by previous fusion with fluor spar (in default of ammonium fluoride), or with sodium carbonate according to the method recommended by Bunsen for Orthoclase, as the glare of the sodium spectrum and the red calcium line become entirely destroyed and intercepted by the glass—provided, of course, that the colour of the latter be not too pale. The question then arises as to the cause of this phenomenon. The red potassium line referred to, is entirely within the red band of the solar spectrum, coinciding practically with the *A* line of the latter. How, then, does this red line pass through the blue glass, whilst the red lines of lithium, strontium, and calcium are completely absorbed and intercepted? If the blue glass be sufficiently deep in colour, the phenomenon does not appear to be in any way affected by the nature of the coloring matter. Can it be that the red band of the solar spectrum consists really of two bands—a violet-red or claret-red band at the commencement of the visible spectrum, and a red band proper, forming the transition between this and the orange zone?

(4.) Molybdic Anhydride.—Distinct and well marked flame-spectra are exhibited as a rule by all substances which impart a colour to the flame of the blowpipe or Bunsen-burner. Molybdenum compounds, however, form one of the exceptions, and perhaps the most striking exception, to this rule. Molybdic anhydride or tri-oxide, which results during the ignition of these compounds generally, communicates to the flame-border a very distinct and characteristic yellowish-green coloration, but no line-spectrum is manifested. This anomalous result appears to be at present without explanation.

V.—*Cruces Mathematicæ.*

By Prof. N. F. DUPUIS, Queen's University, Kingston.

(Read May 8, 1889.)

I.

AN ELEMENTARY METHOD OF OBTAINING THE DISCRIMINANT OF THE GENERAL QUADRATIC.

This is an elementary algebraic method of obtaining the discriminant of the general quadratic in two variables. Algebraically the discriminant is defined as that function of the coëfficients whose vanishing denotes the possibility of separating the quadratic into two factors linear in x and y.

Two well known methods of finding this function are given; one in Hall and Knight's "Higher Algebra," Art. 127, and both in Charles Smith's "Conics," Art. 37. The present method, which I have never seen published, possesses advantages over those mentioned inasmuch as it gives the forms of the factors into which the quadratic is separable.

Let

$$ax^2+by^2+2hxy+2gx+2fy+c$$

be the general quadratic.

Assume

$$ax^2+by^2+2hxy+2gx+2fy+c=\left(ax+\frac{b}{p}y+s\right)\left(x+py+\frac{c}{s}\right),$$

and equate coëfficients, and we obtain

$$p=\frac{1}{a}\left(h+\sqrt{h^2-ab}\right), \qquad s=g+\sqrt{g^2-ac}.$$

Then denoting

$$\sqrt{h^2-ab} \text{ by } H \text{ and } \sqrt{g^2-ac} \text{ by } G,$$

the factors readily reduce to the form—

$$\frac{1}{a}\left\{ax+y(h-H)+g+G\right\}\left\{ax+y(h+H)+g-G\right\}.$$

Now since the factors do not contain f, we must have by equating coëfficients of linear y,

$$2f=\frac{1}{a}\left(\overline{g+G}\,.\,\overline{h+H}+\overline{g-G}\,.\,\overline{h-H}\right)=\frac{2}{a}\left(gh+GH\right).$$

Whence by substitution—

$$(af-gh)^2=(g^2-ac)(h^2-ab),$$

Or

$$abc+2fgh-af^2-bg^2-ch^2=0.$$

The developments of the series which are the equivalents of a^x, $\sin\theta$, $\tan^{-1}x$ according to ascending powers of the variables are among the most important developments in the whole of mathematics, and usually occur quite early in a student's course. These developments are generally effected through the differential calculus, or by some means employing the method of limits. The latter method involves principles which always seem questionable to a beginner and to which he becomes reconciled only after much thought and many applications. The method here presented is inductive and is free from the seemingly questionable feature mentioned.

It is necessary in what follows to premise the following :—

The symbol C_r^n will denote the number of combinations of n things when taken r together; then from the relation existing between combinations and the binomial series we have :—

$$C_1^n + C_2^n + C_3^n + \ldots\ldots \left.\begin{array}{ll} \frac{1}{2}C_{\frac{n}{2}}^n & n \text{ even} \\ C_{\frac{n-1}{2}}^n & n \text{ odd} \end{array}\right\} = 2^{n-1}-1 \ldots\ldots (1)$$

$$C_1^{2n}+C_3^{2n}+C_5^{2n}+ \ldots\ldots \left.\begin{array}{ll} C_{n-1}^{2n} & n \text{ even} \\ \frac{1}{2}C_n^{2n} & n \text{ odd} \end{array}\right\} = 2^{2n-2} \ldots\ldots (2)$$

$$C_2^{2n}+C_4^{2n}+C_6^{2n}+ \ldots\ldots \left.\begin{array}{ll} \frac{1}{2}C_n^{2n} & n \text{ even} \\ C_{n-1}^{2n} & n \text{ odd} \end{array}\right\} = 2^{2n-2}-1 \ldots\ldots (3).$$

II.

Development of the Exponential Series without the Use of Limits.

To develop a^x, assuming that the development can be expressed in ascending powers of x.

Assume

$$a^x = 1+a_1x+a_2x^2+a_3x^3+ \ldots\ldots a_nx + \ldots\ldots$$

The first term of this assumption is correct; since when x becomes zero, a^x becomes unity.

Taking the property $a^{2x} = (a^x)^2$,

and substituting we obtain,

$$a^{2x} = 1+2a_1x+2^2a_2x^2+ \ldots\ldots 2^na_nx^n+ \ldots\ldots$$

and

$$(a^x)^2 = 1+2a_1x+2a_2 \left| \begin{array}{l} a_1a_1 \end{array} \right| x^2+ \ldots\ldots \left| \begin{array}{l} 2a^n \\ 2a_{n-1}a_1 \\ 2a_{n-2}a_2 \\ \ldots\ldots \\ a_{\frac{n}{2}}a_{\frac{n}{2}} \\ \ldots\ldots \\ 2a_{\frac{n+1}{2}}a_{\frac{n-1}{2}} \end{array} \right| \begin{array}{l} x^n+ \ldots\ldots \\ \\ \\ \\ \ldots\ldots n \text{ even;} \\ \\ \ldots\ldots n \text{ odd.} \end{array}$$

Equating coëfficients of x^n,

$$2^{n-1}a_n = a_n + a_{n-1}a_1 + \ldots\ldots a_{\frac{n+1}{2}}a_{\frac{n-1}{2}}, \qquad n \text{ odd};$$
$$\tfrac{1}{2}a_{\frac{n}{2}}a_{\frac{n}{2}} \qquad n \text{ even}.$$

$$\therefore a_n(2^{n-1}-1) = a_{n-1}a_1 + a_{n-2}a_2 + \ldots\ldots a_{\frac{n+1}{2}}a_{\frac{n-1}{2}}, \qquad n \text{ odd};$$
$$\tfrac{1}{2}a_{\frac{n}{2}}a_{\frac{n}{2}}, \qquad n \text{ even}.$$

Now by equating coëfficients of x, of x^2, etc., we readily find that

$$a_1 = \frac{1}{1\,!}, \qquad a_2 = \frac{1}{2\,!}, \qquad a_3 = \frac{1}{3\,!}.$$

Assume that this law holds up to the coëfficient a_{n-1} inclusive. Then,

$$a_n(2^{n-1}-1) = \frac{1}{n\,!}\left\{\frac{n\,!}{(n-1)\,!\;1\,!} + \frac{n\,!}{(n-2)\,!\;2\,!} + \ldots\ldots \tfrac{1}{2}\,\frac{n\,!}{\frac{n}{2}\,!\;\frac{n}{2}\,!}, \qquad n \text{ even};\right.$$

$$\frac{n\,!}{\frac{n+1}{2}\,!\;\frac{n-1}{2}\,!} \qquad n \text{ odd}.$$

$$= \frac{1}{n\,!}\left\{\begin{matrix} C_1^n + C_2^n + \ldots\ldots \tfrac{1}{2}C_{\frac{n}{2}}^n, & n \text{ even}; \\ C_{\frac{n-1}{2}}^n & n \text{ odd}. \end{matrix}\right\}$$

$$= (2^{n-1}-1)\frac{1}{n\,!} \qquad \text{by (1)}$$

$$\therefore a_n = \frac{1}{n\,!}$$

and the law of the coëfficients, holding good for a_n, is established.

$$\therefore a^x = 1 + \frac{x}{1\,!} + \frac{x^2}{2\,!} + \frac{x^3}{3\,!} + \ldots\ldots \frac{x^n}{n\,!} + \ldots\ldots$$

III.

Expansion of the Sine and Cosine without the Use of Limits.

Development of sin θ in ascending powers of θ.

It is well known that the only legitimate assumption for the expression of sin θ in

terms of θ must have its first term θ and must contain only odd powers of θ. Therefore assume

$$\operatorname{Sin}\theta = \theta + a_3\theta^3 + a_5\theta^5 + \ldots\ldots a_{2n-1}\theta^{2n-1} + \ldots\ldots$$

Now take the relation

$$(\operatorname{Sin}\theta + \sin\varphi)(\sin\theta - \sin\varphi) = \operatorname{Sin}(\theta+\varphi)\sin(\theta-\varphi) \ldots\ldots (4).$$

Then

$$\operatorname{Sin}\theta + \sin\varphi = \theta + \varphi + a_3(\theta^3 + \varphi^3) + \ldots a_{2n-1}(\theta^{2n-1} + \varphi^{2n-1}) + \ldots\ldots$$
$$\operatorname{Sin}\theta - \sin\varphi = \theta - \varphi + a_3(\theta^3 - \varphi^3) + \ldots a_{2n-1}(\theta^{2n-1} - \varphi^{2n-1}) + \ldots\ldots$$
$$\operatorname{Sin}(\theta+\varphi) = \theta + \varphi + a_3(\theta+\varphi)^3 + \ldots a_{2n-1}(\theta+\varphi)^{2n-1} + \ldots\ldots$$
$$\operatorname{Sin}(\theta-\varphi) = \theta - \varphi + a_3(\theta-\varphi)^3 + \ldots a_{2n-1}(\theta-\varphi)^{2n-1} + \ldots\ldots$$

And writing these in (4) and dividing throughout by $\theta^2 - \varphi^2$, which now becomes a factor, and then putting $\varphi = \theta$ the relation becomes

$$\left\{1 + a_3\theta^2 + \ldots\ldots a_{2n-1}\theta^{2n-2} + \ldots\ldots\right\} \cdot \left\{1 + 3a_3\theta^2 + \ldots\ldots (2n-1)a_{2n-1}\theta^{2n-2} + \ldots\ldots\right\}$$
$$= \left\{1 + 2^2a_3\theta^2 + \ldots\ldots 2^{2n-2}a_{2n-1}\theta^{2n-2} + \ldots\ldots\right\}.$$

And equating coëfficients of θ^{2n-2} we obtain

$$(2^{2n-2} - 2n)a_{2n-1} = 2n\left\{\begin{array}{ll} a_{2n-3}a_3 + a_{2n-5}a_5 + \ldots\ldots a_{n+1}a_{n-1}, & n \text{ even} \\ \tfrac{1}{2}a_n a_n, & n \text{ odd}\end{array}\right\}.$$

Now by equating coëfficients of θ^3, θ^5, &c., we readily obtain

$$a_3 = -\frac{1}{3!}, \qquad a_5 = \frac{1}{5!}, \qquad \text{\&c.}$$

Assume that this law of inverse factorials holds up to a_{2n-3} inclusive.

Then a_{2n-3} and a_{2n-5} are of opposite signs, and also a_3 and a_5 are of opposite signs. Therefore $a_{2n-5}a_3$ and $a_{2n-3}a_5$, &c., have all the same sign for the same value of n. And we readily see that this sign is opposite that of a_{2n-1}, and is accordingly expressed by $(-)^{n-1}$.

$$\therefore (2^{2n-2} - 2n)a_{2n-1} = (-)^{n-1}\cdot\frac{2n}{(2n)!}\left\{\frac{(2n)!}{(2n-3)!} + \frac{(2n)!}{(2n-5)!\,5}\right.$$
$$\left. + \frac{(2n)!}{(n+1)!\,(n-1)!}, \qquad n \text{ even};\right.$$
$$\left. + \tfrac{1}{2}\frac{(2n)!}{n!\,n!}, \qquad n \text{ odd}.\right.$$

$$= (-)^{n-1}\frac{2n}{(2n)!}\left\{\begin{array}{ll} C^{2n}_3 + C^{2n}_5 + \ldots\ldots C^{2n}_{n-1}, & n \text{ even} \\ \tfrac{1}{2}C^{2n}_n, & n \text{ odd}.\end{array}\right\}$$

$$= (-)^{n-1}\cdot\frac{1}{(2n-1)!}(2^{2n-2} - 2n), \qquad \text{by (2)}$$

$$\therefore a_{2n-1} = \frac{(-)^{n-1}}{(2n-1)!};$$

and the law of the coëfficients is established.

$$\therefore \operatorname{Sin}\theta = \theta - \frac{\theta^3}{3!} + \frac{\theta^5}{5!} - + \ldots \frac{(-)^{n-1}\theta^{2n-1}}{(2n-1)!} + \ldots$$

The development of $\cos\theta$ may be effected in the same manner as that of $\sin\theta$, by taking the relation

$$\cos 2\theta + \cos 2\varphi = 2\cos(\theta+\varphi)\cos(\theta-\varphi);$$

but it is more readily developed from the relation

$$2\cos^2\theta = 1 + \cos 2\theta \ldots\ldots\ldots \quad (5).$$

It is readily established that the series for $\cos\theta$ must have its first term unity and can involve only even powers of θ. Therefore assume

$$\cos\theta = 1 + a_2\theta^2 + a_4\theta^4 + \ldots\ldots a_{2n}\theta^{2n} + \ldots\ldots$$

Then, substituting in relation (5),

$$2 + 2^2a_2\theta^2 + 2^4a_4\theta^4 + \ldots\ldots 2^{2n}a_{2n}\theta^{2n} + \ldots\ldots$$

$$= 2\left\{ 1 + 2a_2\theta^2 + \begin{array}{l|l} 2a_4 & \theta^4 + \ldots\ldots \\ a_2a_2 & \end{array} \begin{array}{l|l} 2a_{2n} & \theta^{2n} \\ 2a_{2n-2}a_2 & \\ 2a_{2n-4}a_4 & \\ \ldots\ldots & \\ 2a_{n+1}a_{n-1} & \ldots\ldots n \text{ odd} \\ \ldots\ldots & \\ a_na_n & \ldots\ldots n \text{ even} \end{array} \right\}$$

Equating coëfficients of θ^{2n},

$$(2^{2n} - 2^2)a_{2n} = 2^2\left\{ a_{2n-2}a_2 + a_{2n-4}a_4 + \ldots\ldots \begin{array}{ll} a_{n+1}a_{n-1}, & n \text{ odd} \\ \frac{1}{2}a_na_n, & n \text{ even} \end{array} \right\}$$

By equating coëfficients of θ^2, θ^4, &c., we readily find that

$$\therefore a_2 = \frac{1}{2!}, \qquad a_4 = \frac{1}{4!}, \quad \&c.$$

Assume this law to hold up to the coëfficient a_{2n-2} inclusive. Then $a_{2n-2}a_2$, $a_{2n-4}a_4$, &c., have all the same sign, and it is easily seen that this sign is given by $(-)^n$.

$$\therefore (2^{2n-2} - 1)a_{2n} = \frac{(-)^n}{(2n)!}\left\{ \frac{(2n)!}{(2n-2)!\,2!} + \ldots\ldots \begin{array}{ll} \dfrac{(2n)!}{(n+1)!\,(n-1)!}, & n \text{ odd} \\ \frac{1}{2}\dfrac{(2n)!}{n!\,n!}, & n \text{ even} \end{array} \right\}$$

$$= \frac{(-)^n}{(2n)!}(2^{2n-2} - 1) \qquad \text{by (3).}$$

$$\therefore a_{2n} = \frac{(-)^n}{(2n)!};$$

and the law of the coëfficients is established.

$$\therefore \cos\theta = 1 - \frac{\theta^2}{2!} + \frac{\theta^4}{4!} - + \ldots\ldots \frac{(-)^n\theta^{2n}}{(2n)!} + \ldots$$

IV.

Expression of the General Bernoullian Number as a Combinational Determinant.

When the function $\frac{x}{e^x - 1}$ is expanded in the form

$$1 - \frac{x}{2} + \frac{x^2}{2!}B_1 - \frac{x^4}{4!}B_2 + \ldots\ldots (-)^{n+1}\frac{x^{2n}}{(2n)!}B_n \ldots\ldots$$

the quantities denoted by $B_1, B_2, \ldots\ldots B_n$ are called the first, second, n^{th} Bernoullian numbers.

This definition gives directly

$$x = x\left\{1 + \frac{x}{2!} + \frac{x^2}{3!} + \ldots \frac{x^{n-1}}{n!} \ldots\right\}\left\{1 - \frac{x}{2} + \frac{x^2}{2!}B_1 - + \ldots (-)^{n+1}\frac{x^{2n}}{(2n)!}B^n \ldots\right\};$$

whence equating coëfficients of x^{2n} in the expanded product gives—

$$(-)^n\left\{\frac{B_n}{(2n)!} - \frac{B_{n-1}}{3!\,(2n-2)!} + \frac{B_{n-2}}{5!\,(2n-4)!} - + \ldots\ldots + \frac{1}{2(2n)!} - \frac{1}{(2n+1)!}\right\} = 0,$$

or multiplying through by $(2n)!$

$$(-)^n\left\{B_n - \frac{(2n)!}{3!\,(2n-2)!}B_{n-1} + \frac{(2n)!}{5!\,(2n-4)!}B_{n-2} - + \ldots\ldots + \frac{(2n)!}{2(2n)!} - \frac{(2n)!}{(2n+1)!}\right\} = 0.$$

But

$$\frac{(2n)!}{2(2n)!} - \frac{(2n)!}{(2n+1)!} = \frac{2n-1}{2(2n+1)},$$

and

$$\frac{(2n)!}{(2r+1)!\,(2n-2r)!} = \frac{(2n)!}{(2r+1)(2r)!\,(2n-2r)!} = \frac{C^{2n}_{2r}}{2r+1}.$$

$$\therefore (-)^n\left\{B_n - \tfrac{1}{3}C^{2n}_2 B_{n-1} + \tfrac{1}{5}C^{2n}_4 B_{n-2} - + \ldots\ldots + \frac{2n-1}{2(2n+1)}\right\} = 0;$$

whence

$$B_n = \tfrac{1}{3}C^{2n}_2 B_{n-1} - \tfrac{1}{5}C^{2n}_4 B_{n-2} + \ldots\ldots (-)^n\frac{1}{2n-1}C^{2n}_{2n-2}B_1 + (-)^{n+1}\frac{2n-1}{2(2n+1)}.$$

which expresses B_n in terms of the numbers of lower orders.

Giving consecutive values to n,

$$(-)^{n+1}B_n \ldots\ldots\ldots\ldots\ldots\ldots\ldots - \frac{1}{2n-3}\,C^{2n}_{2n-4}\,B_2 + \frac{1}{2n-1}\,C^{2n}_{2n-2}\,B_1 = \frac{2n-1}{2(2n+1)}$$

$$(-)^{n}B_{n-1} \ldots\ldots\ldots\ldots\ldots - \frac{1}{2n-5}\,C^{2n-2}_{2n-6}\,B_2 + \frac{1}{2n-3}\,C^{2n-2}_{2n-4}\,B_1 = \frac{2n-3}{2(2n-1)}$$

$$\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots$$

$$B_3 - \tfrac{1}{3}C^6_2 B_2 + \tfrac{1}{3}C^6_4 B_1 = \tfrac{5}{7}$$

$$-\quad B_2 + \tfrac{1}{3}C^4_2 B_1 = \tfrac{13}{10}$$

$$B_1 = \tfrac{1}{6}$$

Whence by determinant elimination and a little reduction we obtain

$$B_n = \tfrac{1}{2}\begin{vmatrix}
1 & 0 & 0 & 0 & \ldots & 0 & 0 & \frac{1}{3} \\
2 & 1 & 0 & 0 & \ldots & 0 & 0 & \frac{3}{5} \\
3 & \frac{C^6_2}{3} & 1 & 0 & \ldots & 0 & 0 & \frac{5}{7} \\
4 & \frac{C^8_4}{5} & \frac{C^8_2}{3} & 1 & \ldots & 0 & 0 & \frac{7}{9} \\
\cdot & \cdot & \cdot & \cdot & \ldots & \cdot & \cdot & \cdot \\
\cdot & \cdot & \cdot & \cdot & \ldots & \cdot & \cdot & \cdot \\
\cdot & \cdot & \cdot & \cdot & \ldots & \cdot & \cdot & \cdot \\
n-1 & \frac{C^{2n-2}_{2n-6}}{2n-5} & \frac{C^{2n-2}_{2n-8}}{2n-7} & \frac{C^{2n-2}_{2n-10}}{2n-9} & \ldots & \frac{C^{2n-2}_{2}}{3} & 1 & \frac{2n-3}{2n-1} \\
n & \frac{C^{2n}_{2n-4}}{2n-3} & \frac{C^{2n}_{2n-6}}{2n-5} & \frac{C^{2n}_{2n-8}}{2n-7} & \ldots & \frac{C^{2n}_{4}}{5} & \frac{C^{2n}_{2}}{3} & \frac{2n-1}{2n+1}
\end{vmatrix}$$

V.

Expansion of the Inverse Tangent without the Use of Limits.

Expansion of $\tan^{-1} x$ without the use of limits.

As in the expansion of $\sin\theta$, a little consideration shows that the expansion of $\tan^{-1} x$ must have its first term x and must contain only odd powers of x.

Therefore assume

$$\tan^{-1} x = x + a_3x^3 + a_5x^5 + \ldots\ldots a_{2n+1}x^{2n+1} + \ldots\ldots$$

Then

$$\tan^{-1} y = y + a_3y^3 + a_5y^5 + \ldots\ldots a_{2n+1}y^{2n+1} + \ldots\ldots$$

and

$$\tan^{-1} x - \tan^{-1} y = x - y + a_3(x^3 - y^3) + \ldots\ldots a_{2n+1}(x^{2n+1} - y^{2n+1}) \ldots\ldots$$

But

$$\tan^{-1}x - \tan^{-1} y = \tan^{-1}\frac{x-y}{1+xy},$$

$$= \frac{x-y}{1+xy} + a_3\left(\frac{x-y}{1+xy}\right)^3 \ldots\ldots a^{2n+1}\left(\frac{x-y}{1+xy}\right)^{2n+1} \ldots\ldots$$

Dividing the equal expressions by $x - y$, and making $y = x$, we obtain

$$\frac{1}{1+x^2} = 1 + 3a_3x^2 + 5a_5x^4 + \ldots\ldots (2n+1)a_{2n+1}x^{2n} + \ldots\ldots$$

and

$$\frac{1}{1+x^2} = 1 - x^2 + x^4 \ldots\ldots (-)^n x^{2n} \ldots\ldots$$

and equating coëfficients of x^{2n},

$$(2n+1)a_{2n+1} = (-1)^n$$

and

$$a_{2n+1} = \frac{(-1)^n}{2n+1}$$

which gives all the coëfficients by giving consecutive powers to n.

$$\therefore \tan^{-1}x = x - \tfrac{1}{3}x^3 + \tfrac{1}{5}x^5 \ldots\ldots \frac{(-1)^n}{2n+1}x^{2n+1} \ldots\ldots$$

VI.—*On the Variation of the Density with the Concentration of Weak Aqueous Solutions of Certain Salts.* By PROF. J. G. MACGREGOR, D. Sc.

(Read May 8, 1889.)

In a paper on "The Density of Weak Aqueous Solutions of Certain Salts,"[1] which I had the honour of laying before the Royal Society of Canada in 1885, I pointed out, as an incidental result, that in the case of Zinc and Magnesium Sulphates, the increase in density produced by adding the anhydrous salt to water was proportional, or very nearly proportional, to the amount of salt added, provided the solutions thus formed did not contain more than about 2 or 1 per cent. respectively of salt. I have recently had occasion to make a number of determinations of the concentration and density of dilute solutions of the above salts and of several others, and to hunt out similar determinations by other observers; and the data thus obtained enable me to settle, in the case of a number of salts, the limits of concentration within which this simple proportionality holds.

The solutions which I examined myself were made by mixing weighed quantities of the crystallised salt with weighed quanties of water. The salts had been purchased as pure, and had been re-purified by crystallisation. The water had been carefully distilled. In the case of Iron Sulphate solutions it was boiled, in order that the solutions employed might contain but little dissolved air.

In all cases, at least two solutions of any one salt were prepared by mixing weighed quantities of the salt and of water. Usually the other solutions required were prepared by diluting one of these with water, or strengthening it by adding salt. In the case of Iron Sulphate, all the solutions used were prepared by mixing salt and water directly, this course being pursued in the case of this salt, because of the fact of its undergoing progressive decomposition after being dissolved in water, and of the consequent necessity of determining the density of a solution as soon as possible after the solution had been formed.

In preparing the solutions, all determinations of mass were made by the method of double weighing and all weighings were made in stoppered bottles. The weighings were of course reduced to vacuo. The errors of the standards employed were neglected. The balance used was a delicate one made by Collot of Paris. In calculating the percentage of anhydrous salt in the various solutions, the values of the atomic weights given in Clarke's "Constants of Nature" were employed.

Densities were in all cases determined by means of a specific gravity bottle. The bottle used had a volume of about 50 cu. cm. It was of thin glass, but was not so thin as to be readily deformable, and was provided with an accurately ground, perforated glass stopper. All determinations of density were made at 20°C. A bottle containing the solution and a thermometer, was placed along with the specific gravity bottle in a bath

[1] Trans. Roy. Soc. Canada, vol. iii (1885) sec. iii, p. 15.

slightly above 20°C. When the solution had taken the temperature of 20° it was at once poured into the specific gravity bottle, and the latter stoppered, dried and weighed. The thermometer used had been provided with a table of corrections at Kew. Weighings for the determination of density were made in one pan only (always of course the same pan), the double weighings for the determination of mass having shown that the ratio of the lengths of the arms of the balance was practically constant. In calculating the densities from the observations, the usual corrections were applied.

In using the determinations of other observers, I found that in many cases they had not stated whether their published percentages were percentages of anhydrous or of crystallised salt in solution, and that in many cases also they had omitted to state whether their specific gravities were referred to water at the same temperature as the solution, or to water at some other temperature as 0°C or 4°C. In the former cases, however, comparison of the observations of different men usually showed whether anhydrous or crystallised salt was meant. In the latter it was often possible, especially when several observations of dilute solutions were given, to determine the temperature of the water which was taken as the standard substance, by plotting a curve of concentrations against specific gravities, and noting the point of its intersection with the axis of specific gravities.

In the case of all salts for which the densities of sufficiently dilute solutions have been determined, either by myself or by other observers, I find that up to certain concentrations, varying from 1 to 5 per cent. of anhydrous salt in solution, the excess of the density of a solution over that of water at the same temperature as the solution, is directly proportional to the percentage of salt in the solution. In symbols, if D_t, d_t are the densities at the same temperature t of a solution and of water respectively, and if p is the percentage of anhydrous salt in the solution, we have thus

$$D_t = d_t + kp,$$

where k is a constant for all sufficiently dilute solutions of any one salt. The value of the constant k for any one salt having been determined, the densities (in grms. per cu. cm.), obtained from the above formula, are found to agree with observed values to the fourth place of decimals within the limits of concentration specified above.

The following tables give the concentrations and observed densities of dilute solutions of a number of salts, together with the densities calculated by the aid of the above formula with the proper value of k. The fourth column gives the differences between the observed and calculated values. The values of the density of water used in these calculations are those given by Volkmann,[1] which are based on the observations of Hagen, Matthiessen, Pierre, Kopp and Jolly.

[1] Wied. Ann. xiv (1881) p. 260.

ZINC SULPHATE.—$ZnSO_4$.

Observer : The author.
Temperature : 20° C.
Formula : $D_{20} = 0{\cdot}99827 + 0{\cdot}0103918\ p$.

Percentage of Anhydrous Salt in solution.	Observed density at 20°C (grms. per cu. cm.)	Calculated density at 20°C (grms. per cu. cm.)	Difference.
1·1622	1·01032	1·01035	+0·00003
1·8698	1·01774	1·01770	—0·00004
2·7281	1·02662	1·02662	0·00000
5·9150	1·06104	1·05973	—0·00131

The above formula thus gives the densities of solutions of Zinc Sulphate accurately to four places of decimals, provided they do not contain more than about 3 per cent. of anhydrous salt in solution.

MAGNESIUM SULPHATE.—$MgSO_4$.

Observer : The author.
Temperature : 20°C.
Formula : $D_{20} = 0{\cdot}99827 + 0{\cdot}0106324\ p$.

Percentage of Anhydrous Salt in solution.	Observed density at 20°C (grms. per cu. cm.)	Calculated density at 20°C (grms. per cu. cm.)	Difference.
0·6907	1·00553	1·00561	+0·00008
1·6525	1·01584	1·01584	0·00000
2·5809	1·02525	1·02571	+0·00046
3·7689	1·03700	1·03834	+0·00134

The formula is thus applicable up to about 2 per cent. The following is another series of observations of solutions of the same salt :—

Observer : Schiff.[1]
Temperature : 23°C.
Formula : $D_{23} = 0{\cdot}99762 + 0{\cdot}0098176\ p$.

Percentage of Anhydrous Salt in solution.	Observed density at 23°C (grms. per cu. cm.)	Calculated density at 23°C (grms. per cu. cm.)	Difference.
0·4879	1·00241	1·00241	0·00000
0·9758	1·00720	1·00720	0·00000
1·4637	1·01199	1·01199	0·00000
2·4395	1·02176	1·02157	—0·00019

[1] Ann. Chem. u. Pharm. cviii, p. 336; see also Watts' Dictionary of Chemistry, Art. MAGNESIUM SULPHATE.

Thus in the case of Schiff's observations also, the formula holds up to between 2 and 2·5 per cent.

IRON SULPHATE.— $FeSO_4$.

Observer : The author.
Temperature : 20°C.
Formula : $D_{20} = 0{\cdot}99827 + 0{\cdot}0099486\,p$.

Percentage of Anhydrous Salt in solution.	Observed density at 20°C (grms. per cu. cm.)	Calculated density at 20°C (grms. per cu. cm.)	Difference.
0·8461	1·00666	1·00669	+0·00003
1·3618	1·01183	1·01182	—0·00001
2·4060	1·02229	1·02221	—0·00008
2·6064	1·02420	1·02420	0·00000

For solutions of Iron Sulphate therefore the above formula holds up to and beyond a concentration of 2·6 per cent.

COPPER SULPHATE.—$CuSO_4$.

Observer : Gerlach.[1]
Temperature : 18°C.
Formula : $D_{18} = 0{\cdot}99866 + 0{\cdot}0098427\,p$.

Percentage of Anhydrous Salt in solution.	Observed density at 18°C (grms. per cu. cm.)	Calculated density at 18°C (grms. per cu. cm.)	Difference.
0·6390	1·00495	1·00495	0·00000
1·2781	1·01124	1·01124	0·00000
1·9171	1·01764	1·01753	+0·00011
2·5561	1·02403	1·02382	+0·00021
3·1952	1·03052	1·03011	+0·00041

Thus according to Gerlach the limit of concentration within which the above formula applies is somewhat less than 2 per cent.

CADMIUM SULPHATE.—$CdSO_4$.

Observer : Grotrian.[2]
Temperature : 18°C.
Formula : $D_{18} = 0{\cdot}99866 + 0{\cdot}0097329\,p$.

Percentage of Anhydrous Salt in solution.	Observed density at 18°C (grms. per cu. cm.)	Calculated density at 18°C (grms. per cu. cm.)	Difference.
0·282	1·0015	1·00141	—0·00009
1·011	1·0085	1·00850	0·00000
5·08	1·0495	1·04810	—0·00140

[1] Fres. Zeitschr. f. analyt. Chem. viii (1869) p. 279; Landolt u Börnstein's Phys.-Chem. Tabellen p. 147.
[2] Wied. Ann. xviii (1883) p. 191.

These experiments are hardly sufficient for our purpose. Nevertheless they seem to show that in the case of this salt the formula holds up to a concentration of about 3 per cent.

ALUMINIUM SULPHATE.—$Al_2(SO_4)_3$.

Observer: Hassenfratz.[1]
Temperature: 12°·5C.
Formula: $D_{12\cdot5} = 0\cdot99949 + 0\cdot0092083\ p$.

Percentage of Anhydrous Salt in solution.	Observed density at 12°.5C (grms. per cu. cm.)	Calculated density at 12°.5C (grms. per cu. cm.)	Difference.
0·5137	1·00418	1·00422	+0·00004
1·0274	1·00888	1·00895	+0·00007
1·5410	1·01368	1·01368	0·00000
2·0547	1·01838	1·01841	+0·00003
2·5684	1·02307	1·02314	+0·00007

These results show the formula to hold up to a concentration of 2·5 per cent. According to Reuss,[2] as reported in the 'Beiblätter zu den Annalen der Physik und Chemie,'[3] the density of Aluminium Sulphate solutions for concentrations ranging from 1 to 25 per cent. of salt (whether anhydrous or crystallised is not stated) in solution, may be represented by the formula :—

$$D_{15} = 1\cdot007 + 0\cdot01\,p.$$

Now we know that for $p = 0$, $D_{15} = 0\cdot99915$. Hence either this formula is inadequate or the law of the variation of density with concentration is very different for solutions containing between 0 and 1 per cent. of salt from what it is for solutions containing between 1 and 25 per cent. Possibly the curve showing the relation between density and concentration is so slightly curved that the densities of solutions within the given limits of concentration may be expressed by the above formula to three places of decimals.

POTASH ALUM.—$AlK(SO_4)_2$.

Observer: The author.
Temperature: 20°C.
Formula: $D_{20} = 0\cdot99827 + 0\cdot0095187\ p$.

Percentage of Anhydrous Salt in solution.	Observed density at 20°C (grms. per cu. cm.	Calculated density at 20°C (grms. per cu. cm.	Difference.
0·7215	1·00512	1·00514	+0·00002
0·7438	1·00535	1·00535	0·00000
1·7260	1.01465	1·01470	+0·00005

[1] Ann. de Chim. xxviii (1799) p. 296.
[2] Chem. Ber. xvii (1884) p. 2888.
[3] Bd. ix (1885) p. 309.

According to these experiments the above formula holds up to a concentration of at least 1·7 per cent.

The following observations were made by Gerlach[1] on solutions of this salt at 17°.5C. The calculated densities are obtained from the formula :—

$$D_{17\cdot5} \quad 0\cdot99875+0.009397\,p.$$

Percentage of Anhydrous Salt in solution.	Observed density at 17°.5C (grms. per cu. cm.)	Calculated density at 17°.5C (grms. per cu. cm.)	Difference.
2·1792	1·01923	1·01923	0.00000
4·3584	1·04020	1·03971	—0·00049

The comparatively small difference between the observed and calculated density for a solution containing 4·36 per cent. of anhydrous salt, makes it probable that the simple proportionality of excess of density of solution over density of water, to concentration, holds up to a concentration of about 2·5 per cent.

POTASSIUM SULPHATE.—K_2SO_4.

Observer: Hassenfratz.[2]
Temperature: 12°.5C.
Formula: $D_{12\cdot5} = 0\cdot99949+0\cdot008595\,p.$

Percentage of Anhydrous Salt in solution.	Observed density at 12°.5C (grms. per cu. cm.)	Calculated density at 12°.5C (grms. per cu. cm.)	Difference.
1	1·00808	1·00808	0·00000
2	1·01658	1·01658	0·00000
3	1·02517	1·02527	+0·00010
4	1·03377	1·03387	+0·00010

The following is another series of observations of solutions of the same salt :—

Observer: Gerlach.[3]
Temperature: 15°C.
Formula: $D_{15} = 0\cdot99915+0.00816\,p.$

Percentage of Anhydrous Salt in solution.	Observed density at 15°C (grms. per cu. cm.)	Calculated density at 15°C (grms. per cu. cm.)	Difference.
1	1·00735	1·00731	—0·00004
3	1·02363	1·02363	0·00000
5	1·04022	1·03995	—0·00027

[1] Beiblätter Ann. Phys. Chem., xi (1887) p. 217. [2] Ann. de Chim. xxviii (1799) p. 296.
[3] Gerlach's Specifische Gewichte der gebräuchlichsten Salzlösungen, Freiberg, 1859; and Jahresbericht u. Fortschritte d. Chem., 1859).

The above sets of observations agree in showing that the excess of the density of solutions of this salt over that of water at the same temperature is, for solutions which do not contain more than about 2·5 per cent of anhydrous salt, directly proportional to the percentage of anhydrous salt which they contain.

SODIUM SULPHATE.—Na_2SO_4.

Observer: Gerlach.[1]
Temperature: 15°C.
Formula: $D_{15} = 0{\cdot}99915 + 0{\cdot}0091267\,p$.

Percentage of Anhydrous Salt in solution.	Observed density at 15°C (grms. per cu. cm.)	Calculated density at 15°C (grms. per cu. cm.)	Difference.
1	1·00824	1·00827	+0·00003
2	1·01734	1·01740	+0·00006
3	1·02653	1·02653	0·00000
4	1·03562	1·03565	+0·00003
5	1·04491	1·04478	—0·00013
6	1·05410	1·05391	—0·00019

These experiments would seem to show that the above formula holds in the case of Sodium Sulphate for solutions containing from 0 to 4 per cent of anhydrous salt. The following are other observations with the same salt:—

Observer: Ostwald.[2]
Temperature: 15°C.
Formula: $D_{15} = 0{\cdot}99915 + 0{\cdot}0091875\,p$.

Percentage of Anhydrous Salt in solution.	Observed density at 15°C (grms. per cu. cm.)	Calculated density at 15°C (grms. per cu. cm.)	Difference.
2	1·0176	1·01753	—0·00007
4	1·0359	1·03590	0·00000

Thus Ostwald's experiments give the same result.

CAUSTIC POTASH.—KHO.

Observer: Thomsen.[3]
Temperature: 18°C.
Formula: $D_{18} = 0{\cdot}99866 + 0{\cdot}0093717\,p$.

Percentage of Anhydrous Salt in solution.	Observed density at 18°C (grms. per cu. cm.)	Calculated density at 18°C (grms. per cu. cm.)	Difference.
1·5344	1·01304	1·01304	0·00000
3·0224	1·02702	1·02698	—0·00004
5·8674	1·05359	1·05364	+0.00005

[1] Fres. Zeitschr. f. analyt. Chem., viii (1869) p. 279; and Landolt u. Börnstein's Phys.-chem. Tabellen (1883).
[2] Journ. f. prakt. Chemie xxii (1880) p. 305.
[3] Thermo-chemische Untersuchungen, Bd. i, p. 47.

The following are other observations with the same substance :—

Observer : Kohlrausch.[1]
Temperature : 15°C.
Formula : $D_{15} = 0{\cdot}99915 + 0{\cdot}0092959\,p$.

Percentage of Anhydrous Salt in solution.	Observed density at 15°C (grms. per cu. cm.)	Calculated density at 15°C (grms. per cu. cm.)	Difference.
4·19	1·0381	1·0381	0·0000
8·42	1·0778	1·0774	—0·0004

Thomsen's experiments shew that in the case of solutions of Caustic Potash, even up to a strength of more than 5 per cent., excess of density over that of water is practically proportional to the percentage of salt. Kohlrausch's results substantiate Thomsen's ; for, as is seen above, a formula in which k is chosen so that the density given by it is exact for $p = 4{\cdot}19$, gives a density for $p = 8{\cdot}42$, which not very far wrong.

CAUSTIC SODA.—NaHO.

Observer : Thomsen.[2]
Temperature : 18°C.
Formula : $D_{18} = 0{\cdot}99866 + 0{\cdot}014563\,p$.

Percentage of Anhydrous Salt in solution.	Observed density at 18°C (grms. per cu. cm.)	Calculated density at 18°C (grms. per cu. cm.)	Difference.
0·8528	1·01105	1·01108	+0·00003
1·6871	1·02323	1·02323	0·00000
3·3023	1·04719	1·04675	—0·00044

The formula therefore holds for solutions of strengths ranging up to about 2 per cent., but not for solutions of greater strength. Caustic Soda thus differs in a marked manner from Caustic Potash.

The above are the only salts for which I have been able to obtain, or to find, data to determine the limits of concentration within which formulæ of the above kind hold—within which, in other words, the concentration-density curves of their solutions are, to the fourth place of decimals, straight lines. In the case of most salts, the weakest solutions, whose densities have been examined, are already beyond the limits referred to.

The table upon the page that follows contains a list of the values of k found above for the various salts examined.

It will be noticed that in most cases the values of k do not differ from one another to any considerable extent. Now k is the rate of increase of the density with the strength of a solution when its strength is but small. Hence the densities of dilute solutions of

[1] Wied. Ann. vi (1879) p. 21.
[2] Thermo-chemische Untersuchungen, Bd. i, p. 47.

these salts increase with their strength at rates which do not differ greatly in the case of the different salts; or, in other words, the concentration-density curves of sufficiently dilute solutions of these salts, are not only practically straight lines but are nearly equally inclined to the axis of concentrations.

Substance.	Temperature.	k.	Observer.
$ZnSO_4$	20·0°C	0·0103918	The author.
$MgSO_4$	20·0	0·0106324	"
"	23·0	0·0098176	Schiff.
$FeSO_4$	20·0	0·0099486	The author.
$CdSO_4$	18·0	0·0097329	Grotrian.
$CuSO_4$	18·0	0·0098427	Gerlach.
$Al_2(SO_4)_3$	12·5	0·0092083	Hassenfratz.
$AlK(SO_4)_2$	20·0	0·0095187	The author.
K_2SO_4	15·0	0·0081600	Gerlach.
"	12·5	0·0085950	Hassenfratz.
Na_2SO_4	15·0	0·0091875	Ostwald.
"	15·0	0·0091267	Gerlach.
KHO	18·0	0·0093717	Thomsen.
NaHO	18·0	0·0145630	"

VII.—*A Problem in Political Science.*

By SANDFORD FLEMING.

(Read May 8, 1889.)

I propose to direct attention to a scientific question within the domain of politics or civil government which appears to me to be of general interest. It presents a problem which up to the present time remains unsolved.

The institution of Parliament, as we all know, is of ancient date. In England a general assembly or council of the nation has been held immemorially under various names. Before the Conquest three designations were at various times assigned to it:—

1. Mycel Synoth, or great synod.
2. Mycel Gemot, or great council.
3. Witenagemot, or council of the wise men.

The name of "Parliament" was not given to the National Council in England until after the Conquest, when the French language was exclusively used by the dominant class, and French became the official language of the English nation.

Parliament has greatly changed since its early days. It has grown and developed from century to century, and it may be said to be still in a condition of growth and development.

Whatever may have been the character of the meetings of the wise men before the Conquest, or of the Parliaments which followed, the central idea of Parliament at the present day, is an assembly of individuals representing the whole nation. The functions of Parliament are to act on behalf of the nation as the supreme authority, and—representing the nation—it possesses every power and every right and every attribute which the nation possesses. The fundamental idea and guiding principle of Parliament is, that it embraces all the separate parts which compose the realm, that in fact it is the nation in essence.

This is the theoretical and proper idea of Parliament, but it cannot be affirmed that the ideal Parliament has ever yet been realized. Indeed it may be held that the means taken to constitute Parliament cannot, in the nature of things, result in producing a national assembly in which every individual elector may be fairly represented and his voice heard. As a matter of fact, under the existing system, it is not practicable to have in the elective house every part of the nation represented: some parts must necessarily remain unrepresented.

Such being the case, the problem which science may be asked to solve, is simply this: *to devise the means of forming an elective assembly which practically as well as theoretically will be the nation in essence.*

What is commonly known as the "Government" or the "Administration," and how it may be constituted, form no part of the problem, but are separate questions which I do not propose to discuss. I merely submit as a general principle, that the Government may be considered in the light of a committee of Parliament, or executive council to carry into effect the acts and resolutions of Parliament and administer affairs to the approval of Parliament.

Nations differ in their social and political circumstances, but in all free countries, at least, it is generally recognised that the elective assembly is of the first importance. The theory of the elective assembly, is that the whole people or such of the people as are duly qualified to vote shall be equally represented. It cannot be said that hitherto this object has been even approximately attained. Its attainment may indeed be impracticable, but the question is of so much importance that it cannot be unworthy of grave consideration. May we not ask if it be possible to devise some means, by which the whole people of the realm may be brought to a central point, to a focus so to speak, in a deliberative assembly or Parliament.

The question of electing representatives to sit in Parliament has received the attention of many political writers and has likewise been investigated at length by many celebrated geometers, who have recorded their dissent from the practice followed. Under the present system, members are elected by a part of the community only, while their election is opposed by another part. It is quite true that the intention is to have the majority of the people represented, but even this is not a necessary result of the existing system; moreover it does not follow that the majority of members returned will hold the views and opinions of the majority of the people on any subject. It may happen and frequently does happen, as a direct result of the present system, that legislative power is placed, not in the representatives of a majority, but in those who represent a minority. Sir John Lubbock gives an apt illustration of this result. He supposes a country in which there are 1,200,000 electors who vote with party *A*, and 1,000,000 who vote with party *B*. Now if the two parties are evenly distributed over the whole country, it is clear that, under the ordinary system of representation, the weaker party will be utterly swamped. To use a familiar illustration (he remarks) whenever you drop a bucket into the sea, you will bring up salt water. In such a case therefore the 1,000,000 will be practically unrepresented. But we must carry the matter a little further. In the House so elected, let the majority bring forward some bill of an advanced character and carry it by two to one, i. e., by the votes of members representing 800,000 electors and against those representing 400,000, in such a case it is clear that the minority in the House would have with them also the 1,000,000 in the country who were left unrepresented; so that in fact the measure would represent the wishes of only 800,000 electors, and would be opposed by those of 1,400,000. Thus he points out that the result of a system "of Government by majorities, is, on the contrary, to enable a minority of 800,000 to overrule a majority of 1,400,000."

This illustrates only one of the many defects in the present system, but it is quite sufficient to show that the principle of Representative Government which is inherently good, has not been realised. It is obvious from the very nature of the system practised in electing members, that, in every Parliament, not the whole but only a part of the electors are represented, and that the representatives of a minority may frequently overrule a majority of the people.

Take the present Parliament of our own Dominion, and in doing so we have a case in which all will acknowledge that the Administration at the present moment is supported by a large working majority of members. At the last General Election (Feb. 1887) the total number of voters on the lists in all the constituencies where contests took place was 948,524. Of this number the votes polled for one party were 370,342 and for the other 354,714. That is to say, 39 per cent. of the whole represents one party, and 37 per cent. the other party in Parliament. As the representatives of the 37 per cent. are swamped in Parliament and are in no way recognised in the administration of affairs, it follows that 39 per cent. of the electors through their representatives have complete control, and the remaining 61 per cent. have practically no voice in the government of the country. Moreover, as the election of members representing the 39 per cent. of votes was in every instance opposed by the voters who number 37 per cent. of the whole, it follows that on all questions settled on strict party lines, Parliament speaks and acts in its decisions by the members who represent but two per cent. of the whole body of electors. This is not an accidental but a common and, indeed, a necessary result, of the present system, which must continue so long as we follow the ordinary method of electing members to sit in Parliament.

The question presented is this: Is there any means whatever by which a national assembly can be formed approximating more closely to the ideal Parliament?

Let us begin the inquiry by assuming that the electorate consists of only two electors, that they are equal in all respects, in ability, in integrity, in worldly means, in public spirit; that they have each equal claims and equal desires to act as representatives, and that each is equally willing to be represented the one by the other.

Under such circumstances what course would be followed by the two to settle the question? Would not the natural method be to cast lots? Assuming that the two electors were left to their own resources, removed from all outside influences, would not this be the only rational means by which they could make a choice?

There are doubtless some minds who would have an innate feeling against resorting to such a practice; the casting of lots being more or less associated with dice-playing, lotteries and games of chance, to which objections are taken on good and sufficient grounds; but in the case presented there remains no way of reaching a decision except by lot. What other course could be followed? A contest would not mend matters; a trial of physical strength and endurance would be at once futile and indefensible. If the object be to turn the two into a single representative unit, unanimity is essential, and while in agreeing in nothing else they could agree in casting lots. Is the principle of settlement by casting lots in itself objectionable? Was it not considered wise and good in ancient times? And would it not be equally good to-day? It is certainly a time-honored usage for determining difficult questions, and is exemplified in many passages in Holy Scripture; indeed the uniform voice of Scripture goes to show that decisions thus obtained are not only wholly unobjectionable in themselves, but that they were considered to have been overruled and directed by special providential interposition.

I shall cite but one example, the selection of an apostle to take the place of Judas Iscariot. An account of this election by casting lots is given in the "Acts of the Apostles," Chap. I, verses 15-26. It is stated that about a hundred and twenty persons were called upon to select one of their number. They proceeded with deliberate wisdom to follow a

usage regarded by them as a means of obtaining the divine mind. They determined by lot who should be the twelfth apostle, and thus they made a selection to which a cheerful acquiescence was unanimously given.

I have assumed a case of two electors, and pointed out the course which might be followed—indeed, the only rational course which could be followed. If the principle laid down be sound, could it not be applied in other cases? Let us assume that the electorate consists of twenty voters, what could be done in this case? If individual voters in the electorate were equal in all respects, as in the first case referred to, the question would be a very simple one, as it might be settled by casting lots for one of the twenty equally eligible persons. It may be taken for granted that under the circumstances no one would object to make the selection in this way, as being the simplest and best mode of making a choice. It would remove antagonism and promote unanimity; and, by the very act of casting lots, each one of the twenty taking part therein would be an assenting party to the choice made. Men as we ordinarily find them are, however, not alike; they differ much in their qualifications, and their opinions are not the same; we must therefore consider cases in which equal eligibility and uniformity of mind in the whole electorate is not the rule.

First, let us suppose that among the twenty electors, five voters favor the choice of A, another five B, another C, and the remainder D. We should thus have A, B, C, D, each equally desired and preferred as the representative of the twenty.

$(A+B+C+D)\div 4$ would therefore be the representative unit of the whole. We cannot, however, take one quarter of A, B, C, and D, and combine these quarters so as to form one individual, but we can reduce the four to one by the principle of casting lots. One of the four can be selected by what may be termed the "Apostolic" method, and the person so selected would be recognized as chosen by the twenty electors as the common representative of the whole.

Secondly, let us suppose a case in which there is less diversity of opinion; two groups of five electors each favor A, one group of five prefer B, another C. The selected men would thus stand A, A, B and C, and the representative unit of the whole would be $(2\,A+B+C)\div 4$. As in the previous case, this complex unit would be reducible to a single individual by casting lots, and it is obvious that the probability of the lot falling upon A, would be as two to one.

Thirdly, suppose three groups of five electors desire to be represented by A and one group by B. In this case we should have $(3\,A+B)\div 4$, as the representative unit: in selecting one of them by lot, there is undoubtedly a possibility of the lot falling upon B, but the probability of A's being chosen would be three times greater than the probability in B's case. True it may be said that there should be no possibility of B's being chosen in a constituency where three-fourths of the electors desire A. We must however bear in mind that the primary object is not so much to have particular sections of the country, as to have the whole nation, fairly represented in Parliament. If we look a little further, if we take four constituencies precisely similar to the one under consideration, according to the mathematical theory of probabilities, there would be returned out of the four, three members in sympathy with A and one member in sympathy with B. Again, if we carry the matter still further if we take into consideration every one of the constituencies into which for convenience the whole nation may be divided, it would be found as a

general result that the representatives returned to sit in Parliament would collectively represent the nation and fairly embody the reason contained in the whole community.

There is one peculiarity of the system suggested which may be noticed; in every case the election of a representative would be effected deliberately and without conflict. It would be accomplished in fact with unanimous assent. Each individual voter would contribute towards a common result—a result which would be reached on principles equally just and fair to all, and thus command general acquiescence.

These results are attainable only by bringing to bear, on matters of doubt or difficulty, the principle of settlement adopted by the Apostles. That principle cannot be objected to on scientific grounds, and those who hold the belief that mundane affairs are over-ruled and directed, should have no difficulty in accepting it as a means of promoting harmony and advancing the common good. The belief in a Providence, who takes cognizance of the affairs of men, is the foundation of all religion; communities therefore the social fabric of which is based on Christianity should have no hesitation in leaving matters of the highest moment to the arbitrament of an infinitely wise Providence rather than to the settlement of men with all their individual interests and selfish views, all their prejudices, all their passions, and all their errors of judgment.

I have so far, for the purpose of the argument, assumed hypothetical cases; it remains to be considered how the principles laid down may be applied practically. Let us take for example the election of a single representative in a constituency of 2,000 voters. It is desirable in the first place that each voter, or group of voters of one mind, should have perfect freedom of choice in the nomination. Suppose, in order to accommodate every shade of opinion, it be arranged that each hundred voters of one way of thinking name the person whom they would wish to represent them. This would separate the constituency into twenty groups of voters, who would each nominate whomsover they most favored. It does not necessarily follow that there would be twenty persons nominated in the constituency, as two or more groups might nominate the same person; a circumstance which would increase the probability of his selection exactly in proportion to the number of groups making him their nominee. On the twenty nominations being made, the next step would be for the persons nominated to proceed, on the principles above set forth, to select one of themselves.

If unable to make an unanimous choice, they might, as in the case of the twenty electors choosing a representative, sort themselves into smaller groups and, by the application of the principles set forth, proceed to reduce the number of voting units, and finally, by the apostolic method, determine the selection of one person. The person so chosen would be held to be the common choice of the whole 2,000 to represent the constituency in Parliament.

In the carrying out of such a system, there would be, as in every system, a number of possible contingencies for which provision would have to be made; these I have not deemed it necessary at present to enter into. My object has been briefly to suggest leading principles by which, as it appears to me, the central idea may be realized. If the principles submitted be sound, I venture to think that it is not impracticable to devise proper machinery to elect representatives who, when brought into one deliberative gathering, would, so far as such a thing is possible, be a mathematical concentration of the whole electoral body—would in fact constitute an assembly which would closely approximate to the ideal Parliament.

Referring to the present system an eminent writer asks: "Is Government only possible by the conflict of opposing principles?" The familiar expression, "government of the people by the people" cannot be held to mean government of the whole by a part or by the conflict of hostile parts. It must be obvious the united energy and wisdom of of a whole nation directed towards one end can only be fully realized, when the supreme power is vested in a Parliament chosen by the whole people, and fairly representing the whole people. This is the great problem for solution and it is manifest that if such a Parliament is ever to be constituted, the people, in choosing members to represent them, must in some way be brought to act not in contestation and conflict, but in concert and in concord.

If it be one of the first of political desiderata to have no large minorities left unrepresented in the national assembly, it appears to me essential to seek for some means of securing the coöperation of the whole body of the electors in the election of members to sit in the High Court of Parliament. To obtain this result it is obviously expedient to adopt a system which necessarily does not develop animosity or provoke hostility; the aim should be to promote friendliness and agreement in a matter which concerns all alike. It cannot be denied that the whole community is concerned in having in Parliament, not men of extreme views, but moderate-minded men of good common sense and good conscience, capable of representing the more enlightened electoral mind. By electing representatives on the principles laid down, these desirable objects would undoubtedly in a large measure be attained; every step would be deliberately taken, free from the excitement and heated feeling which so frequently accompany ordinary elections. In every stage of the proceedings there would be a tendency to return only the best men. At the very first step it is obvious that a candidate must be a person respected and supported by a hundred electors. It is presumable that no hundred electors of any class or race or creed would deliberately put forward a base or unworthy or even an inferior individual; it is not to be supposed that they would choose one of the least intelligent or least honest or least reputable amongst them as their representative in the candidature. As a rule, electors of one mind would arrange themselves into groups of one hundred, and each group would select some man, who on his merits as a citizen would creditably represent them, or who as a statesman commended himself to their favor. In their turn, those selected by the hundreds would follow the same course, selecting generally the best, the worthiest and wisest men until the final choice was reached and a member selected to represent the constituency in Parliament.

It can scarcely be doubted that if such a system could be put in force, the tendency would be upwards from first to last, and that there would be drawn to the legislature accomplished statesmen, men endowed with wisdom and patriotism, practical knowledge and experience. The inevitable effect would be to allay the spirit of faction and remove political rancour. In a higher degree than under the ordinary method of electing members, the system would attract within the pale of Parliament men in generous sympathy not with a part only, but with the whole people. Thus might be constituted an august body which as closely as possible would be a true mirror of the enlightened mind of the nation to reflect its opinions, its wisdom, and its virtues.

In a Parliament so constituted, perfect unanimity on all questions, perhaps on any question, is not to be looked for, and each separate question would have to be settled,

as it arose, by the voice of a majority. Hence it may be said that as every question would in the end have to be determined by a majority, the Parliament as proposed would be no improvement on the present. It will, however, readily be seen that there is a wide difference between a Parliament representing the whole people, deciding questions by a majority of its own members, and a Parliament in which a part only of the electors has any voice. The proposed assembly would not consist of men placed in their seats in direct opposition to a large number of the people, but a Parliament formed through the coöperation and assent of the whole body of the electors, to promote their common welfare; it would approximately be a microcosm, so to speak, of the nation. In and through this Parliament each and every elector would have an equal voice in public affairs.

The proposal is to substitute in our Parliamentary elections the principle of co-operation for the principle of antagonism, and by this means to choose representatives, who when brought together in a deliberative assembly would realize the true idea of Parliament—a "Witenagemot or great council of wise men," representing every part of the realm, and imbued with the spirit of the whole, to act in the name of the whole, and speak the voice of the united nation.

If such a Parliament be an object to be desired; if it be a fundamental principle that all who bear the taxation, should share in the representation; if it be the sacred right of every elector to have a just and proper representation in Parliament; then it must be recognized as a paramount duty, and an object worthy of the highest efforts of the progressive statesman, to find some means by which such a legislative body may be realized. A complete solution of the problem, may be remote, but, as has been stated, Parliament is a growth and development, and in all matters into which the principle of growth enters, the element of time must also enter. The question vitally concerns all free communities, and any change must in the nature of things be preceded by a deliberate and impartial enquiry. I have ventured to submit a scientific solution: it may not be the best means of attaining the desired end, and I offer it with all diffidence merely as a contribution to the general discussion, in the hope that it may not be wholly barren of utility. I cannot but think that if the strictly scientific habit of mind be brought to bear on the question, some practical method of solving the problem will slowly and surely be evolved. Whatever the solution, I humbly think that it must be based on principles which will not beget the conflicts and contestations which result from political activity under the present system.

It is held by the most eminent political economists that by coöperating, two men will do more work and do it better than four men, or four times four men acting in opposition. Is not the rule of universal application? Can there be coöperation without harmony? Can there be antagonism without discord? And are not discord and harmony in the state likened unto disease and health in the human body? This much will be conceded: the chronic feuds between tribes and races which characterized the history of the human family in a less advanced stage of civilization no longer exist. War is manifestly not the normal condition of society in our time. Is it not therefore an anachronism to perpetuate hostility in the internal affairs of a nation? Is it not in the highest interests of the state that each member of the community, in every matter which concerns him as a citizen, should have the fullest opportunity of acting up to the injunction, "Live

peaceably with all men." If the age of belligerency has passed away, is it not eminently fit and proper that we should seek for the removal of the last vestiges of a belligerent age which still remain in our political system?

VIII.—*On the Hygroscopicity of certain Canadian Fossil Fuels.*

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(Presented May 8, 1889.)

The experiments, in this connection, here recorded, and which were conducted upon material in all stages of alteration, ranging from surface peat to anthracite, were all carried out under precisely similar conditions.

The various fuels were all reduced to as near as possible the same state of mechanical division, having been ground just sufficiently fine to allow of their passing a sieve of ninety holes to the linear inch. The material—of which, in each case, one gram and a-half was employed—was placed in low, broad, flat-bottomed, straight-sided, very light glass bottles, provided with accurately ground glass stoppers. In the drying experiments, the specially constructed staging—which carried thirty of these bottles—supported by glass legs, stood over a glass dish (almost equal in area to the mouth of the bell jar) containing strong sulphuric acid; the whole being covered by a bell jar with ground rim resting upon an accurately ground plate. In the absorbtion experiments the glass dish containing the sulphuric acid, was replaced by one containing a shallow stratum of water, over which were heaped shreds of filtering paper, and the bell jar enclosing the experiments was in turn covered by another of much larger dimensions—an arrangement which effectually prevented the deposition of dew. The temperature of the room (which was artificially heated—the work having been carried out during the winter months) in which the experiments were conducted, ranged from 65° to 70° F. The experiments were all made in duplicate—the two experiments with the same fuel being carried out, as affording a better check, on separate occasions.

In some preliminary experiments, fifteen of the lignites, in duplicate, were exposed to an absolutely dry atmosphere for 48 hours, at the expiration of which time they were found to have parted with the greater part of their moisture. They were then further exposed for consecutive periods of 36, 44, 68, 68, 48, and 42 hours, during which periods they incurred an additional loss (in each case the mean of the thirty experiments) of respectively 1·25, 0·84, 0·73, 0·59, 0·29, and 0·15 per cent. of water (the loss—taking the mean of the two experiments with each of the fifteen fuels—ranging from 0·92 to 1·66, 0·71 to 0·97, 0·51 to 0·80, 0·36 to 0·75, and 0·19 to 0·37 per cent.) or a total loss of 3·85 per cent. for the additional 306 hours. A still further exposure for consecutive periods of 93, 120, 70, and 90 hours, was attended by a further loss (in each case the mean of the thirty experiments) of respectively 0·48, 0·45, 0·15, and 0·19 per cent., or an aggregate loss of 1·27 per cent. for the 373 hours (additional to the previous 354 hours) exposure. The peat, which had already been submitted to an exposure of 354 hours, was further exposed for consecutive

periods of 93, 120, 70, 90, and 48 hours, which resulted in an additional loss of respectively 0·53, 0·53, 0·16, 0·16, and 0·05 per cent., or for the total period of 421 hours (additional to the preceding 354 hours) a combined loss of 1·43 per cent. In like manner a lignitic coal which had previously been submitted to an exposure of 354 hours, was also further exposed for consecutive periods of 93, 120, and 70 hours, and with the result that it incurred an additional loss of respectively 0·34, 0·32, and 0·08 per cent., or for the total period of 283 hours (additional to the former 354 hours) an aggregate loss of 0·74 per cent.

The period of exposure—both in a dry and moist atmosphere—finally adopted, in all cases, was 354 hours, weighing at intervals of 190, 94, and 70 hours; and it was found that, during the last 70 hours of this exposure—

In a dry atmosphere, the loss incurred by the—

Lignites	ranged from	0·33 to 0·58	per cent., the average loss being 0·42 per cent.						
Lignitic coals	„	„	0·13 to 0·26	„	„	„	„	0·20	„
Coals	„	„	0·02 to 0·10	„	„	„	„	0·05	„
Semi-anthracites	„	„	0·01 to 0·02	„					
Anthracite	amounted to 0·05 per cent.								

In a moist atmosphere, the amount of water reäbsorbed by the—

Lignites	ranged from	0·26 to 0·85	per cent., the average gain being 0·55 per cent.						
Lignitic coals	„	„	0·07 to 0·26	„	„	„	„	0·19	„
Coals	„	„	0·02 to 0·12	„	„	„	„	0·07	„
Semi-anthracites	„	„	0·02 to 0·04	„	„	„	„	0·03	„
Anthracite	amounted to 0·06 per cent.								

The peat and anthracitic coal comported themselves, in both above regards, in much the same manner as a lignite and coal respectively.

It will be observed that there is a remarkably close agreement in the amounts of water lost and reäbsorbed by each of the respective varieties of fuel during the last 70 of the 354 hours exposure, and that the amount of this loss and reäbsorption is (apart from the anthracite) proportionate to the degree of alteration of the fuel—it being greatest in the lignites, and least in the semi-anthracites.

From the above results, coupled with those obtained in the preliminary experiments, it is evident that, beyond a certain point, the lignites and lignitic coals part with their water but very slowly, so that even after an exposure of 354 hours to an absolutely dry atmosphere, these yet retain a certain amount of water removable by a yet more protracted exposure. The coals and semi-anthracites, on the other hand, may fairly be regarded as dry after such period of exposure—indeed it was found that, in many instances, the semi-anthracites and more altered coals had, during the last 70 hours, suffered no alteration in weight.

In the accompanying table the various fuels have been arranged in the order of their diminishing hygroscopicity. On referring to the same it will be seen that the capacity for retaining, and with it that for reäbsorbing, water varies with the degree of alteration which the fuel has undergone—it being most pronounced in the lignites, less so in the lignitic coals, and least in the coals. Thus, we find that the amount of water retained by

the lignites[1] (and peat—which, in this regard, comports itself like a lignite) ranges from 2·50 to 5·00 (2·43 to 5·12) per cent., whilst that retained by the lignitic coals[2] ranges from 1·00 to 2·00 (1·10 to 2·09) per cent., and that retained by the coals[3] (together with the anthracitic coal, semi-anthracites, and anthracite, which, in this particular, behave like coals) from 0·10 to 1·00 (0·03 to 1·11) per cent.,also—that the amount of water reäbsorbed by the dry fuel, ranges, in the case of the lignites[4] (and peat, whose behaviour, in this regard, is precisely similar to that of a lignite,) from 10·00 to 14·50 (10·06 to 14·45) per cent., in that of the lignitic coals[5] from 6·50 to 9·00 (6·62 to 8·80) per cent., and in that of the coals (together with the anthracitic coal, semi-anthracites, and anthracite[6]) from 1·50 to 6·00 (1·66 to 6·19) per cent.; or briefly:—

Lignites.....	retain	from	2·50 to 5·00,	and	reäbsorb	from	10·00 to 14·50	per cent.	water.
Lignitic coals.....	„	„	1·00 to 2·00,		„	„	6·50 to 9·00	„	„
Coals.....	„	„	0·10 to 1·00,		„	„	1·50 to 6·00	„	„

Comparing the results given in column 8, with those recorded in column 7, we find that the degree of alteration of the fuel as indicated by the potash reäction, is further evidenced by its relative hygroscopicity. Thus, we see that whereas—

The coloration imparted to a solution of caustic potash, by
LIGNITES—is dark to intense brownish-red, and that by
LIGNITIC COALS—most frequently brownish-yellow, but occasionally brownish-red, the
COALS—in many instances give no coloration, at other times a faint yellowish one, or one ranging between that and pale brownish-yellow.

The percentage of water reäbsorbed ranges, in the case of
LIGNITES.....from 10·00 to 14·50
LIGNITIC COALS..... „ 6·50 to 9·00
COALS..... „ 1·50 to 6·00

The considerations which led to the arrangement of the fuels, here treated of, under the headings mentioned, were alluded to in a previous paper (Report of Progress of the Geological and Natural History Survey of Canada, 1882-83-84, Part M, p. 5, et seq.) It was there shown that:—

1. Whereas the Lignites all have a greater or less tendency to disintegrate on exposure to the air; contain a large amount of water; communicate an intense coloration to a solution of caustic potash; yield (by fast coking) a non-coherent coke, and have a chemical composition very similar to that of many foreign lignites.

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[1] Excluding No. 3, which stands out conspicuously from all the rest, in that it retained an exceptionally large amount of water.

[2] Omitting No. 33, which forms the connecting link between the lignites and lignitic coals, and retained a much larger percentage of water than any of the other fuels of the latter class.

[3] Disregarding No. 44, which forms a connecting link between the lignitic coals and coals, and retained a larger percentage of water than any of the other coals.

[4] Passing over No. 37, in which it was found to be exceptionally low.

[5] Omitting No. 42, which forms the connecting link between the lignitic coals and coals, and reäbsorbed a somewhat smaller amount of water than any of the other lignitic coals.

[6] The anthracite, it will be observed, contrary to what might have been expected, reäbsorbed far more water (the experiments were repeated, and with the same results) than any of the semi-anthracites or more altered coals, and in this regard, takes rank with some of the least altered of the latter; its capacity for retaining water is, however, as may be seen, very slight.

2. The Lignitic Coals show a greater disposition to resist[1] exposure to the air—being, on the whole, tolerably firm; contain much less water; do not impart so deep a coloration to a solution of caustic potash; show (by fast coking) a slight caking tendency, and in regard to chemical composition, occupy a position between true lignites and true bituminous coals.

3. Whilst the Coals resist exposure to the air; are hard and firm; contain but a small proportion of water; communicate but a very slight, if any, coloration to a solution of caustic potash; yield (by fast coking), in the majority of instances, a good firm coke, and in respect to general appearance and chemical composition closely resemble some varieties of coal of the Carboniferous system.

[1] Employed, throughout this paper, in the sense of "not breaking down."

NOTES TO TABLE.

(1.) That is to say the amount of water retained by the same after exposure to a perfectly dry atmosphere for 354 hours.

(2.) The treatment with solution of caustic potash was conducted at the ordinary temperature. This offers some advantages over that by digestion at a boiling heat—the action not being so energetic (although sufficiently so, as the results show, to obtain the desired result), a greater number of shades of color are obtained, thus admitting of a more accurate estimate of the nature of the fuel. The experiments were all carried out simultaneously, and under precisely similar conditions; the results admit, therefore, of a fair comparison. The fuels were all reduced to a very fine powder; specific gravity of the potash solution, 1·16; time of contact, shaking at intervals, two hours; after which filtration was proceeded with, the filtrates being collected in flat, broad-faced, narrow-sided white-glass bottles of uniform dimensions. The amount of alkaline solution, and weight of fuel employed, was in all instances the same.

(3.) In appearance it resembles some varieties of coal of the Carboniferous system.

(4.) Is probably an extension of the seam at Blackfoot Crossing, Bow River (specimen No. 23).

(5.) This specimen had been kept in the show-cases of the Museum for years, and may fairly be regarded as, having been in a thoroughly air-dried condition.

(6.) This lignite contains an occasional interstratified layer of mineral charcoal, likewise thin plates of gypsum and numerous minute crystalline aggregations of pyrite; it also had a large amount of lemon-yellow, occasionally brownish-yellow, subtransparent to transparent resin, chiefly in small particles, diffused through its substance.

(7.) From the same seam (points of collection, however, different) as that from which specimen No. 6 was taken.

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

(9.) Specimens Nos. 23 and 28 are from natural exposures of the same seam, the former being about eight, and the latter about six, miles south of the shaft.

(10.) This coal is, here and there, intersected by thin plates of calcite, as also by films of pyrite.

(11.) This coal is intersected by numerous thin plates of gypsum and calcite, and contains, in parts, a few films of pyrite.

(12.) Specimen No. 46 is from a natural exposure of the same seam on the north side of the river.

(13.) This coal is intersected by numerous thin plates of calcite, as also, here and there, by a few films of pyrite.

(14.) This specimen was, in parts, very much soiled with argillaceous matter, and to this circumstance may be attributed the large percentage of incombustible matter which this sample of the fuel was found to contain.

(15.) The sample received for examination was, in parts, coated with earthy matter which was not readily removable: this would account for the large percentage of ash which this particular specimen was found to leave on ignition.

(16.) From a microscopic examination of thin slices of this coal it was inferred that the nodular grains consist of an altered resinous matter.

(17.) The specimen of semi-anthracite No. 69 came from the Cascade mine (Moberly's), which is near Banff Station, on the Canadian Pacific Railway. The Hughes' mine (Stewart's mine) here referred to, is about three miles distant from that mine.

(18.) Determination of the specific gravity. The fuel was reduced to the state of a coarse powder by crushing it in an iron mortar, the application of more force than was absolutely necessary to effect this being carefully avoided, so as to obviate, as far as possible, the production of fine particles and dust. The material was subsequently freed from the latter by shaking it upon a sieve of ninety holes to the linear inch. The specimen having been introduced into the specific gravity bottle, and sufficient water added to thoroughly immerse it, the whole was placed under the receiver of an air-pump, and exhaustion very gradually proceeded with; the exhaustion was repeated at intervals, and until no more bubbles were seen to come off. The bottle was then removed, and the necessary adjustments having been made, weighed; after which, a portion of the water having been withdrawn, it was again placed under the receiver of the air-pump, etc.

HYGROSCOPICITY OF

CERTAIN CANADIAN FOSSIL FUELS.

TABLE.

1. Number of Specimen.	2. Variety of Fuel	3. Locality	4. Description.	5. Specific gravity (lbs) at 15.6°C.	6. Proximate Analysis—Fast Coking. Composition, per cent. Water at 105°	Volatile combustible matter.	Fixed Carbon.	Ash	F.C. / V.H.C. Fuel ratio	Percentage of Coke.	Character of flame. The gases evolved during coking burnt with a	Character of the Coke	Colour of	Texture	7. Hygroscopicity. Per cent. water— a. On dry coal.	b. In saturated coal.	c. Lost in dry atmosphere.	d. Re-absorbed in moist atmosphere	8. Potash Reaction (5) Intense brownish-red.	Deep brownish-red.	Dark brownish-red.	Brownish-red.	Brownish-yellow.	Pale brownish-yellow.	Very pale brownish-yellow.	Faint brownish-yellow.	All but colorless.	Colorless.	9. Number of Specimen.
1	Lignite	Red Deer River, four miles and a-half south of Bull Pound Creek, boundary of townships 23 and 24, range 14, west of the fourth initial meridian, District of Alberta, North-West Territory. Seam one foot and a-half thick. Geo. Pos.—Cretaceous, below Pierre.	Structure fine lamellar—tolerably compact; color black; lustre of surface along the plane of bedding dull, that of the cross fracture resinous; fracture uneven, occasionally somewhat conchoidal; powder black, faint brownish tinge; by exposure to the air splits in the direction of the bedding and falls to pieces.	Undet.	14·63	34·01	39·11	13·25	1·15	52·36	yellowish, slightly luminous, almost smokeless flame.	Non-coherent.	Pale, yellow.	dirty yellow.	4·54	18·98	9·10	14·45	....	....	*									1
2	do.	North Saskatchewan River, right bank, a short distance below Fort Edmonton, District of Alberta, North-West Territory. Seam four feet thick. Geo. Pos.—Lower Laramie, Edmonton series.	Structure very compact and homogeneous; color brownish-black; lustre dull, occasionally sub-resinous; tough; fracture large conchoidal; powder black, with a brownish tinge; by exposure to the air becomes more or less fissured.	1·4259	12·80	33·79	50·57	2·75	1·49	53·32	yellowish, somewhat luminous, slightly smoky flame.	do.	Black, yellow.	waxy.	3·92	17·40	8·97	13·48	....	*										2
3	do.	From seam on branch of Willow Creek, six miles south-east of head of mountain, Cypress Hills, township 7, range 3, west of the fourth initial meridian, District of Assiniboia, North-West Territory. Seam four feet thick. Geo. Pos.—Laramie.	Structure fine lamellar—tolerably compact; it contains an occasional interstratified layer of mineral charcoal; color black; lustre, sub-resinous to resinous; fracture uneven; powder black, with a faint brownish tinge; by exposure to the air splits along the line of bedding and falls to pieces.	Undet.	16·37	15·58	37·23	10·82	1·05	48·05	pale yellowish, feebly luminous, smokeless flame.	do.	Pale green.	coherent.	6·65	19·84	6·72	13·18	*											3
4	do.	North Saskatchewan River, right bank, section 23, township 59, range 4, west of the fifth initial meridian, District of Alberta, North-West Territory. Seam twenty-five feet thick. Geo. Pos.—Lower Laramie, Edmonton series.	Structure coarse lamellar; made up of alternate layers of more or less dense, bright and dull coal, and numerous interstratified layers of mineral charcoal; color black; lustre along the surface of bedding dull, that of the cross fracture sub-resinous to resinous; fracture uneven, that of the brighter layers somewhat conchoidal; powder almost black; by exposure to the air falls to pieces.	1·4341	14·78	30·48	48·67	6·07	1·59	54·74	yellowish, slightly luminous, almost smokeless flame.	do.	Pale brown.	coherent.	2·73	15·04	12·05	12·91	....	....	*									4
5	do.	Souris River, one mile west of La Roche Percée, at the junction of Short Creek and Souris River, township 1, range 5, west of the second initial meridian, District of Assiniboia, North-West Territory. Sutherland's mine. Seam five feet thick. Geo. Pos.—Laramie.	A brownish-black, compact lignite; ligneous texture very marked; lustre for the greater part dull, in more altered parts sub-resinous to resinous; tough; fracture on the whole uneven, occasionally verging on the sub-conchoidal; powder black, with a brownish tinge; by exposure to the air becomes more or less fissured and falls to pieces.	1·4168	21·84	35·12	38·64	4·40	1·10	43·04	... ...	do.	Brownish	yellow.	4·76	17·66	17·68	12·90	...	*										5
6	do.	Red Deer River, two miles below the mouth of Rosebud or Arrow-wood River, township 28, range 19, west of the fourth initial meridian, District of Alberta, North-West Territory. (4.) Seam five feet thick. Geo. Pos.—Lower Laramie, Edmonton series.	Structure very fine lamellar; the lines of bedding are, however, often almost obliterated—tolerably compact; color black; lustre sub-resinous to resinous; fracture uneven, occasionally approaching the conchoidal; powder almost black; cracks somewhat by exposure to the air and has a tendency to fall to pieces.	1·2929	14·20	34·22	47·91	3·67	1·40	51·58	yellowish, somewhat luminous, slightly smoky flame.	do.	Bright	red	2·96	15·85	11·24	12·84	....	....	*									6
7	do.	Hay Flat, Wood Mountain, ten miles and a-half east of Wood Mountain Post, township 4, range 1, west of the third initial meridian, District of Assiniboia, North-West Territory. Seam six feet thick. Geo. Pos.—Laramie	Structure, for the most part, moderately fine lamellar, it contains, however, an occasional somewhat thick, irregular shaped layer of dense material—tolerably compact; color greyish-black; lustre sub-resinous; fracture uneven; the dense material has a pure black color, a resinous to vitreous lustre, and a more or less conchoidal fracture; powder dark brown, inclining to blackish-brown; by exposure to the air becomes somewhat fissured and hence tender.	Undet.	12·74	8·01	38·54	8·82	0·99	47·36	yellowish, slightly luminous, almost smokeless flame.	do.	Light brown.	waxy.	4·77	17·63	8·96	12·86	....	*										7
8	do.	South Saskatchewan River, north bank, seven miles west of Medicine Hat, township 13, range 6, west of the fourth initial meridian, District of Assiniboia, North-West Territory. Saskatchewan Coal Mining and Transportation Company's Mine. From No. 6 level, three hundred and twenty feet from the entrance. Geo. Pos.—Cretaceous, Belly River series.	Presented, with the exception of one layer, a general appearance of great uniformity alike in texture, color and lustre. The material composing the layer was very compact, exhibited a delicate ligneous structure, had a black color, a resinous lustre, and a conchoidal fracture. The other portion exhibited a very fine lamellar structure, was compact, had a greyish-black color, a resinous lustre, and an uneven, occasionally imperfectly conchoidal fracture; powder black, with a slight brownish tinge: by exposure to the air becomes fissured, and hence tender. (6.)	Undet.	20·54	32·26	41·15	5·05	1·24	46·50	yellowish, feebly luminous, almost smokeless flame.	do.	Brownish	yellow.	3·76	16·33	16·78	12·75	....	....	*									8
9	do.	Red Deer River, two miles south of Bull Pound Creek, township 24, range 15, west of the fourth initial meridian, District of Alberta, North-West Territory. North-north-east extension of the Coal Banks main seam (specimen No. 38). Geo. Pos.—Cretaceous, base of Pierre.	Structure fine lamellar—tolerably compact; color black; lustre along the plane of bedding dull, that of the cross fracture, resinous; fracture irregular; intersected throughout by numerous thin plates of gypsum; powder black, slight brownish tinge; by exposure to the air falls to pieces.	1·4121	12·62	5·99	12·81	8·58	1·19	51·39	yellow, luminous, somewhat smoky flame.	do.	Pale dirty brown.	reddish	3·17	16·76	8·95	2·69	....	....	*									9
10	Peat.	From St. Hubert, Chambly county, Province of Quebec.	Structure somewhat dense; contained a rather large proportion of intermixed rootlets; color clove-brown; dull; fracture uneven; powder brown. This peat had been pulped, sticks and roots separated, and dried by exposure to the air—it had not been compressed. (5.)	0·7484	10·28	61·48	25·23	3·01	0·41	28·24	pale yellow, slightly luminous, smokeless flame.	Loosely matted.	Pale brown.	rich-yellow.	1·20	16·86	6·08	12·06	*											10
11.	Lignite	South Saskatchewan River, north bank, seven miles west of Medicine Hat, township 13, range 6, west of the fourth initial meridian, District of Assiniboia, North-West Territory. Saskatchewan Coal Mining and Transportation Company's mine. Main seam. Seam about five feet thick. Geo. Pos.—Cretaceous, Belly River series.	Structure somewhat coarse lamellar—moderately compact; with the exception of one layer presented a general appearance of great uniformity, alike in texture, color and lustre—This layer was very compact, exhibited a delicate ligneous structure, had a black color, a resinous lustre and a conchoidal fracture. The other portion had a greyish-black color, a resinous lustre, and uneven fracture; powder black with a slight brownish tinge. By exposure to the air becomes fissured and tender. (6).	Undet.	19·00	33·73	41·58	5·19	1·25	46·77	yellowish, slightly luminous, almost smokeless flame.	Non-coherent.	Brownish	yellow	4·02	16·54	15·83	12·47	....	....	*									11
12.	do.	Red Deer River; nine miles and a-half south of Bull Pound Creek, south-east corner of township 23, range 15, west of the fourth initial meridian, District of Alberta, North-West Territory. Seam three feet and a-half thick. Geo. Pos.—Cretaceous, below Pierre.	Structure somewhat fine lamellar; contains an occasional layer of mineral charcoal; reticulated throughout with delicate laminæ of gypsum; lustre in the direction of the bedding dull, that of the cross fracture resinous; powder almost black; by exposure to the air becomes very tender.	1·4137	13·06	23·75	41·17	9·02	1·39	53·19	yellowish, some of luminous, slightly smoky flame.	do.	Brownish	yellow	3·83	16·18	9·23	12·35	....	....	*									12
13	do.	From seam near mouth of Egg Creek, North Saskatchewan River, opposite Victoria, township 58, range 17, west of the fourth initial meridian, District of Alberta, North-West Territory. Seam thirteen inches thick. Geo. Pos.—Cretaceous, Pierre.	Structure somewhat fine lamellar—tolerably compact; contains numerous interposed patches of mineral charcoal; color greyish-black to almost black; lustre along the surfaces of bedding dull, that of the cross fracture sub-resinous to resinous; fracture uneven; powder dark brown, inclining to blackish brown; by exposure to the air falls to pieces.	Undet.	11·91	36·39	45·04	6·66	1·24	51·70	yellowish, feebly luminous, smokeless flame.	do.	Light brown.	yellowish-brown.	3·14	17·51	6·79	13·27		*										13
14	do.	Red Deer River, at the mouth of Rosebud or Arrow-wood River; township 28, range 19, west of the fourth initial meridian, District of Alberta, North-West Territory. (7). Seam six feet thick. Geo. Pos.—Lower Laramie, Edmonton series	Structure very fine lamellar—tolerably compact; color black; lustre sub-resinous to resinous; fracture uneven, occasionally verging on the conchoidal; powder almost black; by exposure to the air becomes somewhat fissured and has a tendency to fall to pieces.	1·4027	13·08	31·50	48·74	4·68	1·40	52·42	yellowish, slightly luminous, almost smokeless flame.	do.	Reddish-brown.		3·49	15·73	9·59	12·74		*										14
15.	do.	From coulée six miles and a-half south-east of Blackfoot Crossing, township 20, range 20, west of the fourth initial meridian, District of Alberta, North-West Territory. From the lower or three feet seam. Geo. Pos.—Lower Laramie, Edmonton series	The material here referred to, and which has been designated "conchoidal" lignite, is found only in some parts of the seam. Structure compact; homogeneous, like jet—some fragments exhibited, although but faintly, a delicate ligneous texture; color velvet black; lustre resinous; brittle; fracture conchoidal; feel smooth; powder black, faint brownish tinge. (8).	1·3840	12·31	29·83	52·74	2·12	1·60	54·86	... .	do.	Dark brown.	rich.	3·89	16·01	8·42	12·15	...		*									15

1. Number of Specimens	2. Variety of Fuel	3. Locality	4. Description	5. Specific gravity (18) at 15·5°C.	6. Proximate Analysis—Fast Coking. Composition, per cent: Water at 115°C.	Volatile combustible matter.	Fixed Carbon.	Ash.	F.C. / V.H.C.	Percentage of Coke.	Character of flame — The gases evolved during coking burnt with a—	Character of the Coke.	Color of the ash.	7. Hygroscopicity. a. Per cent water— in dry coal. (1)	b. in saturated coal.	c. lost in dry atmosphere	d. re-absorbed in moist atmosphere	8. Potash Reaction. (2) Intense brownish-red.	Deep brownish-red.	Dark brownish-red.	Brownish-red.	Brownish-yellow.	Pale brownish-yellow.	Very pale brownish-yellow.	Faint brownish-yellow.	All but colorless.	Colorless.	9. Number of Specimens.
16.	Lignite	From a seam on Meeting Creek (a tributary of Battle River), township 45, range 17, west of the fourth initial meridian, District of Alberta, North-West Territory. Seam four feet and a-half thick. Geo. Pos.—Lower Laramie, Edmonton series.	Structure fine lamellar—compact; color black; lustre resinous; fracture uneven; powder brownish-black; by exposure to the air splits in the direction of the bedding and falls to pieces.	Undet.	11·68	35·82	49·88	2·62	1·39	52·50	yellowish, freely luminous, smokeless flame.	Non-coherent.	Reddish brown.	4·19	16·28	7·49	12·09	..	•									16.
17.	do	Grassy Island, Bow River, township 17, range 17, west of the fourth initial meridian, District of Alberta, North-West Territory. Main seam. Seam four feet and a-half thick. North-north-east extension of Coal Banks main seam (specimen No. 38). Geo. Pos.—Cretaceous, base of Pierre.	Structure fine lamellar—tolerably compact; fracture uneven; lustre of surface parallel to the bedding dull, that across the bedding sub-resinous; color black; contains an occasional interposed patch of mineral charcoal; powder black, slight brownish tinge; by exposure to the air falls to pieces.	1·4162	11·90	35·02	47·15	5·93	1·34	53·08	yellow, luminous, somewhat smoky flame.	do	Bright red.	3·38	15·17	8·52	12·09	....	....	•								17.
18.	do	From Ross' seam, North Saskatchewan River, right bank, one mile and a-half below ferry at Edmonton, District of Alberta, North-West Territory. Seam four feet thick. Geo. Pos.—Lower Laramie, Edmonton series.	Structure fine lamellar—compact; color black; lustre resinous; fracture uneven; powder dark-brown, inclining to blackish-brown; by exposure to the air splits along the line of bedding and falls to pieces.	Undet.	11·47	36·12	48·57	3·84	1·34	52·41	yellowish, somewhat luminous, slightly smoky flame.	do	Dull yellow.	3·70	15·70	7·77	12·00	.	....	•								18.
19.	do	South Saskatchewan River, south side, about ten miles above Medicine Hat, township 13, range 6, west of the fourth initial meridian, District of Assiniboia, North-West Territory. Lower seam. Seam four feet thick. Geo. Pos.—Cretaceous.	Structure coarse lamellar—the layers differing somewhat in lustre; contains an occasional interstratified layer of mineral charcoal; color black; lustre along the plane of bedding dull, that of the cross fracture sub-resinous to resinous; fracture uneven, occasionally verging on the conchoidal; powder brownish-black; by exposure to the air falls to pieces.	1·3972	16·82	31·90	45·98	7·30	1·38	51·28	yellowish, somewhat luminous, slightly smoky flame.	do.	Reddish brown.	3·68	15·64	13·14	11·96	....	....	•								19.
20.	do	From the Big Island seam, North Saskatchewan River, twelve miles above Edmonton, township 51, range 25, west of the fourth initial meridian, District of Alberta, North-West Territory. Seam three feet eight inches thick. Geo. Pos.—Lower Laramie, Edmonton series.	Structure coarse lamellar—made up of layers of a greyish-black, dull, and dense, bright black coal, with numerous interposed patches of mineral charcoal; fracture uneven; powder brownish-black; by exposure to the air falls to pieces.	Undet.	8·92	28·70	37·41	24·94	1·30	62·38	yellowish, slightly luminous, smokeless flame.	do.	Reddish white.	2·74	14·52	6·21	11·81	...	..	•								20.
21.	do	From three miles south of Horse-shoe Bend, Bow River, township 20, range 19, west of the fourth initial meridian, District of Alberta, North-West Territory. Seam four feet and a-half thick. From upper part of seam. Geo. Pos.—Cretaceous, top of Pierre.	Structure fine lamellar—tolerably compact; color black; lustre in the direction of the bedding dull, that of the cross fracture resinous; fracture uneven, occasionally somewhat conchoidal; powder black, with a brownish tinge; by exposure to the air becomes incrusted with a white efflorescence resulting from the oxidation of pyrite, which is disseminated through it in a very finely divided state; by exposure to the air splits in the direction of the bedding and falls to pieces.	Undet.	11·13	38·75	40·93	9·19	1·06	50·12	.	do.	Dark brownish-red.	4·03	15·80	7·10	11·77	•										21.
22.	Lignitified wood.	Swan River, Manitoba, township 37, range 26, west of the principal meridian. Geo. Pos.—Cretaceous (Lower portion of Niobrara-Benton shales).	Has a dense wood-like structure; color black, with a faint brownish tinge; lustre dull, that of a freshly fractured surface resinous; fracture uneven, occasionally sub-conchoidal; hard and tough; powder brownish-black; by exposure to the air becomes fissured.	Undet.	9·66	43·16	43·64	3·57	1·01	47·18	yellowish, somewhat luminous, slightly smoky flame.	Loosely fritted	Pale brownish-yellow.	4·12	15·83	5·54	11·71		....	•								22.
23.	Lignite	From coulée six miles and a-half south-east of Blackfoot crossing, township 20, range 20, west of the fourth initial meridian, District of Alberta, North-West Territory. From lower or three feet seam. Geo. Pos.—Lower Laramie, Edmonton series.	Structure fine lamellar, tolerably compact; color black; lustre in the direction of the bedding dull, that of the cross fracture resinous; contains an occasional interposed patch of mineral charcoal; fracture uneven, occasionally somewhat conchoidal; powder black, faint brownish tinge; by exposure to the air falls to pieces.	1·3970	11·91	33·25	51·57	3·27	1·55	54·84	yellow luminous, slightly smoky flame.	Non coherent	Yellowish-brown.	3·70	15·39	8·21	11·69	....		•								23.
24.	do	Crowfoot Creek, four miles from its entry into Bow River, District of Alberta, North-West Territory. Seam six feet thick. Geo. Pos.—Lower Laramie, Edmonton series.	Structure fine lamellar; reticulated throughout with delicate laminæ of gypsum; fracture uneven; color black; lustre bright; powder black, with a brownish tinge; by exposure to the air does not readily fall to pieces.	Undet.	11·25	35·50	47·24	5·02	1·33	53·16	.....	do.	Brownish yellow	3·19	14·84	8·06	11·65	....	. .	•								24.
25.	do	Red Deer River, four miles below Tail Creek, township 37, range 22, west of the fourth initial meridian, District of Alberta, North-West Territory. Ten feet and a-half coal in an eighteen-foot section, thickest seam three feet. Geo. Pos.—Lower Laramie, Edmonton series.	Structure compact; color black; lustre resinous; fracture more or less conchoidal; powder brownish-black; by exposure to the air falls to pieces.	Undet.	10·02	32·11	45·19	12·68	1·41	57·87	yellowish slightly luminous, smokeless flame	do	Light reddish-brown	3·38	14·32	6·64	10·91	. . ....		•								25.
26.	do	Athabasca River, about fifty-five miles above the site of old Fort Assineboine, District of Alberta, North-West Territory. Upper seam. Seam ten feet thick. Geo. Pos.—Laramie.	Structure coarse lamellar—made up of bright, and somewhat dull, layers of lignite, and an occasional interstratified layer of mineral charcoal; color black; lustre of some of the layers sub-resinous, that of others shining resinous; fracture uneven; some of the layers of lignite are reticulated throughout with delicate laminæ of gypsum; powder black, with a brownish tinge; by exposure to the air falls to pieces.	1·4123	11·47	32·09	47·79	8·65	1·49	56·44	yellow, luminous, somewhat smoky flame	do.	Light bluish grey	2·86	11·73	8·61	10·87		....	•								26.
27.	do	Athabasca River, about fifty-five miles above the site of old Fort Assineboine, District of Alberta, North-West Territory. Lower seam. Seam three feet thick. Geo. Pos.—Laramie.	Structure somewhat coarse lamellar—made up of successive layers of a bright, and dull lignite, with an occasional intervening layer of mineral charcoal; color black; fracture uneven; powder black, with a brownish tinge; by exposure to the air it has a tendency to split in the direction of the bedding.	1·4387	10·58	32·79	50·19	6·44	1·53	56·63		do	Light grey	2·40	11·19	8·18	10·79	... .		•								27.
28.	do	Bow River, south side, about four miles below Blackfoot Crossing, District of Alberta, North-West Territory. Geo. Pos.—Lower Laramie, Edmonton series.	Structure somewhat coarse lamellar; contains an occasional layer of mineral charcoal; color black; lustre of freshly fractured surface, bright; some of the layers of lignite are reticulated throughout with films of gypsum; powder black, with a brownish tinge; by exposure to the air it has a tendency to split along the line of bedding.	Undet	10·72	32·63	42·72	13·93	1·31	56·65	....	do	Reddish-white.	2·86	11·64	7·86	10·78	....		•								28.
29.	do	Knee Hills Creek (a tributary of the Red Deer River), township 29, range 23, west of the fourth initial meridian, District of Alberta, North-West Territory. Seam four feet thick. Geo. Pos.—Lower Laramie, Edmonton series.	Structure somewhat coarse lamellar—made up of greyish-black, dull, and bright black layers; fracture uneven; contains, in parts, a little brownish-yellow transparent resin; powder brownish-black; by exposure to the air becomes slightly fissured, still remaining, however, tolerably firm.	Undet.	9·86	34·89	46·57	8·68	1·34	55·27	yellowish, somewhat luminous, smokeless flame.	do.	Yellowish-brown.	2·95	13·28	6·91	10·33	... .		•								29.
30.	do	Smoky River, five miles below the mouth of Little Smoky River, District of Athabasca, North-West Territory. Seam two inches and a-half thick. Geo. Pos.—Cretaceous, Dunvegan group.	Structure coarse lamellar—made up of alternate layers of a dull, and bright lignite, and mineral charcoal, of which latter it contains a good deal; contains, in parts, small fragments of a pale yellowish, sub-transparent resin; color black; powder black, with a brownish tinge.	Undet	11·52	31·83	49·17	4·18	1·12	53·65	.	Slightly fritted	Pale reddish-brown.	3·37	13·66	8·15	10·29	. . ...		•								30.
31.	do	Belly River, five miles below the mouth of Little Bow River, township 10, range 18, west of the fourth initial meridian, District of Alberta, North-West Territory. Geo. Pos.—Cretaceous	Structure very fine lamellar—compact; contains an occasional interposed patch of mineral charcoal, color black, in parts iridescent; lustre along the plane of bedding dull, that of the cross fracture resinous, sometimes brilliant; fracture uneven, at times somewhat conchoidal; powder almost black; by exposure to the air becomes slightly fissured, but is, on the whole, a tolerably firm coal. (3.)	1·3976	9·18	34·97	49·60	6·85	1·40	55·85	yellow luminous, slightly smoky flame	Non coherent	Brownish yellow	2·64	12·88	6·54	10·21	...	..									31.

1. Number of specimen.	2. Variety of Fuel.	3. Locality.	4. Description.	5. Specific gravity (3) at 15°C.	6. Proximate analysis—Fast coking. Composition, per cent. Water at 115°C.	Volatile combustible matter.	Fixed Carbon.	Ash.	F.C./V.H.C.	Percentage of Coke.	Character of flame. The gases evolved during coking burnt with a—	Character of the Coke.	Color of the ash.	7. Hygroscopicity. Per cent. water— a. in dry coal (1)	b. in unsaturated coal.	c. left in dry atmosphere.	d. recaptured in moist atmosphere.	8. Potash reaction. (2) Intense brownish-red.	Deep brownish-red.	Dark brownish-red.	Brownish-red.	Brownish-yellow.	Pale brownish-yellow.	Very pale brownish-yellow.	Faint brownish-yellow.	All but colorless.	Colorless.	9. Number of Specimen.
32.	Lignite.	From shaft on Crowfoot Creek, about five miles from its entry into Bow River; section 7, township 22, range 20, west of the fourth initial meridian, District of Alberta, North-West Territory. Depth of shaft to bottom of coal 135 feet. Seam nine feet thick with two partings of twelve and three inches respectively. Geo. Pos.—Lower Laramie, Edmonton series. (9).	Structure somewhat fine lamellar—compact; it contains, interstratified, more or less disconnected, lenticular layers of dense, pitch-black, highly lustrous material, and an occasional layer of mineral charcoal; lustre sub-resinous to resinous; shows well defined planes of cleat; color greyish-black to black; powder black, with a faint brownish tinge; by exposure to the air becomes slightly fissured, but is, on the whole, tolerably hard and firm. (3).	Undet.	10·35	34·40	39·61	15·64	1·15	55·25	yellow, luminous, slightly smoky flame.	Non-coherent.	Light brownish-grey.	2·60	12·66	7·75	10·06	....	....	..								32.
33.	Lignitic coal.	Lewes River (a branch of the Yukon), four miles and a-half above Kink Rapid, North-West Territory. Seam about three feet, but in parts shaly. Geo. Pos.—Laramie.	Structure fine lamellar—compact; color greyish-black; lustre resinous; hard and firm; fracture uneven; powder brownish-black; resists exposure to the air.	Undet	6·03	36·92	49·03	8·02	1·33	57·05	. . .	do.	Brown, faint red dish tinge.	2·81	11·61	3·22	8·80	....	....	....	*							33.
34.	do.	North edge of Milk River Ridge, one mile and a-half east of Fossil Coulée, township 4, range 19, west of the fourth initial meridian, District of Alberta, North-West Territory. Seam eighteen inches thick. Southern extension of Coal Banks main seam (specimen No. 38). Geo. Pos.—Cretaceous, base of Pierre.	Structure somewhat fine lamellar—tolerably compact; color greyish-black, almost pure black; lustre resinous; intersected by numerous thin films of calcite and pyrite; powder black, with a brownish tinge; does not become fissured by exposure to the air, and may, on the whole, be said to be a firm coal.	Undet.	5·58	37·77	49·85	6·80	1·32	56·65	yellow, luminous, somewhat smoky flame.	Slightly fritted.	Pale, dirty red dish brown.	1·67	10·44	3·91	8·70	....	....	....	....	*						34.
35.	do.	St. Mary River, seven miles above its junction with Belly River, District of Alberta, North-West Territory. Southern exposure, on St. Mary River, of Coal Banks main seam (specimen No. 38). Geo. Pos.—Cretaceous, base of Pierre.	Structure somewhat coarse lamellar—made up of alternate layers of a greyish-black, dull, and bright black coal, with an occasional interstratified layer of mineral charcoal; fracture uneven, occasionally breaks into more or less rhombic fragments; powder black with a faint brownish tinge; by exposure to the air becomes slightly fissured, but is, on the whole, a tolerably firm coal. (10).	1·3590	7·02	36·47	50·22	6·29	1·38	56·51	yellow, luminous, somewhat smoky flame.	do.	Reddish-brown	1·52	10·27	5·50	8·75	....	..	..	....	*						35.
36.	do.	Rocky Mountain House seam, one mile below the mouth of Clearwater River, on the North Saskatchewan River, section 33, township 39, range 7, west of the fifth initial meridian, District of Alberta, North-West Territory. Seam two feet, or more. Geo. Pos.—Laramie.	Structure compact; shows well defined planes of cleat; color black; lustre resinous; powder brownish black; by exposure to the air becomes fissured, and hence somewhat tender. Another specimen from this seam had a somewhat coarse lamellar structure, made up of layers of a greyish-black, dull, and bright black coal; this also showed well defined planes of cleat; exposed to the air for the same length of time as the other specimen, remained hard and firm. (11).	Undet.	7·64	34·63	50·34	8·02	1·45	58·36	yellowish, somewhat luminous, slightly smoky flame.	Non-coherent.	Dark brownish yellow	2·09	9·75	4·92	7·66	....	....	..	....	*						36.
37.	Lignite.	Red Deer River, twelve miles above Tail Creek, township 38, range 24, west of the fourth initial meridian, District of Alberta, North-West Territory. Seam ten feet, with three feet of interbedded sandstone and shale. Geo. Pos.—Lower Laramie, Edmonton series.	Structure somewhat fine lamellar—made up of greyish-black, dull, and bright black layers, with an occasional intervening layer of mineral charcoal; fracture uneven, occasionally verging on the conchoidal; powder greyish-brownish-black: by exposure to the air falls to pieces.	Undet.	7·66	25·90	34·53	31·91	1·33	66·44	yellowish, slightly luminous, smokeless flame.	do.	Greyish-brown.	2·67	10·22	4·99	7·55	...	....	*								37
38.	Lignitic coal.	Belly River, main seam at Lethbridge or Coal Banks, District of Alberta, North-West Territory. The seam averages about five feet and a-half in thickness. Geo. Pos.—Cretaceous, base of Pierre.	Structure very fine lamellar—compact, contains interstratified, more or less disconnected, lenticular layers of dense, pitch-black, highly lustrous coal, and an occasional patch of mineral charcoal; also contains, in parts, a little reddish-brown translucent resin; color black; lustre resinous, fracture uneven, occasionally more or less conchoidal; powder black, with a faint brownish tinge; hard and firm; resists exposure to the air. (3).	1·3587	6·50	38·04	47·91	7·55	1·26	55·46	yellow, luminous, smoky flame.	Slightly fritted.	Brownish-yellow.	1·42	8·72	5·08	7·30	...	....	....	....	*						38
39.	do.	Pine River, Coal Brook, about two miles and a-half east of the Lower Forks, British Columbia. Seam six inches thick. Geo. Pos.—Cretaceous, Dunsmuir Group.	Structure very fine lamellar—compact; color black; lustre sub-resinous to resinous, occasionally, in parts, brilliant; shows well defined planes of cleat; powder brownish-black; hard and firm; resists exposure to the air. In appearance, it resembles some varieties of coal of the Carboniferous system.	1·4217	7·83	34·21	52·09	5·87	1·52	57·96	. . . .	Non-coherent.	Reddish-white	1·86	9·08	5·97	7·27	...	*									39.
40.	do.	Government Indian Farm, south of Fincher Creek, about one mile from the farm buildings, up the valley of the small stream on which they are situated, township 5, range 29, west of the fourth initial meridian, District of Alberta, North-West Territory. Seam two feet thick where examined, but reported as considerably thicker where worked into. Geo. Pos.—Base of Laramie.	Structure foliated, highly contorted; shows slickensides; color black; lustre resinous; fracture uneven, powder black, faint brownish tinge; firm; resists exposure to the air. In appearance it much resembles some varieties of coal of the Carboniferous system.	1·3999	5·38	33·19	52·34	9·09	1·58	61·43	yellow, luminous, rather smoky flame	Slightly fritted.	Pale reddish-brown.	1·15	8·24	4·23	7·09	....	.	..		*						40.
41.	do	Red Deer River, near the outer edge of the Foot Hills, township 31, range 7, west of the fifth initial meridian, District of Alberta, North-West Territory. Seam nine feet thick. Geo Pos.—Laramie.	Structure very fine lamellar—compact; contains interstratified, more or less disconnected, lenticular layers of jet black lustrous coal, and numerous patches of mineral charcoal; color greyish-black to black; lustre, apart from layers above referred to, resinous; fracture uneven; powder dark-brown, inclining to blackish-brown; it apparently resists exposure to the air, and is, on the whole, a firm coal.	Undet.	4·07	36·87	54·05	4·11	1·46	58·16	yellow, luminous, smoky flame.	Non-coherent.	Brownish-yellow.	1·10	7·72	3·87	6·62	..	....	....	.	*						41.
42.	do.	Highwood River, North Fork, five miles above Forks, township 18, range 2, west of the fifth initial meridian, District of Alberta, North-West Territory. Seam one foot and a-half thick. Geo, Pos.—Laramie.	Structure compact; shows slickensides; color black; lustre sub-resinous to resinous; fracture uneven; powder black, slight brownish tinge; hard and firm; does not readily fall to pieces when exposed to the air. In appearance it resembles some varieties of coal of the Carboniferous system.	1·1663	6·12	31·92	49·88	12·08	1·56	61·96	yellow, luminous, smoky flame.	Slightly fritted.	Reddish-grey	1·57	7·57	4·75	6·20	....	....	...		*						42.
43.	Coal.	Bow River coal mine, south side of Bow River, a quarter of a mile S. 25 E. from mouth of Coal Creek, section 13, township 26, range 5, and section 18, township 26, range 4, west of the fourth initial meridian, District of Alberta, North-West Territory. Seam ten feet ten inches, with three partings, total thickness of coal, seven feet seven inches. From lower part of seam. Geo. Pos.—Lower Laramie. (12)	Structure somewhat coarse lamellar, made up of alternating layers of a greyish-black, somewhat dull, and bright black coal; it contains a large amount of brownish-yellow resin diffused through its substance; fracture, on the whole, irregular, that of the more lustrous layers, occasionally imperfectly conchoidal; powder dark brown, inclining to blackish-brown; resists exposure to the air.	Undet.	4·41	40·32	48·27	7·00	1·20	55·27	do.	Firm, compact.	Brown-red	0·82	7·01	3·59	6·19	....		....	..	....	....	*				43.
44.	do	Suquash, north-east end of Vancouver Island, British Columbia. From site at which coal was mined by the Hudson's Bay Company. Upper seam. Seam one to two feet thick. Geo. Pos.—Cretaceous.	Structure, on the whole, moderately fine lamellar, of greyish-black color and dull lustre, with occasional somewhat coarse layers of shining, velvet-black coal; it is here and there intersected by a few films of calcite, and contains, in parts, a little lemon-yellow sub-transparent resin; fracture uneven; powder dark brown, inclining to blackish-brown; hard and firm; resists exposure to the air	Undet.	5·03	41·51	46·52	6·94	1·12	53·46	do.	Moderately firm.	Light bluish-grey.	1·40	7·58	3·63	6·18	....	..	....	....	....	*					44.
45.	do	Ki-ok River, the mouth of which is about three miles south of Beaver Harbor, Vancouver Island, British Columbia. Seam six inches thick. Geo. Pos.—Cretaceous	Structure, for the most part, tolerably fine lamellar, with an intervening broad layer of compact, homogeneous, velvet-black, jet-like material, and an occasional interposed layer of mineral charcoal; it is intersected by numerous films of calcite; powder dark-brown, inclining to blackish-brown; hard and firm; resists exposure to the air.	Undet.	3·68	39·29	47·03	10·00	1·19	57·03	do.	Firm, coherent.	Light reddish-grey.	0·90	7·07	2·78	6·17	....	....	....	....	....	*					45.
46.	do.	Coal Creek, Bow River, between Morley and Calgary, township 26, range 5, west of the fifth initial meridian, District of Alberta, North-West Territory. Seam four feet and a-half thick. Geo. Pos.—Base of Laramie.	Structure coarse lamellar; contains occasional interposed layers of mineral charcoal; and is intersected by numerous thin plates of calcite; color black; lustre along the line of bedding dull, that of the cross fracture resinous; fracture uneven, at times somewhat conchoidal; powder black, faint brownish tinge; does not readily become fissured when exposed to the air; a tolerably firm coal.	1·4002	4·93	33·55	46·21	15·31	1·38	61·52	do.	Coherent, but tender.	Reddish brown	1·07	6·69	3·86	5·62	....	..	....	....	....	....	*				46

1. Number of specimen.	2. Variety of fuel.	3. Locality.	4. Description.	5. Specific gravity (lb) at 15·6°C.	6. Proximate analysis—fast coking. Composition, per cent. Water at 105°C.	Volatile combustible matter.	Fixed Carbon.	Ash.	Fuel ratio F.C./V.B.C.	Percentage of Coke.	Character of flame. The gases evolved during coking burnt with a—	Character of the Coke.	Color of the ash.	7. Hygroscopicity. Per cent. water— a. in dry coal (4)	b. in saturated coal.	c. left in dry atmosphere.	d. re-absorbed in moist atmosphere	8. Potash reaction. (2) Intense brownish-red.	Deep brownish-red.	Dark brownish-red.	Brownish-red.	Brownish-yellow.	Pale brownish-yellow.	Very pale brownish-yellow.	Faint brownish-yellow.	All but colorless.	Colorless.	9. Number of Specimen.
47	Coal	From a small stream, three-quarters of a mile due south of mouth of Klik-si-wi River, north-east coast of Vancouver Island, British Columbia. Seam sixteen inches thick. Geo. Pos.—Cretaceous.	Structure tolerably fine lamellar—compact; color black; lustre resinous; hard and firm; fracture uneven; powder dark brown, inclining to blackish-brown; on exposure to the air it becomes, in parts, incrusted with a white efflorescence, resulting from the oxidation of pyrite. In appearance, it is not unlike some varieties of coal of the Carboniferous system.	Undet	3·65	42·23	39·84	14·28	0·94	54·12	yellow, luminous, smoky flame.	Coherent, but tender.	Reddish-brown	1·11	6·64	2·54	5·53												47.
48	do.	Upper Belly River, twenty-five miles and a-half above the mouth of Kootanie (Waterton) River, township 3, range 27, west of the fourth initial meridian, District of Alberta, North-West Territory. Seam one foot thick. Geo. Pos.—Probably near marine base of Laramie.	Structure fine lamellar—it is interstratified with very thin layers of bright black coal, and contains, here and there, a patch of mineral charcoal; color greyish-black, almost black; lustre resinous; fracture uneven; shows tolerably well defined planes of cleat; powder brownish-black; hard and firm; resists exposure to the air. In appearance it much resembles some varieties of coal of the Carboniferous system. (13)	1·3802	3·91	38·01	46·75	11·33	1·23	58·08	do.	Firm, compact.	Grey sh-brown.	0·83	6·06	3·08	5·23												48.
49.	Anthracite.	From Hooper Creek or Nicholson's Tunnel, Cowgitz, on Skidegate Channel, southern end of Graham Island, Queen Charlotte Islands, British Columbia. Main seam. Geo. Pos.—Cretaceous.	Structure compact; it is, here and there, intersected by films of calcite; color velvet-black; lustre bright; brittle; fracture sub-conchoidal; powder greyish-black, almost black; when suddenly heated, decrepitates slightly.	1·5027	1·99	7·65	80·62	9·74	10·54	90·36	slightly yellowish, smokeless flame	Non-coherent.	Reddish-white.	0·19	5·26	1·80	5·07									*		49.
50.	Coal.	Oyster Creek, north-west branch of the North Fork of the Old Man River, District of Alberta, North-West Territory. From one of numerous thin seams. Geo. Pos.—Laramie.	Structure very fine lamellar—compact; color greyish-black; lustre sub-resinous to resinous; fracture uneven—not unfrequently breaks into more or less rhombic fragments; powder brownish-black; hard and firm; resists exposure to the air. (14)	Undet.	4·03	31·82	39·46	24·69	1·24	64·15	yellow, luminous, very smoky flame	Firm, coherent.	Pale reddish-brown.	0·80	5·78	3·23	4·98									*		50.
51.	do.	Old Man River, Middle Fork, township 7, range 2, west of the fifth initial meridian, District of Alberta, North-West Territory. Upper seam. Seam three feet thick. Geo. Post.—Probably Laramie.	Structure very fine lamellar—the successive layers differing somewhat in lustre—compact; color black, but not pure black; lustre sub-resinous to resinous; fracture uneven; here and there intersected by a thin plate of calcite; powder black, slight brownish tinge; hard and firm; resists exposure to the air.	1·4316	3·27	32·53	44·38	19·82	1·36	64·20	do.	Firm.	Light bluish-grey.	0·73	5·10	2·54	4·37									*		51.
52	do.	Old Man River, Middle Fork, township 7, range 2, west of the fifth initial meridian, District of Alberta, North-West Territory. Lower seam. Seam about three feet thick. Geo. Pos.—Probably Laramie.	Structure compact; shows traces of slickensides; color black; lustre sub-resinous to resinous; fracture uneven, occasionally somewhat conchoidal; intersected by numerous thin plates of calcite; powder brownish black; hard and firm; resists exposure to the air.	1·3111	2·36	40·66	47·78	9·20	1·18	56·98	yellow, luminous, smoky flame.	Firm, compact.	Dirty reddish-brown.	0·60	3·90	1·76	3·30									*		52
53.	do.	Wellington Mine, Vancouver Island, British Columbia. This mine is situated five miles and a-half north-west of Nanaimo, and three miles west of Departure Bay. The seam, which is known as the Newcastle seam, has, in this mine, a thickness of from six to ten feet. Geo. Pos.—Cretaceous.	Structure very fine lamellar—compact; color black; lustre resinous; fracture uneven; intersected in many places by thin films of calcite, and contains, interstratified with it, an occasional thin calcareous layer consisting of what, at a first glance, appears to be the crushed fragments of minute shells—a close examination, however, led to the inference that the same was most probably not of organic origin; powder brownish-black; hard and firm; resists exposure to the air. (3)	1·3222	2·75	38·03	52·64	6·58	1·38	59·22	yellow, luminous, very smoky flame.	do.	Brownish-yellow.	0·69	3·89	2·06	3·20									*		53
54.	Anthracite coal.	Cascade River, two miles and three-quarters from its confluence with the Bow, Bow River Pass, Rocky Mountains, section 8, township 26, range 11, west of the fifth initial meridian, District of Alberta, North-West Territory. Seam about twenty inches thick. Geo. Pos.—Cretaceous, Kootanie series.	The coal in this part of the seam—a point, apparently of exceptional disturbance—was found to be in a pulverulent condition.	Undet.	2·07	15·84	74·35	7·74	4·69	82·09	.....	Non-coherent.	Pale reddish-yellow.	0·50	3·59	1·57	3·09									*		54.
55	Coal	From a seam near Ya-koun River—which flows into Masett Inlet—about twelve miles to the north of Skidegate Inlet, Graham Island, Queen Charlotte Islands, British Columbia. Seam said to be about eighteen feet thick. Geo. Pos.—Cretaceous.	Structure compact; color black; lustre resinous, in parts brilliant; fracture uneven, occasionally somewhat conchoidal; here and there intersected by thin plates of gypsum and calcite, as also by a few films of pyrite; powder dark brown, inclining to blackish-brown; hard and firm, resists exposure to the air. In appearance, it closely resembles some varieties of coal of the Carboniferous system.	Undet.	2·65	38·19	53·73	5·43	1·41	59·16	yellow, luminous, smoky flame.	Firm, compact.	Light reddish-white.	0·24	3·29	2·42	3·00											*	55
56.	do.	Red Deer River, Rocky Mountains, District of Alberta, North-West Territory. Northern continuation of Cascade River anthracite trough. Seam broken up where exposed, and the thickness uncertain, but at least several feet. Geo. Pos.—Cretaceous, Kootanie series.	Structure very fine lamellar—compact; color black, but not pure black; lustre resinous; fracture uneven; powder almost black; hard and firm, resists exposure to the air. In appearance it closely resembles some varieties of coal of the Carboniferous system.	Undet.	2·90	29·26	62·95	4·89	2·15	67·84	do.	Compact, firm, coherent.	White, faint reddish tinge.	0·60	3·66	2·30	3·66									*		56
57	do.	From seam near the head waters of Mill and Pincher Creeks, section 19, township 5, range 1, west of the fifth initial meridian, District of Alberta, North-West Territory. Seam has a thickness of about eight feet. Geo. Pos.—Cretaceous.	Structure somewhat coarse lamellar—made up of layers of a greyish-black, somewhat dull, and jet black coal of brilliant lustre, with an occasional layer of mineral charcoal; shows slickensides; fracture irregular, that of the brighter layers not unfrequently conchoidal; powder brownish-black, almost black; hard and firm.	Undet.	1·99	20·58	61·87	15·26	2·98	77·13	yellow, luminous, somewhat smoky flame	Non-coherent.	White.	0·46	3·38	1·53	2·91											*	57
58	do.	Pine River, five miles above the Lower Forks, British Columbia. From the two feet seam. Geo. Pos.—Cretaceous, Dunsmuir Group	Structure very fine lamellar—compact; color black; lustre of fracture parallel to the bedding dull, that of the cross fracture resinous, occasionally brilliant; fracture uneven; contains a brownish-yellow sub-transparent resin, chiefly in small particles, diffused through its substance; powder dark brown inclining to blackish-brown; hard and firm; resists exposure to the air. In appearance, it is not unlike some varieties of coal of the Carboniferous system.	1·4169	2·45	33·76	48·69	15·10	1·44	63·79	.....	Firm, compact.	White.	0·64	3·47	1·81	2·83									*		58.
59	Semi-anthracite	Bow River, right bank, one mile and a-half from Canmore station, C. P. R., section 29, township 24, range 10, west of the fifth initial meridian, District of Alberta, North-West Territory. Seam about one foot thick. Southern continuation of Cascade River anthracite trough. Geo. Pos.—Cretaceous, Kootanie series.	Structure lamellar—compact; shows slickensides; contains an occasional very thin layer of mineral charcoal; color black, in parts iridescent; lustre for the most part bright, that of some of the denser layers sub-metallic; brittle; fracture, on the whole, uneven, that of the more lustrous bands, more or less conchoidal; powder black; when suddenly heated, decrepitates somewhat.	Undet	1·60	12·24	82·32	3·85	6·73	86·17	yellowish, somewhat luminous, almost smokeless flame.	Non-coherent.	Reddish-white.	0·23	2·94	1·27	2·71											*	59.
60.	Coal.	Second crossing, Marten Creek, Crow Nest Pass, Rocky Mountains, British Columbia. Seam about two feet thick. Geo. Pos.—Cretaceous, Kootanie series.	Structure very fine lamellar—compact; color black; lustre resinous; fracture uneven; powder greyish-black; hard and firm; resists exposure to the air. In appearance, it resembles some varieties of coal of the Carboniferous system. (15)	Undet.	2·12	26·92	43·48	27·48	1·61	70·96	yellow, luminous, very smoky flame.	Compact, firm, coherent.	Very pale reddish-brown.	0·25	2·95	1·77	2·60												60.
61	do.	Second Crossing, Marten Creek, Crow Nest Pass, Rocky Mountains, British Columbia. From the "Jubilee" seam. Seam said to be thirty feet thick. Geo. Pos.—Cretaceous, Kootanie series.	Has a crumpled, foliated structure; shows slickensides; color greyish-black to black; lustre resinous, that of the slickensided surfaces occasionally inclining to vitreous; firm; fracture irregular; powder brownish-black; resists exposure to the air.	1·3068	1·89	30·41	63·33	4·37	2·08	67·70	yellow, luminous, smoky flame.	do.	White.	0·11	2·62	1·78	2·51											*	61

1. Number of specimens.	2. Variety of fuel.	3. Locality	4. Description.	5. Specific gravity (lb) at 15.5°C.	6. Proximate analysis—fast cooking. Composition, per cent. Water at 105°C.	Volatile combustible matter.	Fixed Carbon.	Ash.	Fuel ratio F.C./V.B.C.	Percentage of Coke.	Character of flame. The gases evolved during coking burnt with a—	Character of the Coke.	Color of the ash.	7. Hygroscopicity. Per cent. water— a. in dry coal. (1)	b. in saturated coal.	c. not in dry atmosphere.	d. re-absorbed in moist atmosphere	8. Potash reaction. (2) Intense brownish-red.	Deep brownish-red.	Dark brownish-red.	Brownish-red.	Brownish-yellow.	Pale brownish-yellow.	Very pale brownish-yellow.	Faint brownish-yellow.	All but colorless.	Colorless.	9. Number of Specimens.
[illegible]	Coal	Mill Creek, about four miles above the mill, township 5, range 1, west of the fifth initial meridian, District of Alberta, North-West Territory. Seam eight to nine feet thick, with shaly partings. Geo. Pos.—Cretaceous, or possibly Laramie.	Structure fine lamellar—made up of layers of a greyish-black, somewhat dull, and jet-black coal of brilliant lustre—compact; fracture uneven, that of the brighter layers conchoidal; powder black, with a faint brownish tinge; hard and firm. In appearance, it closely resembles some varieties of coal of the Carboniferous system.	1·4226	1·63	28·43	57·57	12·37	2·02	69·04	yellow, luminous, smoky flame.	Firm.	Greyish-white.	0·38	2·83	1·25	2·45	....	....	....	....	....	....	....	....	....	*	62.
[illegible]	do.	Second crossing, Marten Creek, Crow Nest Pass, Rocky Mountains, British Columbia. There are said to be four seams of this material at this locality, having a thickness of respectively three, four, five, and six feet. Geo. Pos.—Cretaceous, Kootanie series.	Structure compact—made up of more or less spherical or lenticular shaped nodular grains of pitch-black color and brilliant lustre, thickly disseminated through a matrix of dull, greyish-black, coaly matter; tough; sonorous; fracture somewhat irregular with a tendency to large conchoidal; powder brownish-black. Resists exposure to the air. (16)	Undet.	2·10	57·71	30·33	9·86	0·52	40·19	yellow, luminous, very smoky flame.	do.	Pale reddish-white.	0·64	3·06	1·46	2·42	....	....	....	*	....	....	....	....	....	....	63.
64	do.	Second crossing, Marten Creek, Crow Nest Pass, Rocky Mountains, British Columbia. From the "Peter" seam. Seam said to be fourteen feet thick. Geo. Pos.—Cretaceous, Kootanie series.	Has a crumpled foliated structure; shows slickensides; color greyish-black to black; lustre resinous—that of the slickensided surfaces occasionally inclining to vitreous; firm; fracture irregular; contains, here and there, a delicate film of pyrite; powder brownish-black; resists exposure to the air.	1·3052	1·79	33·04	61·55	3·62	1·86	65·17	yellow, luminous, smoky flame.	Compact, firm, coherent.	White, faint reddish tinge.	0·03	2·44	1·78	2·41	....	....	....	....	....	....	....	....	....	*	64
65.	do.	South Fork of the Old Man River, four miles above the south branch, Rocky Mountains, District of Alberta, North-West Territory. Seam nine feet nine inches thick. Geo. Pos.—Cretaceous.	Structure very fine lamellar—compact; color greyish-black; lustre sub-resinous to resinous; fracture uneven; powder almost black; hard and firm; resists exposure to the air. In appearance, it is not unlike some varieties of coal of the Carboniferous system.	Undet.	1·93	23·23	57·50	17·34	2·47	74·84	yellow, luminous, slightly smoky flame	Firm coherent.	White.	0·43	2·73	1·50	2·30	....	....	....	....	....	....	*	....	....	....	65.
66.	Semi-anthracite.	Cascade River, near Bow River, about a quarter of a mile from the line of the Canadian Pacific Railway, south-east corner of section 8, township 26, range 11, west of the fifth initial meridian, District of Alberta, North-West Territory. Upper thick seam near Hughes' mine. (17). Seam three feet ten inches thick. Geo. Pos.—Cretaceous, Kootanie series.	Structure lamellar, made up of irregularly alternating layers of a greyish-black, somewhat bright, and dense jet-black coal of brilliant lustre—compact; in parts iridescent; brittle; fracture, on the whole, uneven, that of the denser and more lustrous layers, more or less conchoidal; powder black; hard and firm; resists exposure to the air; when suddenly heated it decrepitates, but not very considerably.	Undet.	1·04	9·15	87·18	2·63	9·53	89·81	pale yellow, smokeless flame of feeble luminosity.	Non-coherent.	White.	0·12	2·27	0·92	2·15	....	....	....	....	....	....	....	....	....	*	66
67.	Coal	Old Man River, North Fork, one mile and a-half from the base of the Rocky Mountains, township 10, range 3, west of the fifth initial meridian, District of Alberta, North-West Territory. Seam five feet thick. Geo. Pos.—Cretaceous, lower than Pierro shales, probably Kootanie series.	Structure compact—lines of bedding somewhat indistinct; contains a few thin layers of interstratified bright black coal; shows traces of slickensides; fracture uneven, that of the bright layers conchoidal; lustre sub-resinous to resinous; powder almost black; hard and firm; resists exposure to the air.	1·5299	1·75	19·99	58·40	19·86	2·92	78·26	yellow, luminous, rather smoky flame.	Coherent but tender.	Reddish-white.	0·39	2·53	1·36	2·14	....	....	....	....	....	*	....	....	....	....	67
68	do.	From shaft sunk on two to three feet seam, north of Coal Harbor, Quatsino Sound, Vancouver Island, British Columbia. Geo. Pos.—Cretaceous.	Structure very fine lamellar—compact; it is here and there intersected by thin plates of calcite, as also by an occasional film of pyrite; color greyish-black, almost black; lustre resinous; fracture uneven; powder dark brown, inclining to blackish-brown; hard and firm; resists exposure to the air. In appearance, it resembles some varieties of the Carboniferous system.	Undet.	1·05	34·38	54·01	10·56	1·57	64·57	yellow, luminous, smoky flame.	Firm, compact.	Pale, dull yellowish white.	0·09	2·21	0·96	2·12	....	....	....	....	....	....	....	....	....	*	68.
69	Semi-anthracite	Cascade River, Bow River Pass, Rocky Mountains, section 18, township 26, range 11, west of the fifth initial meridian, District of Alberta, North-West Territory. Fair average of the entire face of seam—which, at the point of collection, had a thickness of about four feet. Geo. Pos.—Cretaceous, Kootanie series.	Structures very fine lamellar—compact; shows slickensides, some specimens in an eminent degree; contains interstratified, more or less disconnected, lenticular layers of pitch-black, highly lustrous coal in which no structure is visible, and an occasional patch of mineral charcoal; brittle; fracture, on the whole, uneven, that of the denser and more lustrous layers, imperfectly conchoidal; color greyish-black to black, varying with the layers—in parts iridescent; lustre resinous to vitreous; powder pure black; when heated decrepitates; hard and firm.	1·4272	0·71	10·79	80·93	7·57	7·50	88·50	pale yellow, smokeless flame of feeble luminosity.	Non-coherent;	White.	0·20	2·24	0·51	2·04	....	....	....	....	....	....	....	....	....	*	69
70.	Coal	North-west branch of the North Fork of the Old Man River, Rocky Mountains, District of Alberta, North-West Territory. Seam eight feet, or more, thick. Geo. Pos.—Cretaceous.	Compact; shows slickensides; color greyish-black; lustre sub-resinous to resinous; firm; fracture uneven; powder almost black: resists exposure to the air. In appearance, it resembles some varieties of coal of the Carboniferous system.	ndet.	1·24	24·62	66·61	7·53	2·70	74·14	yellow, luminous, smoky flame.	Firm, coherent.	White.	0·22	2·26	1·02	2·04	....	....	....	....	....	....	....	*	....	....	70.
71	do.	Crow Nest Pass, Rocky Mountains, District of Alberta, North-West Territory. Middle seam. Seam two feet ten inches thick. Geo. Pos.—Cretaceous.	Structure fine lamellar—compact; shows slickensides; color black; lustre vitreous; fracture uneven; powder almost black; hard and firm; resists exposure to the air. In appearance, it closely resembles some varieties of coal of the Carboniferous system.	Undet.	1·82	24·55	51·22	22·41	2·09	73·63	yellow, luminous, smoky flame.	Compact, firm, coherent.	White, with a faint greyish tinge	0·39	2·35	1·43	1·96	....	....	....	....	....	....	....	....	....	....	71
7.	Semi-anthracite.	From Marsh's Mine, about one mile and a-half south of Bow River, at Gap siding, Rocky Mountains, District of Alberta. North-West Territory. Upper seam. Seam about twelve feet thick. Geo. Pos.—Cretaceous.	Structure compact; highly contorted, shows slickensides in an eminent degree, made up of alternating layers of a greyish-black, dull, and jet-black coal of brilliant lustre; brittle; fracture, on the whole, uneven, that of the more lustrous layers conchoidal; powder black; hard and firm; resists exposure to the air.	Undet.	0·70	11·03	79·78	8·49	7·23	88·27	yellowish, somewhat luminous, almost smokeless flame	Non-coherent.	White.	0·12	1·78	0·58	1·66	....	....	....	....	....	....	....	....	....	....	72

IX.—*Computation of Occultation and Eclipses for a given locality by Graphic Construction.* By N. F. DUPUIS, Queen's College, Kingston. [Plate I.]

(Read May 31, 1889.)

At the meeting of this Society last year a paper was read upon the prediction of eclipses by graphic construction. The method employed, as I understand it, is the same in principle as that given many years ago by James Ferguson, the celebrated "peasant boy" astronomer of Scotland, in his work upon astronomy, and which is also given in Robinson's "University Astronomy," published in 1859. How often the method has been given, I do not know; these are the only two works in which I have seen it.

This method consists essentially in projecting, upon a plane through the earth's centre, the earth and moon, from the sun in the case of an eclipse, or from the star in the case of an occultation. The earth thus becomes a circular disc upon the plane of the paper, and the moon a circular disc, a little more than one-fourth the diameter of the former, and which, in the course of the eclipse or occultation, gradually moves across and obscures more or less of the earth's disc.

I need not here enter into the particularities of this method. When certain kinds of information are required, it offers advantages over any other graphic method. But it has serious disadvantages, and when only local phases of the phenomenon are required, the method becomes so tedious as to become of little practical utility. The earth, being given in orthogonal projection upon the plane, the meridians and parallels of latitude become, in general, ellipses; and, as we have no simple instrument, like the compasses, for constructing ellipses, these curves have to be constructed by points, and hence more or less irregularly and inaccurately. Moreover, during the progress of the phenomenon, any particular place on the earth's surface is carried forward, in the projection, along an elliptic arc, while the moon's centre moves in a path which is in itself more or less curved.

A tentative measurement between two moving points thus becomes necessary in order to determine the beginning or end of the phenomenon, and these are the things usually sought in the construction. Also if the phenomenon takes place when the moon is far out of the meridian of the plane of observation, the interspaces denoting equal fixed spaces of time, as hours, on the path of the place of observation are very irregular. So that equal parts of these interspaces cannot be determined by inspection or by mere division, but must be obtained by careful and laborious construction.

Having had to make a large number of approximate predictions of the times of beginning and ending of occultations, the method referred to became so laborious that I devised another method which I found to be much more convenient. This I here propose to give.

I reversed what I may here call Ferguson's method. Instead of projecting the earth and moon from the star or sun, I project the moon and star, or in the case of an eclipse,

the moon and the sun, upon the surface of the heavens, a small portion of which is taken as a plane, taking the place of observation as the centre of projection. This method gives us matters in their natural appearances; and in the projection, the star becomes a point on the paper, and the moon becomes a circular disc which moves over and obscures or occults the star; or in the case of an eclipse, we have two discs, representing the ☉ and ☽, of which the sun remains fixed, while the moon, moving along her path, passes over and obscures more or less of the sun.

If we were situated at the earth's centre, nothing would be easier than, from the Nautical Almanac, to lay down upon paper the position of a star to be occulted, and the positions of the moon's centre from time to time at intervals of an hour, or a half-hour, or ten minutes, or less; and the moon's apparent motion during these intervals would be sufficiently uniform to admit of the employment of proportional parts in determining smaller intervals. But from our position upon the earth's surface, the moon suffers parallactic displacement; and this displacement is practically the same as that of the place of observation, with respect to the earth's centre, as seen from the centre of the moon.

Now putting π to denote the moon's horizontal parallax (i.e. the angular value of the earth's radius as seen from the moon), δ to denote the moon's declination, φ the geocentric latitude of the place of observation, and a the hour angle of the moon east or west of the meridian of the place, we have for the displacement, from the well known formulæ for the transformation of spherical coördinates :—

$$D = \pi \sin \varphi \cos \delta - \pi \cos \varphi \sin \delta \cos a$$
$$\Delta = \pi \cos \varphi \sin a$$

where D is the displacement of the moon's centre, north if + and south if — ; and Δ is the displacement of the centre in R. A., east or west from the meridian of the star.

To find these quantities :—

In the application φ is a fixed angle for any particular place, and π, δ, a, are found in, or through the means of the Nautical Almanac for any particular epoch.

These being obtained draw any line QOS and OG a perpendicular to it. Make the angle GOP equal to φ, the latitude of the place of observation, and the angle GOH equal to the declination of the moon at mean time of conjunction, as taken from the Nautical Almanac. Next, take OP equal to π from a scale of equal parts. The value of π is best expressed in minutes of arc, and all other lengths concerned must be reduced to the same unit and taken from the same scale of equal parts. Draw PQ perpendicular to OQ, and with Q as centre, and QP as radius, describe the quadrant PE, and take the angle PQA equal to a, the hour angle of the moon for the particular epoch required, i.e, the angle between the meridian of the moon and the meridian of the place of observation. Draw Aa perpendicular upon QP, and aa' perpendicular upon OH.

Then for the hour angle a, aa' is equal to D and Aa is equal to Δ.

To show this.

$$aa' = QO \cos \delta - Qa \sin \delta.$$

But

$$QO = \pi \sin \varphi, \text{ and } Qa = QA \cos a = \pi \cos \varphi \cos a$$
$$\therefore aa' = \pi \sin \varphi \cos \delta - \pi \cos \varphi \cos a \sin \delta = D,$$

and

$$Aa = QA \sin a = \pi \cos \varphi \sin a = \Delta$$

We have thus a construction for finding the moon's displacement.

The application of this construction, and the final determination of the occultation will be best understood from an explanatory example.

For the occultation of the star 54 Arietis, as seen at Greenwich on Oct. 9th, 1881, we have the following elements :—

☽'s horizontal parallax	$\pi =$	57·6
☽'s semi-diameter	$s =$	15·7
☽'s hourly motion in R. A.	$H =$	35·0
☽'s " " " dec	$h =$	6·7 N
☽'s declination at mean conjunction	$\delta =$	19°·2 N
Mean time of conjunction	$T =$	$12^h{\cdot}75$
☽ north of ✳ at conjunction	$d =$	48·8

Project for the hours	$t =$	11^h	12^h	13^h
Corresponding sid. time	$\theta =$	$0^h\ 14^m\ 46^s$	$1^h\ 14^m\ 56^s$	$2^h\ 16^m\ 6^s$
☽'s R. A.	$\alpha =$	2 57 38	2 59 57	3 2 17
Corresponding hour angle, a, in time		2 42 52	1 45 1	0 47 11
" " " in arc		40°·7	26°·3	11°·8

The latitude of Greenwich is $\varphi = 51°{\cdot}5$ N.

Construct the figure already described having the angle $POG = 51°{\cdot}5$ and $OP = 57{\cdot}6$. Take the angles PQA, PQB, $PQC = 40°{\cdot}7$, $26°{\cdot}3$ and $11°{\cdot}8$ respectively.

In this figure QP represents the meridian of the place and A, B, C, the positions of the moon at the hours XI, XII and XIII respectively; and since the moon is approaching the meridian, it is east of the meridian at the hour named. Hence the horizontal displacement of the moon is eastward, or from right to left in the plot.

Draw OH to make the angle GOH $\delta = 19°{\cdot}2$; and as the declination is north OH lies above OG. For south declination OH will lie below OG.

Take $OH = H = 35{\cdot}0$ and draw HGh perpendicular to OG, and make $Gh = h = 6{\cdot}7$. When the moon is moving northwards Gh is to be taken downwards, and upwards when the moon is moving southwards.

Draw Oh and produce both ways.

OH is the moon's hourly motion in R. A.; OG its hourly motion along its circle of declination; and Oh its hourly motion in its path as seen from the earth's centre. If O denotes the time of mean conjunction, we take OK equal to three-fourths, $(T - 12)$, Oh, and make KJ and KL each equal to Oh. J, K, L are the positions of the moon's centre at the hours XI, XII, and XIII as seen from the earth's centre.

At these hours set off the displacements, parallel to OQ, viz.:—$Jj = aa'$, $Kk = bb'$, $Ll = cc'$; and at j, k, l set off the displacements perpendicular to OQ, viz.: j·XI $= Aa$, k·XII $= Bb$ and l·XIII $= Cc$.

XI, XII, and XIII are the apparent positions of the moon's centre at these hours respectively.

Lastly, take $OS = d = 48{\cdot}8$. S is the apparent position of the star.

With S as centre and a radius $= s = 15{\cdot}7$ describe an arc cutting the line drawn through XI, XII, and XIII, in D and R. D is the time of disappearance of the star, or the beginning of the occultation, and R is the time of reäppearance, or the end of the occultation. These are in the present example about $11^h\ 52^m$ for the beginning and $12^h\ 30^m$ for the end.

This particular occultation was taken because it gives in the construction a convenient diagram for explanations, because it is not a very favorable case where accuracy is expected, and because, being calculated for Greenwich in the Nautical Almanac, we have a ready means of comparing results.

Such a comparison shows a complete coincidence in the times of beginning and end.

As a modification of this purely graphic method we may employ a certain amount of calculation—principally by means of tables—to find the values of the displacements Aa, aa', etc., and then through these we may readily find the coördinates of the moon's centre, referred to the star as origin. This method dispenses with a great portion of the graphic construction, the construction being employed only in the last stage of the determination.

The tables herewith given are logarithmic in character, but on account of their arrangement they are very simple in their working. The arguments for Table I are φ, δ, a, and their complements denoted by φ', δ', a'.

For Table II the arguments are H and π. The tabular results are for convenience indicated by the same symbols as the arguments.

Table III enables us to return from the logarithm to the corresponding numbers, and is, in fact, a table of anti-logarithms.

To illustrate the application of the tables we apply it to the same example as the diagram, the occultation of 54 Arietis, as seen at Greenwich, Oct. 9th, 1881.

We have then

$$\varphi = 51^\circ\cdot5 \qquad \varphi' = 38^\circ\cdot5$$
$$\delta = 19^\circ\cdot2 \qquad \delta' = 70^\circ\cdot8$$
$$a = 40^\circ\cdot7,\ 26^\circ\cdot3,\ 11^\circ\cdot8 \qquad a' = 49^\circ\cdot3,\ 63^\circ\cdot7,\ 78^\circ\cdot2$$

for the hours 11, 12 and 13 respectively. Also

$$\pi = 57\cdot6 \qquad H = 35\cdot0$$

The corresponding tabular numbers from Table I are

$$\varphi = 3894 \quad \delta = 3517 \quad \pi = 760 \quad a = 3814 \quad 3646 \quad 3311$$
$$\varphi' = 3794 \quad \delta' = 3975 \quad H = 544 \quad a' = 3880 \quad 3953 \quad 3990$$

Now

$$\Delta = \text{No. from Table III to } (\pi+\varphi'+a-2000),$$
$$A = \quad \text{"} \quad \text{"} \quad \text{"} \quad (\pi+\varphi+\delta'-2000),$$
$$B = \quad \text{"} \quad \text{"} \quad \text{"} \quad (\pi+\varphi'+a'+\delta-6000),$$

and

$$D = A - B.$$

These give the following results—

$$\Delta = 23\cdot33 \quad 15\cdot85 \quad 7\cdot32,$$
$$D = 33\cdot63 \quad 31\cdot99 \quad 31\cdot05,$$

when

$$t = 11^h \quad 12^h \quad 13^h.$$

And these are the values of the displacements Aa, Bb, ... aa', bb', ... at the hours given.

Next to find the coördinates of the moon's centre.

$$H_1 = \text{No. from Table III. to } (H+\delta'+2000)$$
$$= 33{\cdot}04$$

Then T, t, h and d denoting as before,—

$$x = (T-t)\,H_1 + \Delta_t,$$
$$y = d - (D_t + T - t{\cdot}h).$$

Hence when

$t =$	11^h	12^h	13^h
$T-t =$	1·75	0·75	—0·25
$(T-t)H_1 =$	57·82	24·78	—8·26
$\Delta =$	23·33	15·85	7·32
$\therefore\ x =$	34·49	8·93	—15·58
$(T-t)h =$	11·71	5·01	— 1·67
$D =$	33·63	31·99	31·05
$d =$	48 80	48·80	48·80
$\therefore\ y =$	3·46	11·80	19·42

The quantities x and y are the coördinates of the moon's centre taken in the usual sense, with the star as origin, and at the times indicated. Nothing is now required but to lay down the moon's position in relation to that of the star, and then obtain the moon's apparent path.

In the application of the preceding method the following things must be attended to.

(1.) The moon's motion across the paper is always from right to left.

(2.) B has the same sign as the declination, i.e., + for north and — for south declination.

(3.) Δ is + when the moon is west of the meridian, and — when east.

(4.) h is + when the moon is moving northwards, and — when moving southwards.

(5.) A is + for north latitude, and — for south.

The values of x and y so found are coördinates at intervals of an hour. Coördinates at intervals of one-half hour and thence at intervals of ten minutes are readily found as follows:—

Let x_1, x_2, x_3, denote the three given values of x, and let m be the required term intermediate between x_1 and x_2, and n the one intermediate between x_2 and x_3,

Then

$$m = \tfrac{1}{8}(3x_1 + 6x_2 - x_3) = 21{\cdot}58$$
$$n = \tfrac{1}{8}(3x_3 + 6x_2 - x_1) = -3{\cdot}45$$

Similarly for y,

$$m = \tfrac{1}{8}(3y_1 + 6y_2 - y_3) = 7{\cdot}72$$
$$n = \tfrac{1}{8}(3y_3 + 6y_2 - y_1) = 15{\cdot}70$$

$\therefore$ for

$t =$	11^h	$11^h\ 30^m$	12^h	$12^h\ 30^m$	13^h
$x =$	34·49	21·58	8·93	—3·45	—15·58
$y =$	3·46	7·72	11·80	15·70	19·42

Moreover we may divide the original hour spaces into intervals of 20 minutes by employing the following formulæ, x_1, x_2, x_3 denoting as before, m, n being the terms between x_1 and x_2 and p, q those between x_2 and x_3.

$$m = \tfrac{1}{9}(5x_1+5x_2-x_3) = 25{\cdot}84$$
$$n = \tfrac{1}{9}(2x_1+8x_2-x_3) = 17{\cdot}33$$
$$p = \tfrac{1}{9}(2x_3+8x_2-x_1) = 0.64$$
$$q = \tfrac{1}{9}(5x_3+5x_2-x_1) = -7{\cdot}53$$

and similarly for y.

In applying the preceding methods to the prediction of solar eclipses a few modifications are required.

Thus for π we employ (the moon's horizontal parallax) — (the sun's horizontal parallax).

For s we employ the sum of the semidiameters of the sun and moon.

For H we take (moon's hourly motion in R. A.) — (sun's hourly motion in R. A.)

For h we take (moon's hourly motion in declination) — (sun's hourly motion in declination).

If the sun and moon are moving in opposite directions, we take the sum instead of the difference of their hourly motions in declination.

As an example, we have for the solar eclipse of May 16th, 1882, as seen from Greenwich,

$T = 19^{h}{\cdot}7$ $\quad d = 19{\cdot}2$ $\quad H = 33{\cdot}75$ $\quad h = 4{\cdot}4$ N. $\quad \delta = 19^{\circ}{\cdot}3$ $N.$ $\quad \pi = 58{\cdot}1$ $\quad s = 31{\cdot}73$

For the hours

$t =$	18	19	20

we have

$a =$	$88^{\circ}{\cdot}1$	$73^{\circ}{\cdot}6$	$59^{\circ}{\cdot}2$

Thence we find by the tables, etc.,

$x =$	17·86	— 12·43	— 40·57
$y =$	—30·84	— 23·47	— 16·33

Then drawing any line L, we take upon it a convenient point S as the sun's centre, and set off $SA = 17{\cdot}86$, $SB = 12{\cdot}43$, $SC = 40{\cdot}57$. Then setting off downwards A·XVIII = 30·84, B·XIX = 23·47, C·XX = 16·33, and drawing a curve through the three points thus found, we have the moon's apparent path. Taking $SB = s = 31{\cdot}73$ (B being on the moon's path) we find the time of beginning, B, as 18 h. 11 m., and the time of ending, E, as 19 h. 25 m. Drawing SM perpendicular to the moon's path gives the middle of the eclipse, i.e., the time of the greatest phase, M, as 18 h. 46 m.

With centre S and radius equal to the sun's semidiameter, 15·84, describe the circle f, and with M as centre and with a radius equal to the moon's semidiameter, 15·9, describe a circle g. The figure produced represents the appearance at greatest obscuration. Dividing the distance fg by the sun's diameter gives 0·187 for the magnitude of the eclipse.

The angle $ASB+90$ is the angle from the north point of the sun, toward the west, at which first contact takes place. This angle is by measurement on the plot 158°.

The angle $CSE+90$ is the angle from the north point of the sun at which last contact takes place. This angle measures $129\frac{1}{2}°$.

The foregoing quantities as given in the Nautical Almanac are—

Eclipse begins, 18 h. $10\frac{1}{2}$ m.
Greatest phase, 18 h. 46 m.
Eclipse ends, 19 h. 23 m.
Magnitude, 0·186.
Angle from N. of first contact 158° W.
" " last " 130° E.

The unit of the scale here employed is one-sixteenth of an inch. A larger scale would give greater accuracy.

But, in general, the smaller the magnitude of the eclipse, the greater will be the probable error of the prediction.

TABLE I. *Arguments, φ, δ, a, φ', δ', a'.*

°	0	0·1	0·2	0·3	0·4	0·5	0·6	0·7	0·8	0·9
0		1242	1543	1719	1844	1941	2020	2087	2145	2196
1	2242	2283	2321	2356	2388	2418	2446	2472	2497	2521
2	2543	2564	2584	2603	2622	2640	2657	2673	2689	2704
3	2719	2733	2747	2760	2773	2786	2798	2810	2821	2833
4	2844	2854	2865	2875	2885	2895	2904	2913	2923	2932
5	2940	2949	2957	2966	2974	2981	2989	2997	3005	3012
6	3019	3026	3033	3040	3047	3054	3060	3067	3073	3080
7	3086	3092	3098	3104	3110	3116	3121	3127	3133	3138
8	3144	3149	3154	3159	3165	3169	3175	3180	3185	3190
9	3194	3199	3204	3208	3213	3218	3222	3227	3231	3235
10	3240	3244	3248	3252	3257	3261	3265	3269	3273	3277
11	3281	3284	3288	3292	3296	3300	3303	3307	3311	3314
12	3318	3321	3325	3328	3332	3335	3339	3342	3345	3349
13	3352	3355	3359	3362	3365	3368	3371	3374	3378	3381
14	3384	3387	3390	3393	3396	3399	3402	3404	3407	3410
15	3413	3416	3419	3421	3424	3427	3430	3432	3435	3438

°		dif.	°		dif.	°		dif.	°		dif.	°		dif.
16	3440	26	31	3712	12	46	3857	7	61	3942	4	76	3987	2
17	3466	24	32	3724	12	47	3864	7	62	3946	4	77	3989	1
18	3490	23	33	3736	12	48	3871	7	63	3950	4	78	3990	2
19	3513	21	34	3748	11	49	3878	6	64	3954	3	79	3992	1
20	3534	20	35	3759	10	50	3884	7	65	3957	4	80	3993	2
21	3554	20	36	3769	10	51	3891	6	66	3961	3	81	3995	1
22	3574	18	37	3779	10	52	3897	5	67	3964	3	82	3996	1
23	3592	17	38	3789	10	53	3902	6	68	3967	3	83	3997	1
24	3609	17	39	3799	9	54	3908	5	69	3970	3	84	3998	0
25	3626	16	40	3808	9	55	3913	6	70	3973	3	85	3998	1
26	3642	15	41	3817	9	56	3919	5	71	3976	2	86	3999	1
27	3657	15	42	3826	8	57	3924	4	72	3978	3	87	4000	0
28	3672	14	43	3834	8	58	3928	5	73	3981	2	88	4000	0
29	3686	13	44	3842	7	59	3933	5	74	3983	2	89	4000	
30	3699	13	45	3849	8	60	3938	4	75	3985	2			

TABLE II. *Arguments, H, π.*

Arg.		dif.	Arg.		dif.	Arg.		dif.	Arg.		dif.	Arg.		dif.
25	398	17	31	491	14	37	568	12	52	716	8	58	763	8
26	415	16	32	505	14	38	580	11	53	724	8	59	771	7
27	431	16	33	519	13	39	591	11	54	732	8	60	778	7
28	447	15	34	532	12	40	602	11	55	740	8	61	785	7
29	462	15	35	544	12	41	613	10	56	748	8	62	792	7
30	477	14	36	556	12	42	623		57	756	7	63	799	

TABLE III. *Arguments* = Sums from other tables.

Arg.		D.	Arg.		D.	Arg.		D.	Arg.		D.	Arg.		D.
3000	0·01	0	5200	1·58	4	5600	3·98	9	6000	10·00	24	6400	25·12	58
3100	0·01	1	5210	1·62	4	5610	4·07	10	6010	10·24	24	6410	25·70	60
3200	0·02	0	5220	1·66	4	5620	4·17	10	6020	10·48	24	6420	26·30	62
3300	0·02	1	5230	1·70	4	5630	4·27	10	6030	10·72	25	6430	26·92	63
3400	0·03	0	5240	1·74	4	5640	4·37	10	6040	10·97	25	6440	27·55	64
3500	0.03	1	5250	1·78	4	5650	4·47	10	6050	11·22	26	6450	28·19	65
3600	0·04	1	5260	1·82	4	5660	4·57	11	6060	11·48	27	6460	28·84	67
3700	0·05	1	5270	1·86	5	5670	4·68	11	6070	11·75	27	6470	29·51	69
3800	0·06	2	5280	1·91	4	5680	4·79	11	6080	12·02	28	6480	30·20	70
3900	0·08	2	5290	1·95	5	5690	4·90	11	6090	12·30	29	6490	30·90	72
4000	0·10	3	5300	2 00	4	5700	5·01	12	6100	12·59	29	6500	31·62	74
4100	0·13	3	5310	2·04	5	5710	5·13	12	6110	12·88	30	6510	32·36	75
4200	0.16	4	5320	2·09	5	5720	5·25	12	6120	13·18	31	6520	33·11	77
4300	0·20	5	5330	2·14	5	5730	5·37	13	6130	13·49	31	6530	33·88	79
4400	0·25	7	5340	2·19	5	5740	5·50	12	6140	13·80	33	6540	34·67	81
4500	0.32	8	5350	2·24	5	5750	5·62	13	6150	14·13	33	6550	35·48	83
4600	0·40	10	5360	2·29	6	5760	5·75	14	6160	14·46	33	6560	36·31	84
4700	0·50	13	5370	2·35	5	5770	5·89	14	6170	14·79	35	6570	37·15	87
4800	0·63	16	5380	2·40	6	5780	6·03	14	6180	15·14	35	6580	38·02	88
4900	0·79	21	5390	2·46	5	5790	6·17	14	6190	15·49	36	6590	38·90	91
			5400	2·51	6	5800	6·31	15	6200	15·85	37	6600	39·81	93
5000	1·00	2	5410	2·57	6	5810	6·46	15	6210	16·22	38	6610	40·74	95
5010	1·02	3	5420	2·63	6	5820	6·61	15	6220	16·60	38	6620	41·69	97
5020	1·05	2	5430	2·69	7	5830	6·76	16	6230	16·98	40	6630	42·66	99
5030	1·07	3	5440	2·76	6	5840	6·92	16	6240	17·38	40	6640	43·65	102
5040	1·10	2	5450	2·82	6	5850	7·08	16	6250	17·78	42	6650	44·67	104
5050	1·12	3	5460	2·88	7	5860	7·24	17	6260	18·20	42	6660	45·71	106
5060	1·15	2	5470	2·95	7	5870	7·41	18	6270	18.62	43	6670	46·77	109
5070	1·17	3	5480	3·02	7	5880	7·59	17	6280	19·05	45	6680	47·86	112
5080	1·20	3	5490	3·09	7	5890	7·76	18	6290	19·50	46	6690	48·98	114
5090	1·23	3	5500	3·16	8	5900	7·94	19	6300	19·96	46	6700	50·12	117
5100	1·26	3	5510	3·24	7	5910	8·13	19	6310	20.42	47	6710	51·29	119
5110	1·29	3	5520	3·31	8	5920	8·32	19	6320	20·89	49	6720	52·48	122
5120	1·32	3	5530	3·39	8	5930	8·51	20	6330	21·38	50	6730	53·70	125
5130	1·35	3	5540	3·47	8	5940	8·71	20	6340	21 88	51	6740	54·95	128
5140	1·38	3	5550	3·55	8	5950	8·91	21	6350	22·39	52	6750	56·23	131
5150	1.41	4	5560	3·63	9	5960	9·12	21	6360	22·91	53	6760	57·54	134
5160	1·45	3	5570	3·72	8	5970	9·33	22	6370	23·44	55	6770	58·88	138
5170	1·48	3	5580	3·80	9	5980	9·55	22	6380	23·99	56	6780	60·26	140
5180	1·51	4	5590	3·89	9	5990	9·77	23	6390	24 55	57	6790	61·66	
5190	1·55	3												

X.—*Annotated List of the Minerals occurring in Canada.*

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(Presented May 8, 1889.)

The following alphabetically arranged list of minerals embraces all such as have, up to date (See Addenda), been identified, with any degree of certainty, as occurring in Canada. It includes species, varieties and synonyms—the names of species being printed in black-faced type. Doubtful species; such as have been shown on reëxamination not to be good species; those requiring further investigation; and one or two, the occurrence of which in Canada has not been placed beyond all doubt, are enclosed in brackets—the note to each of these particular minerals explaining for which of the foregoing reasons it has been thus distinguished. It would have been foreign to the present intention to have enumerated all the localities of occurrence of each particular mineral. Hence it is only in some few instances—those of the more rarely occurring,—that this has been done. In the case of those of more frequent occurrence, the principal localities where they are found are, not infrequently, for the most part given; whilst in instances of very general occurrence, mention is sometimes merely made of those places where the mineral has been met with in its most interesting form. In the preparation of this list the writer has freely availed himself of the writings of Dr. T. Sterry Hunt, Prof. E. J. Chapman and the late Prof. H. How; but more especially of those of Dr. Hunt, whose extended and important contributions to the mineralogy of Canada may indeed be said to form the basis upon which the present work has been constructed.

ABBREVIATIONS.

AM. JOURN. SCI.—American Journal of Science and Arts.

ANN. REP. GEOL. CAN.—Annual Reports of the Geological and Natural History Survey of Canada (commencing 1885). Montreal.

CAN. JOURN.—Canadian Journal of Industry, Science and Art. Toronto.

CAN. NAT.—Canadian Naturalist and Quarterly Journal of Science. Montreal.

CAN. REC. SCI.—Canadian Record of Science. Montreal.

DANA, MIN.—A System of Mineralogy; by J. D. Dana, aided by G. J. Brush. 5th ed. New York, 1871—with three appendices, bringing the work up to 1882.

ED. N. PHIL. JOURN.—Edinburgh New Philosophical Journal. Edinburgh.

GEOL. CAN.—Geology of Canada (Report of progress from its commencement to 1863). Montreal, 1863.

JOURN. CHEM. SOC.—Journal of the Chemical Society, London.

MIN. N. S.—Mineralogy of Nova Scotia; by H. How. Halifax, 1869.

PHIL MAG.—The London, Edinburgh and Dublin Philopsophical Magazine and Journal of Science. London.

Rep. Geol. Can.—Reports of Progress of the Geological Survey of Canada (years 1863–1884, inc.=14 vols.). Montreal.
Trans. Roy. Soc. Can.—Proceedings and Transactions of the Royal Society of Canada. Montreal.
Trans. N. S. Inst.—Proceedings and Transactions of the Nova Scotian Institute of Natural Science. Halifax.
Tsch. Min. Mitth.—Tschermak Mineralogische Mittheilungen. Vienna.
Var., variety of. *Syn.*, synonym of. *Anal.*, analysis.

List of Minerals.

Acadialite, 1 ..... *var.* Chabazite.
Acmite, 2 ..... —
Actinolite, 3 ..... *var.* Amphibole.
Agalmatolite, 4 ..... *var.* Pinite.
Agate, 5 ..... *var.* Quartz.
Alabaster, 6 ..... *var.* Gypsum.
Albertite, 7 ..... near Asphaltum.
Albite, 8 ..... —
Allanite, 9 ..... —
Almandite, 10 ..... *var.* Garnet.
Alum. Native, ... *syn.* Kalinite.
" Feather, ... *syn.* Halotrichite.
" Iron, ... *syn.* Halotrichite.
" Magnesium, ... *syn.* Pickeringite.
Alunite, 11 ..... —
Alunogen, 12 ..... —
Amazon-stone, 13 ..... *var.* Microcline.
Amethyst, 14 ..... *var.* Quartz.
Amianthus ..... *syn.* Asbestus.
Ammonium chloride ..... = Sal-ammoniac.
Amphibole, 15 ..... —
Analcite, 16 ..... —
Anatase ..... *syn.* Octahedrite.
Andalusite, 17 ..... —
Andesite, 18 ..... —
Andradite, 19 ..... *var.* Garnet.
Anhydrite, 20 ..... —
[Animikite], 21 ..... —
Ankerite, 22 ..... —
Anorthite, 23 ..... —
Anthracite, 24 ..... *var.* Mineral coal.
Anthraxolite, 25 ..... near Asphaltum ?
Antimonite ..... *syn.* Stibnite.
Antimony. Native, 26 ..... —
" blende ..... *syn.* Kermesite.
" bloom ..... *syn.* Valentinite.
" glance ..... *syn.* Stibnite.
" Grey, ... *syn.* Stibnite.
" oxide ..... = Senarmontite, Valentinite.
" oxy-sulphide = Kermesite.
" Red, ... *syn.* Kermesite.
" sulphide ..... = Stibnite.
Apatite, 27 ..... —
Aphrodite, 28 ..... —
Apophyllite, 29 ..... —
Argentite, 30 ..... —
Arquerite, 31 ..... —
Arragonite, 32 ..... —
Arsenic. Native, 33 ..... —
Arsenical copper ..... *syn.* Domeykite.
" nickel ..... *syn.* Niccolite.
" pyrites ..... *syn.* Arsenopyrite.
Arsenide of platinum ..... = Sperrylite.
Arsenopyrite, 34 ..... —
Asbestus, 35 ..... *var.* Amphibole and Pyroxene.
Asphaltum, 36 ..... —
Augite, 37 ..... *var.* Pyroxene.
Axinite, 38 ..... —
Azurite, 39 ..... —
Barite, 40 ..... —
Barium carbonate ..... = Witherite.
" sulphate ..... = Barite.
Barytes ..... *syn.* Barite.
Berthierite, 41 ..... —
Beryl, 42 ..... —
Biotite, 43 ..... —
Bismuth. Native, 44 ..... —
" carbonate ..... = Bismutite.
" glance ..... *syn.* Bismuthinite.
" sulphide ..... = Bismuthinite.
Bismuthinite, 45 ..... —
Bismutite, 46 ..... —
Bitter-spar ..... *var.* Dolomite.
Bitumen ..... *syn.* Asphaltum.
Bituminious coal, 47 ..... *var.* Mineral coal.
Black copper ..... *syn.* Melaconite.
Black lead ..... *syn.* Graphite.
Blende ..... *syn.* Sphalerite.
Blood-stone ..... *syn.* Heliotrope.
Blue iron earth ..... *syn.* Vivianite.
Blue malachite ..... *syn.* Azurite.
Bog iron-ore, 48 ..... *var.* Limonite.
Bog manganese ..... *var.* Wad.
Bornite, 49 ..... —
Brown hematite ..... *syn.* Limonite.
[Bytownite], 50 ..... —
Cacholong, 51 ..... *var.* Opal.
[Cacoclasite], 52 ..... —
Cacoxenite, 53 ..... —
Cairngorm stone, 231 ..... *var.* Quartz.

Hematite, 119 ..... —
" Brown, ... *syn.* Limonite.
Heulandite. 120 ..... —
Hornblende, 121 ..... *var.* Amphibole.
Hornstone, 122 ..... *var.* Quartz.
Howlite, 123 ..... —
Humboldtine, 124 ..... —
[Huntilite], 21 ..... —
Huronite, 125 ..... —
Hyacinth, 126 ..... *var.* Zircon.
Hypersthene, 127 ..... —
Iceland-spar, 128 ..... *var.* Calcite.
Idocrase ..... *syn.* Vesuvianite.
Ilmenite, 129 ..... *var.* Menaccanite.
[Ilvaite], 130 ..... —
Infusorial earth, 131 ..... = Earthy tripolite.
Iridosmine, 132 ..... —
Iron alum ..... *syn.* Halotrichite.
Iron. Meteoric, ... —
" carbonate ..... = Siderite.
" chromate ..... = Chromite.
" ochre, 133 ..... *var.* Hematite, Limonite.
" oxalate ..... = Humboldtine.
" oxides ..... = Göthite, Hematite, Limonite, Magnetite, Martite.
" phosphate ..... = Vivianite.
" silicate ..... = Ilvaite.
" Spathic, ... *syn.* Siderite.
" sulphate ..... = Melanterite.
" sulphide ..... = Pyrite, Pyrrhotite, Marcasite.
" tungstate ..... = Wolframite.
Iron ore. Magnetic, ... *syn.* Magnetite.
" Micaceous, ... *var.* Hematite.
" Specular, ... *var.* Hematite.
" Titanic ..... *syn.* Menaccanite.
Iron pyrites ..... *syn.* Pyrite.
" Magnetic, ... *syn.* Pyrrhotite.
" White, ... *syn.* Marcasite.
Iron sand, 134 ..... —
Ironstone, Clay, ... *var.* Siderite.
Iserite, 135 ..... *var.* Menaccanite.
Jade ..... *syn.* Nephrite.
[Jamesonite], 136 ..... —
Jasper, 137 ..... *var.* Quartz.
Kalinite, 138 ..... —
Kämmererite, 139 ..... *var.* Penninite.
Kaolinite, 140 ..... —
Kermesite. 141 ..... —
Labradorite, 142 ..... —
Laumontite, 143 ..... —
Lazulite, 144 ..... —
Lead. Native, 145 ..... —
" carbonate ..... = Cerussite.
" sulphide ..... = Galenite.
Lederer ite ..... *syn.* Gmelinite.
Lederite ..... *syn.* Titanite.
Lepidomelane, 146 ..... —
Lignite, 147 ..... *var.* Mineral coal.
Limonite, 148 ..... —
Loganite, 149 ..... *var.* Penninite.
[Louisite], 150 ..... —
[Macfarlinite], 21 ..... —
Macle ..... *syn.* Chiastolite.
Magnesite, 151 ..... —
Magnesium alum ..... *syn.* Pickeringite.
Magnesium carbonate ..... = Magnesite.
" silicate ..... = Aphrodite, Chondrodite, Serpentine, Talc.
" sulphate ..... = Epsomite.
Magnetic iron ore ..... *syn.* Magnetite.
Magnetic pyrites ..... *syn.* Pyrrhotite.
Magnetite, 152 ..... —
Malachite, 153 ..... —
Malacolite, 154 ..... *var.* Pyroxene.
Maltha ..... *syn.* Pittasphalt.
Manganese-spar ..... *syn.* Rhodochrosite.
Manganese, Bog, ... *var.* Wad.
" oxide ..... = Manganite, Psilomelane, Pyrolusite.
Manganite, 155 ..... —
Manganosiderite ..... *syn.* Rhodochrosite.
Marble ..... *var.* Calcite.
Marcasite, 156 ..... —
Martite, 157 ..... *var.* Hematite.
Melaconite, 158 ..... —
Melanterite, 159 ..... —
Menaccanite, 276 ..... —
Meneghinite, 160 ..... —
Mercury sulphide ..... = Cinnabar.
Mesole, 161 ..... *var.* Thomsonite.
Mesolite, 162 ..... —
Meteoric iron, 163 ..... *var.* iron.
Micaceous iron-ore, 164 ..... *var.* Hematite.
Mica. Biotite ..... —
" Chromiferous, 165 ..... —
" Lepidomelane ..... —
" Muscovite ..... —
" Phlogopite ..... —
" Rose-colored, 177 ..... —
Microcline, 166 ..... —
Millerite, 167 ..... —
Mineral coal, 168 ..... —
" oil ..... *syn.* Petroleum.
" pitch ..... *syn.* Asphaltum.
" resin, 169 ..... —
" tar, 170 ..... *syn.* Pittasphalt.
Mirabilite, 171 ..... —
Mispickel ..... *syn.* Arsenopyrite.
Molybdenite, 172 ..... —
Molybdenum oxide ..... = Molybdite.
" sulphide ..... = Molybdenite.
Molybdic ochre ..... *syn.* Molybdite.
Molybdite, 173 ..... —
Monazite, 174 ..... —
Mordenite. 175 ..... —
Morenosite, 176 ..... —
Mountain cork, 35 ..... *var.* Asbestus.
" leather, 35 ..... *var.* Asbestus.
Muscovite, 177 ..... —
Nail-head-spar, 178 ..... *var.* Calcite.

Naphtha ..... *syn.* Petroleum.
Natroborocalcite.. ..... *syn.* Ulexite.
Natrolite, 179..... —
Nephelite, 180..... —
Nephrite, 181..... ..... *var.* Amphibole.
Niccolite, 182 ..... —
Nickel. Arsenical, ... *syn.* Niccolite.
" arsenide ..... = Niccolite.
" silicate... .... = Genthite.
" sulphate..... = Morenosite.
" sulphide..... = Millerite, Polydymite.
" vitriol .... *syn.* Morenosite.
Nickel-Gymnite..... *syn.* Genthite.
Nitre, 183 ..... —
Obsidian, 184.... ..... —
Octahedrite, 185..... —
Oligoclase, 186..... —
Olivine..... *syn.* Chrysolite.
[Ontariolite], 187.... ..... —
Opal, 188..... —
Orthoclase, 189 ..... —
Osmiridium.... ..... *syn.* Iridosmine.
Oxalite..... *syn.* Humboldtine.
Pargasite, 190..... *var.* Amphibole.
Paulite, 127..... *syn.* Hypersthene.
Pearl-spar, 191..... *var.* Dolomite.
Pectolite, 192 ..... —
Peridot..... *syn.* Chrysolite.
Peristerite. 193..... *var.* Albite.
Perthite, 194..... —
Petalite, 195..... —
Petroleum, 196..... —
Phlogopite, 197 .... —
Pickeringite, 198..... —
Picrolite, 199 ..... *var.* Serpentine.
Pitchblende..... ..... *syn.* Uraninite.
Pitchstone, 200 ..... —
Pittasphalt, 170 ..... —
Platinum. Native, 201... —
" arsenide ..... = Sperrylite.
Plumbago ..... *syn.* Graphite.
Polydymite, 202..... —
Potassium alum ..... *syn.* Kalinite.
" nitrate ..... = Nitre.
Prehnite, 203..... —
Pseudomorphous quartz, 204. —
Psilomelane, 205..... —
Purple copper-ore..... *syn.* Bornite.
Pyrallolite, 206 ..... *var.* Talc.
Pyrite, 207..... —
Pyrites. Arsenical,..... *syn.* Arsenopyrite.
" Capilliary,..... *syn.* Millerite.
" Copper,..... *syn.* Chalcopyrite.
" Iron,..... *syn.* Pyrite.
" Magnetic, ... *syn.* Pyrrhotite.
" White iron,..... *syn.* Marcasite.
Pyrolusite, 208..... —
Pyroxene, 209 ..... —
Pyrrhotite, 210 ..... —
Quartz.
" *var.* Agate ..... —
Quartz.
" Amethyst..... —
" Cairngorm stone —
" Carnelian..... —
" Chalcedony.... —
" Heliotrope..... —
" Hornstone .... —
" Jasper ..... —
" Pseudomorphous, —
" Rock crystal... —
" Rose,.... ..... —
" Smoky,.. ..... —
Raphilite..... *syn.* Tremolite.
Red antimony .... *syn.* Kermesite.
" copper ore ..... *syn.* Cuprite.
" hematite .... *syn.* Hematite.
Rensellaerite.. ..... *syn.* Pyrallolite.
Retinalite, 211 ..... *var.* Serpentine.
Rhodochrome ..... *syn.* Kämmererite.
Rhodochrosite, 212.... —
Ripidolite, 213..... —
Rock crystal, 214..... *var.* Quartz.
Rock salt..... *syn.* Halite
Rose quartz, 215..... *var.* Quartz.
Rutile, 216..... —
Sagenite, 217 ..... *var.* Rutile.
Sahlite, 218..... *var.* Pyroxene.
Sal-ammoniac, 219 .... —
Salt. Common, ... *syn.* Halite.
Samarskite, 220 ..... —
Saponite, 221..... —
Scapolite..... ..... *syn.* Wernerite.
Schorl..... *syn.* Tourmaline.
Selenite, 222..... *var.* Gypsum.
Senarmontite, 223..... —
Serpentine, 224 ..... —
Seybertite, 225..... —
Siderite, 226..... —
Sideroplesite, 227..... *var.* Siderite.
Silicified wood, 228..... *var.* Quartz.
Silicoborocalcite ..... *syn.* Howlite.
Silver glance..... *syn.* Argentite.
Silver. Native, 229..... —
" antimonide ..... = [Animikite].
" arsenide ..... = [Huntilite].
" sulphide ..... = Argentite.
Smaltite, 230 ..... —
Smoky quartz, 231..... *var.* Quartz.
Soapstone, 232.. ..... *var.* Talc.
Sodalite, 233..... —
Sodium chloride ..... = Halite.
" sulphate..... = Mirabilite.
Spathic iron ..... *syn.* Siderite.
Specular iron, 234..... *var.* Hematite.
Sperrylite, 235 ..... —
Spessartite, 236.. ..... *var.* Garnet.
Sphaerostilbite, 237 ..... *var.* Stilbite.
Sphalerite, 238..... —
Sphene..... *syn.* Titanite.
Spinel, 239..... —
Spodumene, 240.... .... —

Staurolite, 241 ..... —
Steatite, 242 ..... *var.* Talc.
Steeleite, 243 ..... *var.* Mordenite.
Stellarite, 244 ..... —
Stibnite, 245 ..... —
Stilbite, 246 ..... —
Strontianite, 247 ..... —
Strontium carbonate ..... = Strontianite.
" sulphate ..... = Celestite.
Sulphatite, 248 ..... —
Sulphur, Native, 249 ..... —
Sulphuric acid ..... = Sulphatite.
Sylvanite, 250 ..... —
Tabular-spar ..... *syn.* Wollastonite.
Tachylite, 251 ..... —
Talc, 252 ..... —
Tellurium. Graphic, ... *syn.* Sylvanite.
Tennantite, 253 ..... —
Tenorite ..... *syn.* Melaconite.
Tetrahedrite, 254 ..... —
Thomsonite, 255 ..... —
Titanite, 256 ..... —
Titanium oxide ..... = Octahedrite, Rutile.
Tin oxide ..... = Cassiterite.
Tinstone ..... *syn.* Cassiterite.
Tourmaline, 257 ..... —
Travertine, 258 ..... *var.* Calcite.
Tremolite, 259 ..... *var.* Amphibole.
Tripolite, 131 ..... *var.* Opal.
Turgite, 260 ..... —
Ulexite, 261 ..... —
Uraconite, 262 ..... —
Uralite, 263 ..... *var.* Amphibole.
Uraninite, 264 ..... —
Uranium oxide ..... = Uraninite.
" sulphate ..... = Uraconite.
Uranochre ..... *syn.* Uraconite.
Valentinite, 265 ..... —
Vesuvianite, 266 ..... —
Vitreous copper ..... *syn.* Chalcocite.
" silver ..... *syn.* Argentite.
Vivianite, 267 ..... —
Wad, 268 ..... —
Wernerite, 269 ..... —
White antimony ..... *syn.* Valentinite.
" iron pyrites ..... *syn.* Marcasite.
" lead ore ..... *syn.* Cerussite.
Wilsonite, 270 ..... *var.* Pinite.
[Winkworthite], 271 ..... —
Witherite, 272 ..... —
Wolframite, 273 ..... —
Wollastonite, 274 ..... —
Yellow copper ore ..... *syn.* Chalcopyrite.
Zinc blende ..... *syn.* Sphalerite.
" sulphide ..... = Sphalerite.
Zircon, 275 ..... —

Remarks on Foregoing List.

1. Acadialite—The flesh-red, brownish-red, purplish-red, and yellowish-red varieties of chabazite (which have been named Acadialite) are found at Partridge Island, Swan Creek and Two Islands (Cumberland Co.), in the province of Nova Scotia.
2. Acmite—Forms an important constituent of some of the nephelene-seyenites of Montreal (Hochelaga Co.) and Beloeil (Rouville Co.), in the province of Quebec. Anal., B. J. Harrington, Trans. Roy. Soc. Can., vol. i, sec. iii, p. 81, 1882 and 1883.
3. Actinolite—A bed of actinolite, mingled with an asbestiform serpentine and talc, occurs in the township of Bolton (Brome Co.), and a finely fibrous variety, without admixture, constitutes a bed in St. Francis (Beauce Co.), province of Quebec.
4. Agalmatolite—Of a greenish-white to olive-green color occurs in layers in an indurated clay-slate at St. Nicholas (Levis Co.); of a honey-yellow color, forming a thin bed in clay-slate in the parish of St. Francis (Beauce Co.), and of an amber-yellow, with chloritic slates, on Lake Memphramagog (Stanstead Co.), province of Quebec. Analyses, T. S. Hunt, Geol. Can., 1863, pp. 484, 485.
5. Agate—Many beautiful varieties are found in the trap regions of Nova Scotia: as on the shore extending from Sandy Cove to the head of St. Mary's Bay (Digby Co.); near Cape Blomidon, in large blocks (King's Co.), and fine moss agates are met with near Cape Split and at Scot's Bay (King's Co.), also at Two Islands (Cumberland

Co.). Agates are found in abundance in the amygdaloids of Lake Superior, and sometimes of considerable size and beauty. They abound in rolled masses on the beaches of Michipicoten and St. Ignace Islands, at Thunder Bay and elsewhere along the shore of this lake—province of Ontario.

6. ALABASTER—Considerable masses of a very beautiful snow-white gypsum or alabaster are met with in the gypsum quarries of Hillsborough (Albert Co.), in the province of New Brunswick.

7. ALBERTITE—This beautiful mineral has, so far, only been met with in King's, Albert and Westmoreland counties—the most important locality being in the parish of Hillsborough (Albert Co.)—in the province of New Brunswick. It is not found in beds, but in true cutting veins, which, although at times coincident with the bedding, are as often oblique or at right angles to it. The chief deposits, those of the Albert mines (in Hillsborough), occur in highly bituminous and oil-bearing shales situated near or at the base of the Lower Carboniferous ; but, at points not widely separated, veins of the mineral are found penetrating, for short distances, the underlying metamorphic rocks—supposed to be of Huronian age—and the overlying and little disturbed beds of the Millstone grit. The maximum thickness of the vein as first found near the surface was twenty-two feet, that of the smaller veins only a few inches, while the veinlets were often not thicker than a sheet of paper. It is estimated that since its first discovery (by John Duffy in 1849) some 200,000 tons of this material have been raised at the Albert mines. The deposit has, however, now become practically exhausted, and the mine in consequence abandoned. (From information communicated by Prof. L. W. Bailey, of the University of New Brunswick.)

8. ALBITE—Large cleavable masses of white albite, with quartz and mica, constitute a granite found at the Lake of Three Mountains, on the River Rouge, in the township of Clyde (Ottawa Co.), and a faintly greyish-white almost white albite, exhibiting a fine bluish opalescence, occurs in large fragments in a coarse pegmatite vein—composed of quartz, muscovite, microcline, with occasionally black tourmaline, garnet, etc.—cutting a greyish garnetiferous gneiss in the township of Villeneuve, also in Ottawa county, province of Quebec. See also note to "Peristerite."

9. ALLANITE—Small crystals of this mineral were found, by Dr. T. S. Hunt, in a felspathic rock near Bay St. Paul (Charlevoix Co.), and in a rock composed of labradorite and hypersthene from Lake St. John (Chicoutimi Co.), province of Quebec. Also occurs (Prof. E. J. Chapman, Can. Journ., new series, vol. ix, p. 103, 1864), in the form of a narrow vein in granitoid strata at Hollow Lake, the head waters of the South Muskoka, in the province of Ontario.

10. ALMANDITE—The red garnet from the Stickeen and Skeena Rivers, as also many of the other red varieties alluded to under "Garnet," will, most probably, be found to be referable to this variety.

11. ALUNITE—A massive, fine granular, light reddish colored alunite, has been met with —associated with a greyish translucent quartz and specular iron—at New Ireland Road, parish of Alma (Albert Co.), in the province of New Brunswick.

12. ALUNOGEN—Has been found, in the form of a crust of from 5 to 5½ cm. thick, on

an old heap of shale at the Scotia mine, Springhill coal-field, Cumberland Co., province of Nova Scotia. Anal., F. D. Adams, Rep. Geol. Can., 1878-79, p. 8 H.

13. AMAZON-STONE—Occurs abundantly, and of good color, in the township of Sebastopol (Renfrew Co.), in the province of Ontario. It has also been found in the pegmatite vein, referred to under "Albite," in the township of Villeneuve, and is again met with in the townships of Wakefield and Hull (Ottawa Co.), province of Quebec.

14. AMETHYST—Often of great beauty, is found at many places on the shores of Cumberland, King's, Annapolis and Digby counties, Nova Scotia. The best localities are:—Cape Sharp and Partridge Island (Cumberland Co.), Cape Blomidon (King's Co.), and Digby Neck (Digby Co.). Fine specimens occur in veins around Thunder Bay—more especially at Amethyst Harbor, and at the mouth of McKenzie's River—and at other points on the north shore of Lake Superior, province of Ontario.

15. AMPHIBOLE—See under "Actinolite," "Asbestus," "Hornblende," "Nephrite," "Pargasite," "Tremolite."

16. ANALCITE—Fine specimens of this mineral are found at Cape d'Or, Swan Creek, and Two Islands (Cumberland Co.), also at Cape Blomidon (King's Co.), in the province of Nova Scotia. It has been observed, in association with natrolite, in some of the dykes cutting the Trenton limestone at the reservoir extension, Montreal (Hochelaga Co.), province of Quebec. Also occurs in the amygdaloidal traps of the north shore of Lake Superior, province of Ontario. Anal., B. J. Harrington, Rep. Geol. Can., 1877-78, p. 45 G.

17. ANDALUSITE—Occurs in pale flesh-red colored crystals in a fine grained micaceous schist at Moore's Mills (Charlotte Co.), province of New Brunswick. Also found, in somewhat micaceous argillites, on Lake St. Francis (Beauce Co.), in the province of Quebec. See also note to "Chiastolite."

18. ANDESITE—Occurs in large striated cleavable masses of a reddish color, with hypersthene and ilmenite, constituting a rock at Château Richer (Montmorency Co.), province of Quebec. Analyses, T. S. Hunt, Geol. Can., 1863, p. 478.

19. ANDRADITE—Is found in pale yellowish, honey-yellow, and brownish-yellow colored crystals, imbedded in chalcopyrite; and in yellowish-green colored masses, in association with white fibrous tremolite and dolomite, at the Malaspina copper-mine, north-east side of Texada Island, province of British Columbia.

20. ANHYDRITE—Is met with in considerable quantities, constituting beds, in the gypsum deposits of Nova Scotia and New Brunswick.

21. ANIMIKITE—HUNTILITE—MACFARLINITE. The minerals thus designated occur at the Silver Islet mine, Lake Superior, province of Ontario. The two first named were described by Dr. H. Wurtz (Eng. Min. Journ., xxvii, pp. 55 and 124, 1879), the last by T. Macfarlane (Can. Nat., 2 ser., vol. iv, p. 463, 1870), the results of whose investigations of the foregoing are given in the Trans. Amer. Inst. Min. Eng., viii, 236, 1880. [The true nature of the individual minerals present in the Silver Islet ores is still to be determined, but there is probably present a silver arsenide (Huntilite), and perhaps also a silver antimonide (animikite) allied to dyscrasite—(Dana, Min., App. iii, p. 71, 1882.)

22. ANKERITE—This is one of the most plentiful and characteristic of the minerals filling the numerous fissure veins occurring at the base of the southern slope of the

Cobequid Mountains, Londonderry, Colchester Co., Nova Scotia. Analyses, H. Louis, Trans. N. S. Inst., vol. v, p. 49, 1879-82.

23. ANORTHITE—This felspar is one of the component minerals of the coarsely crystalline intrusive diorite of Yamaska Mountain (Yamaska Co.), in the province of Quebec. Analyses, T. S. Hunt, Geol. Can., 1863, p. 479.

24. ANTHRACITE—Of the Carboniferous system is not known to occur in Canada: there are, however, deposits of this mineral, of Cretaceous age, on the Queen Charlotte Islands—the best known locality being at Cowgitz, on Skidegate channel, at the southern end of Graham Island—province of British Columbia. For reference to analyses, see under "Mineral Coal."

25. ANTHRAXOLITE—This name has been given, by Prof. E. J. Chapman, but simply as a convenient term for present use, to the black combustible coal-like matter which is not unfrequently met with in the provinces of Quebec and Ontario. He describes it as follows:—Black, lustrous, resembling anthracite in general characters, but very brittle. Hardness equals 2·25—2·50; specific gravity, 1·35—1·55. Generally decrepitates when heated. Before the blowpipe, a small fragment loses its lustre, but exhibits no further change. Composition, essentially carbon, with from 3—25 per cent. of volatile matter, including a small amount of moisture, and ash varying from 0—11 per cent. Exhibits under the microscope no trace of organic structure. Dr. T. S. Hunt, in speaking of this material says, "It can scarcely be doubted but that it has resulted from the slow alteration of liquid bitumen in the fissures of the strata." This would explain the great variability in the percentage of volatile matter (exclusive of moisture) which is observed in specimens from different localities the amount of alteration having in some instances proceeded further than in others. It never occurs in true beds like coal, but is found either lining fissures or filling veins and fissures, sometimes several inches in diameter, in the limestones, shales and sandstones,and even in the trap rocks which traverse these. Sometimes it occurs in buttons or drops, forming botyroidal masses. It has been met with in many places in the province of Quebec, viz., on the Island of Orleans, at Quebec and Sillery (Quebec Co.), Point Lévis, and St. Nicholas (Lévis Co.), Lotbinière (Lotbinière Co.), Drummondville (Drummond Co.), Acton (Bagot Co.), in the vicinity of Chatte River in Gaspé, and elsewhere. In the province of Ontario it has been observed filling fissures in the chert beds among the Upper Copper-bearing rocks of Lake Superior. Analyses, T. S. Hunt, Geol. Can., 1863, pp. 524-526.

26. ANTIMONY. NATIVE,—In a lamellar or, more rarely, finely granular form, occurs, in association with stibnite, valentinite, senarmontite and kermesite, accompanied by quartz and a little brown-spar, in veins in argillite in the township of South Ham, Wolfe county, province of Quebec.

27. APATITE—The variety fluor-apatite is very common in the Laurentian rocks of Canada, where it occurs both in the form of veins and of large irregular shaped deposits or lenticular masses. The most important deposits are in the townships of Buckingham, Templeton, Portland and Wakefield (Ottawa Co.), in the province of Quebec—but extensive deposits also occur in the townships of North and South Burgess and North Elmsley, in the province of Ontario. This mineral also occurs in connection with crystalline limestone—being found, in the form of olive-green terminated

crystals, with rounded angles, together with grains of purple fluorite, and crystals of black spinel, imbedded in a yellowish crystalline limestone, in the township of Ross (Renfrew Co., Ont.); and crystals of blue apatite and quartz are imbedded in a coarsely cleavable, sky-blue calcite at the Calumet Falls in the township of Litchfield (Pontiac Co., Que.). Small hexagonal prisms, sometimes an inch in length and one or two lines in diameter, transparent, of a pink or purple color, with surfaces often dull, and angles rounded, occur, in association with crystals of augite, in an intrusive mass of fine grained, grey dolerite at St. Roch, on the Achigan River, L'Assomption Co. Que. Anal., T. S. Hunt, Rep. Geol. Can., 1863-66, p. 203. On the composition of Canadian apatites, G. C. Hoffmann, Rep. Geol. Can., 1877-78 pp. 1-14 H.

28. APHRODITE—Is found filling fissures in the massive pyrallolite of the township of Grenville (Argenteuil Co.), in the province of Quebec. Anal., T. S. Hunt, Geol. Can., 1863, p. 473.

29. APOPHYLLITE—Green and white crystals, aggregated in plates or in square prisms, occur at Two Islands and Cape d'Or (Cumberland Co.), Blomidon (King's Co.), and Margaretville (Annapolis Co.), in the province of Nova Scotia. Also, in foliated masses or plates, often of a red color, in association with calcite, on Prince's Location, Spar Island, Lake Superior, province of Ontario.

30. ARGENTITE—Occurs, with native silver, chalcocite, sphalerite, etc., in a vein of calcite at Prince's mine; with native silver, in a vein of barite, celestite and calcite, on Jarvis Island; with native silver, sphalerite, and a little galenite and pyrite, in a vein of barite and calcite on McKellar's Island; and with sphalerite, pyrite, niccolite, etc., in a veinstone consisting of calc-spar, bitter-spar and quartz, on Silver Islet, Lake Superior. With native silver, in a gangue of calcite, at the Duncan mine—also at the Rabbit Mountain, Porcupine, Beaver and other mines in the district of Thunder Bay (Lake Superior), province of Ontario.

31. ARQUERITE—Is found with alluvial gold upon Vital and Silver Creeks, Omenica District, province of British Columbia. Anal., H. G. Hanks, Dana, Min., App. iii, p. 4, 1882.

32. ARRAGONITE—Is met with, in the form of acicular crystals, varying in size from microscopic minuteness to an inch or more in length, lining fissures or cavities in the ankerite, or implanted upon barite or calcite, in the ankerite deposits of Londonderry (Colchester Co.), province of Nova Scotia. Has been observed forming stalactites and delicate fibrous masses in a calcareous rock in the township of Tring (Beauce Co.), province of Quebec—and sparingly amongst the Lake Superior traps, province of Ontario.

33. ARSENIC. NATIVE,—Is found, in veins, seven miles up Watson Creek, west side of Fraser River, twenty-five miles above Lytton, province of British Columbia. Ann. Rep. Geol. Can., vol. ii, p. 9 T, 1886.

34. ARSENOPYRITE—Is of exceedingly common occurrence in the gold-bearing quartz bands of Nova Scotia. Is found, according to Dr. Hunt, well crystallized, with galena, in a quartz vein on the Chaudière in St. Francis (Beauce Co.); and still more abundantly in small crystals, in association with galena, in a large vein of quartz on Moulton Hill, near Lennoxville (Sherbrooke Co.), province of Quebec. Occurs in

large quantities in quartzose veins in the township of Marmora (Hastings Co.), and it is also met with in the township of Tudor, in the same county, province of Ontairo.

35. ASBESTUS—A more or less delicately fibrous variety of hornblende has been met with in the townships of Templeton and Buckingham (Ottawa Co.), province of Quebec. In the latter township, mountain cork was found in quantity and in masses of considerable size at the Emerald phosphate mine. Mountain leather has also been met with in this township as well as at the Beaver mine in the township of O'Connor, District of Thunder Bay, in the province of Ontario. The fibrous variety of serpentine, which constitutes a largeproportion of what is known in commerce as asbestus, occurs in quantity in the Eastern Townships of the province of Quebec.—See under "Chrysotile."

36. ASPHALTUM—Occurs in the vicinity of Oil Creek, in the southern part of the township of Enniskillen (Lambton Co.), province of Ontario, where it forms two layers, of a viscid consistency, known as gum-beds, occupying areas of about an acre, each, in extent, and having a thickness varying from a few inches to two feet. Another bed of bitumen, of from two to four inches in thickness, is met with at Petrolia, in the northern part of the same township. The material of this bed, which is more solid than that of those just referred to, and mixed with a good deal of earthy matter, is readily separable into thin layers, which are soft and flexible. Very extensive deposits of a bituminous sand-rock occur for great distances along the banks of the lower Athabasca River, North-west Territory ; these are described in Rep. Geol. Can., 1882-84, part CC., and the results of the examination of the material appear in Rep. Geol. Can., 1880-82, p. 3 H.

37. AUGITE—Well defined crystals of black augite are found imbedded in the dolerites of Montreal (Hochelaga Co.), Rougemont (Rouville Co.), and Montarville (Chambly Co.) Mountains, in the province of Quebec. Anal., T. S. Hunt, Geol. Can., 1863, p. 468.

38. AXINITE—Is said by Dr. Bigsby to have been found, in fine crystals, lining a cavity in a boulder of primitive rock at Hawkesbury (Prescott Co.), in the province of Ontario. It has been found *in situ* by Dr. R. Bell, in small veins in trap, on the east coast of Hudson Bay, about one mile and a-half south of the mouth of Little Whale River. Here it occurs, of a purplish-brown color, in association with epidote, imbedded in a matrix of calcite with a little quartz.

39. AZURITE—Has, so far, not been met with in characteristic specimens, but merely as an incrustation on copper-ores, or in the form of stains and small earthy masses in copper-holding rock. Among the many localities where it has been observed, may be mentioned :—The Prince of Wales mine, Upton (Bagot Co.), and at the Black River mine—in a drusy calcite, with sulphurets of copper, in the form of small crystals—St. Flavien (Lotbinière Co.), province of Quebec. With green carbonate of copper at Batchewanung Bay and Prince's mine, Lake Superior, province of Ontario.

40. BARITE—Occurs, sometimes in very beautiful crystalline masses, in numerous irregular veins or pockets in the slates of the East River of the Five Islands (Colchester Co.), Nova Scotia. In a vein cutting Laurentian limestone, in the township of Hull (Ottawa Co.), province of Quebec—and the following localities in the province of Ontario, viz., the townships of Bathurst and North Burgess (Lanark Co.), McNab (Renfrew Co.) Dummer and Galway (Peterborough Co.), and Summerville (Victoria

Co.), also—constituting large veins, on Jarvis, McKellar's and Pie Islands, Lake Superior. Red crystals associated with purple fluorite are found on Iron Island, Lake Nipissing; and isolated pale reddish-yellow crystals have been found by Prof. Chapman (Can. Journ., Nov., 1885) in veins, in the township of Neebing, near Fort William, Thunder Bay, Lake Superior, and subsequently in other mineral veins in that region.

41. Berthierite—Is mentioned (Dana, Minn., p. 86) as occurring near Fredericton, province of New Brunswick. Prof. Bailey thinks the locality referred to would most probably be the antimony mine in the parish of Prince William, about twenty-five miles from Fredericton (York Co., N.B.)

42. Beryl—Crystals of this mineral, having a diameter of three inches and more, and a length of from twelve to fifteen inches, have been met with, by Abbé J. C. K. Laflamme, in the township of Jonquière (Chicoutimi Co.), and it has also been found in the township of Brassard (Berthier Co.), province of Quebec.

43. Biotite—A dark bottle-green mica from Moore's slide (Roche-Fendue channel) on the Ottawa River, has been referred to this species.

44. Bismuth. Native,—Was recognized by Prof. Chapman in some rolled pieces of quartz from near Echo Lake, on the north-west shore of Lake Huron; and agreeably with the observations of Dr. Hunt, it also occurs, in traces, in a veinstone in the township of Tudor (Hastings Co.), province of Ontario.

45. Bismuthinite—Has been met with, in small lamellar and sub-fibrous masses, in a quartz vein at Hill's mine, in the rear of Tudor township, Hastings county, province of Ontario.

46. Bismutite—Has been recognized, by Dr. Hunt, as occurring in a quartz vein at Hill's mine, in the rear of the township of Tudor, Hastings county, province of Ontario.

47. Bituminous Coal—Of the Carboniferous formation occurs in the provinces of New Brunswick and Nova Scotia. In the former, though covering a large surface area, more than two-thirds of the entire extent of the province, the Carboniferous or coal bearing rocks have afforded as yet but little promise of large or valuable deposits, and with the exception of the beds at Grand Lake in Queen's county, which are about two feet in thickness, no stratum of bituminous coal, sufficiently large or pure to be profitably worked, has as yet been discovered. In the province of Nova Scotia there are three important coal basins, viz., those of Cape Bretou, Pictou, and Cumberland counties—the first mentioned occupying an area of at least 190 square miles, with a thickness of not less than 7,000 feet of the Carboniferous strata; the second occupies an area of only some 22 square miles, but several of the coal seams are of extraordinary thickness; the area of the Cumberland field is likewise small, but includes several good coal seams. Coal is not found in the provinces of Quebec and Ontario; the black combustible coal-like matter referred to under "Anthraxolite," is however met with in small quantity at various localities in both these provinces. In the North-west Territory in the Rocky Mountains, and in the adjacent foot-hills, there are extensive deposits of a bitumenous coal which, although of Cretaceous age, is in all respects—physical character and chemical composition—undistinguishable from coal of the Carboniferous, and the same may be said of the coal of the extensive and important deposits, also of Cretaceous age, which exist in various parts of British Columbia. For reference to analyses, see under "Mineral coal."

48. Bog Iron-ore—Occurs in great abundance at numerous localities in the provinces of Quebec and Ontario. In the former, the most important sites are in the Three Rivers district, or between the Rivers St. Maurice, Batiscan and St. Anne. Other deposits occur in the townships of Stanbridge, Farnham, Simpson, Ascot, Ireland, Eardley, Hull, Templeton—the seigniories of Vaudreuil, Lotbinière, Lauzon, St. Vallier, and elsewhere. In Ontario it is met with, in greater or less quantity, in the townships of Charlotteville, Middleton, and Windham (Norfolk Co.), Cambden (Kent Co.), Bastard (Leeds Co.), etc. Analyses, T. S. Hunt, Geol. Can., 1863, p. 510.

49. Bornite—Occurs, most commonly associated with chalcopyrite and chalcocite, in the townships of Cleveland and Melbourne (Richmond Co.), Acton (Bagot Co.), Leeds and Halifax (Megantic Co.), Sutton (Brome Co.), and elsewhere in this section of the province of Quebec. It has been found at the West Canada mines on Lake Huron, also at some points on Lake Superior, in the province of Ontario—and near the head of Salmon Arm of Jarvis inlet, and between that inlet and Howe Sound, province of British Columbia.

50. Bytownite—The name given by Dr. Thompson to a greenish-white felspathic mineral found in a boulder, near Bytown (now the city of Ottawa), in the province of Ontario,—and which has since been shown by Zirkel (Tsch. Min. Mitth., 1871, 61) to be a mixture. An analysis of a portion of the specimen upon which Dr. Thompson founded the species, is given by Dr. T. S. Hunt in the Geol. Can., 1863, p. 479.

51. Cacholong—Beautiful specimens of this mineral are obtainable on the coast between Capes Split and Blomidon (King's Co.), in the province of Nova Scotia.

52. Cacoclasite—The cacoclasite of Prof. H. C. Lewis (The Naturalist's Leisure Hour and Monthly Bulletin, A. E. Foote, No. 87, Exposition extra, 1885), has quite recently been submitted to a careful reëxamination by Dr. F. A. Genth, and shown not to be a good species. Am. Journ. Sci., 3 ser., vol. xxxviii, p. 200, 1889.

53. Cacoxenite—Has been observed by Dr. Harrington as occurring in the form of beautiful little yellow tufts on the walls of cavities in calcite at the pyrite deposit near Brockville, in Elizabethtown, province of Ontario.

54. Calcareous tufa—See note to "Travertine."

55. Calcite—Is found in large rhombohedral, also modified crystals, at Partridge Island (Cumberland Co.), and on the coast between Capes Split and Blomidon (King's Co.), and a very fine apple-green calcite is found at McKenzie's River (Inverness Co.), province of Nova Scotia. A coarsely cleavable sky-blue calcite occurs at the Calumet Falls in Litchfield (Pontiac Co.), also in the township of Wakefield (Ottawa Co.), and a yellow, cleavable calcite, also a fibrous variety, in the township of Templeton (Ottawa Co.), province of Quebec. A salmon-red, cleavable calcite in the township of Sebastopol, Renfrew county, in the province of Ontario. Crystalline limestone, suitable for employment as marble, for architectural purposes, occurs in most, and is very abundant in some, of the provinces of the Dominion. White, red, grey, brown, and black (and various shades of these colors) varieties are met with, respectively, at :—St. Armand (Missisquoi Co.), Caughnawaga (Laprairie Co.), Dudswell (Wolfe Co.), Point Claire (Jacques Cartier Co.), St. Dominique (Bagot Co.), St. Joseph (Beauce Co.), etc., in the province of Quebec—and Arnprior (Renfrew Co.), Cornwall (Stormont Co.), L'Orignal (Prescott Co.), Pakenham (Lanark Co.), and elsewhere in

the province of Ontario. See also notes to "Dog-tooth-spar," "Foetid calcite," 'Iceland-spar," "Nail-head-spar," "Travertine." For a list of minerals of the Laurentian limestones, see Report "On the Laurentian limestones of North America," by Dr. T. S. Hunt, Rep. Geol. Can., 1863-66, p. 181, et seq.

56. FOETID CALCITE—A milk-white, cleavable, foetid calcite, forms a large bed in the township of Grenville, and is also met with in the adjoining township of Chatham (Argenteuil Co.), province of Quebec.

57. CANCRINITE—Occurs in the nepheline-syenites of Montreal (Hochelaga Co.), and Beloeil (Rouville Co.), province of Quebec. Anal., B. J. Harrington, Trans. Roy. Soc. Can., vol. i, sec. iii, p. 81, 1882 and 1883.

58. CANNEL COAL—Occurs at Little Glace Bay, Cape Breton, province of Nova Scotia. Anal., H. How, Phil. Mag., 4 ser., vol. xxxvii, p. 268, 1869.

59. CARNELIAN—Is found at Blomidon (King's Co.); at Trout Cove (Digby Co.), and the north shore of Granville (Annapolis Co.), province of Nova Scotia.

60. CASSITERITE—Small quantities of this mineral, in the form of minute grains, were found to be associated with the Sperrylite obtained at the Vermillion mine, in the township of Denison, District of Algoma, province of Ontario (H. L. Wells, Am. Journ. Sci., 3 ser., vol. xxxvii, p. 68, 1889). Very small quantities of this mineral, in the form of minute crystals, have also been found by Dr. Genth (priv. com.) in some tailings from the Battery lead, Malaga gold mining district, Queen's county, province of Nova Scotia.

61. CELESTITE—Occurs:—in white translucent crystalline foliated masses, which are sometimes radiated, and often several inches in diameter, in the Black River or Trenton limestone of Kingston (Frontenac Co.): in large crystallized masses, semi-transparent and of a bluish or occasionally, in parts, pale reddish color, in a vein cutting Laurentian limestone in the township of Lansdown (Leeds Co.); in radiating fibrous masses, constituting a vein in the Laurentian strata of Bagot (Renfrew Co.); a red variety, in cavities in dolomite, at the forks of the Credit, township of Caledon (Peel Co.). Other localties in this province (Ontario) are:—Owen Sound, Drummond and Grand Manitoulin Islands (Lake Huron), etc.

62. CENTRALLASSITE—Is found in trap of Triassic age near Black Rock (King's Co.), in the province of Nova Scotia. Anal., H. How, Ed. N. Phil. Journ., new series, vol. x, p. 84, 1859: Phil. Mag., 5 ser., vol. i, p. 128, 1876.

63. CERUSSITE—Has hitherto been met with only in small earthy masses and incrustations, associated with the galenite of certain localities in British Columbia.

64. CHABAZITE—Is found in large and very perfect crystals at Swan Creek (Cumberland Co.), Mink Cove and Sandy Cove, Digby Neck, and Williams Brook (Digby Co.), and Pinnacle Island (Colchester Co.), in the province of Nova Scotia. See also note to "Acadialite."

65. CHALCEDONY—Is found in many parts of the trap district of Nova Scotia, where, according to Dr. How, an almost unique blue chalcedony is found on the coast between Capes Split and Blomidon (King's Co.), and a very fine milk-white chalcedony near Trout Cove, Digby Neck (Digby Co.). It occurs—of an olive-green color, in small veins on Belanger's Island, lying off the entrance to Richmond Gulf, eastern coast of Hudson Bay; in thin bands or veins, with jasper, on the River

Ouelle (Kamouraska Co.), in the province of Quebec. In veins in the amygdaloidal traps of Lake Superior, province of Ontario ; and elsewhere in Canada.

66. CHALCOCITE—Is found, most frequently in association with chalcopyrite, or chalcopyrite and bornite, in the townships of Leeds and Halifax (Megantic Co.), Brome, Sutton (Brome Co.), Shefford, Stukeley (Shefford Co.), Melbourne, Cleveland, Brompton (Richmond Co.), Acton (Bagot Co.), and Tingwick (Arthabaska Co.), in the province of Quebec—at the Canada West mines on Lake Huron, and Prince's location, Lake Superior, in the province of Ontario.

67. CHALCOPYRITE—Is widely distributed throughout many of the Eastern Townships of the province of Quebec. In some of them it is occasionally met with unaccompanied by other ores of copper, but it is more frequently associated with chalcocite or bornite, or both. The more important localities lie in the townships of Bolton, Brome, Sutton (Brome Co.), Leeds, Halifax (Megantic Co.), Stukeley (Shefford Co,), Ascot (Sherbrooke Co.), Acton (Bagot Co.), Cleveland, Melbourne (Richmond Co.), Chester (Arthabaska Co.), and Ham (Wolfe Co.). Other noteworthy localities are—the township of McKim, and adjoining townships, in the District of Nipissing ; the West Canada mines, Lake Huron, and Point-aux-Mines and other places on Lake Superior, in the province of Ontario.

68. CHIASTOLITE—Occurs in a fine grained micaceous schist at Moore's Mills, Charlotte county, province of New Brunswick ; and in the somewhat micaceous argillites on Lake St. Francis in Beauce county, province of Quebec.

69. CHLORITE (PENNINITE)—Occurs, most frequently, in admixture with other minerals, forming beds of chloritic slates as in Bolton (Brome Co.), Shefford (Shefford Co.), Ascot (Sherbrooke Co.), Cleveland and Melbourne (Richmond Co.), and other Eastern Townships of the province of Quebec. In some of these townships, however, as for instance those of Potton and Bolton (Brome Co.), and Broughton (Beauce Co.), beds of pure compact chlorite are met with, and occasionally, as in Cleveland (Richmond Co.), the chloritic slates are traversed by thin, well defined veins, which are filled with pure scaly chlorite. Anal., T. S. Hunt, Geol. Can., 1863, p. 607,

70. CHLORITOID—Is of common occurrence in the micaceous schists of the Eastern Townships, in which it is disseminated in small grains and crystalline plates, or small lamellar and spherical masses. It is thus found in the townships of Leeds (Megantic Co.), Brome and Sutton (Brome Co.), in the province of Quebec. Anal., T. S. Hunt, Geol. Can., 1863, p. 498.

71. CHONDRODITE—Is often met with in the crystalline limestones of the Laurentian series. It is found, in grains, in the limestones of St. Jérôme (Terrebonne Co.) ; in a magnesian limestone in Aldfield (Pontiac Co.), province of Quebec—and, with small scales of graphite, in a white crystalline limestone near Newborough in North Crosby, also in South Crosby (Leeds Co.), in the province of Ontario, and elsewhere in these provinces.

72. CHROMIFEROUS GARNET—A very beautiful emerald-green chromiferous garnet occurs, in granular masses and minute crystals, thickly disseminated through a vein of white cleavable calcite, on the east side of Brompton Lake, in the township of Orford (Sherbrooke Co.), and a very similar garnet is found, associated with apatite, pyroxene, calcite, orthoclase, tourmaline and idocrase, in the township of Wakefield (Ottawa

Co.), province of Quebec. Analyses, T. S. Hunt, Geol. Can., 1863, p. 497: B. J. Harrington, Can. Nat., 2 ser., vol. ix, p. 305, 1881.

73. CHROMITE—Is found in pockets, scattered through serpentine, at Mount Albert, Shickshock Range (Gaspé Co.), and in considerable quantity, in connection with serpentine and other magnesian rocks of the Quebec group, in the townships of Bolton (Brome Co.), Ham and Wolfstown (Wolfe Co.), and Leeds (Megantic Co.), in the province of Quebec. Analyses, T. S. Hunt, Geol. Can., 1863, p. 504.

74. CHRYSOCOLLA—Is found sparingly amongst some of the copper ores of Lake Superior, province of Ontario.

75. CHRYSOLITE—Occurs in the form of grains, and occasionally as ill-defined crystals, in a dark grey dolerite, near South Lake (Antigonish Co.), province of Nova Scotia. In well-defined green crystals, and olive or amber-colored imperfect crystals, and small honey-yellow grains, in the eruptive rocks of Rougemont (Rouville Co.), Montarville (Chambly Co.), and Montreal (Hochelaga Co.): in red angular masses in a dyke at St. Anne's (Jacques Cartier Co.), and of a pale yellowish to greyish-green color, forming rock masses at Mount Albert, Shickshock Range (Gaspé Co.), in the province of Quebec. Olivine has also been detected in several of the eruptive rocks of British Columbia. Analyses, T. S. Hunt, Geol. Can., 1863, p. 464: B. J. Harrington, Rep. Geol. Can., 1877-78, p. 39 G.

76. CHRYSOTILE—Often constitutes seams, sometimes nearly seven inches thick, in the serpentine of the Eastern Townships of the province of Quebec: the more important localities comprising—the townships of Thetford and Coleraine (Megantic Co.), Shipton and Melbourne (Richmond Co.), Ham (Wolfe Co.), Broughton (Beauce Co.), and Bolton in Brome county. Anal., E. G. Smith, Am. Journ. Sci., 3 ser., vol. xxix, p. 32, 1885.

77. CINNABAR—Occurs, *in situ*, sparsely disseminated through a fine crystalline granular limestone, at the Ebenezer mine, Hector (Kicking Horse) Pass, Rocky Mountains, British Columbia.

78. CLAY IRONSTONE—Is found everywhere in the Coal Measures of Pictou county, Nova Scotia, in irregular beds from five to forty inches thick. Occurs in layers and nodules, in connection with a small seam of coal at Gaspé, province of Quebec. Is widely distributed in the North-west Territory, in some localities in considerable abundance, in the form of nodules and nodular sheets. Analyses, G. C. Hoffmann, Rep. Geol. Can., 1880-82, p. 8—12 H.

79. COCCOLITE—A greenish-grey granular pyroxene or coccolite, occurs in the township of Portland, and the same mineral, of a pale green color, is met with in the, in part, adjoining township of Buckingham (Ottawa Co.), province of Quebec.

80. COOKEITE—A micaceous mineral having all the blow-pipe characters of, and which may prove to be identical with, Cookeite was found sparsely disseminated through a specimen of galenite from Otter Tail Creek, province of British Columbia. Ann. Rep. Geol. Can., vol. ii, p. 10 T., 1886 [where, however, the locality is erroneously given—read as above].

81. COPPER. NATIVE,—Is found, in the form of grains and irregular shaped masses, occasionally several pounds in weight, in veins and fissures traversing the trap at Cape d'Or and Spencer's Island (Cumberland Co.), Five Islands (Colchester Co.), Margaret-

ville (Annapolis Co.), Briar Island (Digby Co.), and many other places in this section of Nova Scotia. More abundantly, however, in the province of Ontario, occurring in fine particles, filaments, grains or masses, the latter sometimes more than one hundred pounds in weight, in amygdaloidal traps and greenstones, in veins and fissures traversing these, and in sandstones associated with the same, in many localities on the north and east shore of Lake Superior, some of the more important of which are —Battle Island, the Islands of St. Ignace and Michipicoten, also at Mamainse and Cape Gargantua.

82. CORACITE—Is said to form a vein about two inches in width, at the junction of the trap and syenite, at Mamainse, east side of Lake Superior, province of Ontario.

83. CORUNDUM—Has been found in small light blue crystals imbedded in crystalline Laurentian limestone, also in rose-red to sapphire-blue grains, disseminated through a rock made up of felspar, quartz, calcite, mica and sphene, in the township of Burgess (Lanark Co.), province of Ontario.

84. COVELLITE—Occurs in nodular form, with nodules of more or less altered chalcocite, at New Annan (Colchester Co.), province of Nova Scotia. Anal., H. Louis, Trans. N. S. Inst., vol. iv, p. 427, 1878.

85. CRYPTOMORPHITE—Is found, in conjunction with ulexite, Howlite, mirabilite, halite, Arragonite, calcite and selenite, in gypsum deposits at the Clifton quarry, Windsor (Hants Co.), province of Nova Scotia. Anal., H. How, Am. Journ. Sci., 2 ser., vol. xxxii, p. 9, 1861.

86. CUPRITE—Has been found, in association with a little native copper and blue and green carbonate, in quartz, at Spencer's Island (Cumberland Co.),—the collector, Mr. C. W. Willimott, informing me that it occurs, *in situ*, at Bennett's Brook, one mile east of Horse-shoe Cove, and at intermediate points between that and Cape d'Or, one mile west of Horse-shoe Cove (Cumberland Co.), Nova Scotia. Also occurs, but in small quantity only, in some of the copper deposits of the Eastern Townships of the province of Quebec, as at Acton (Bagot Co.), where it has been observed in the form of cinnabar-red stains upon blackish shales.

87. CYANITE—Occurs in the form of radiated columnar aggregates of a pure blue, light bluish-grey, and greenish-grey color, imbedded in a granular quartz, on the North Thompson River, British Columbia. Anal., G. C. Hoffmann, Rep. Geol. Can., 1878-79, p. 1 H.

88. DAWSONITE—Occurs in the joints of a white felspathic dyke, cutting the Trenton limestone, near the western end of McGill College, Montreal (Hochelaga Co.), province of Quebec. Anal., B. J. Harrington, Can. Nat., 2 ser., vol. vii, p. 305, 1875; see also vol. x, p. 84, 1883.

89. DIALLAGE (HYDROUS)—Small masses of a pearly, translucent, celandine-green diallage, occur in a rock in the township of Orford (Sherbrooke Co.), and a coarsely cleavable, bronze-colored variety of diallage, forming a rock, is met with in the township of Ham (Wolfe Co.), province of Quebec. Analyses, T. S. Hunt, Geol. Can., 1863, p. 469.

90. DIOPSIDE—See note to "Malacolite."

91. DOG-TOOTH-SPAR—Large scalenohedrons of calcite have been found at the Bruce and Wellington mines on Lake Huron, also at the Silver Islet and Duncan (formerly

Shuniah) mines (at the last named, Professor Chapman observed, in a *vug*, a bunch of crystals, many of which measured upwards of eighteen inches in length), Thunder Bay, Lake Superior, province of Ontario. Good specimens of dog-tooth-spar are also found at Teny Cape (Hants Co.), Black Rock (King's Co.), Partridge Island and Two Islands (Cumberland Co.), etc., in the province of Nova Scotia.

92. DOLOMITE—In the form of rock-masses, is of very common occurrence in Canada. Besides forming great beds among the Laurentian limestones, dolomites make up the chief part of the so-called Calciferous formation, and are developed on a great scale in its geological equivalent, the Quebec group. The so-called limestones of the whole of the Middle and Upper Silurian series in Ontario are, with few exceptions, dolomites, including the Clinton, Niagara, Guelph, and Onondaga formations. See also note to "Pearl-spar."

93. DOMEYKITE—Has been found, in admixture with niccolite, in a vein cutting a bed of amygdaloid on Michipicoten Island, Lake Superior, province of Ontario. Analyses, T. S. Hunt, Geol. Can., 1863, p. 506.

94. ELAEOLITE—Is mentioned, by Dr. Hunt, as occurring in orange-red grains, with black hornblende, in a white felspathic rock, which is found in boulders on Pic Island in Lake Superior, province of Ontario.

95. EPIDOTE—Characterizes large portions of the metamorphic rocks of the province of Quebec, in many parts of which occur beds which are entirely made up of quartz and epidote; sometimes in distinct grains, at other times forming a homogeneous, generally pale green, very tough and sonorous rock. Characteristic specimens of this rock are met with in the township of Melbourne (Richmond Co.), but beds of the same occur in numerous localities in this section of the province. This mineral has been met with in the crystalline form, in a concretionary epidotic rock, at St. Joseph (Beauce Co.), province of Quebec; also in some of the amygdaloidal traps and greenstones of Lake Superior—as at Mamainse, where crystals of the same are found implanted upon mesolite—in the province of Ontario.

96. EPISTILBITE—Is found with stilbite on ledges of trap at Margaretville, about seven miles east of Port George, Annapolis county, province of Nova Scotia Analyses, H. How, Am. Journ. Sci., 2 ser., vol. xxvi, p. 33, 1858.

97. EPSOMITE—Occurs at the Clifton gypsum quarry, Windsor, Hants county, province of Nova Scotia. As an efflorescence on the black shales of the Utica formation near Montreal (Hochelaga Co.), and upon the black shales of Quebec (Quebec Co.), province of Quebec. As an efflorescence on a serpentine rock near the iron-ore bed of Crow Lake in Marmora (Hastings Co.), and as a crystalline incrustation upon sheltered surfaces of the dolomites at various points along their outcrop from Niagara Falls to Lake Huron, and near Niagara is said to be found, with gypsum, in geodes in the rock—province of Ontario. Also occurs, in association with mirabilite, as an incrustation upon the cliffs of shale at Fort St. John, Peace River, British Columbia. Anal., G. C. Hoffmann, Rep. Geol. Can., 1875-76, p. 421.

98. ERYTHRITE—Is found as a rose-red incrustation on calcareous spar, at Prince's mine on Lake Superior, province of Ontario.

99. ESSONITE—Occurs, in small crystals, with crystals of idocrase, pyroxene and zircon, in calcite at Grenville (Argenteuil Co.), and both massive and crystallized, in the townships of Portland and Wakefield (Ottawa Co.), in the province of Quebec.

100. FAHLUNITE—Is mentioned, by Prof. How, as occurring in granite on the road between Windsor and Chester, Hants county, province of Nova Scotia.

101. FASSAITE—A black, occasionally blackish-green, pyroxene from the township of Templeton (Ottawa Co.), province of Quebec, would seem, from its chemical composition and other characters, to be referable to this variety. Anal., B. J. Harrington, Rep. Geol. Can., 1877-78, p. 17 G.

102. FLUORITE—Occurs, in green octahedral crystals, with barite, lining fissures in porphyry, on an island three miles east of Gravelly Point ; in green cubes, associated with quartz and calcite, at Prince's mine ; of a purple color, filling veins in syenite, on the main land opposite Pic Island, and also, with calcite, in amygdaloid three miles east of Cape Gargantua ; in cubes two or more inches in diameter, associated with large crystals of amethyst, in *vugs* in the large irregular veins in the syenite at the mouth of McKenzie's River, Thunder Bay ; in veins near Black Bay and Terrace Bay ; on Fluor Island in Neepigon Bay, and elsewhere on Lake Superior, province of Ontario.

103. FREIBERGITE—An argentiferous tetrahedrite, associated with some galenite and sphalerite, in a gangue of quartz, is found at Cherry Creek, thirty-three miles east of the head of Okanagon Lake, province of British Columbia.

104. GALENITE—Is very widely distributed throughout Canada: both in interstratified masses, veins, and small crystalline aggregations, etc., scattered through rocks of various kinds. Some of the most noteworthy localities of its occurrence are situate —in the counties of Carleton, Lanark, Leeds, Frontenac, Hastings, and Peterborough, and on the north shore of Lake Superior, as at Prince's Mine, Thunder Cape, and Point des Mines, etc., in the province of Ontario. Extensive deposits of galenite exist in the Illecillewaet district,—at Mount Stephen (Tunnel Mountain), and at Hot Springs and Hendryx Camp's, Kootanie Lake, etc., in the province of British Columbia. Fine specimens consisting of more or less perfect octahedra, the axes of some of which were five centimetres in length, have been found, in *vugs*, at the Silver Islet mine Lake Superior.

105. GARNET—Is very frequently met with, and in nearly all parts of the Dominion. The following comprise some of the many localities of its occurrence. In the province of Quebec: small beds of granular red garnet occur at St. Jérôme (Terrebonne Co.), in Rawdon (Montcalm Co.), and at the north-east side of Bay St. Paul (Charlevoix Co.) : white lime-alumina garnet, mixed with serpentine, is met with at Orford, (Sherbrooke Co.), and an apparently homogeneous rock composed in great part of a similar variety, occurs at St. Francis (Beauce Co.) : red and yellowish-red varieties are met with in the townships of Chatham and Grenville (Argenteuil Co.) : a rose-red iron-alumina garnet is found disseminated in small masses through gneiss on the Rouge River and vicinity in the township of Clyde, and dark red garnet in the townships of Villeneuve and Templeton, and large and handsome crystals of colorless, light brownish, pale olive-green, and brownish-yellow garnet in the township of Wakefield, Ottawa county. Magnificent crystals of red garnet occur, imbedded in micaceous schist, on the Skeena and Stickeen rivers, and a massive brownish-red manganesian lime-iron garnet is found near Foster's Bar, Fraser River—in the province of British Columbia. Analyses, T. S. Hunt, Geol. Can., 1863, 496. See further under

"Almandite," "Andradite," "Chromiferous garnet," "Essonite," "Grossularite," "Spessartite."

106. GENTHITE—A mineral apparently identical with Genthite has been met with in a vein on Michipicoten Island, Lake Superior, province of Ontario. Anaylses, T. S. Hunt, Geol. Can., 1863, pp. 506, 507.

107. GIESECKITE—Dysyntribite occurs at Arisaig pier and Frenchman's Barn in Antigonish county, province of Nova Scotia.

108. GLAUCONITE—Occurs in a sandstone of the Lauzon formation, near Point Lévis (Lévis Co.), and on the Island of Orleans, in the province of Quebec. Analyses, T. S. Hunt, Geol. Can., 1863, p. 487.

109. GMELINITE—Has been found at Cape Blomidon (King's Co.), and Two Islands and Five Islands (Colchester Co.), in the province of Nova Scotia. Analyses, A. A. Hayes, Am. Journ. Sci., vol. xxv, p. 78, 1834; O. C. Marsh, ib., 2 ser., vol. xliv, p. 362, 1867; A. B. Howe, ib., 3 ser., vol. xii, p. 270, 1876.

110. GOLD—The most important auriferous regions of Canada are situated in the provinces of British Columbia, Quebec, and Nova Scotia; the first on the Pacific coast, the last forming the extreme eastern portion of the Dominion. Gold is, however, also found in some of the rivers of the North-west Territory—in the Lake of the Woods and Lake Superior region, and in the district north of Lake Ontario, in the province of Ontario,—and is reported to have been found in a few localities in the province of New Brunswick. In British Columbia mining has been almost entirely confined to the placer deposits. In the vicinity of the Lake of the Woods and of Lake Superior gold occurs in veins associated with silver and other ores. In the counties of Madoc and Marmora (province of Ontario), in auriferous mispickel. In the province of Quebec the placer deposits of the Chaudière region and of the township of Ditton are the only ones in which much work has as yet been attempted. The gold of Nova Scotia is found in quartz, the alluvial gold so far discovered being quite inconsiderable in quantity.

111. GÖTHITE—Is mentioned by Dr. Harrington, as occurring, in association with black oxide of manganese and calcite, in veins cutting the Lower Carboniferous limestones at Black Rock, near the mouth of the Shubenacadie, province of Nova Scotia.

112. GRAPHITE—This mineral is met with in most of the stratified rocks of the Laurentian system; not only the limestones, but the gneiss, pyroxenite, quartzite and pyrallolite beds sometimes hold disseminated graphite. It is also met with in the iron ores of the series, as in the township of Hull (Ottawa Co.), in the province of Quebec Apart from its being met with in a disseminated form, it occurs in beds or seams from a few inches to two or three feet in thickness. These are often interrupted giving rise to lenticular masses, which are sometimes nearly pure and at other times mingled with carbonate of lime, pyroxene, and other foreign minerals. The most important deposits are in the townships of Buckingham and Lochaber (Ottawa Co.), and Grenville (Argenteuil Co.), province of Quebec; but it is also found in the townships of Burgess (Lanark Co.), Loughborough and Bedford (Frontenac Co.), province of Ontario, and, in small quantity, in other localities in these provinces. It is also met with, in a disseminated form, at French Vale and Glendale, in the province of Nova Scotia; in the vicinity of St. John, province of New Bruns-

wick; and at Alkow Harbor, Dean's Canal, in the province of British Columbia. Localities and general mode of occurrence, T. S. Hunt, Geol. Can., 1863, pp. 529, 793, and Rep. Geol. Can., 1863-66, pp. 218–223. Analyses, etc., of Canadian Graphite, G. C. Hoffmann, Rep. Geol. Can., 1876-77, pp. 489–510: analyses of disseminated graphite from Nova Scotia and New Brunswick, G. C. Hoffmann, Rep. Geol. Can., 1878-79, p. 2; ib., 1879-80, p. 1 H.

113. GROSSULARITE—Handsome specimens of a white lime-alumina garnet are found in the township of Wakefield (Ottawa Co.), province of Quebec (G. F. Kunz, Anal., C. Bullman, Am. Journ. Sci., 3 ser., vol. xxvii, p. 306, 1884). The white lime-alumina garnet from Orford (Sherbrooke Co., P. Que.), referred to under "Garnet," is also referable to this variety.

114. GYPSUM—Occurs in connection with the Lower Carboniferous limestones, in enormous deposits in the province of Nova Scotia. It is largely quarried at Windsor, Newport, Walton, Wentworth, Shubenacadie, and a number of other places. It is a very abundant mineral in the province of New Brunswick, the deposits being both numerous and extensive. They occur in all parts of the Lower Carboniferous dis-district, in King's, Albert, Westmorland, and Victoria counties. Rock masses of granular and compact gypsum, more or less mixed with dolomite, characterize the Onondaga formation of western Ontario, and occur largely in the valley of the Grand River, more especially in the townships of Dumfries, Brantford, Oneida, Seneca, and Cayuga, etc.—It is also met with in the province of Manitoba. See also notes to "Alabaster," "Selenite."

115. GYROLITE—Is found on apophyllite in trap, about twenty-five miles south-west of Cape Blomidon, between Margaretville and Port George, Annapolis county, province of Nova Scotia. Anal., H. How, Ed. N. Phil. Journ., new series, vol. xiv, p. 117, 1861.

116. HALITE—An important deposit of rock salt is known to exist along the eastern shore of Lake Huron, embracing the counties of Bruce, Huron and Lambton, in the province of Ontario. It was first met with at Goderich, in 1866, at a depth of 964 feet; in the year following at Clinton, at a depth of 1,180 feet, and in the succeeding year at Kincardine, at a depth of about 900 feet; subsequently at Seaforth at 1,035 feet, and again at Kingstone's Mills in Warwick, at 1,200 feet. A boring made in Goderich in 1876, and which was carried to a depth of 1,517 feet, has shown the existence of no less than six beds of rock salt, one of which is close upon 31 feet, and another very nearly 35 feet in thickness. For geological details, records of borings, and analyses of brines and salt, see following reports by Dr. T. Sterry Hunt—"On Brine-Springs and Salt," Rep. Geol. Can., 1863-66, pp. 263-272. "On the Goderich Salt Region," ib., 1866-69, pp. 211-242, and a second report on the Goderich salt region, ib., 1876-77, pp. 221-243.

117. HALOTRICHITE—Has been found in some heaps of shale and slack coal, at the Glace Bay coal mines, in Cape Breton county, province of Nova Scotia. Anal., E. Gilpin, Trans. N.S. Inst., vol. vi, p. 175, 1883-86.

118. HELIOTROPE—Reported by Prof. How, as having been found by Dr. Gesner in small nodules or fragments of rock on the beach of Chute's Cove (Annapolis Co.), has been found, *in situ*, by Mr. C. W. Willimott, at Two Islands (Cumberland Co.), province of Nova Scotia.

119. HEMATITE—Important deposits of red hematite are met with at several localities in Pictou and other counties in Nova Scotia. It occurs, in association with specular iron ore, among the Huronian strata of the Quaco hills, and more abundantly in those of West Beach and Black River, St. John county, province of New Brunswick. Forms an extensive bed in the township of McNab (Renfrew Co.), and is further found in the townships of Dalhousie and Beckwith (Lanark Co.), Palmerston (Frontenac Co.), Madoc (Hastings Co.), Leeds (Leeds Co.), etc.—at Gros Cap, north side of Michipicoten Harbor, and other localities in the Lakes Superior and Huron region, province of Ontario. See also notes to "Micaceous iron ore," "Specular iron ore," "Martite." Mineral associations of hematite, B. J. Harrington, Rep. Geol. Can., 1873-74, p. 212. Analyses, by various analysts, ib., pp. 223-226, and subsequent Reports.

120. HEULANDITE—Fine specimens of this mineral are met with at Isle Haute, Partridge Island, and Two Islands (Cumberland Co.), also at Black Rock, Hall's Harbor, Long Point, and Cape Blomidon (King's Co.), in the province of Nova Scotia.

121. HORNBLENDE—Black crystallized hornblende enters abundantly into the diorites of Yamaska Mountain (Yamaska Co.), and Mount Johnson (Iberville Co.), and occurs sparingly in the trachytes of Brome (Brome Co.), and Shefford (Shefford Co.) Mountains: beds of black hornblende, holding garnets, are associated with the serpentines of Mount Albert in the Shickshock Mountains (Gaspé Co.), and black or greenish hornblende is very commonly disseminated through the felspathic rocks of the Laurentian series, giving rise to syenite and syenitic gneiss: also forming beds of hornblendic rock, as at Lake St. John (Chicoutimi Co.), province of Quebec. Black or dark green hornblende, in cleavable masses, is found associated with the magnetite of Bathurst and South Sherbrooke townships (Lanark Co.), province of Ontario. Anal., B. J. Harrington, Rep. Geol. Can., 1873-74, p. 201.

122. HORNSTONE OR CHERT—Occurs, in veins traversing syenite in the township of Grenville (Argenteuil Co.), in the province of Quebec; in great abundance, in nodular masses and thin layers, in the Corniferous formation, and occasionally, in a similar form, in the limestones of the Trenton and Niagara groups; also, in layers, in the lower beds of the silver-bearing rocks of Thunder Bay (the lower division of the Upper Copper-bearing rocks of Logan), Lake Superior, province of Ontario.

123. HOWLITE—Occurs, in the form of nodules which are generally about the size of filberts or pigeon's eggs, and occasionally, but rarely, as much as two inches in diameter, imbedded in anhydrite and gypsum at Brookville, and in gypsum at Winkworth, Newport Station, Noel, etc., in Hants county, province of Nova Scotia. Analyses, H. How, Phil. Mag., 4 ser., vol. xxxv, p. 32, 1868.

124. HUMBOLDTINE—Has been observed as a sulphur-yellow incrustation upon the black schists at Kettle Point in the township of Bosanquet, Lambton county, province of Ontario.

125. HURONITE—The Huronite of Dr. Thompson—an impure or altered form of anorthite—is found, *in situ*, near Sudbury (District of Nipissing, province of Ontario), where it occurs in rounded or somewhat angular masses, in a dark green dyke of diabase. Anal., B. J. Harrington, Trans. Roy. Soc. Can., vol. iv, sec. iii, p. 82, 1886.

126. HYACINTH—Cherry-red, transparent crystals of zircon, are mentioned by Dr. Hunt

as occurring in the crystalline limestone of the township of Grenville, Argenteuil county, province of Quebec.

127. HYPERSTHENE—Occurs, in broad lamellar masses, with andesite and ilmenite, constituting a rock, at Château Richer (Montmorency Co.), and in the parish of St. Urbain, near Bay St. Paul (Charlevoix Co.), in the province of Quebec. Also (Paulit) at Paul Island, Nain, coast of Labrador. Anal., T. S. Hunt, Geol. Can., 1863, p. 468.

128. ICELAND-SPAR—Fine cleavable and transparent masses of calcite occur at Harrison's location on St. Ignace Island, Lake Superior, and in the township of Galway (Peterborough Co.), province of Ontario.

129. ILMENITE—Occurs in vast beds or masses in anorthosite rock in the parish of St. Urbain, at Bay St. Paul (Charlevoix Co.), and in a similar rock in Château Richer (Montmorency Co.), and in Rawdon (Montcalm Co). Large deposits, associated with labradorite rocks, have also been observed near the mouth of Rapid River (Bay of Seven Islands), on the Saguenay River, on the shores of Lake Kenogami, and it has also been met with in several other localities in the province of Quebec. Analyses, T. S. Hunt, Geol. Can., 1863, p. 501, and Rep. Geol. Can., 1866-69, p. 260.

130. ILVAITE—A substance which, from its composition and physical characters, was regarded as a variety of lievrite, was found in the form of a boulder, in the vicinity of Ottawa (formerly Bytown), Carleton county, province of Ontario. Description and analysis, T. S. Hunt, Geol. Can., 1863, p. 465.

131. INFUSORIAL EARTH—Is found occupying the bottoms of lakes in several of the counties of the maritime provinces. The deposits are not unfrequently of considerable depth, and the earth remarkably pure. Some of the more important localities are—Fountain Lake, Amherst (Cumberland Co.), Folly Lake (Colchester Co.), and Merigonish (Pictou Co.), in the province of Nova Scotia, and Fitzgerald Lake, about seven or eight miles from St. John (St. John Co.), Pollet Lake, Mechanic Settlement, and Pleasant Lake, about six miles to the south-west (King's Co.), in the province of New Brunswick. Anal., G. C. Hoffmann, Rep. Geol. Can., 1878-79, p. 4 H.

132. IRIDOSMINE—Occurs, as first observed by Dr. T. S. Hunt, in the form of small hard steel-grey plates, associated with the native platinum found in the gold washings of the Rivière du Loup, Beauce county, province of Quebec.

133. IRON-OCHRE—Extensive deposits of iron-ochre (*var.* limonite) are met with in numerous localities in the province of Quebec. A remarkable deposit of this material is found in St. Anne (Montmorency Co.), and very large beds of the same occur in Cap de la Madeleine (Champlain Co.), and in Pointe du Lac (St. Maurice Co). Amongst other places, where deposits of more or less importance occur, may be mentioned the counties of Bonaventure, Joliette, Laval and Vaudreuil. In the province of Ontario, beds of ochre are met with in Walsingham (Norfolk Co.), Esquesing (Halton Co.), Sydenham (Grey Co.), Nottawasaga (Simcoe Co.), and other townships. Chemical examination of iron-ochres, T. S. Hunt, Geol. Can., 1863, p. 512.

134. IRON SAND—Occurs at St. Mary's Bay, Digby county, province of Nova Scotia. Considerable deposits of the same are met with at Moisie, Portneuf, Bersimis, Mingan, and Natashquan, in Saguenay county, and at Batiscan, in Champlain county, and elsewhere in the province of Quebec. It is also found on the shores and islands of Lakes Superior, Huron, Erie, Ontario, and many of the smaller lakes in the

province of Ontario. Mode of occurrence, examination, and analyses, T. S. Hunt, Rep. Geol. Can., 1866-69, pp. 261-269.

135. ISERITE—Constitutes a certain portion of the black magnetic sands met with at St. Mary's Bay, Digby county, province of Nova Scotia, on the north shore and gulf of the St. Lawrence, province of Quebec, and on the shores and islands of Lakes Superior, Huron, Erie, and Ontario, etc., in the province of Ontario.

136. JAMESONITE—Is stated to occur near Fredericton, New Brunswick. Prof. Bailey (of the University of New Brunswick) informs me that should such be the case, it would most probably be at the antimony mine in the parish of Prince William (about twenty-five miles from Fredericton), York county, province of New Brunswick.

137. JASPER—A red and purple striped, and red and yellow striped jasper, is abundant at St. Mary's Bay (Digby Co.), and a red variety is found on Briar Island, in the same county, on Partridge Island (Cumberland Co.), Long Island, and at Woodworth's Cove (King's Co.), in the province Nova Scotia. A blood-red jasper, often finely clouded, occurs near Sherbrooke (Sherbrooke Co.), a small bed of dark green and reddish-brown jasper, traversed by small veins of white chalcedony, at River Ouelle (Kamouraska Co.), and a dark-red jasper in the township of Hull (Ottawa Co.), province of Quebec. This mineral also enters largely into the composition of the beautiful jasper conglomerate—consisting of pebbles of red and reddish-brown jasper and smoky quartz, thickly imbedded in a white quartzite—which constitutes great beds on the north shore of Lake Huron, province of Ontario.

138. KALINITE—Is mentioned by Prof. Chapman as occurring in considerable abundance on the exposed faces of some high bluffs of argillaceous shale on Slate River, a tributary of the Kaministiquia, about twelve miles west of Fort William, Lake Superior, province of Ontario.

139. KÄMMERERITE—Is mentioned by Dr. Hunt as occurring, with chromite, in serpentine in the townships of Bolton (Brome Co.), and Melbourne (Richmond Co.), in the province of Quebec.

140. KAOLINITE—Is met with in masses, sometimes half an inch thick, in fissures in a sandstone of the Sillery formation, just below the Chaudière Falls (Lévis Co.). The masses have a greenish or yellowish-white color and are composed of minute soft scales, very unctuous and slightly coherent (Anal., T. S. Hunt, Geol. Can., 1863, 495). This mineral has also been found in the form of minute pearly scales of a yellowish-white color, unctuous and plastic, lining cavities in a rock in the township of Acton (Bagot Co.), likewise in the province of Quebec. Anal., G. C. Hoffmann, Rep. Geol. Can., 1874-75, p. 314.

141. KERMESITE—Occurs, in small crystalline tufts, with native antimony, stibnite, valentinite, and senarmontite, in veins traversing argillite in the township of South Ham, Wolfe county, province of Quebec.

142. LABRADORITE—Fine examples of this felspar occur in St. Jérôme, Morin—bluish, opalescent, cleavable,—Abercrombie, and Mille Isles (Terrebonne Co.), also at Rawdon—as a bluish-white granular homogeneous rock—(Montcalm Co.), and Château Richer—as a pale bluish or greenish-grey rock, with red spots—(Montmorency Co.), in the province of Quebec. Analyses, T. S. Hunt, Geol. Can., 1863, p. 478; G. C. Hoffmann, Rep. Geol. Can., 1874-75, p. 316.

143. LAUMONTITE—Is very abundant at Port George, where occasionally veins of three inches thickness are seen intersecting the sides of the cliff, and is also found at Margaretville, where it occurs colored green by copper, Annapolis county, province of Nova Scotia. Anal., H. How, Am. Journ. Sci., 2 ser., vol. xxvi, p. 30, 1858.

144. LAZULITE—Has been found—massive, of a deep azure-blue color, in narrow veins traversing a greyish-white, in parts milk-white, subtranslucent quartz—three-quarters of a mile east of the mouth of the Churchill River, District of Keewatin. Anal., G. C. Hoffmann, Rep. Geol. Can., 1878-79, p. 2 H.

145. LEAD. NATIVE,—Was observed by Prof. Chapman to occur, in the form of thin strings, in a colorless quartz from the vicinity of Dog Lake of the Kaministiquia, Thunder Bay, Lake Superior, province of Ontario.

146. LEPIDOMELANE—Has been met with, as an associate of arsenopyrite, in the township of Marmora, Hastings county, province of Ontario. (See under Addenda.)

147. LIGNITE—Of varying composition, but for the most part of very superior quality, of Cretaceous and Laramie age, is found over very extensive areas throughout the North-west Territories: there are also extensive Tertiary deposits, supposed to be of Miocene age, both on the coast and interior of British Columbia, which in many places contain lignites. For reference to analyses, see under "Mineral coal."

148. LIMONITE—Important deposits of this mineral are met with in Pictou and Colchester counties, province of Nova Scotia. As there met with, it occurs in the form of lustrous botryoidal or mammillary and stalactitic masses, which exhibit a fibrous structure when broken; also compact and lustreless, and at other times earthy. Analyses, B. J. Harrington and G. C. Hoffmann, Rep. Geol. Can., 1873-74, pp. 231-234.—See also notes to "Bog-Iron-ore," "Iron-ochre."

149. LOGANITE—Occurs, in the form of short thick oblique rhombic prisms of a clove or chocolate-brown color, in association with serpentine, phlogopite and apatite, in a white crystalline limestone at the Calumet Falls, Pontiac county, province of Quebec. Analyses, T. S. Hunt, Geol. Can., 1863, p. 490.

150. LOUISITE—Honeyman, with analysis, Trans. N.S. Inst., vol. v, p. 15, 1879-82. [Needs further examination; free silica is very probably present—Dana, Min., App. 3, p. 70, 1882].

151. MAGNESITE—Has, so far, only been met with in rock masses, forming, in association with serpentine, dolomite and steatite, beds in the townships of Sutton and Bolton, Brome county, province of Quebec.

152. MAGNETITE—Is found, often beautifully crystallized, in veins in the Triassic trap of King's and Annapolis counties, in the province of Nova Scotia. Occurs massive, or disseminated in crystals in dolomite and chloritic slate (sometimes constituting fifty-six per cent. of the mass) in the metamorphic strata of the Eastern Townships of Sutton, Bolton, Ascot, Leeds and Orford; in the Laurentian, in the township of Hull, etc.,—also, in the form of black sand (see note to iron-sand), on the north shore of the Gulf of St. Lawrence,—in the province of Quebec. Forms deposits, frequently of very great extent, among the Laurentian rocks, in the counties of Frontenac, Hastings, Haliburton, Lanark, Leeds, Peterborough, Renfrew, etc., and is also met with in certain localities on Lakes Superior and Huron, province of Ontario. Further west, important deposits occur in crystalline rocks, supposed to be of Carboniferous age, in

the vicinity of Gillies Bay, south side of Texada Island, province of British Columbia. Crystals pseudomorph after pyrite, E. B. Kenrick, Ann. Rep. Geol. Can., vol. iii, p. 58 T, 1887. Mineral associations of magnetite, B. J. Harrington, Rep. Geol. Can., 1873-74, p. 194. Analyses, by various analysts, ib., pp. 208-211.

153. MALACHITE—Has, so far, not been met with in characteristic specimens, but merely as an incrustation on copper ores or in the form of stains and small earthy masses in copper-holding rocks. Of the numerous localities where it has been observed may be mentioned—Spanish River, where some of the quartz veins carrying chalcocite are stained throughout with green carbonate of copper; with galenite in a lode which crosses a long narrow island near the shore at Thunder Cape, Lake Superior, province of Ontario. In the form of little fibrous masses, with sulphurets of copper, in a drusy calcite at the Black River mine, St. Flavien, Lotbinière county, province of Quebec.

154. MALACOLITE (DIOPSIDE)—Large twin-crystals of white pyroxene, associated with cinnamon-colored garnets, are found in druses in a pale greenish pyroxene rock in the township of Orford (Sherbrooke Co.), and slender, pale greyish-green colored crystals, sometimes six inches in length, occur imbedded in limestone at the Calumet Falls (Pontiac Co.), province of Quebec. Crystals of pale greyish-green pyroxene—often replaced on their acute lateral edges, and occasionally several inches in diameter—associated with crystals of dark green pargasite, and black tourmaline, are found at the High Falls and at the Ragged Chute in the township of Blythfield, Renfrew county, province of Ontario. Analyses, T. S. Hunt, Geol. Can., 1863, pp. 467, 468.

155. MANGANITE—Is frequently found associated with pyrolusite at Teny Cape (Hants Co.) and elsewhere—often crystallized on that ore. It is abundant at Walton and Cheverie, and is met with at Douglas and Rawdon, in Hants county, province of Nova Scotia. Also occurs on Amherst Island, Magdalen Islands, province of Quebec.

156. MARCASITE—Has been obtained, by Prof. Chapman, from the walls of a vein holding galenite and chalcopyrite, in the township of Neebing, a few miles east of the Kaministiquia River, north-west shore of Lake Superior, province of Ontario.

157. MARTITE—Has been met with in the Triassic trap of North Mountain, Digby county, province of Nova Scotia, and was also observed by Prof. Chapman in a gneissoid boulder from Bass Lake, a few miles north of Orillia, Simcoe county, province of Ontario.

158. MELACONITE—Is recorded by Prof. Chapman as occurring, but in traces only, in some of the copper deposits of the Eastern Townships of the province of Quebec.

159. MELANTERITE—Has been found in some heaps of shale and slack coal at the Glace Bay coal mines, in Cape Breton county, province of Nova Scotia. Also occurs, in small quantities, in many of the ores from the mineral veins of Lake Superior, Lake Huron, and the Hastings region, province of Ontario.

160. MENEGHINITE—Is found, apparently in a veinstone of quartz and dolomite, in the vicinity of Marble Lake, in the township of Barrie, Frontenac county, province of Ontario. Anal., B. J. Harrington, Trans. Roy. Soc. Can., vol. i, sec. iii, p. 79, 1882 and 1883.

161. MESOLE—Occurs, in association with mesolite, in trap rock in the neighborhood of Port George, Annapolis county, province of Nova Scotia. Anal., H. How, Ed. N. Phil. Journ., new series, vol. viii, p. 207, 1858.

162. MESOLITE—Is found at Port George, and is also said to be very abundant in the North Mountains, Annapolis county, province of Nova Scotia. Analyses, H. How, Am. Journ. Sci., 2 ser., vol. xxvi, p. 32, 1858.

163. METEORIC IRON—A specimen of meteoric iron, weighing 370 pounds, was found, in 1854, on the surface of the ground, in the township of Madoc, Hastings county, province of Ontario. Its shape is rudely rectangular and flattened on one side. The surface is irregularly pitted, and coated with a film of dark oxide. The iron is malleable, and highly crystalline in texture. A polished surface when etched by an acid exhibits the so-called Widmannstädt's figures. It contains 6·35 per cent. of nickel; small amounts of the phosphide of iron and nickel (Schreibersite) are disseminated through it, and in making a section of it, rounded masses of magnetic sulphide of iron (troilite?) were met with. Results of its examination by Dr. T. S. Hunt, Geol. Can., 1863, p. 508.

164. MICACEOUS IRON-ORE—Is found in veins in the Cobequid Hills of Londonderry (Colchester Co.): constitutes an important deposit on the west side of the East River (Pictou Co.): is met with on Salmon River, at Melrose, Manchester, and Roman's Valley in Guysborough county, and at St. Peters, Richmond county, province of Nova Scotia. Mingled with variable amounts of quartz and chlorite, it constitutes beds of a schistose rock in the townships of St. Armand (Missisquoi Co.), Brome and Sutton (Brome Co.); occurs in small beds in the township of Bristol (Pontiac Co.), and is also met with in the townships of Templeton and Hull (Ottawa Co.), and elsewhere in the province of Quebec. Forms small beds in Potsdam sandstone in the townships of Bastard (Leeds Co.), and Ramsay (Lanark Co.), in the province of Ontario.

165. CHROMIFEROUS MICA—Is found in several localities in the Eastern Townships of the province of Quebec, Minute scales of it occur in the magnesite of Sutton (Brome Co.), and is has also been observed, in larger plates and imperfect crystals, in a dolomite from Bolton, in the same county.

166. MICROCLINE—Is found in large cleavable masses, in association with quartz, muscovite, albite, etc., constituting a coarse pegmatite vein in the township of Villeneuve, Ottawa county, province of Quebec.

167. MILLERITE—Is met with in small grains and prismatic crystals, together with minute grains and crystals of a bright green chromiferous garnet, disseminated through a white cleavable calcite, in a vein on the east side of Brompton Lake, in the township of Orford (Sherbrooke Co.), province of Quebec.

168. MINERAL COAL—See under "Anthracite," "Bituminous coal," "Cannel coal," "Lignite."

Analyses, E. Hartley, Rep. Geol. Can., 1866-69, pp. 365-447—T. S. Hunt, ib., 1871-72, p. 98—B. J. Harrington, ib., 1872-73,pp. 76-81; ib., 1873-74, p. 63; ib., 1876-77, pp. 466-470—G. C. Hoffmann, ib., 1873-74, pp. 90-93 and 188-191; ib., 1875-76, p. 423, ib., 1879-80, pp. 8-14 H.; ib., 1882-84, pp. 1-44 M.; Ann. Rep. Geol. Can., 1885, pp. 1-11 M.; ib., 1887-88, pp. 5-20 T.

169. MINERAL RESIN—Is not unfrequently very freely disseminated through some of the coals and lignites of the North-west Territory, in the form of small flattened grains and nodules of a yellow, yellowish-brown or brown color. The nodules do not, generally speaking, exceed a-quarter of an inch in diameter, but occasionally some of

much larger dimensions are met with. One from a coal seam on the Middle Fork of the Old Man River, Rocky Mountains (North-west Territory), was found to be a little over an inch and a-half in diameter, and three-quarters of an inch thick.

170. MINERAL TAR—Is often seen exuding from the deposits of bituminous sand rock occurring along the banks of the Athabasca River (see note to "Asphaltum"), and in numerous places on the ground at the foot of either bank, or on terraces lower than their summits, this tar collects in pools, or flows in sluggish streams to lower levels. It also occurs at several localities on the shores of the western part of Great Slave Lake; at one or two places on Peace River, and elsewhere in this part of the North-west Territory.

171. MIRABILITE—Occurs at the Clifton gypsum quarry, Windsor, Hants county, province of Nova Scotia; and, associated with epsomite, as an incrustation upon the cliffs of shale at Fort St. John, Peace River, province of British Columbia. Anal., G. C. Hoffmann, Rep. Geol. Can., 1875-76, p. 421.

172. MOLYBDENITE—Is somewhat widely distributed, being found, although in most instances only in small quantities, in nearly all the provinces of the Dominion. Some of the most noteworthy localities of its occurrence are those in the province of Quebec, as—near the mouth of the Quetachoo River, in Manicougan Bay, on the north shore of the Gulf of the St. Lawrence, where it occurs disseminated in a bed of quartz six inches thick, in the form of nodules from one to three inches in diameter, and in flakes which are sometimes twelve inches broad, by one-fourth of an inch in thickness; at Harvey Hill in the township of Leeds (Megantic Co.), occurring in small rounded masses of fine granular structure, in veins of quartz and bitter-spar; and the township of Aldfield (Pontiac Co.), where perfect and very handsome crystals have occasionally been found, and others, less perfect but of considerable dimensions, are met with.

173. MOLYBDITE—Has been met with in the form of an earthy yellow powder on molybdenite, in the township of Alleyn (Pontiac Co.), in the province of Quebec, and in the township of Ross (Renfrew Co.), in the province of Ontario.

174. MONAZITE—In the form of a nodular mass, was found at the Villeneuve mica mine, in the township of Villeneuve, Ottawa county, province of Quebec (Ann. Rep. Geol. Can., vol. ii, p. 11 T, 1886). Dr. F. A. Genth has recently made an analysis of a specimen from this locality, the results of which are given in Am. Journ. Sci., 3 ser., vol. xxxviii, p. 203, 1889.

175. MORDENITE—Occurs imbedded in trap, some two or three miles east of Morden or French Cross, in King's county, province of Nova Scotia. Anal., H. How, Journ. Chem Soc., new series, vol. ii, p. 100, 1864.

176. MORENOSITE—Is mentioned by Dr. Hunt as having been observed, as an efflorescence of minute acicular greenish-white crystals, on an ore of nickel from the Wallace mine, Lake Huron, province of Ontario.

177. MUSCOVITE—Large plates and crystals of this species occur in a vein of graphic granite on Alumette Lake, at Montgomery's clearing, about five miles above Pembroke, Renfrew county, province of Ontario. It is met with, in association with black tourmaline, on Yeo's Island in the Upper St. Maurice (Portneuf Co.), and abundantly, and not unfrequently, in crystals of very large dimensions, in a coarse

pegmatite vein (described in note to "Albite"),in the township of Villeneuve (Ottawa Co.), province of Quebec. A rose-colored mica, closely resembling, if indeed not identical with, the rose-colored muscovite of Goshen, Mass., has recently been met with by Mr. C. W. Willimott, in the township of Villeneuve (Ottawa Co., P. Que.). It was associated with pale green muscovite, in a matrix composed of albite with a little white translucent quartz.

178. NAIL-HEAD-SPAR—Very fine specimens of nail-head-spar are found at Teny Cape, Hants county, in the province of Nova Scotia.

179. NATROLITE—Handsome specimens of this mineral are found at Swan Creek (Cumberland Co.), Cape Blomidon (King's Co.), and Gate's Mountain (Annapolis Co.), etc., in the province of Nova Scotia. It occurs, associated with analcite, in some of the dykes cutting the Trenton limestone at the reservoir extension, Montreal (Hochelaga Co.), province of Quebec. Anal. B. J. Harrington, Rep. Geol. Can., 1874-75, p. 303.

180. NEPHELITE—Is stated, by Dr. Hunt, to occur in white crystals, with small grains of blue sodalite, in the nepheline syenite of Brome Mountain (Brome Co.), it also occurs, as a constituent of a similar rock, at Montreal (Hochelaga Co.), and Belœil (Rouville Co.), province of Quebec. See also note to "Elaeolite."

181. NEPHRITE—This mineral has been found by Dr. G. M. Dawson, in the valley of the lower Fraser River (British Columbia), in the vicinity of Lytton, on the site of an abandoned Indian village, in small water-worn boulders, evidently derived from the beaches of the river, some having been merely more or less broken, whilst others had been sawn or otherwise partly manufactured into implements (Can. Rec. Sci., vol. ii, p. 364, 1886-87). It has also been found (as first announced in Science, April 20, 1888), by Dr. G. M. Dawson and Mr. W. Ogilvie, on the Lewes River, a tributary of the Yukon, North-west Territory (Ann. Rep. Geol. Can., vol. iii, p. 38 B, 1887), but has not as yet been found *in situ*.

182. NICCOLITE—Has been found, in admixture with domeykite, in a vein cutting a bed of amygdaloid on Michipicoten Island, Lake Superior, province of Ontario. Anal., T. S. Hunt, Geol. Can., 1863, p. 506.

183. Nitre—Has been found in cavities in calcareous tufa, on the Nazco River, and has also been met with at Big Bar, Fraser River, province of British Columbia.

184. OBSIDIAN—Is found in large and small masses on the higher eastern slopes of Il-ga-chuz Mountain, but the most notable locality for this mineral is the mountain named Beece or Anahim's Peak, an isolated summit between the Il-ga-chuz and Tsi-tsutl Mountains, in the upper Blackwater country (G. M. Dawson, Rep. Geol. Can., 1876-77, pp. 78,79) : it also occurs at Tsooskatli, the upper part of Masset Inlet, (on a small islet north-east of Tas-kai-guns), Queen Charlotte Islands (id.—ib., 1878-79, p. 88 B), and other localities in British Columbia.

185. OCTAHEDRITE—Is reported, by Prof. How, as occurring in small but fine crystals, in quartz, at Sherbrooke, Guysborough county, province of Nova Scotia.

186. OLIGOCLASE—Occurs in more or less perfect crystals, in groups, of a white or faintly greyish-white color, in the township of Hull (Ottawa Co.), and a white, rarely greenish or greyish, felspar, having the composition of oligoclase forms, with black hornblende, the intrusive diorite of Mount Johnson (Iberville Co.), province of Quebec. A white to pale grey felspar, also referable to this species, is the constituent of a

coarse crystalline diorite occurring at the Fournier mine, in the township of South Sherbrooke, Lanark county, in the province of Ontario. Analyses, T. S. Hunt, Geol. Can., 1863, p. 477: B. J. Harrington, Rep. Geol. Can., 1873-74, p. 198.

187. ONTARIOLITE—A scapolite from the township of Galway, Peterborough county, province of Ontario, has been called Ontariolite by C. U. Shepard (Am. Journ. Sci., 3 ser., vol. xx, p. 54, 1880). [The value of an approximate analysis given, is destroyed by the impurity of the material analyzed; thus far it has no claim to be considered an independent species—Dana, Min., App. iii, p. 106, 1882.]

188. OPAL—Common opal or semi-opal is mentioned, by Dr. How, as occurring at a few localities in the province of Nova Scotia. See also notes to "Cacholong," "Hyalite" (under Addenda), "Tripolite."

189. ORTHOCLASE—This felspar is very abundant among the rocks of the Laurentian system, and well-defined cleavable masses of a reddish, greyish-white or white color, may be obtained in many localities, some of the most important (Laurentian) of which are—the townships of North Burgess and Elmsley (Lanark Co.), Ross, in large crystals, and Sebastopol, also in very large crystals (Renfrew Co.), in the province of Ontario—Grenville and Chatham (Argenteuil Co.), and most of the townships of Ottawa county. Also occurs in veins cutting altered slates in the townships of Leeds and Inverness (Megantic Co.), and Sutton (Brome Co.); and in the trachytes of Chambly, Brome and Shefford Mountains, and Mount Royal, province of Quebec. Analyses, T. S. Hunt, Geol. Can., 1863, pp. 475,476: G. C. Hoffmann, Rep. Geol. Can., 1876-77, pp. 511,512.

190. PARGASITE—Finely terminated crystals of dark green pargasite, sometimes an inch in diameter, are found implanted upon, or imbedded in, a greenish-white pyroxene, at the High Falls and at the Ragged Chute, on the Madawaska in the township of Blythfield, Renfrew county, province of Ontario. Anal., T. S. Hunt, Geol. Can., 1863, p. 466.

191. PEARL-SPAR—Is abundant, generally associated with calcite and gypsum, in cavities and geodes in the dolomites of the Niagara formation; also, in association with calcite, gypsum, barite and quartz, in geodes in the dolomites of the Calciferous formation, and is found in many of the metalliferous veins of Lake Superior and Lake Huron, province of Ontario—and occasionally in those of the Eastern Townships of the province of Quebec.

192. PECTOLITE—Occurs in radiated fibrous aggregations, the fibres being an inch and a quarter and less in length, at Cathcart (now McKellar's) Point, Thunder Bay, Lake Superior, province of Ontario.

193. PERISTERITE—The felspar described by Dr. Thompson under this name (in allusion to its beautiful blueish opalescence)—a variety of albite, occurs in large cleavable masses, with quartz, in veins in the township of Bathurst (Lanark Co.), and in a vein made up of a fine-grained mixture of reddish-white albite and quartz, enclosing large cleavable masses of the opalescent albite, on the north shore of Stoney Lake, near the mouth of Eel Creek, in Burleigh (Peterborough Co.), province of Ontario. Analysis of a specimen from first-named locality, T. S. Hunt, Geol. Can., 1863, p. 477.

194. PERTHITE—The Perthite of Dr. Thompson (a flesh-red aventurine felspar, which, as shown by Breithaupt, consists of interlaminated albite and orthoclase) occurs in large

cleavable masses, in pegmatite veins cutting Laurentian strata, in the township of North Burgess, Lanark county, province of Ontario.

195. PETALITE—Is here mentioned among the minerals of Canada, upon the authority of Dr. Bigsby, according to whom this mineral was found, with tremolite, in a large boulder on the lake shore, at Toronto, York county, province of Ontario.

196. PETROLEUM—The most important oil springs are in the township of Enniskillen, in the western peninsula of Ontario, but it also occurs in other townships of this section of the country, as for instance those of Mosa, Oxford and Dereham. It is found, in small quantity, on Great Manitoulin Island in Lake Huron, province of Ontario—also on the St. John River, and on a branch of Silver Brook, and other localities in the county of Gaspé, province of Quebec

197. PHLOGOPITE—This mineral is of very common occurrence among the crystalline limestones of the Laurentian system, through which it is sometimes more or less abundantly disseminated in the form of small scales or crystals. The largest specimens are generally found in beds near to bands of quartzite or pyroxenic gneiss, which often limit the crystalline limestones, or are interstratified with them. It is also met with imbedded in massive pyroxene rock. Large plates are obtainable in the townships of Grenville (Argenteuil Co.), Buckingham, Templeton, etc. (Ottawa Co.), in the province of Quebec—and in the townships of North and South Burgess, in the province of Ontario. Anal., T. S. Hunt, Geol. Can., 1863, p. 495.

198. PICKERINGITE—Occurs as an efflorescence on the shale of a sheltered cliff on the banks of the Meander, Newport, Hants county, province of Nova Scotia. Anal., H. How, Journ. Chem. Soc., new series, vol. i, p. 200, 1863.

199. PICROLITE—This variety of serpentine is met with in the townships of Bolton (Brome Co.), Shipton (Richmond Co.), etc, in the province of Quebec. Anal., T. S. Hunt, Geol. Can., 1863, p. 472.

200. PITCHSTONE—A pitchstone-porphyry, and pitchstone with veins of agate, occurs on the eastern extremity of Michipicoten Island, Lake Superior, province of Ontario.

201. PLATINUM. NATIVE,—The earliest reference to the finding of native platinum in Canada, is that by Dr. T. Sterry Hunt (Rep. Geol. Can., 1851-52, p. 120), who mentions having observed it, in association with iridosmine, in the gold washings of the Rivière du Loup and Rivière des Plantes, Beauce county, in the province of Quebec. It has since been met with, according to Dr. G. M. Dawson (Ann. Rep. Geol. Can., vol. iii, 1887, Part R), in association with placer gold in several localities in the province of British Columbia—occurring in notable quantity in the region of the Upper Similkameen and Tulameen Rivers, in minute scales where the gold is "fine" but increasing in coarseness to small pellets and nuggets in places where "coarse" gold is found. Coarse grains and pellets have, so far, been found only on Granite, Cedar and Slate Creeks, all entering the Tulameen on the south side. He also mentions its occurrence, in fine scales with gold, on Tranquille River, Kamloops Lake; at a place ten miles below Lillooet on the Fraser River, and in nearly all the tributaries of the Yukon River which have been worked. Analyses, G. C. Hoffmann, Trans. Roy. Soc. Can, vol. v, sec. iii, p. 17, 1887—and an abridged statement of results, Ann. Rep. Geol. Can., vol. ii, p. 5 T, 1886.

202. POLYDYMITE—What is regarded as evidently a ferriferous variety of this mineral is

found in association with pyrrhotite, chalcopyrite, some pyrite, etc., at the mines of the Canadian Copper Company, Sudbury, District of Nipissing, province of Ontario. Anal., F. W. Clarke and C. Catlett, Am. Journ. Sci., 3 ser., xxxvii, p. 372, 1889.

203. PREHNITE—Occurs chiefly in the trap rocks of Lake Superior, sometimes forming distinct veins, as on Slate River an affluent of the Kaministiquia, and with imbedded nodules of native copper on an island near St. Ignace—province of Ontario. It has also been found in the Laurentian of the township of Templeton (Ottawa Co.) in the province of Quebec. Analyses, E. J. Chapman, Can. Journ., 2 ser., vol. xii, p. 267, 1869: B. J. Harrington, Rep. Geol. Can., 1877-78, p. 34 G.

204. PSEUDOMORPHOUS QUARTZ—Fine specimens of quartz pseudomorph after chabazite, have been found at Horse-shoe Cove, Cape d'Or, and of quartz pseudomorph after stilbite, at Clarke's Head (Cumberland Co.), province of Nova Scotia. Silicified wood is found in the vicinity of the Elbow of the South Saskatchewan River, and very characteristic specimens of the same at Ross Coulée, Irvine, District of Assiniboia, North-west Territory.

205. PSILOMELANE—Occurs, in association with pyrolusite, at Douglas, Hants county, province of Nova Scotia.

206. PYRALLOLITE—Occurs in beds in the crystalline limestone of Grenville (Argenteuil Co.), and Clarendon (Pontiac Co.), in the province of Quebec—also in the townships of Ramsay (Lanark Co.), and Rawdon (Hastings Co.), in the province of Ontario. Analyses, T. S. Hunt, Geol. Can., 1863, p. 471—and of a specimen from Portage du Fort, township of Clarendon, B. J. Harrington, Rep. Geol. Can., 1876-77, p. 484.

207. PYRITE—Is very widely distributed throughout the Dominion. The following are a few of the localities where it is met with in a crystalline form:—in fine crystals at La Have (Lunenburg Co.) and Seven Mile Plain (Hants Co.), in the province of Nova Scotia—in large cubical crystals in a vein of copper ore in the township of Melbourne (Richmond Co.), province of Quebec—in perfect octahedra at Elizabethtown (Leeds Co.), also in a crystalline form in many of the veins and gneissoid rocks of the townships of Madoc, Elzevir and Tudor (Hastings Co.), and in the trap dykes of Lakes Superior and Huron; province of Ontario.

208. PYROLUSITE—Is met with near Kentville (King's Co.), at Springville (Pictou Co.), Musquodoboit (Halifax Co.), Onslow (Colchester Co.), near Amherst (Cumberland Co.) and at Walton and other places, especially at Teny Cape, in Hants county, province of Nova Scotia. This mineral also occurs at several places in the counties of Westmoreland, Albert, St. John and King's,—the most important deposit being at Markhamville, in the parish of Upham, King's county,—in the province of New Brunswick.

209. PYROXENE—Is of common occurrence, especially among the rocks of the Laurentian system, where it not unfrequently forms beds, or large segregated veins, which sometimes consist of pure pyroxene, at other times of pyroxene in admixture with other minerals, constituting pyroxenite. It also sometimes occurs disseminated in in beds of magnetite and, in the form of grains and imperfect crystals, it is common in the beds of limestone. Among the numerous localities of its occurrence may be mentioned:—Kildare (Joliette Co.), the townships of Argenteuil and Grenville (Argenteuil Co.), Buckingham, Templeton, Portland, Wakefield and adjoining town-

ships (in Ottawa Co.), and Litchfield (Pontiac Co.), in the province of Quebec. The townships of North Elmsley and North Burgess (Lanark Co.), and elsewhere in this part of the province of Ontario. Very large crystals of pyroxene are not unfrequently met with in the above referred to townships of Templeton, Portland and Wakefield, as also in the townships of Sebastopol and Blythfield (Renfrew Co.), in the province of Ontario—and a very handsome lilac-colored pyroxene occurs in the Augmentation of the aforementioned township of Grenville. See also notes to "Augite," "Coccolite," "Diallage," "Fassaite," "Malacolite," "Sahlite."

210. Pyrrhotite—Occurs in many localities; among which may be mentioned the townships of Barford (Stanstead Co.) Sutton and Bolton (Brome Co.) where it is associated with copper ores; St. Francois (Beauce Co.) associated with pyrite, arsenopyrite, etc., and St. Jérôme (Terrebonne Co.) associated with pyrite—in the province of Quebec. Abundantly, more or less associated with chalcopyrite, in McKim and adjoining townships (District of Nipissing); accompanying pyrite in Elizabethtown (Leeds Co.), at Balsam Lake (Peterborough Co.), province of Ontario. A very interesting twin crystal found by Dr. Harrington at the Elizabethtown deposit (Anal., B. J. Harrington, Rep. Geol. Can., 1874-75, p. 304), was examined by Dr. E. S. Dana, Am. Journ. Sci., vol. xi, p. 386, 1876.

211. Retinalite—Is found, imbedded in crystalline limestone, in the township of Grenville (Argenteuil Co.), and on Calumet Island (Pontiac Co.), in the province of Quebec. Analyses, T. S. Hunt, Geol. Can., 1863, p. 471.

212. Rhodochrosite—Has not, as yet, been found in Canada in distinct examples, but occurs in admixture with many of the manganese ochres, and is also present, in traces, in some of the altered strata of the Eastern Townships of the province of Quebec.

213. Ripidolite—Has, so far, not been identified with certainty as occurring in Canada. A chloritic mineral occurring—in uneven folia, of an olive-green color and pearly lustre—in association with apatite, quartz, pyrite and calcite, in the township of Templeton (Ottawa Co.), province of Quebec, has been examined by Dr. Harrington (Rep. Geol. Can., 1877-78, p. 34 G, and found to have, approximately, the composition of ripidolite. A foliaceous mineral found in a serpentine rock in the adjoining township of Buckingham would, so far as it has yet been examined, also appear to be referable to this species.

214. Rock Crystal—Is found, in large crystals, at South River (Antigonish Co.): in perfect crystals at Spencer's Island (Cumberland Co.): at Sandy and Mink Coves (Digby Co.), etc., in the province of Nova Scotia. In crystals (known as Quebec diamonds) showing unusual modifications in form, in fissures and cavities in limestone rocks in the vicinity of Quebec, and in large transparent crystals, in quartz veins, at Harvey's Hill mine (Leeds Co.), province of Quebec. Also in good crystals in cavities of the quartz veins of the Bruce mines, Lake Huron, and similar veins at Thunder Bay, Lake Superior, province of Ontario.

215. Rosequartz—Is found at Westfield (Queen's Co.) and, in the form of pebbles, near the town of Shelburne (Shelburne Co.), in the province of Nova Scotia.

216. Rutile—Occurs, in the form of needles in quartz, at Scot's Bay (King's Co.), province of Nova Scotia. In small orange-red grains in the ilmenite of St. Urbain, Bay St.

Paul (Charlevoix Co.); in small red flattened crystals in the chloritic schists of the township of Sutton (Brome Co.); in minute grains in the black sand obtained in the washing of the auriferous gravel at Rivière du Loup (Beauce Co.), and in somewhat large crystals, occasionally geniculated, in a gangue of dolomite and barite, in the township of Templeton (Ottawa Co.), province of Quebec. It has been found in tolerably distinct crystals in crystalline limestone on Green Island in Moira Lake, in the township of Madoc (Hastings Co.), and in the form of delicate acicular crystals, in quartz cavities at the Wallace mine, Lake Huron, province of Ontario. See also note to "Sagenite."

217. SAGENITE—A transparent quartz penetrated with needles of rutile is stated, by Prof. How, to have been found at Scot's Bay, King's county, province of Nova Scotia.

218. SAHLITE—The most common variety of pyroxene met with in the apatite deposits of Ottawa county, province of Quebec, would appear to be a lime-magnesia-iron pyroxene or sahlite. On peculiarities in forms of crystals from this locality, see results of observations by B. J. Harrington, Rep. Geol. Can., 1877-78, p. 18 G.

219. SALAMMONIAC—Has been met with, in association with native sulphur, constituting a deposit on the cliffs of shale on Smoky River, North-west Territory. Anal., G. C. Hoffmann, Rep. Geol. Can., 1875-76, p. 420.

220. SAMARSKITE—Has been found on lots one and two of the second range of Maisonneuve, Berthier county, province of Quebec. [When first met with, this township was not laid out, consequently the locality could not be given more definitely than as it appears in the report, here referred to, viz., just beyond the north-western limits of Brassard (the adjoining township), Berthier Co.]. Anal., G. C. Hoffmann, Rep. Geol. Can., 1880-82, p. 1 H.

221. SAPONITE—Occurs in cavities in the trap of St. George or Hog Island, Richmond Bay, north coast of Prince Edward Island. Anal., B. J. Harrington, Can. Nat., 2 ser., vol. vii, p. 179, 1875.

222. SELENITE—Is met with in greater or less quantity at several of the gypsum deposits in the province of Nova Scotia, as at Oxford, River Philip (Cumberland Co). In the province of New Brunswick it is especially abundant at Petitcodiac (Westmoreland Co.) where the gypsum deposit, which has a breadth of about forty rods and a total length of about one mile, is traversed through its entire extent by a vein of nearly pure selenite eight feet wide. This mineral is also met with in the provinces of Quebec, Ontario, Manitoba and elsewhere.

223. SENARMONTITE—Occurs, with native antimony, stibnite, valentinite and kermesite, in veins traversing argillite in the township of Ham, Wolfe county, province of Quebec.

224. SERPENTINE—Is met with abundantly among the metamorphic rocks of the Eastern Townships and Gaspé peninsula, in the province of Quebec, where it forms vast masses, which are frequently almost free from other admixture, but at times enclose diallage, actinolite, garnet and chromite; or are intermixed with carbonate of lime, dolomite and occasionally ferruginous magnesite. Extensive beds, mostly containing intermixed carbonate of lime and dolomite, occur in the townships of Thetford and Coleraine (Megantic Co.), Broughton (Beauce Co.), South Ham and Garthby (Wolfe Co.), Melbourne (Richmond Co.), Orford (Sherbrooke Co.), and Bolton (Brome

Co.); around Mount Albert in the Shickshock Mountains, and at Mount Serpentine near Gaspé Bay, in Gaspé county. Among the massive and nearly pure Laurentian serpentines may be mentioned those of the townships of Grenville (Argenteuil Co.), in above named province—and North Burgess (Lanark Co.), in the province of Ontario. See also notes to "Chrysotile," "Picrolite" and "Retinalite." Analyses, T. S. Hunt, Geol. Can., 1863, p. 472.

225. SEYBERTITE—Is mentioned by Dr. Hunt, as occurring, with small crystals of blue spinel, in a crystalline limestone in the seigniory of Daillebout, Joliette county, province of Quebec.

226. SIDERITE—A bed of spathic iron, varying in thickness from six to ten feet, occurs in sandstones of the Millstone-grit formation, near Sutherland's River, Pictou county, province of Nova Scotia. Occurs in thin veins in Huronian rocks in the Nerepis valley, and is also diffused to a considerable extent through rocks of Devonian age in the northern part of Charlotte county, in the province of New Brunswick. Is found in quantity, in beds, on Flint, Davieu's, and other islands of the Nastapoka group, eastern coast of Hudson Bay—and is also met with in quantity in the township of McIntyre, Thunder Bay, Lake Superior, province of Ontario. See also notes to "Clay iron-stone," "Sideroplesite." Analyses, Gordon Broome, Rep. Geol. Can., 1866-69, p. 442: B. J. Harrington, ib., 1877-78, p. 47 G.

227. SIDEROPLESITE—Occurs in the ankerite deposits of Londonderry, Colchester county, province of Nova Scotia. Anal., H. Louis, Trans. N. S. Inst., vol. v, p. 50, 1879-82.

228. SILICIFIED WOOD—See note to "Pseudomorphous quartz."

229. SILVER. NATIVE,—Nuggets and grains of native silver have been found in washing for gold in a great many parts of British Columbia, the largest being obtained in the Omenica district. It also occurs, in association with argentite, at the various mines enumerated in the note to "Argentite."

230. SMALTITE—Has been met with in the form of minute crystals, in association with chalcopyrite, in the township of McKim, District of Nipissing, province of Ontario. Ann. Rep. Geol. Can., vol. ii, p. 11 T., 1886.

231. SMOKY QUARTZ, CAIRNGORM STONE—Is met with in several localities in the province of Nova Scotia, amongst the most noted being Paradise River and the neighborhood of Bridgetown and Laurencetown in Annapolis county; is also found at Mud Village (Lunenburg Co.), at Margaret's Bay (Halifax Co.), and of very dark color at Little River, about five miles from Halifax.

232. SOAPSTONE—See note to "Talc."

233. SODALITE—Occurs in the nepheline-syenites of Brome (Brome Co.), Montreal (Hochelaga Co.), and Belœil (Rouville Co.), in the province of Quebec. A very beautiful blue sodalite, in large specimens, has been found by Dr. G. M. Dawson, in abundance, in the vicinity of Ice River, a tributary of the Beaver-foot, in the Rocky Mountains, province of British Columbia. Anal., B. J. Harrington, Trans. Roy. Soc. Can., vol. iv, sec. iii, p. 81, 1886.

234. SPECULAR-IRON—Amongst other localities, is met with in tabular crystals at Sandy Cove, Digby Neck (Digby Co.), province of Nova Scotia: in tabular crystals, or thick plates, in the township of Leeds (Megantic Co.), also in thick plates in the township of Shefford (Shefford Co.), in the province of Quebec.

235. SPERRYLITE—This recently discovered and highly interesting mineral, arsenide of platinum, was found at the Vermillion mine, township of Denison, District of Algoma, province of Ontario. Anal., H. L. Wells, Am. Journ. Sci., 3 ser., vol. xxxvii, p. 67, 1889: on the crystalline form of Sperrylite, S. L. Penfield, ibid, p. 71.

236. SPESSARTITE—Is found, together with black tourmaline, uraninite, monazite, etc., in a coarse pegmatite vein—composed of microcline, albite, muscovite and white and smoky-brown quartz—in the township of Villeneuve, Ottawa county, province of Quebec.

237. SPHAEROSTILBITE—Has been met with by Prof. How, at Hall's Harbor, King's county, province of Nova Scotia.

238. SPHALERITE—Is somewhat widely distributed, being found, but most frequently in small quantities only, in all the provinces of the Dominion. It is met with, in greater or less abundance, in almost every metalliferous vein which has been opened on the east and north shores of Lake Superior, and an important deposit of the same is situate some eleven miles north-east of Rossport (formerly McKay's Harbor) on the north shore of that lake, province of Ontario. Also occurs in quantity in the township of Calumet—where it is associated with more or less galenite and a little pyrite, —Pontiac county, in the province of Quebec.

239. SPINEL—Small translucent octahedrons of blue spinel are found in a bed of crystalline limestone in the seigniory of Daillebout (Joliette Co.), in the province of Quebec. Large and not unfrequently very symmetrical black crystals, sometimes an inch or even two inches in diameter, occur in crystallized limestone in Burgess (Lanark Co.), and similar crystals, though less perfect, are found, together with fluorite, apatite and crystals of white orthoclase, in a vein of flesh-red calcite in the township of Ross, Renfrew county, province of Ontario.

240. SPODUMENE—Is said, by Dr. Hunt, to have been observed in a small rolled mass of granite near Perth, Lanark county, in the province of Ontario.

241. STAUROLITE—Occurs in mica-schists of Moore's Lake, near to Moore's Mills, Charlotte county, province of New Brunswick.

242. STEATITE—See note to "Talc."

243. STEELEITE—Is found imbedded in red clay in cavities in Triassac trap, at Cape Split, thirteen miles west of Cape Blomidon, King's county, province of Nova Scotia.

244. STELLARITE—The name given by Prof. How to the so-called "stellar" or "oil-coal," which occurs with bituminous coal (in a seam five feet thick, of which one foot ten inches are stellarite) at the Acadia mines on the Acadia Coal Company's area, Pictou county, province of Nova Scotia. Analyses, H. How, Min. N.S., p. 24, 1869. Sir William Dawson, referring to this substance (Acadian Geology, 3rd ed., 1878, p. 339) says:—"The material known as stellar-coal is, as I have maintained in previous publications, of the nature of an earthy bitumen; and, geologically is to be regarded as an underclay or fossil soil, extremely rich in bituminous matter, derived from decayed and comminuted vegetable substances. It is, in short, a fossil swamp muck or mud which, as I have elsewhere pointed out, is the character of the earthy bitumens and highly bituminous shales of the Coal formation generally."

245. STIBNITE—An important deposit of this mineral exists in the parish of Prince William (York Co.), in the province of New Brunswick, where it is contained in

numerous large and well-defined veins of quartz, filling lines of dislocation in highly tilted argillaceous slates and quartzites: also at Rawdon—where, in association with a little quartz and calcite, it constitutes a vein cutting talcose slates,—and West Gore, Hants county, province of Nova Scotia. It is found in small radiating prismatic crystallizations, with native antimony, valentinite, senarmontite and kermesite, in veins in argillite, in the township of South Ham (Wolfe Co.), province of Quebec. It has been met with in small quantities, in association with pyrite and mica, in a band of crystalline dolomite in the township of Sheffield (Addington Co.), and in small masses mixed with tremolite, under similar conditions, in the township of Marmora (Hastings Co.), province of Ontario—also occurs near Foster's Bar, about twenty-three miles from Lytton, Fraser River, province of British Columbia.

246. STILBITE—Is abundant, and exhibits a large number of crystallized varieties, often of great beauty, at Partridge Island (Cumberland Co.), Hall's Harbor and Morden (King's Co.), and Margaretville (Annapolis Co.), in the province of Nova Scotia. Anal., H. How, Phil. Mag., 5 ser., vol. i, p. 134, 1876.

247. STRONTIANITE—Occurs, in the form of white fibrous tufts, in cracks in concretionary limestone masses in the Utica slate of St. Helen's Island, Montreal, province of Quebec. Anal., B. J. Harrington, Trans. Roy. Soc. Can., vol. i, sec. iii., p. 81, 1882-83.

248. SULPHATITE—The water of the so-called Sour Spring of Tuscarora (Brant Co.), as also that of a spring in the south-west corner of Niagara, and of one at St. David's, in the same township (Lincoln Co.), and of another about a mile and a-half above Chippewa (Welland Co.), in the province of Ontario, are all remarkable for containing a large proportion of free sulphuric acid. Analyses, T. S. Hunt, Geol. Can., 1863, pp. 540, 545.

249. SULPHUR. NATIVE,—Has been met with in the form of shattered crystals, in a gypsum quarry in Colchester county, province of Nova Scotia. It occurs as a deposit from sulphurous springs in several localities in the province of Ontario, as at Charlotteville (Norfolk Co.), and in Clinton (Huron Co.), at which latter place there is a deposit affording masses of pure yellow compact, or fine-grained, sulphur, together with small transparent crystals of the same. Has also been found, in association with sal-ammoniac, as a deposit on cliffs of shale on Smoky River, North-west Territory. Anal., G. C. Hoffmann, Rep. Geol. Can., 1875-76, p. 420.

250. SYLVANITE—Occurs, in association with argentite and more or less galenite and chalcopyrite, in a gangue of white sub-translucent quartz, at the Huronian mine, township of Moss, District of Thunder Bay, province of Ontario.

251. TACHYLITE—Occurs, according to Dr. G. M. Dawson (Rep. Geol. Can., 1876-77, p. 84), as masses in agglomerate, near the entrance of Peninsula Bay, Fraser Lake, province of British Columbia.

252. TALC—Talc in crystalline foliated masses is sometimes met with in Canada, but it more frequently forms beds of a compact or schistose variety of steatite or soapstone, interstratified with serpentine, magnesite, or clay-slate, and often enclosing actinolite, or bitter-spar. These beds, which occur in strata of Pre-Cambrian or Cambrian age, and are often of considerable thickness and extent, lie principally in the townships of Bolton, Sutton and Potton (Brome Co.), in the province of Quebec. An unctuous foliated rock, consisting of talc with intermixed carbonates of lime and

magnesia, and small quantities of quartz and magnetite, is found in the Laurentian of the township of Elzevir (Hastings Co.), in the province of Ontario. Analyses, T. S. Hunt, Geol. Can., 1863, p. 469.

253. TENNANTITE—Occurs, in association with chalcopyrite, pyrite, quartz, etc., at the Crown mine, Capelton, Sherbrooke county, in the province of Quebec. Anal., B. J. Harrington, Trans. Roy. Soc. Can., vol. i, sec. iii., p. 80, 1882-83.

254. TETRAHEDRITE—Ordinary tetrahedrite (containing only a little silver) occurs, in a gangue of ankerite, in the vicinity of Foster's Bar, about twenty-five miles above Lytton, Fraser River, and a more or less argentiferous tetrahedrite, associated with variable amounts of galenite and small quantities of one or more, or all, of the following minerals, viz., pyrite, chalcopyrite, bornite, sphalerite, is found at the Illecillewaet mines, between the north and south branches of the Illecillewaet River, Selkirk Range, and at the International claim on the west side of Kootanie Lake; on Otter-tail Creek and Carbonate Creek; at Cherry Creek, thirty-three miles east of the head of Okanagan Lake: at some of the Stump Lake mines, Nicola Valley; on Jamieson Creek, which flows into the North Thompson River, and elsewhere in the province of British Columbia.

255. THOMSONITE—Specimens of this mineral, in the form of radiating crystals, have been found at the North Mountains of King's county, province of Nova Scotia. See also note to "Mesole."

256. TITANITE—Occurs in minute amber-colored grains and crystals, in the granitoid trachytes of Brome (Brome Co.), Shefford (Shefford Co.), and Yamaska (Yamaska Co.) Mountains, and in the diorite of Mount Johnson (Iberville Co.)—in crystals, often of considerable size, of a clove-brown or chocolate-brown color, in the Laurentian of the townships of Argenteuil and Grenville (Argenteuil Co.), Buckingham, Templeton, Wakefield and Hull (Ottawa Co.), and at the Calumet Falls in Litchfield (Pontiac Co.), in the province of Quebec. It is also met with in the Laurentian of the townships of Sebastopol—where very large crystals are sometimes found, also fine twin crystals, and a massive form—(Renfrew Co.), North Burgess—of a honey-yellow color—and North Elmsley (Lanark Co.), and other townships in this part of the province of Ontario. Analyses, T. S. Hunt, Geol. Can., 1863, 503, and B. J. Harrington, Rep. Geol. Can., 1877-78, p. 28 G.

257. TOURMALINE—Principally black, but not unfrequently brown—is of comparatively common occurrence, in many places, in rocks of the Laurentian series. Among the numerous localities of its occurrence may be mentioned:—Near Hunterstown—where a single transparent brown crystal, remarkable for its modifications, was obtained—(Maskinongé Co.): at Calumet Falls in the township of Litchfield, fine translucent, rich yellowish-brown colored, highly modified crystals with brilliant faces—(Pontiac Co.); in the township of Clarendon—brown crystals of great beauty—(Pontiac Co.): in the townships of Grenville and Argenteuil—black crystals—(Argenteuil Co.): also black crystals on the west side of the North River at St. Jérôme (Terrebonne Co.)—in the province of Quebec. In the province of Ontario:—the townships of North Elmsley, North Burgess and Bathurst (Lanark Co.), Ross—where crystals almost equal in beauty to those from the Calumet Falls have been found,—and Blythfield (Renfrew Co.), Galway and Stoney Lake in Dummer (Peterborough Co.), and Charleston Lake in Leeds county.

258. TRAVERTINE—Deposits from calcareous springs—the material of which is in some instances hard and solid, at other times porous and tufaceous—are abundant in many parts of western Ontario, being met with in the counties of York, Wentworth, Oxford, Wellington, Grey, Simcoe, etc.

259. TREMOLITE—Is abundant in the Laurentian limestones at the Calumet Falls in Litchfield (Pontiac Co.), province of Quebec; also in the townships of Blythfield (Renfrew Co.), and Dalhousie (Lanark Co.), and short thick and highly modified prisms of a white transparent tremolite, have been observed by Prof. Chapman, in a white crystalline limestone in the township of Algona (Renfrew Co.), province of Ontario.

260. TURGITE—Occurs with brown hematite at Teny Cape, Hants county, province of Nova Scotia. Anal., H. How, Phil. Mag., 4 ser., vol. xxxvii, p. 268, 1869.

261. ULEXITE—Occurs with cryptomorphite, Howlite, mirabilite, halite, Arragonite and selenite in the gypsum deposits of Hants county—as at Clifton quarry, Windsor; Brookville; Trecothick's quarry; Three Mile Plains; Winkworth; Newport Station —province of Nova Scotia. Anal., H. How, Phil. Mag., 4 ser., vol. xxxv, p. 32, 1868.

262. URACONITE—Was observed by Dr. Hunt, in the form of a sulphur-yellow crystalline crust, lining fissures in magnetite in the township of Madoc (Hastings Co.), and by Prof. Chapman, in a deposit of magnetite in the township of Snowden (Peterborough Co.), province of Ontario.

263. URALITE—Good specimens showing the partial and complete alteration of pyroxene to uralite, have been found in the township of Templeton, Ottawa county, province of Quebec. Analyses, B. J. Harrington, Rep. Geol. Can., 1877-78, p. 20 G et seq.

264. URANINITE—Has been found at the Villeneuve mica mine, in the township of Villeneuve, Ottawa county, province of Quebec. Ann. Rep. Geol. Can., vol. ii, p. 10 T., 1886.

265. VALENTINITE—Is found with native antimony, stibnite, senarmontite and kermesite, in veins in argillite, in the township of South Ham, Wolfe county, province of Quebec.

266. VESUVIANITE—Occurs in yellow crystals, with garnet, pyroxene and zircon, in calcite, in the township of Grenville, and in large brown crystals, with tourmaline, at the Calumet Falls in Litchfield (Pontiac Co.): in large brownish-red crystals in a quartzose rock, in the township of Templeton (Ottawa Co.), and Dr. Harrington has recorded the finding of small prisms of green idocrase imbedded in cinnamon stone, in the township of Wakefield, in the same county—province of Quebec.

267. VIVIANITE—An earthy form of this mineral, of a bright blue color, occurs underlying a bed of bog iron-ore in Côte St. Charles, Vaudreuil (Vaudreuil Co.), in the province of Quebec. It has also been met with, in a similar form, at the "Ramparts," Porcupine River, Yukon district, North-west Territory.

268. WAD—This variety of bog-manganese has been met with in Bolton (Brome Co.), Stanstead (Stanstead Co.), Tring, Aubert-Gallion and Ste. Marie (Beauce Co.), and several other localities in the province of Quebec. At Parrsborough (Cumberland Co.) and in Halifax county: at the head of Lewis Bay (Cape Breton Co.), and in association with the iron ore of the Martin Brook mines at Londonderry (Colchester Co.), province of Nova Scotia. Anal., H. Louis, Trans. N. S. Inst., vol. iv, p. 427, 1878.

269. WERNERITE—Scapolite is very frequently met with in the Laurentian : it occurs in large crystals and cleavable masses, with pyroxene and sphene, in Hunterstown (Maskinongé Co.) ; in the townships of Grenville—in the Augmentation of, pale lemon-yellow—(Argenteuil Co.), Templeton—where good, and occasionally very large though less perfect, crystals are met with—Portland and Wakefield, etc. (Ottawa Co.), and Calumet Island—lilac-colored—(Pontiac Co.), province of Quebec. In very large, but imperfect crystals, on Turner's Island in Lake Clear, in the township of Sebastopol, at Golden Lake in the adjoining township of Algona (Renfrew Co.), and in good crystals in the township of Ross, in the same county—province of Ontario. Analyses, T. S. Hunt, Geol. Can., 1863, p. 474, and F D. Adams (showing presence of chlorine in scapolites), Rep. Geol. Can., 1877-78, p. 32 G.

270. WILSONITE—Fine specimens of this mineral are found in the townships of Portland, Templeton and Hull (Ottawa Co.), in the province of Quebec. As there met with, it is most frequently intimately associated with scapolite, the two minerals occasionally blending into each other. It also occurs in the townships of Bathurst—the locality of its first discovery by Dr. Wilson—and North Burgess (Lanark Co.), in the province of Ontario.

271. WINKWORTHITE—The name proposed by Prof. How for a mineral found by him, in gypsum at Winkworth, Hants county, province of Nova Scotia. Analyses, H. How, Phil. Mag., 4 ser., vol. xli, p. 270, 1871. [Assumed to require further investigation.]

272. WITHERITE—Occurs in a silver-bearing vein—the veinstone of which consists of calcite and quartz with some fluorite, carrying argentite and native silver—at Twin Cities mine, near Rabbit Mountain, Thunder Bay, Lake Superior, province of Ontario.

273. WOLFRAMITE—Was found by Prof. Chapman, in a large boulder of gneiss, on the north shore of Chief's Island, in Lake Couchiching, province of Ontario. Anal. T. S. Hunt, Geol. Can., 1863, p. 503.

274. WOLLASTONITE—Fibrous wollastonite is often found in the limestones of the Laurentian series, associated with pyroxene, felspar, quartz, mica and other minerals. Some of the best known localities of its occurrence are : St. Jérôme and Morin (Terrebonne Co.), and the township of Grenville (Argenteuil Co.), in the province of Quebec—and the townships of North Burgess (Lanark Co.), and Bastard (Leeds Co.), in the province of Ontario. Anal., Mr. Bunce, Geol. Can., 1863, p. 465.

275. ZIRCON—Small brownish crystals of zircon, with tourmaline, are found in granitic veins which traverse gneiss on the North River, in St. Jérôme (Terrebonne Co.) ; reddish-brown crystals, which are sometimes half an inch in diameter, occur, in association with wollastonite, pyroxene, sphene, plumbago, etc., in abundance in the crystalline limestone of the township of Grenville (Argenteuil Co.), and it is of frequent occurrence, often in fine crystals, in the apatite veins of Templeton and adjoining townships (Ottawa Co.), province of Quebec. Handsome crystals, including fine twins of zircon, are found in the township of Sebastopol, also large and good crystals of the same in the adjoining township of Brudenell (Renfrew Co.) ; in small crystals in a graphitic vein in the township of North Burgess (Lanark Co), and in a syenitic rock on Pic Island in Lake Superior, province of Ontario.

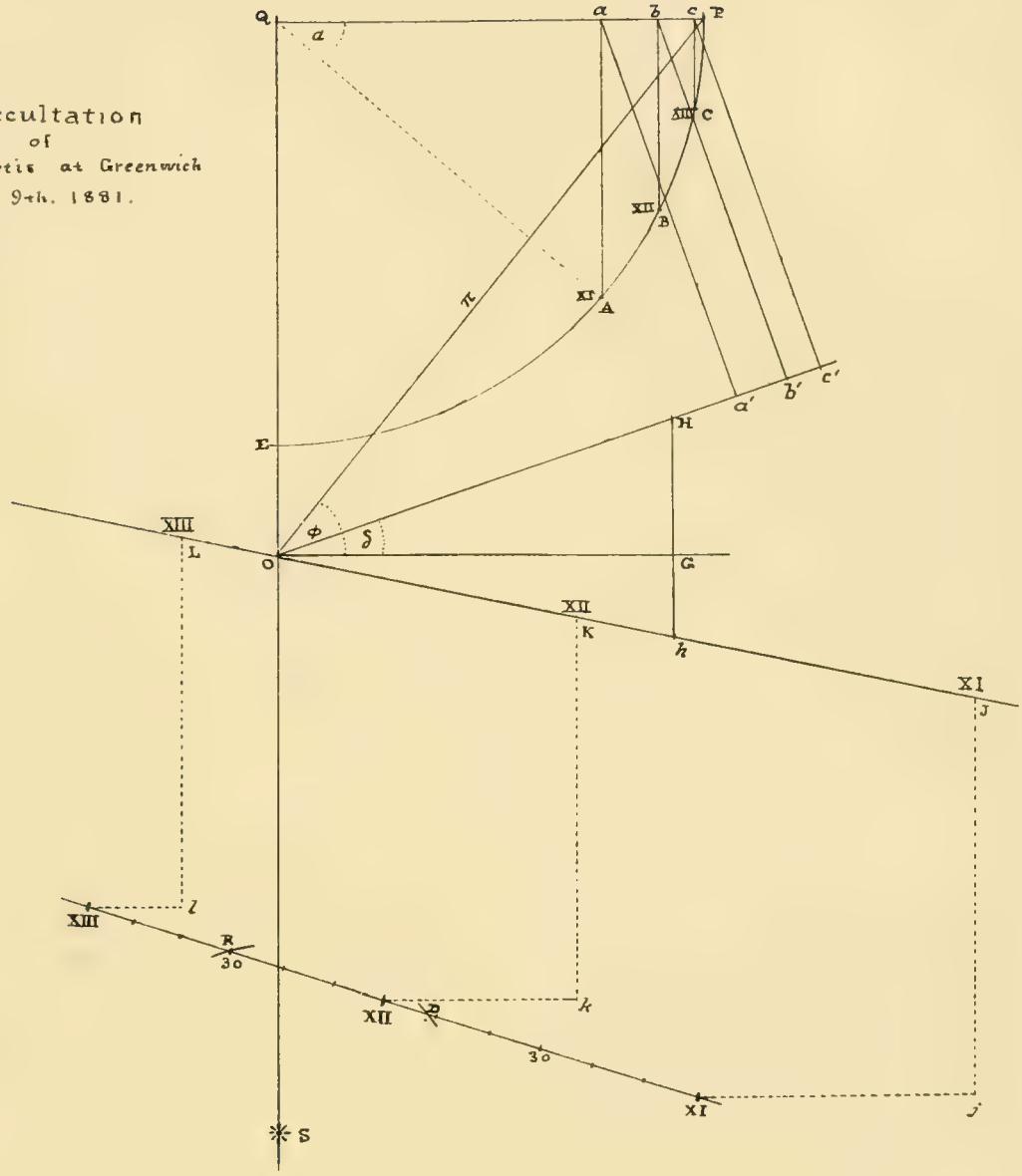
276. MENACCANITE—See notes to " Ilmenite," " Iserite."

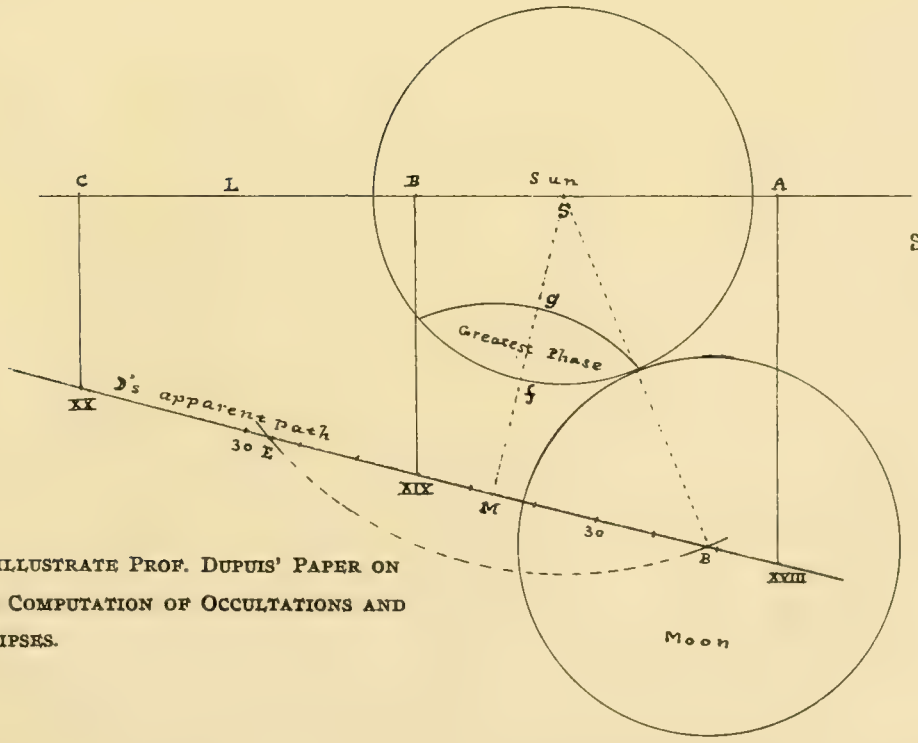
ADDENDA.

Since the preparation of the foregoing list, the following additional minerals have been identified as occurring in Canada:

1. BOURNONITE—Was identified by Mr. R. A. A. Johnston in samples of ore (sent to the survey for assay) from the following localities in the province of Ontario, viz., lot 18, range 8, of the township of Marmora (Hastings Co.), the material in this instance consisting of bournonite in association with small quantities of chalcopyrite and pyrite in a gangue of quartz; and from the east half of lot 22, range 3, and west half of lot 22, range 4, of the township of Darling (Lanark Co.), the material from the first of these two localities consisting of bournonite disseminated through a somewhat fine crystalline dolomite, while that from the last mentioned consisted of bournonite with some chalcopyrite in a gangue of white sub-translucent quartz.
2. HYALITE—Good specimens of this mineral were obtained by Mr. J. McEvoy from cavities in a dark grey foliated basalt occurring near Hīh-hūm Lake, south of Loon Lake, British Columbia.
3. LEPIDOMELANE—Was recognized by Mr. R. A. A. Johnston in a sample of ore from the township of Marmora, Hastings county, province of Ontario. The material consisted of a fine granular arsenopyrite, through which was distributed a somewhat large amount of lepidomelane and a little white sub-translucent quartz.
4. MICHEL-LÉVYTE—Barium sulphate crystallizing, according to A. Lacroix, in the monoclinic system (Comptes Rendus, vol. 118, p. 1126). The locality of occurrence, which is described as being near Perkins' Mill, is on lot 12, range 12 (about three miles, following the path, from Perkins' Mill) of the township of Templeton, Ottawa county, province of Quebec. Material from this locality has been examined by Dr. Edward S. Dana, who informs me "that he finds it to possess peculiarities in cleavage and lustre like those noted by Lacroix, which, however, he is disposed to regard as due to pressure. It differs from normal barite chiefly in the peculiar development of one of the prismatic cleavages. No variation in optical character from the requirements of the orthorhombic system was observed, while the optical properties are throughout those of ordinary barite." See "On the Barium Sulphate from Perkins' Mill, Templeton, province of Quebec, by Edward S. Dana." Am. Journ. Sci., 3rd ser., vol. xxxix, p. 61, 1890.
5. PRASE—A breccia, consisting of angular fragments of prase cemented together with white chalcedony, was found by Dr. G. M. Dawson filling cavities in Tertiary basaltic rocks in mountains at head of Nicoamen River, British Columbia.

March 31*st*, 1890.





Solar Eclipse
at Greenwich
May 16th 1882.

To illustrate Prof. Dupuis' Paper on the Computation of Occultations and Eclipses.

ROYAL SOCIETY OF CANADA.

TRANSACTIONS

SECTION IV.

GEOLOGICAL AND BIOLOGICAL SCIENCES.

PAPERS FOR 1889.

I.—*Presidential Address: On the Progress of Geological Investigation in New Brunswick.* By L. W. BAILEY.

(Read May 10, 1889.)

It is, I believe, the custom in our Society, as in others similarly constituted, and one the utility of which has been justified by experience, that he who may have been honored by selection as the Presiding Officer of a Section should make to that Section something of the nature of a formal address, and that this should take the shape of a review, or at least be upon some topic of general interest, rather than upon one which is only local or technical. To one, therefore, whose labours, like my own, have been wholly confined to unravelling the intricacies in the geology of such little known and so complicated regions as that of the interior of New Brunswick, the attempt to meet the requirements of the custom referred to presents unusual difficulty. But, one source of satisfaction connected with the working out of such problems is always present in the fact that their issue has often a bearing far beyond the immediate region in which they are undertaken. It has thus happened, at several different periods since the investigation of New Brunswick geology was begun, that discoveries, at first apparently of little value, have been found to really possess a significance of vast and general moment. I think, therefore, that I cannot do better, upon the present occasion, than to bring before you some facts referring to the progress and present status of New Brunswick geology, and while thus dealing with a theme upon which I may hope to speak with some degree of personal knowledge, to suggest at the same time some points and comparisons which may be found to have a much wider application. As regards the few members of the Section who are not geologists, I must ask their kind indulgence, reminding them at the same time, that many most interesting facts connected with the botany, zoology, agriculture, and climate of different districts, are also connected with and dependant upon their geology, some few of which in the present instance I may take occasion to notice.

The present time seems an appropriate one at which to make such a review as I have proposed, as this year witnesses the issue of the final sheets of the maps prepared by the Geological Survey, in illustration of the geology of New Brunswick. The first efforts in the direction of the preparation of such maps were made in the year 1870, but owing to the great difficulty experienced in obtaining even a probable solution of some of the problems necessary for that purpose, it was not until the year 1880 that the first sheets of the map were actually issued. These were three in number, two in illustration of the southern counties (Charlotte, St. John, and King's) and largely based upon work done in this region prior to the extension thereto of the work of the Geological Survey, and another embracing portions of Queen's, Sunbury, and York Counties, illustrating the position and relations of the Grand Lake coal-field. A special report and map, exhibiting the distribution of the Albert bituminous shales and Albertite deposits of Albert and Westmoreland Counties, had previously been issued in 1877. Following upon the investiga-

tion embodied in these maps and reports, those next undertaken had relation chiefly to the formations bordering upon the Gulf of St. Lawrence and Bay des Chaleurs, while examinations were simultaneously made of portions of the Province lying to the north of the great central coal-field, and along the valley of the St. John. Maps, illustrative of the eastern coast, five in number, were prepared and issued, under direction of Dr. Ells, in 1882, while of those relating to the St. John River region, the first appeared in 1884, a second in 1886, and the last two, completing the entire series for New Brunswick, will be published in the present year.

Prior to the preparation of these maps, two geological maps of the Province had been published, viz., one by Prof. James Robb, in 1850, chiefly based upon the earlier observations of Dr. A. Gesner, though to some extent supplemented and modified by his own, and a second published by Sir W. Dawson in his "Acadian Geology," 1886, and further modified in 1888. That those since issued by the Geological Survey should exhibit a great advance upon the former is no more than would naturally be expected; for though the map of Dr. Robb represents, in a large measure, the results of surveys made with provincial aid, these nevertheless embody the labors, at most, of but two observers, were undertaken at a time when the country was far less generally cleared and less accessible than at present, and belong to a period when the science of geology itself was comparatively in a state of infancy; while that of Sir W. Dawson, though far more advanced than the former, and far more accurate both in its topographical and geological details, was also largely based upon the scattered observations made by himself and others, and largely without governmental assistance. The progress made in the Survey maps, under the direction of Dr. Selwyn, is specially marked in more exact topographical delineation, the result of careful and systematic instrumental surveys, and also in the more positive determination, through fossils and stratigraphy, of the age of the formations represented. In the later sheets, increased attention has been paid to the determination of elevation and the representation of reliefs, but owing to the increased cost involved in work of this kind, the maps, in this particular, are still less complete than could be desired. These maps are then, for the present at least, to be regarded as the final results of the official surveys of New Brunswick. It will, however, be readily understood that, in the course of labours extending over eighteen years, carried on by various observers, and that too in a region remarkable for the complexity of its structure, some diversity of opinion should exist, and that results obtained in the later years, and in the portions of the Province last examined, should, by reflection, tend to modify, to some extent, those gathered in the districts first studied. It will probably, therefore, not be without advantage to make here a brief resurvey of the field, stating which of the earlier conclusions, of general interest, have stood their ground, those which require modification in the light of more recent knowledge, and in what directions further information is desired.

Commencing with the earlier formations, it is gratifying to know that the recognition of Azoic or Archæan rocks, as occurring near the city of St. John, and which was first announced by Mr. Matthew and the author, in 1865,[1] has been amply and fully confirmed. Between these rocks and the overlying Primordial, the evidences of unconformability are

[1] Observations on Geology of Southern New Brunswick, Fredericton, 1865.

clear, varied and widely distributed. It is equally evident that among these Archæan rocks, at least two great groups of sediments are to be distinguished, which, in a general way, bear many features of resemblance to those which in other parts of Canada are known as the Laurentian and Huronian systems. At the same time it is impossible for any one familiar with the rocks of the first named of these great systems not to see that between them and the supposed Laurentian rocks of St. John there are equally striking differences. This is especially to be seen in the greater proportionate amount, in the case of the district last mentioned, of distinctly stratified rocks, such as slates and quartzites, in the comparative absence of coarsely crystalline deposits, of crystalline minerals and ore-beds, and in the much greater regularity and uniformity of the whole. But too much weight must not be given to differences of this kind, more especially as the area in question is itself but very limited. A more satisfactory basis of comparison might perhaps be found in the examination of the microscopic characters afforded by the rocks of the two series, but neither in the case of the supposed Laurentian, nor in that of the Huronian strata, has this yet been done. As regards the Huronian rocks, such examination is especially to be desired, as the greater part of the rocks which make up the bulk of the formation, and which have been referred to as felsites, claystones, porphyries, petrosilex, etc., were described some years prior to the introduction of the present methods of petrological research, and their names, in some instances at least, are probably misapplied.

Another desideratum in connection with these two ancient systems is a better understanding of their true relations to each other, for, though no doubt is entertained by the author as to the fact that the felsitic and schistose rocks referred to the Huronian are more recent than the granitoid and gneissic rocks and the great belts of crystalline limestone which have been regarded as Laurentian, a contrary view has been taken by others; while neither has any satisfactory contact of the two formations been observed, nor any instance in which the conglomerates of the one are unquestionably made up of material derived from the other.

In addition to the areas above referred to as Archæan, several other tracts, of more or less considerable extent, occur in the northern part of the Province, and have also been represented as of Pre-Cambrian age, but the evidence as to these is of less satisfactory character, no overlying Cambrian beds having been here observed, while both their limits and relations are rendered difficult of determination by the uncleared, rugged and almost inaccessible character of the region in which they are found. Judged, however, by their lithological aspect, and the fact that they are bordered in places by rocks which are at least as old as the so-called Quebec Group, a good degree of probability is given to the belief that a belt of such rocks traverses the northern interior of the Province, where it also constitutes its most elevated section, and forms the watershed from which flow many of its most important streams.

Of the formations succeeding the Archæan, to none does a greater interest attach than to the Primordial or Cambrian, so assiduously and so successfully studied by our associate, Mr. Matthew. As the important results of these studies have been given to the world through the medium of our own Transactions, it will be unnecessary to speak of them here at length; but to convey some idea of the extent to which they have added to our knowledge of this ancient fauna, it may be sufficient to state that whereas, in the first publi-

cation relating thereto by the late Prof. Hartt,[1] the total number of organic forms recognized was limited to eight genera (four genera, including thirteen species, of Trilobites, and six species of Brachiopods) there are now recognized from the same formation four species of Protozoa (sponges), two of Hydrozoa, one Cystid, twelve Brachiopods, seven Pteropods, two Gasteropods, six Phyllopods, four Ostracoids, and at least thirty-two species of Trilobites ; among the latter one, the *Paradoxides regina*, being the largest fairly complete example of the genus yet found in any part of the world.

But it is not solely, nor even chiefly, in the recognition of new species that these researches are important. It is largely in the information which they afford as to the relationships of specific types and the phases of their developmental history that they acquire greatest interest and value. They are still further of importance as helping to establish more exactly the range and relations of the entire Cambrian fauna, both as regards its own subdivisions and those of subsequent periods. As originally described under the name of the St. John Group, the formation was regarded as including only the series of dark slates and sandstones, at the base of which were found the Paradoxides and other forms by which Prof. Hartt was enabled, in 1868, to fix their age as Primordial, and the probable equivalent of Barrande's Stage C, as represented in Bohemia. At the same time a series of red beds, of considerable thickness, was found to intervene between these fossiliferous strata and those of the older volcanic or Huronian Group, and though at first referred to the latter as an upper member, was subsequently regarded as being more intimately associated with the former. At a still later period, the unconformability of the Primordial series, as including these red beds, to the underlying Huronian, was placed beyond question by investigations extending along their entire lines of contact; but it is only quite recently that evidence has been found, by Mr. Matthew,[2] tending to show that between the Paradoxides beds and the supposed equivalents of the Huronian, two physical breaks, rather than one, intervene, the red rocks being really unconformable to the overlying as well as the underlying series. A discovery of still greater interest, made at the same time, was that of the occurrence in these same beds, of organic remains which, though few and somewhat obscure, seem sufficient to show the existence, in this part of America, of a fauna older than that of the Paradoxides zone, and the equivalent of the Lower Cambrian fauna of Newfoundland, or that of the Caerfai Group of Wales. Thus, the whole Cambrian system at St. John, originally described collectively as Primordial, has now been shown to be divisible into two distinct series, of which the first, Series A-B, the Basal or Georgian Group, includes the Olenellus fauna, while the second, Series C., the St. John Group or Cambrian proper, includes part of the Lower and the whole of the Middle Cambrian as recognized in Europe, being equivalent to the Solva and Menevian groups of Hicks, and the Lingula flags of Murchison, as well as the Regiones B and C of Angelin. Series D, the equivalent of the Potsdam Sandstone, so far as known, is absent from Acadia. Of the groups represented, the St. John Group is further regarded as embracing three stages or divisions, including in the first division four subgroups or bands, each characterized by its own peculiar forms of organic life. Thus, so far as the Maritime Provinces (and New-

[1] Geology of Southern New Brunswick, Fredericton, 1865.

[2] On a Basal Series of Cambrian Rocks in Acadia, Can. Record of Science, vol. iii, no. 1, 1888.

foundland) are concerned, the Cambrian succession may now be regarded as having been placed upon a substantial basis, and may serve as an invaluable guide towards removing or lessening the obscurity still enveloping that succession elsewhere.

The possibility of making such divisions as have been referred to, and of satisfactorily establishing their correspondence with those of the Cambrian zones recognized in other parts of the world, is sufficient proof of the zeal, care, and ability with which these minute investigations have been carried on by our associate; but I cannot let this opportunity pass without adding my testimony, as that of one personally conversant with the facts, to the energy and untiring perseverance which has led to such important results in the face of difficulties which seemed at one time to be well-nigh insuperable. It may be added that the field in this direction is even now only partially explored, and the studies still in progress can hardly fail to enlarge still further our knowledge of this ancient and earliest known era of undoubted organic existence.

Our attention is again directed, in this connection, to the importance of the use of the microscope in geological investigation, not only as revealing petrological distinctions and conditions of origination not otherwise recognizable, but also as an aid in the search for minute organic relics. Through its means, a series of rocks lying altogether below the first trilobitic beds of the Cambrian, and to ordinary observation utterly barren of fossils, is now known to be filled with the remains of sponges, radiolarians, etc., and therefore shows what we may reasonably expect when the same method of study is applied to the study of like formations, both in the old world and in the new, in which as yet but few observations of this kind have been made.

Of the formation next succeeding the Cambrian, that of the Cambro-Silurian or Ordovician, as occurring in New Brunswick, our knowledge is much less complete and satisfactory. Very large areas, it is true, have, in reports of the Survey, been referred to this horizon, and are so represented upon the accompanying maps, but always with some degree of hesitation, and rather for the reason that this reference is more consistent with such facts as we happen to possess, than that these facts are, for all the areas so represented, entirely conclusive. At one point only, viz., on Beccaguimic River, in Carleton County, have fossils been found, including such genera as *Obolella*, *Acrotreta*, *Lingula*, *Leptæna*, *Orthis*, *Strophomena* (?), *Camerella* or *Rhynchonella* and a Trilobite apparently identical with the *Trinuclens seticornis* of Hisinger, as well as crinoidal or cystidean fragments and sponge-like spicules, which, are certainly Lower Silurian (or Ordovician); but the rocks in which they occur, consisting of hard black siliceous and pyritiferous limestones, are exposed over a very small area, and are quite different in character from anything which has been elsewhere observed in the areas referred to this system. It is certainly very remarkable that nothing corresponding directly either to the thick limestones of the Trenton formation or the Utica shales, with their abundant fossils, has been met with here. The bulk of the strata would seem rather to correspond to the less altered portions of the so-called Quebec Group, consisting chiefly of slates and sandstones, which are occasionally highly colored, but even with the latter, the correspondence, except over limited areas, can hardly be regarded as very close, there being but little to represent the coarse grits of the Sillery formation, and almost nothing to represent the heavy beds of white quartzite, of limestone, or of limestone-conglomerate, which are so conspicuously displayed along the south shore of the St. Lawrence. Another element of doubt in con-

nection with the areas referred to this horizon arises from the finding, at different points within the latter, of fossils which indicate a more recent origin than that assigned to the larger districts in which they occur. Thus, in the very heart of the supposed Cambro-Silurian band, in York County, a narrow belt containing forms of transitional character between the Silurian and Devonian, was found as early as 1879, by the late Chas. Robb; and quite recently still other forms, somewhat obscure but apparently Devonian, have been discovered, by Mr. W. T. H. Reed of Fredericton, in the slates a few miles north of that city. It may thus eventually prove to be the case that within the area ascribed to the Cambro-Silurian, there are considerable tracts of younger strata, either Silurian or Devonian, or both; but the fact that on the north side of the central granite belt the slates in question are so obviously and at so many points met and overlapped by undoubted Silurian strata, taken with the known occurrence of Lower Silurian forms on the Beccaguimic, and of graptolitic slates which are probably Lower Silurian, in the eastern extension of the same belt, near Bathurst, would seem to be sufficient reason for continuing for the present to assign this age to the group in question. It may be added that rocks very nearly resembling many of those which have in New Brunswick been regarded as Lower Silurian, have recently been observed by the writer in northern Maine, where they would seem to be unconformably covered by Silurian conglomerates, made up of their debris; but the determination of the exact age of all these slaty rocks in both countries, is among the most important problems in the geology of this region still requiring solution.

I may add that the same uncertainty rests upon the age of the so-called Kingston Group, of southern New Brunswick, and which in its westward extension becomes, in part at least, continuous with that to which Prof. Shaler has assigned the name of "the Campo Bello Series." By that author, who assigns to strata of the group a thickness of at least 4,000 feet, and compares them with the slates of the Cambridge district in Massachusetts, they are regarded as being Lower Cambrian; but as beds of very similar character occur within a very short distance of the known Cambrian of St. John, and yet bear but little resemblance to the latter, this supposition seems untenable. As they are certainly older than Silurian, and in all probability not Cambrian, they must either be regarded as Pre-Cambrian, the view adopted in the Survey reports, or as Cambro-Silurian.

The rocks of the Silurian system are among the most widely spread and most interesting of those found within the district to which this paper relates. No other formation has determined so large an extent of arable land; none is more remarkable for its physical features, whether of mountains, lakes or rivers, and over none is the distribution of native plants more peculiar. Within it are included the Aroostook region, so well known for its fertility, in northern Maine, and a corresponding "fertile belt" in northern New Brunswick; and it was long since pointed out, by Prof. G. L. Goodale, that many of the species of plants here met with are such as naturally belong to a more southern parallel. Finally, the formation is the first one in which is indicated anything like a definite idea of the early geography of this portion of America.

Although the general age and distribution of the larger part of the rocks referred to this system has been long known, it is only quite recently that any attempt has been made, so far as New Brunswick is concerned, to effect any subdivision of the latter or to determine the relation or equivalency of its different portions. Indeed, this could not

well be done until the entire field had been surveyed and the rocks of this Province brought into connection with the previously studied and more typical sections afforded by the Island of Anticosti and the Gaspé Peninsula. This has now to a large extent been effected, partly by the explorations of Dr. R. W. Ells and his associates, in the peninsula referred to, and more recently by the author, in connection with Mr. McInnes, in the district lying between the Metapedia River and Lake Temiscouata. In the same connection a considerable amount of exploration has been made in the very interesting and highly fossiliferous region of Aroostook County, Maine, and thus the data are now at hand, not only for a comparison of these several localities with each other and the typical section at Cape Gaspé, but also for instituting a similar comparison between the succession and origin of the Silurian strata in northern New Brunswick, Quebec and Maine, and those of the equivalent strata near the Bay of Fundy. Several papers relating to this subject I have already had the honour to lay before the Section ; and during our present meeting, it is my desire, in another paper, to discuss at some length, the subject of our early Silurian geography, as indicated by the facts now in our possession. It will therefore not be necessary to dwell upon this topic now, further than to say that we have here, apparently, a pretty full representation of the entire Silurian system, with, however, considerable diversity, both of character and fossils, in the southern as compared with the northern sections of the area considered, and in both with features, particularly of life, which approximate to the geology of Europe rather than to that of the more westerly portions of our own continent. Thus, as regards the former point, while in both districts fossiliferous horizons have been recognized ranging from the lower part of the Niagara formation up to and including the Lower Helderberg, and while in both there are evidences of physical movements, accompanied by igneous extrusions and unconformability, between the lower and higher members of the formation, these in northern New Brunswick and Quebec were followed by a general subsidence, leading to an extensive invasion of the sea, and the formation of thick limestone strata abounding in corals, etc., while in southern New Brunswick, about the Bay of Fundy and Passamaquoddy Bay, the movement was largely upward, leading to the origination of shallow water sediments, with but little limestone.

Again, as regards the European aspect of our Silurian basin, this was early recognized and commented upon by the late Mr. Billings, being seen not only in the large number of genera common to the two, but also in the close approximation or identity of many of the species. It has also been quite fully and ably considered in a recent article by Sir W. Dawson.[1]

An interesting discussion of the character and relations of the Silurian rocks as developed about Cobscook and Passamaquoddy Bays, near the boundary between Maine and New Brunswick, has, since the termination of the labours of the Canadian Survey in that region, been made by Prof. N. S. Shaler,[2] on behalf of the Geological Survey of the United States, but the conclusions reached are, for the most part, in accord with those already announced by the former.

The evidences of igneous activity, to which reference has been made as occurring during the progress of the Silurian era in the Acadian basin, constitutes another of its

[1] On the Eozoic and Palæozoic Rocks of the Atlantic Coast of Canada, Quart. Journ. Geol. Soc., Nov., 1888.

[2] Am. Journal of Science, July, 1886.

most noticeable peculiarities. No other system, unless it be the Huronian, will compare with it in this respect, and it is noticeable that between the volcanic members of these two great groups, the lithological resemblances are often so close as to make their recognition difficult. For this reason, and in consequence of the not infrequent close association of the two systems in the same district, several considerable areas have been alternately referred to one or the other of these formations; but it is probable that a closer microscopic study of both—a work which is greatly needed—will do much to remove this difficulty.

Still another most interesting fact in connection with our knowledge of the Silurian rocks of New Brunswick has been the discovery, made by Mr. Matthew in 1886, of the remains of Pteraspidian fishes, related to the genus *Cyathaspis* of Lankester, in Division III of that system, or in rocks which are about of the age of the Lower Ludlow, and probably of about the same age as those which in Pennsylvania hold the *Palæaspis* of Prof. Claypole. This is believed to be our first knowledge of the occurrence of this type of animal life in strata of so great antiquity, so far at least as Canada is concerned.

The most important facts in our knowledge of the Devonian system in New Brunswick were obtained prior to the extension thereto of the work of the Canadian Survey, the rich flora of Perry, Maine, and Carleton, N. B., together with the interesting insect-remains of the latter, having been previously made known to the world through the labours of Prof. Hartt, Mr. Matthew and Sir W. Dawson. A very important limitation, both in the supposed distribution and bulk of this formation, was, however, made in the first year of the survey by the transference to a very much lower (Pre-Cambrian) horizon of a great mass of non-fossiliferous rocks, occupying chiefly the north side of the Bay of Fundy, and which, from their apparently conformable superposition upon undoubted Devonian strata at St. John, had been regarded as a portion of the latter system. In the same year (1870) the rocks of Perry, with their supposed equivalents at St. Andrew's and Point Lepreau, were described by the present author and his associate as much more nearly resembling, both in character and position, the rocks of the Lower Carboniferous formation than those which, at St. John, held similar plant remains. At that time, however, the rocks of St. John were looked upon as the equivalents of the Chemung and Portage Groups, whereas later investigations showed that their position was rather that of the Hamilton formation, if not even still older. At that time also but little had been done in the study of the Devonian basin of Bay des Chaleurs, where our knowledge of the relations of these two formations has since been so greatly enlarged by the observations of Mr. R. W. Ells and others. They bear to each other, in this latter region, the same resemblance lithologically as that which led to their association in Passamaquoddy Bay, but both their relative position and their contained fossils are, according to Mr. Ells, such as render their separation comparatively easy. In view of these facts, it would seem probable that the rocks of the "Perry Group," as all along maintained by Sir W. Dawson, must be accepted as true Devonian, though occupying in that system a position considerably more recent than that of the St. John and Carleton rocks, and being probably the equivalents of the Catskill beds, which in character they nearly resemble.

The discovery, in connection with the Devonian rocks of Bay des Chaleurs, of fossil fishes (*Pterichthys*, *Coccosteus*, *Pteraspis*, etc.) of the same type as those of the Old Red Sand-

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[1] Can. Record of Science, vol. ii, no. 4, Oct., 1886.

stone of Scotland, and their careful and elaborate description by Mr. Whiteaves, in the Transactions of our Society, constitute other and most important steps of progress in the development of our knowledge of this system, as they supply another link between the geology of eastern America and that of Europe.

A still more recent discovery in connection with our Devonian system is that of new types of insects and crustaceans, found only last summer by Mr. W. J. Wilson in the same plant-beds at Carleton, near St. John, as those in which Devonian insects were first found by Hartt. The latter, and which were for a long time the earliest insect-remains known from any part of the world, were synthetic forms, combining features of the neuropterous and orthopterous orders. They have since been placed by Scudder in a new Palæozoic order, on the ground that they antedate both those modern orders and that they represent the source from which these latter have sprung.

The fact that considerable tracts in northern Maine, described in the Reports of the Survey of that State, have been found to contain a well-marked Silurian fauna, has already been referred to. On the other hand, small areas, carrying characteristic fossils of Oriskany age, have been observed by Mr. W. McInnes about the head-waters of the Tobique, in New Brunswick, in a region previously supposed to be wholly Silurian.[1]

In the case of the Carboniferous system, the facts ascertained during the period now under review have had to do rather with its economic aspects than with questions of general scientific interest. In the year 1876-77 the distribution and succession of the Lower Carboniferous formation, as represented in King's, Albert and Westmorland Counties, was worked out in considerable detail, with special reference to the so-called Albert shales and the unique and valuable mineral, albertite, associated with the latter.[2] These investigations amply confirmed the idea of albertite being an altered mineral oil, and distributed much after the manner of ordinary mineral veins, with few, if any, of the characteristics of a true coal, and also indicated the wide extent of the area, fully fifty miles, over which the conditions resulting in these products had operated. In the very same year, however, the original deposit of the Albert mines, which had been so long and so profitably worked, was found to have so greatly decreased in amount as to render its further prosecution useless, and thus what had been for many years the seat of a most active industry as well as a source of considerable revenue to the Province, had to be abandoned. This was not done without long and expensive search for further extensions of the deposit, but though these, and explorations since made, resulted in the discovery of the mineral at quite a number of points, at none of these have the veins proved sufficiently large to warrant their further prosecution.

The existence of true coal in the Grand Lake district in Queen's County was discovered soon after the first settlement of the Province, and the subsequent explorations of Dr. Gesner and others sufficed to show the enormous area over which the rocks of the coal formation are spread within its limits. Prior, however, to the year 1872, but little was definitely known either as to the true thickness of the formation or its probable productive capacity. The idea having been generally entertained by those resident in the Grand Lake region that other and much thicker beds really existed there than the small twenty-two-inch seam which had been so long known and worked near the surface, the members

[1] Geological Survey, Report 1886.

[2] Report of Progress, Geological Survey, 1876-77.

of the Geological Staff at that time employed in the Province were, in the year above mentioned, directed by the Government of Canada to see what definite information could be obtained upon the subject. The result of the enquiries thus made was to show that the rocks of the Grand Lake coal-field are disposed in the form of a very shallow basin, having a maximum depth of not over 400 feet, and having, on at least three of its borders, rocks older than the coal-formation coming to the surface. The employment of a diamond drill, under the direction of Mr. Ells, gave further confirmation to the results thus obtained, by showing that at many different points, and at depths averaging about 200 feet, similar Pre-Carboniferous rocks were penetrated, and that without passing through any additional seams of coal. Thus, for this particular district at least, the facts ascertained would appear to be decidedly unfavorable to the belief in the existence here of any considerable thickness of coal-rocks or of any great productive capacity. At the same time, however, the remarkable fact was brought to notice, and was subsequently confirmed ed in other parts of the Province, that the rocks of the coal-formation are unconformable not only to the Devonian, Silurian and other older formations, but to the Lower Carboniferous as well, and may rest directly upon either of these, without the interposition of the others. It may hence follow that the coal-rocks, being deposited horizontally over a folded and eroded surface, may differ greatly in thickness in different localities, and while evidently shallow in the Newcastle region, may elsewhere attain greater volume. So far, however, as observations have yet been made, but little has been found to confirm this belief.

The only other point to which allusion need here be made, in connection with the Carboniferous system, is the reference of considerable portions of that system, in New Brunswick, as well as in Prince Edward's Island, to the Permian Group by Dr. R. W. Ells. The grounds for this reference will be found in the Report of the Geological Survey for 1883.

It may be in place to observe that, in connection with the identification of our different geological formations, and the study of their distribution, character and contained fossils, endeavours have been made to employ these data as a means of working out the varying geography of the periods which they represent, and thus of tracing the historical and physical growth of this portion of America. Among articles bearing upon this subject are some by Mr. Matthew relating to Quaternary changes in the vicinity of St. John, one by the present author relating to ancient erosion in New Brunswick, and another on the history of the St. John River in the same Province, both published in our Transactions; the paper by Prof. Shaler on the geology of Cobscook Bay previously referred to; and finally, an elaborate paper by Sir W. Dawson on the Eozoic and Palæozoic rocks of the Atlantic coast of Canada (Quarterly Journal of Geological Society, November, 1888.) From the observations thus made, the following general conclusions may be regarded as fairly established:—

(1.) The origination of an Acadian basin, as distinct from the other great basins of the continent, by a series of great uplifts antedating the opening of the Cambrian era. While on the north the basin was chiefly limited, as now, by the great chain of the Laurentide hills, with possibly a few outlying islets in the Gaspé peninsula, it was, upon the south, similarly but less completely limited, and separated from the Atlantic, by a series of long and probably low ridges stretching along the southern coast of New

England, continued in the Archæan belts of southern New Brunswick, Nova Scotia and Cape Breton, and finally bending around to connect with those of Newfoundland, thus closing in the same basin on the east. As the result of these uplifts and the accompanying processes of plication and metamorphism, the interior of the basin became, to some extent, protected against the subsequent action of those similar earth-movements which in aftertime affected so seriously other portions of eastern America.

(2.) The following of the period of Archæan uplifts last referred to, by a period of intense volcanic activity, confined for the most part to the same areas as those affected by the former, and synchronous, in all probability, with that of the similar volcanic outbursts of Lakes Superior and Huron. These outbursts were accompanied by, or were attendant upon, movements which chiefly affected the southern border of the Province, adjacent to the Bay of Fundy; the Huronian rocks being here piled up to an enormous thickness, with evidences of frequent changes of level in the course of their accumulation, while in the interior of the Province they are comparatively scarce. The nature of the deposits would indicate a somewhat rapid deposition, and mostly in shallow water.

(3.) The submergence of portions of the basin beneath the sea-level in the Canadian era, as indicated by the limestones of this age bordering the Straits of Belleisle, as well as the boulders, containing relics of the Georgia or Olenellus fauna in the limestone-conglomerates of the Quebec Group. Portions of the rim of the basin were also submerged, as indicated by the character and fossils of the Cambrian formation at St. John and elsewhere, but the movements here would seem to have been quite various, as indicated by the following table, based upon the observations of Mr. Matthew :—

A-B. Basal or Georgian Series.	*Etcheminian Stage.*	Conglomerates, &c.,	showing littoral origin.
		Fine shales,	indicating deeper water.
		Shales and sandstones,	of shallow water origin.
	Georgian Stage.	Glauconite shale,	indicating deeper waters.
		Shales,	
		Shales,	
C. St. John or Acadian Series.	*Stage* 1.	*a.* Sandstone,	formed in shallow waters.
		b. Sandstone,	
		c. Dark shale,	formed in deeper waters.
		d. Black shales,	formed in the deep sea.
	Stage 2.	Sandstones,	worm burrows and ripple marks, — shore and shallow waters.
		Coarse shales,	
	Stage 3.	Black shales,	with deep-water sponges.
		Ctenopyge beds,	
		Grey shales,	

It is not a little singular that the formation ends with deep-sea deposits, there being nothing to mark that return to or above the sea-level which would naturally usher in the changing conditions and the changing life of a succeeding era.

(4.) A more general submergence in the Cambro-Silurian or Ordovician era, deter-

mining the formation of limestones at Anticosti and to some extent along the St. Lawrence valley, but mostly marked by shallow-water sediments, mingled, according to Sir W. Dawson, with the products of ice-driftage; and followed by a period of disturbance in which these same sediments, including those of the so-called Quebec Group, were compressed and uplifted into the ridges now constituting the Notre Dame range and the axis of the Gaspé peninsula. Further south, similar movements may have affected the Cambro-Silurian strata of central and northern New Brunswick, producing a partial subdivision of the basin into a northern and a southern area.

(5.) A continuation during the first half of the Upper Silurian, of conditions similar to those of the Lower Silurian in south-eastern Quebec and northern Maine, viz., of shallow water sediments, including locally heavy beds of conglomerate, and thick accumulations of volcanic origin, but chiefly limestones at Anticosti; followed, however, by movements which in the northern half of the basin led to a greater depression of the latter and the formation of impure limestones and calcareous shales over much of northern Maine, as well as New Brunswick, but in the south by a movement of elevation which, except at a few points along the coast, raised this region above the sea-level.

(6.) The apparent limitation of purely marine deposition in the Devonian to the northern division of the Acadian basin, and mostly to its first or Oriskany period. Along the southern coast the plant and insect-bearing beds of St. John and Carleton referred to the Hamilton Group, point to their probable origin along the northern border of a trough coinciding in the main with that of the present Bay of Fundy, and about the mouths of rivers which may in part mark the beginning of the modern St. John; while the character and fossils of the slates bordering the central coal-field indicate the continued existence there of the great central basin. The distribution and character of the rocks bordering Bay des Chaleurs, with their remarkable assemblage of land plants and of fishes, both ranging from the Lower to the Upper Devonian, clearly indicate the existence of the depression during the continuance of these periods, as well as its general correspondence with that which now exists. The abundance of trappean deposits in association with these rocks would further indicate that the region was one of considerable instability, and subject to frequent igneous outbursts. Near the Bay of Fundy, and in the interior of New Brunswick, such trappean masses do not accompany the Devonian strata, or only to a limited extent, but important physical movements are indicated by the marked discordance of attitude between the lower and higher beds of the formation.

(7.) An epoch, or epochs, of excessive disturbance, plication and uplift, accompanied by regional metamorphism, and the extrusion of great masses of granite, in the interval between the close of the Silurian era and that introducing the Carboniferous age. The granites have invaded and altered the Silurian strata upon an extensive scale, while they are not known, at least in New Brunswick, to have so invaded the Devonian rocks. The fact, however, that the latter, in common with all the Pre-Carboniferous strata, show abundant evidence of alteration and a parallelism with the granitic axes, gives support to the view that the period of origination of these granites was the close of the Devonian era.

(8.) A general depression in the Lower Carboniferous era, affecting but slightly the northern and western portions of the New Brunswick, but to a greater extent its central and southern parts, submerging all preëxisting valleys, both in New Brunswick and

Nova Scotia, including the great central basin of the former, and partially submerging their bordering hills, to an amount equal, in some cases, to 1,000 feet of their present height. The character of the sediments (largely coarse red sandstone and conglomerates, with impure limestones and beds of gypsum), their impregnation with salt and comparative paucity of marine fossils, indicate a shallow water origin and general conditions similar to those of the Salina period of the Silurian of New York. The close of the era is marked by frequent igneous outflows, by long-continued and extensive denudation and, in some instances, by uplifts, leading to unconformity with the overlying coal-measures.

(9.) The replacement, in the Coal era, of the bays, straits, shallow basins and evaporating flats of the Lower Carboniferous by fresh-water swamps and bogs supporting the coal vegetation. In northern and central New Brunswick, the movements involved in this and succeeding changes, though affecting large areas, were but small in amount, the coal seams being few, and the entire thickness of the formation but slight. In Nova Scotia, as is well known, the thickness is enormous, and includes coal beds remarkable alike for their number and magnitude. In the former, over the central counties, the strata are still very nearly horizontal; along the Bay of Fundy they are more highly inclined, with numerous faults and dislocations; in Nova Scotia they are thrown into numerous basins, showing similar evidences of powerful physical movements.

(10.) Finally, with the changes marking the New Red Sandstone era, a depression and deepening of the Bay of Fundy trough, followed by igneous extrusions along its bed, and subsequent elevation to form the North Mountains of Nova Scotia and the Island of Grand Manan, the Acadian basin assumes essentially its present physical aspect, subsequently to be broken only by the events connected with the origination and decline of the great Glacial era, synchronous in all probability with the first appearance of man.

Passing now to these more recent formations, we find, as regards the Quaternary geology of New Brunswick, that, in addition to numerous more or less scattered observations made by nearly all the field observers, special study of this subject has been made both by Mr. Matthew and Mr. Robert Chalmers, the last named gentleman being still engaged in the prosecution of this work. The members of the Section are probably already familiar with the more important conclusions of Mr. Chalmers, as set forth in an elaborate contribution to the memoirs of the Society, and in an article on the glaciation of eastern America in the 'Canadian Record of Science.' These views are of great interest and importance as tending to modify, to a large extent, the opinions previously held as to the character, amount and direction of ice-action in this region in glacial times, and as giving confirmation to the view, so long and ably advocated by Sir. W. Dawson, that the glaciation of this part of the continent was the result of *local* rather than *continental* glaciers, assisted by icebergs, at a time when the country stood *below* its present level. A highly important work in this connection is the preparation, by Mr. Chalmers, of a series of maps, duplicating the geological maps referred to in previous pages, but in which the geological distinctions are replaced by others showing the surface features of the country, the distribution of the various Quaternary deposits, the character of the soil, the distribution of forests, peat bogs, plains, etc. These, when completed, will be of the greatest possible service, not only in connection with the wants of intending settlers, but also in any discussion of the facts of our Quaternary history.

The subject of the prehistoric human occupation of Acadia is one of considerable interest, and although, according to the organization of our Society, it is one which properly appertains to another Section, it is really quite as appropriate to our own, and a few facts relating thereto may be acceptable.

Among the most important investigations connected with this subject, so far as New Brunswick is concerned, are those of the recognition and exploration of the shell-heaps, which are found at different points along the coast, and especially about the shores of Passamaquoddy Bay. Some of these were very fully examined by the late Prof. S. F. Baird, about fifteen years ago, and many interesting articles were obtained, which are now in the collections of the Smithsonian Institution at Washington, but of which no published description has yet been made. Others were explored by a committee of the Natural History Society of St. John, and in their Proceedings is contained a very interesting account, from the pen of Mr. Matthew, of what was evidently an ancient Indian village, at the mouth of Bocabee River, in Charlotte County. In the interior of the Province, scattered relics, chiefly the coarser stone implements and arrow-heads, are of common occurrence, and with these are sometimes found such articles as pipes, pottery, wampum, net-sinkers, pendants etc., often somewhat elaborately ornamented. The coarser and finer relics, including both chipped and polished implements, are, however, promiscuously mixed together, and no facts have been observed from which, in any case, any high degree of antiquity can be inferred. An article by the author, summing up the facts upon this subject, and accompanied by photographic illustrations, is contained in the Sixth Bulletin of the Natural History Society of St. John (1887). This, it is hoped, will soon be followed by a similar article, by Mr. Matthew, upon the prehistoric relics of the coast.

The author cannot close this brief review of scientific progress in New Brunswick without some reference to work which, though not directly geological, must be of some interest to the geologist, as it will also be to other members of the Section. I allude to the advances made in our knowledge of the botany and zoology of the Province. As regards the former, much interesting and valuable work has been done by various local observers, in the way of adding to the lists of species occurring within our limits, or of more accurately defining the range of their distribution; but by far the most important contribution to the subject is that of the systematic synopsis of our entire flora, by Prof. James Fowler, and which has since been incorporated in the still more extensive and elaborate flora of the Dominion, published under the auspices of the Geological and Natural History Survey, by Prof. Macoun. A valuable supplement to the work of Prof. Fowler, which is confined to terrestial forms, is that of Mr. G. U. Hay and Mr. A. H. MacKay, on the marine Algae of New Brunswick, and which was published in Volume V of our Transactions. An interesting and thoughtful article, showing some of the relations of our plant distribution to the climate and physical conditions affecting it, was published by Mr. Matthew in 1869, under the title "The Occurrence of Arctic and Western Plants in Continental Acadia,"[1] and a somewhat similar article, by Prof. Fowler, "Arctic Plants growing in New Brunswick," in Volume V of our Transactions.

Among important papers bearing upon the subject of our zoology are those of Mr.

[1] Can. Naturalist, June, 1869.

Montague Chamberlin on the distribution and habits of our native birds; those of Mr. W. F. Ganong on the distribution of the cray-fish; on the introduction of *Littorina littorea;* on the marine Mollusca of New Brunswick, and finally, within the last year, on the Echinodermata of New Brunswick.

It will, I think, be admitted that scientific work has not been backward in the section of the Dominion to which I have this evening directed your attention, while to the Royal Society is due, in no small measure, the possibility of making known its results to the scientific world.

II.—*Notes on Devonian Plants.*

By D. P. PENHALLOW.

(Presented May 8, 1889.)

In a paper presented to this Society last year, I gave the results of certain investigations into the histology of Prototaxites, and among the conclusions then reached was a confirmation of the view advanced by Carruthers, that this plant is in reality an Alga and allied to the Laminariæ of our modern flora.

During the past year I have continued my examination of these fossils whenever fresh material was brought to notice, and it is only necessary to remark here, that all the results thus obtained have only served to confirm more fully the conclusion already reached. I have also been able to add to the genus three species previously recognized under other names. In the present paper, therefore, I propose, chiefly, to deal with these latter, and present a complete revision of the genus as a whole.

NEMATOPHYTON HICKSII, *Dn.*

In a former paper on Nematophyton,[1] I dealt but briefly with the characteristics of *N. Hicksii*, as I did not feel that the imperfect material then available would admit of a more lengthy description. Since then, Sir Wm. Dawson has placed in my hands some additional material, which, although it does not add very largely to the facts already gathered, yet enables me to confirm and state, in a somewhat more detailed form, the characters previously assigned to this species.

The only form in which this plant is at present found, is in small fragments imbedded in clay. In its general appearance, the material suggests the operation of decay followed by the mechanical action of water—as waves on a shore—whereby the plants became broken into small fragments. It therefore resembles the material commonly found on beaches. The fragments are small and all highly silicified, and the organic matter is so far removed, or so completely broken up as to render them extremely friable. In consequence of this, complete sections showing the normal relationship of parts cannot be obtained, and almost all my observations have necessarily been made upon isolated cells. Furthermore, the destruction of the organic matter has extended so far that the specimens are essentially represented only by siliceous casts of the cells, though, in some cases, patches of carbonaceous matter adhere to the casts in such a way as to convey an approximate idea of the thickness of the original cell wall. From this I am led to consider the wall as somewhat thick. The cells are also, without doubt, tubular and non-

[1] Trans. Roy. Soc. Canada, vol. vi, sec. iv, p. 45.

septate, and more recent examinations have shown so many undoubted instances of branching—as may be seen in the figure—that the relationship to *N. Logani* cannot be questioned.

As stated in my former paper, these larger cells have a diameter of 12 - 22 μ, but as this applies only to the siliceous casts, we must add to this, assuming the walls to be of the same thickness as in *N. Logani*, 10.5 μ, which would make the total diameter of the original cells 31.5 μ, or equal to some of the larger cells of *N. Logani.*

A secondary system of filaments is also evidently present. Casts of small tubular cells are very frequent. They have a diameter ranging from 1 to 1.5 μ. Together with these there are also casts of branching filaments, many of which have free terminations and exactly resemble the young hyphæ of a fungus. These latter were in all probability derived from a fungus growing in the plant as a feature of its decay. The fact, however, that the larger cells of the medulla branch, permits me to consider that some of the casts, at least, belonged to a secondary plexus of filaments which were in all essential respects the same as in *N. Logani* or *N. laxum.*

Spores are abundant. These bodies are of a reddish-brown color, measure 1.58 μ in diameter and are often aggregated into dense, spherical masses of reddish brown. resinous looking substance. To this I would refer the spherical masses of a similar character already noted as occurring in both *N. Logani* and *N. crassum*, and it seems highly probable that they were derived, in each case, from associated fungi.

The fine striation or transverse marking on the casts, as originally pointed out by Mr. Etheridge,[1] has been noted by me in more than one case. It is not, however, a constant feature, but occurs only now and then. If such marking represented structure in the cell wall, we might reasonably expect to find it, if not on the casts of all the cells, at least on so many of them as to leave no doubt in our minds relative to its proper connection. On the other hand, such markings are distinct from the ordinary striation of the cell wall and their position is variable. They resemble in fact markings made upon the casts by pressure of some external structure exerted through the cell wall. In my last communication on this plant,[2] I expressed a doubt as to these markings representing any structure in the cell wall, and from more recent examinations I do not hesitate to express the belief that that they are in reality caused by the filaments of the intercellular plexus.

From the facts stated above, it would appear that there is ample reason for confirming the position already assigned to this plant. It may be only another condition of *N. Logani;* but this, in view of the highly altered nature of the specimens so far obtained, cannot be definitely affirmed, and for the present, therefore, it must necessarily remain under its present specific name.

Nematoxylon crassum, *Dn.*

The original description of this plant is as follows[3] :—

" Fragments of wood with a smooth, thin bark and a tissue wholly composed of elongated cylindrical cells with irregular pores or markings. No pith, medullary rays, nor rings of growth."

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[1] Quart. Jn'l. Geol. Soc., Aug., 1881, 492 ; fig. 4.

[2] Trans. R. S. C., vi, iv. 43.

[3] Quart. Jn'l. Geol. Soc., Nov., 1863, 466.

I have not been able to inspect the original specimens from which the sections were taken, but the text following the above description refers to them as fragments, the largest of which may have been two inches long, an inch wide, and half an inch thick. The statement is also made that they are calcified and, under the microscope, remind one of Prototaxites (Nematophyton); "but the cells are of one-third greater diameter than in *P. Logani*, and are destitute of its peculiar markings, and there are no rings of growth or medullary rays. The wood cells are of good length, somewhat tortuous, loosely aggregated and much thickened by ligneous deposit, which appears to be traversed by many narrow, tortuous lines or pores. The whole stem seems to be perfectly homogeneous, and the only other structure observed was a faint and doubtful trace of the existence of parenchymatous cells in some of the spaces between the fibres."

In a later communication,[1] Sir Wm. Dawson says: "I place these plants here, simply because of the resemblance of their tissues to those of Prototaxites (Nematophyton), with which it is possible they may have had some connection, being, perhaps, stems or slender roots of similar species of smaller size. No additional specimens have been obtained since the publication of my paper above cited (Jn'l. Geolog. Soc.), which would indicate that specimens of these plants are rare at Gaspé, and they have not been found elsewhere. The original specimens were collected by Mr. Bell of the Geological Survey."

This plant occurs in the Middle Erian of Gaspé, and it will be of interest, in connection with what follows, to bear in mind that the *Nematophyton Logani*, Dn., although found in the same locality, belongs to a lower horizon, viz., the Lower Erian.

The desirability of a revision of this species was suggested by its strong general resemblance to Nematophyton, and by the facts developed by the recent examination of the latter. The results obtained by me from the sections in possession of Sir Wm. Dawson, which were submitted to additional grinding, are as follows :—

In transverse section, the cells are large, thin walled, somewhat remote and tolerably uniform in size. Our measurements show that they average about 35 μ in diameter, varying from 32 μ to 59 μ. It will thus be seen that they are, on the whole, fully as large as the largest cells of *N. Logani*,[2] but they do not present the same extreme variation in size, nor is there that peculiar grouping of larger and smaller cells which, in the latter plant, gives rise to the appearance of rings in the stem. We do not lay much stress upon this fact, however, since such tracts of larger and smaller cells may have been present in the original plant, though not represented in the small fragments brought to our notice. No radial openings are to be found, but in their place there are frequent small and irregular tracts of open structure into which the cells penetrate very much as in Nematophyton. The form of the cells is in most cases well preserved; in other cases they show the effect of compression in their flattened form. Moreover, a transverse section of the stem is not transverse to all the contained cells, which are, therefore, not wholly parallel. The somewhat wide areas between the cells are largely occupied by a structure which is not easily made out in all cases, but which consists of smaller tubes running diagonally or transversely to the direction of the general structure, and this is what appears to be referred to in the original description above given, as "a faint and doubtful trace of the existence of parenchyma cells in some of the spaces between the fibres."

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[1] Geol. Sur. of Can., Fossil Plants, part i. 20.

[2] Trans. R. S. C., vi. iv. 39.

The question of decay cannot be regarded as a factor in the present case since there is no alteration of structure such as it would be liable to produce, and in consequence, I find that the organic matter has not suffered redistribution, but occupies its original position. I have stated that the cell walls are thin. This is true with reference to the carbonaceous residue, but on the whole, the walls, as they appear in the specimens, are very thick and the cell cavaties small or none. This great increase of thickness is stated, in the original description cited, to be due to a "ligneous deposit."

The appearance of the cells is just that exhibited by a cross section of Laminaria stained with logwood, in which a thin outer wall is seen to be stained, while the inner and thicker wall remains colorless, showing an obvious differentiation of the cellulose substance. In *N. crassum* a similar differentiation may have been developed, and the inner thick layer may have become replaced by the siliceous cast as now found.

Treatment of a section with hydrochloric acid discloses the presence of calcite, which is almost wholly located in the intercellular regions, as upon its removal the whole section breaks up into separate cells.

In longitudinal section the cells are found to be tubular, non-septate and somewhat strongly vermicular, rather more so, perhaps, than in *N. Logani.* The open tracts are now seen to be somewhat elongated longitudinally so that they become two to four times as long as broad. The siliceous deposits are also seen to be continuous, although embracing the fractures peculiar to such formations. These fractures are the many narrow, tortuous lines or pores of the original description; and the deposits, as a whole, are the counterparts of those siliceous casts upon which the description of *N. Hicksii* is based.

The most significant fact so far observed, consists of the discovery of a distinctly branching system, similar in its general character to that of *N. Logani.* though differing from it in some important respects. In one case I found a branch projecting from the side of a large cell with a diameter of of 5.8 μ and a length to the point where cut off, of about 35 μ. Two other branches near together were each 4.6 μ; two more were 2.3 μ and 4.6 μ; another, 6.9 μ in diameter. These were all I could find within this range of dimensions, and all, with one exception, were found in transverse section. Numerous other secondary filaments may be readily observed, especially in cross section, and they are found to have a diameter which varies but little from 10 μ. It is, therefore, clear that the larger cells of this plant branch into a secondary plexus as in *N. Logani*, and as all of the instances, in which the branches were seen to emanate from the larger cells, occurred in the open tracts above described, it would appear that these latter serve as the special regions in which the branching is effected, as in *N. Logani.* My measurements show, however, that the secondary filaments of this latter plant are smaller on the average, much more uniform in size, and more numerous than in the plant now under consideration; and this explains what is stated in the original description, that the cells "are destitute of their (*N. Logani*) peculiar markings."

The silicified thickenings of the cells are seen in the longitudinal section to be continuous, though traversed by occasional fissures, the "tortuous lines or pores" of the original description as pointed out above. So far, none of the specimens I have examined show any evidence of structural markings in the cell walls, which are perfectly continuous. I have, however, frequently noted small round bodies of a refractive nature and a deep reddish brown color, suggesting small aggregations of resinous matter elsewhere referred

to as associated with *N. Logani.* Their exact nature remains doubtful. They are usually found disposed in the cell in linear series of two to twelve or more. They are in all cases quite distinct from the cell wall. Bodies of the same kind have also been seen, though less frequently, in *N. Logani*, and abundantly in *N. Hicksii*, where they are obviously composed of pores.

From the above it is evident that our plant is a Nemaphyton, though it differs from *N. Logani* in important respects. It approaches more nearly to *N. laxum*, but again differs from it in its more compact structure, greater uniformity of size in its cells, and in its less prominent intercellular plexus. We may, therefore, regard it as a distinct species for which I would retain the name *crassum* as properly descriptive.

A revised description would be as follows :—

NEMATOPHYTON CRASSUM, *Pen.*

Nematoxylon crassum, Dn.

Growth rings (?), pith and radial tracts none. The plant wholly composed of thin-walled, structureless, vermicular and non-septate cells which branch into a secondary plexus. Open tracts frequent, and of irregular size, in which the branching chiefly occurs. Cells of the medulla rather uniform and thick walled—wall double—35 μ in diameter. Cells of the hyphal structure variable, from 2 μ to 10 μ in diameter.

Specimens found only in fragments. From the Middle Erian of Gaspé.

CELLULOXLYON PRIMÆVUM, *Dn.*

In the course of my examinations of Nematophyton during the past two years, certain peculiarities of structure due to alteration in the distribution of the organic matter attracted attention, and suggested their possible identity with the structure of certain fossils already brought to my notice by Sir Wm. Dawson, under the name of *Celluloxylon primævum.* These latter have therefore been subjected to a more critical examination with a view of determining if they are in reality distinct species, or merely altered forms of some other plant. As a preliminary to this examination, I may detail the peculiarities of structure in Nematophyton above referred to.

NEMATOPHYTON.

In most of the specimens of Nematophyton examined by me, the tubular character of the cells is so perfectly preserved as to admit of no doubt concerning their correct form and size. In section taken from very highly silicified and crystalline specimens, however, it is found that the infiltrated silica has often so far replaced the organic matter as to leave not the faintest trace of cellular structure, and very frequently no trace of organic matter. In other specimens, various intermediate stages of silification are to be observed in which both organic matter and cellular structure are more or less conspicuous, but of an obviously altered character. In many cases it has been found that the infiltration of siliceous matter, under certain conditions, has resulted in its deposition in a distinctly crystalline form which fills the tubular cells throughout. In all such cases I have

noted a variable tendency towards the redistribution of the organic matter, with a consequent breaking up of the normal structure and its replacement by a granulated, carbonaceous substance which always tends to be determined along the lines of contact between contiguous crystals. It is obvious, therefore, that if the proper conditions of structure are present in the first instance, together with sufficient growth in the crystals, the organic matter will not only suffer complete redistribution, but at the same time will take up such positions as to produce a false cellular structure which will have the same general character in both longitudinal and transverse sections; although, in the former, there will always be a tendency for the false cells to be distributed in lines, as determined by the direction of the cells from which they were derived. This view, we find, was advanced by Sir Wm. Dawson in one of his earliest papers on Prototaxites, when he pointed out that, "In parts of the larger trunks, as is usual with fossil woods, it has been replaced by a concretionary structure, or by that pseudo-cellular structure which proceeds from the formation of granular crystals of silica in the midst of the tissues.

"In fossils woods the carbonaceous matter, being reduced to a pulpy mass, sometimes partly becomes moulded on the surfaces of hexagonal or granular crystals in such a manner as to deceive, very readily, an observer not aware of this circumstance."[1]

The statements thus made admit of ready confirmation, since it is precisely what occurs in many specimens of Nematophyton, and not only do we find plants in which the entire structure is thus transformed, but in others, where the normal structure is preserved, there are often found localized tracts within which such alteration has taken place. From facts brought to my notice, I am led to consider a more or less advanced condition of decay as preceding the impregnation by silica, and thus essential to the changes noted.

These statements are partly based upon the following observations, which will serve to indicate the correctness of my position.

No. 1.—A transverse section. The organic matter was found to be nearly eliminated, but still enough was present to show it sredistribution to such an extent as to completely destroy the normal structure and give rise to a false cellular structure, closely resembling that of Celluloxylon in all its essential features. Upon measurement it was found that ten cells, selected at random, gave a mean diameter of 60 μ and an extreme variation of from 40 μ to 90 μ.

No. 2.—A silicified specimen in which the organic matter was much more abundant, but subjected to precisely the same redistribution and closely resembling Celluloxylon. Ten measurements gave an average diameter of 62 μ and an extreme variation from 40 μ to 130 μ.

No. 3.—A sicilified specimen in which the tubular cells were occasionally found, but for the most part the organic matter was redistributed as in the previous cases. Ten measurements gave an average diameter of 61 μ and an extreme variation of from 40 μ to 90 μ. In this specimen it was also noted that still larger cells were obviously formed by coalescence of two or more smaller cells, and this fact explains the unusually large one observed in No. 2.

No. 4.—A silicified specimen in which the normal structure was largely preserved,

[1] Month. Mic. Jn'l., x. 69, 70.

and containing areas of altered structure where the tissue appeared as in the other specimens. Ten measurements gave an extreme variation of from 30 μ to 70 μ and an average diameter of 51 μ.

In addition to these I have also examined a special series of sections taken from plants in different degrees of silification. In all of these, the characters above noted were present, but the size of the false cells appeared to present greater variation. It is from one of these that the photo-micrograph (Plate I fig. 1) was taken. I have also noted that, on the whole, the false cells are of greater size in those specimens where the crystallization of the silica was carried to the highest degree. The same fact is apparent by comparison of the measurements in Nos. 1–4 as above stated. From this it would appear clear to us that the degree of crystallization, and hence, the redistribution of the organic matter, depend upon and are directly related to the previous operation, as well as the extent, of decay in the organic structure. Therefore, the more advanced the condition of decay at the time when silica was deposited, the larger will be the crystals and false cells dependent upon them. The significance of these facts, as bearing upon the true character of Celluloxylon, will hardly admit of question.

Celluloxylon.

The original specimens from which were cut the sections of Celluloxylon examined by me, were obtained by Sir Wm. Dawson from the collection of Prof. H. M. Clarke, of Amherst, Massachusetts having been found in the Hamilton Group (Middle Erian), Canandaigua, New York.[1] This is described as "A silicified trunk showing in cross-section large and somewhat unequal, hexagonal cells, with an appearance of lines of growth caused by concentric bands of smaller cells. No medullary rays. The longitudinal section shows either cells superimposed in vertical rows, or a sort of banded prosenchymatous tissue but the structure is much masked by the crystallization of the quartz.

"Additional specimens received from Prof. Clarke show that the appearance of rings of growth is caused by large cells disposed in concentric, narrow bands between the wider bands of fine, fibrous tissue. In the longitudinal section, three bands of large cells appear to be parenchymatous and not vascular. There are no medullary rays, but rounded patches of cellular tissue appear here and there in fibrous layers."

The original specimens from which the sections were cut have been again examined by me. With one or two exceptions, all of these pieces are so curved as to show that they are parts of concentric layers about one-fourth of an inch thick. A concentric lamination in the stem, similar to that of *N. Logani*, is evident. All of the specimens are of the same kind with respect to silicification, and show that the alteration has been carried on to a high degree. The texture is finely granular and, under a lens of low power, the material appears to be very finely crystalline, quite similar to that found in large stems of *N. Logani*, where the crystallization is also advanced. A certain longitudinal striation, of not very pronounced character, may also be detected. The absence of any radial markings is conspicuous, as noted in the original description. This, in the highly altered condition of the material, does not of necessity imply their absence from the original structure.

[1] Quart. Jn'l. Geol. Soc., May, 1881, p. 302.

An examination of the internal structure shows that the following characters are common to all the sections. The structure is coarsely cellular. In transverse section the cells are variable in size, averaging about 50 μ in diameter. The walls are not well defined and continuous, but are often poorly defined and consist of a granulated carbonaceous substance which often becomes irregularly scattered, sometimes intruding upon the cell cavity, though in most cases localized along definite lines. We have found cells of only one kind, and are therefore unable to confirm the statement of the original description to the effect that "the appearance of rings of growth is caused by large cells disposed in concentric, narrow bands between the wider bands of fine, fibrous tissue," although from analogy we should infer that this might have been the case in the original stem.

In longitudinal section the cells are found to present the same appearance as to their general characteristics, as in the transverse section, and also a marked similarity in size—measuring about 50 μ in diameter. There is, however, a more or less marked tendency, as noted in the original description, for the cells to fall into longitudinal rows which follow a somewhat vermicular course. This is most conspicuous under a low power, although to be observed, in many cases, under a $\frac{1}{6}$ objective.

My measurements show that, as determined from cells taken at random, the average size in transverse section is 48 μ, the range being from 40 μ to 70 μ. In longitudinal section, the same number of measurements give an average of 54 μ, and an extreme range between 30 μ and 70 μ.

These facts, taken in connection with the similarity here noted between this plant and Nematophyton in certain conditions, lead to the conclusion that it is only a highly altered condition of this latter. This view is also supported by the opinion expressed some time since by Sir Wm. Dawson that "Celluloxlon is allied to Prototaxites."[1]

Furthermore, while it is quite possible that this may have been a distinct species, which I have no present means of proving, the fact that it occurs in the Middle Erian and not in the lower horizon, where alone *N. Logani* has been found, together with the probability that the radial openings of *N. Logani* were represented here by scattered, open areas of small size as in *N. crassum*, would lead one to refer it, for the present at least, to the latter species.

Nematoxylon tenue, *Dn.*

This plant was originally described by Sir Wm. Dawson, as follows[2]:—

"Slender stems with thick, coaly bark and woody fibres of much smaller diameter than in the last species (*N. crassum*) and marked with minute dots." In connection with this it was also stated that "the stems of this species are small, not exceeding half an inch in diameter, but are distinctly surrounded by a thick, shining, coaly bark. The wood is calcified and appears to be perfectly homogeneous. . . . . It may be doubted if this species has any real affinity with the last (*N. crassum*), but they correspond in their negative characters, and both appear to indicate the existence of certain woody plants of singularly simple and homogeneous structure."

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[1] Geolog. Surv. of Canada, Fossil Plants, part ii, p. 126.

[2] Quart. Jn'l. Geol. Soc., Nov. 1863, 467.

My first examination of sections of this plant, showed that I had to deal with a structure of much finer quality than found in any of the species of Nematophyton, and I was at first led to consider that it might be a plant of very different type. Upon closer inspection, however, this view required important modification and, as will be seen from the following description, it now seems most probable that we have to deal with an organism which, if not generically related, is at least allied to Nematophyton through the general character of its structure.

The specimens examined by me are all somewhat highly crystalline and the structure has, in consequence, suffered important modifications which, although the general form and disposition of the cells can still be made out, have tended to obscure the structure and render details difficult of determination. The material is also, in consequence of its crystalline character, very friable, and this has seriously interfered with securing sections of sufficient thinness to make a close examination possible.

In transverse section the structure is found to consist of small and closely compacted cells—the tissue being so dense as to make the contiguous cells appear in most intimate contact. This relation is probably the result of alteration and not that which existed in the growing plant, since cells are found at intervals which are as distinct as in Nematophyton, while it is also evident from the oblique section of many, that they were not all parallel to the axis of growth.

The cell walls are thin, and it is also a fact of some interest, in this connection, that the tissue presents almost the exact appearance of the intercellular structure seen in cross sections of *N. Logani*, with reference to size, form and general disposition of the cells and thickness of the walls. Occasionally, somewhat linear tracts are found, within which the cells follow a direction transverse to the axis of growth.

Scattered through the otherwise homogeneous tissue at rather wide intervals, are relatively large, rounded or oval openings. These, so far as can be determined at present, appear to be structureless, i.e. there is no separate wall, nor are there any surrounding cells such as form the resin passages of modern plants. They measure 10 – 13.5 μ in diameter and their proper significance is at present a matter of doubt, although the invariable presence in them of highly crystalline silica suggests that they may have been caused by mechanical separation of the surrounding cells. Small and irregular open tracts are also to be seen in the tissue, similar, although much smaller, to those in *N. crassum*.

In longitudinal section the cells are found to be distinctly vermicular, and although the more compact nature of the structure tends to render them less sinuous than in either *N. Logani* or *N. crassum*, yet the peculiar way in which the cells interlace and sometimes cross one another very abruptly, leaves no room for doubt upon this point. Furthermore, the cells are non-septate and in diameter are tolerably uniform, measuring 5 – 8 μ. In this latter we again notice a curious resemblance to the intercellular structure of both *N. Logani* and *N. crassum*, and also of *N. laxum*. In *N. Logani* the filaments show a variation in size ranging 3.7 – 8.9 μ. In *N. laxum* the corresponding structures range 3 – 9 μ and in *N. crassum* 2 – 10 μ, so that the cells of the medulla in this plant may be fairly regarded as essentially of the same size. Moreover, in *N. laxum*, it frequently happens that the secondary filaments constitute the only structure within fairly large areas, and in such cases these cells are generally found to run parallel to the axis of growth

and form a very compact structure which presents a most striking resemblance to the longitudinal structure of the plant now under consideration.

The rounded openings, observed in transverse section, are here seen to be continuous tubes filled with highly crystalline matter, while the open tracts appear as rounded and small areas of irregular size and form. The branching of the cells has not as yet been determined as fully as might be desired. In only one case thus far have we found the large cells to branch, but this was of so pronounced a nature as to admit of no question. What appear to be secondary filaments, having a diameter about one-fifth that of the large cells, have been observed in both transverse and longitudinal sections, in every case appearing in the open tracts above described. While, therefore, it seems probable that such an intercellular structure exists, I must, for the present, speak with some reserve on this point.

The "minute dots" on the cell walls, referred to in the original description, cannot be regarded as having any structural significance, and we have so far found the walls to be wholly structureless. Many of the cells show irregularly scattered, dark bodies which, of variable size, are sometimes spherical, again distinctly angular. The material of which they are composed has been so altered as to render their true character a matter of some doubt; but from what has been observed in the various species of Nematophyton thus far described, it is quite probable that they have similarly originated from spores.

The evidence thus far obtained points, with considerable force, to an affinity with Nematophyton to which genus I would transfer it, retaining the specific name originally given.

Genus.—NEMATOPHYTON, *Dn.*

Quart. Jn'l. Geolog. Soc. XV, 484; Nov., 1862, 299, 307, 326; Nov., 1863, 466, 467; May, 1881, 302; Aug., 1881, 482; May, 1882, 104; Geolog. Surv. of Can., 1863, 401; 1871, 16 and 20; 1882, II, 97, 107; Can. Nat. V, 9; VI, 177, 179; (New Ser.) VII, 173; Ann. and Mag. Nat. Hist. 5, IX, 59; M. Mic. Jn'l. VIII, 160; X, 66, 208; XI, 83; Quart. Jn'l. Mic. Soc. XIII, 313; Amer. Nat. V, 185, 245; Geolog. Hist. of Plants, 21, 42; Trans. Roy. Soc. Can., VI, iv, 27; Proc. Amer. Ass. Adv. Sci., 1856.

Plants of arborescent form from a branching, root-like base. Stem branching, often exceeding 1° in diameter. Structure composed of unjointed, interlacing, structureless cells which branch into an intercellular system of small and closely-woven filaments.

1.—N. Logani, *Dn.*

Prototaxites Logani, Dn.

Nematophycus Logani, Carr.

Stem distinguished by its concentric layers, which simulate an exogenous structure; irregular and disjointed radial openings of variable length, and often a thin cortical layer appearing in the form of coal.

Cells of the medulla, thick-walled, 13 – 35 μ in diameter, interwoven, loosely aggregated and turning into the radial spaces. Hyphal structure composed of branching filaments 4 – 9 μ in diameter, which branch from the cells of the medulla and form a closely-woven intercellular plexus.

Lower Erian of Gaspé; Silurian (Upper Ludlow) of England; and Silurian (Cape Bon Ami) of New Brunswick (*Dawson*).

2.—N. HICKSII, *Dn.*

Prototaxites Hicksii, Dn.

Nematophycus Hicksii, Eth.

Cells of the medulla, 12 – 22 μ in diameter, and somewhat compact. Hyphal filaments, 1 – 1.5 μ in diameter,[1] forming a rather less prominent plexus than in *N. Logani*, otherwise the same.

Specimens occurring only in small fragments and the structure represented wholly by siliceous casts, with occasionally adherent fragments of carbonaceous matter.

Denbighshire Grit (Silurian) of Wales (*Hicks*).

3.—N. CRASSUM, *Pen.*

Nematoxylon crassum, Dn.

Celluloxylon primævum, Dn.

Radial tracts none; open tracts frequent, small and of irregular form and size.

Cells of the medulla thick-walled, showing two layers, and rather uniform, 35 μ in diameter. Cells of the hyphal structure variable, 2 – 10 μ in diameter. Highly crystalline forms often show a replacement of the normal cells by a pseudo-cellular structure (Celluloxylon).

Specimens found only in fragments. Middle Erian of Gaspé (*Bell*), Hamilton Group (Middle Erian) of New York (*Clarke*).

4.—N. LAXUM, *Pen.*

Concentric layers and radial openings, none. Cells of the medulla, 15 – 31 μ in diameter, thick-walled, remote and branching into hyphal filaments, 3 – 9 μ in diameter, which form a compact network constituting the greater part of the structure, which is thus rendered very loose and spongy.

Lower Erian of Gaspé (*Dawson*).

5.—N. TENUE, *Pen.*

Nematoxylon tenue, Dn.

Concentric rings and radial tracts, none; open tracts small, irregular and frequent. Structure dense, and traversed at intervals by tubular openings 10 – 14 μ in diameter.

Cells of the medulla, thin-walled, closely approximated and 5 – 8 μ in diameter. Cells of the hyphal structure 1 μ+. Structure highly crystalline and friable. Stems small and invested by a thickish layer of coal.

Lower Erian of Gaspé (*Bell*).

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[1] These measurements refer only to the siliceous casts, and are, therefore, not strictly comparable with those for other species.

Description of Figures.

Plate I.

Fig. 1.—*Nematophyton Logani.*—Transverse section, showing conversion of the normal into a pseudo-cellular structure through crystallization. Taken from a specimen also showing normal structure. × 154.

Fig. 2.—*Nematophyton crassum* (?).—Transverse section showing effects of crystallization. × 154.

Fig. 3.—*Nematophyton crassum* (?).—Longitudinal section showing tendency of false cells to follow lines of normal structure. × 154.

Fig. 4.—*Nematophyton Logani.*—Longitudinal section of normal structure showing the secondary filaments crossing the cells of the medulla. × 154.

Figs. 5 & 6.—Transverse and longitudinal sections of *Nematophyton crassum.* Normal. × 154.

Plate II.

Fig. 1.—*Nematophyton Hicksii.*—Showing siliceous casts with carbonaceous fragments adherent to them. × 210.

Fig. 2.—*Nematophyton tenue.*—Longitudinal section, showing general character of the structure. One of the large tubular openings is seen in the centre. × 300.

III.—*On New Species of Fossil Sponges from the Siluro-Cambrian at Little Metis on the Lower St. Lawrence.* By SIR J. WILLIAM DAWSON, LL.D., F.R.S., &c. (*Including Notes on the Specimens*, by DR. G. J. HINDE, F.G.S.) [Plate III.]

(Presented May 7, 1889.)

The specimens described in the following paper show the existence of a rich fauna of siliceous sponges, more especially of the genus *Protospongia* of Salter, on the muddy sea bottoms of the Siluro-Cambrian period, and in that early portion of this period represented by the Quebec series of Logan, and probably by the Levis division of the group.[1] They are also remarkable as illustrating the structures and habit of these ancient forms and the manner of their preservation.

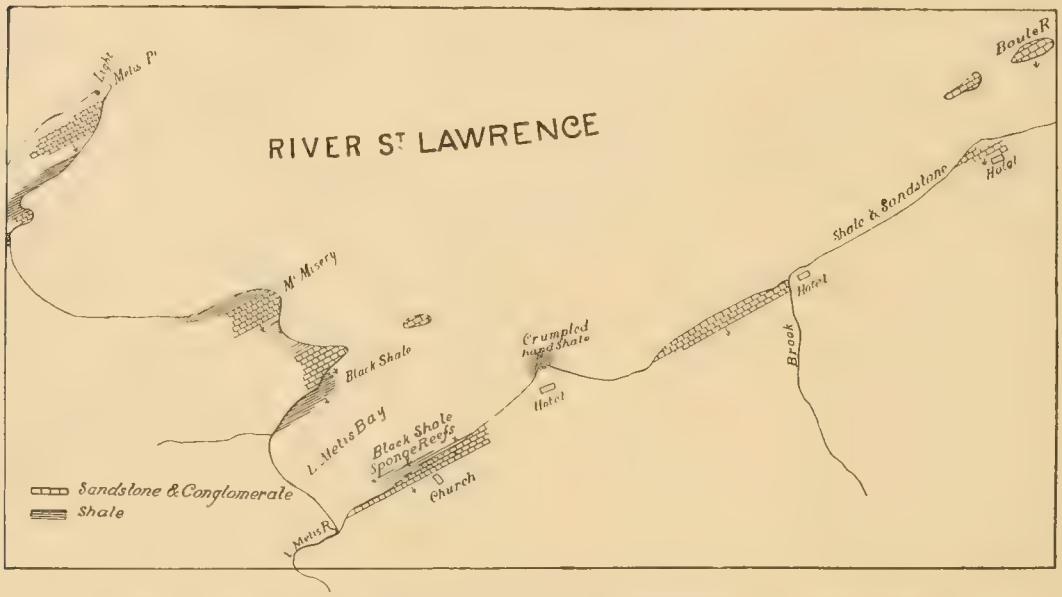
The beds at Little Metis have hitherto been very unproductive of fossils, but in the summer of 1887, Dr. B. J. Harrington, F.G.S., was so fortunate as to find a bed of black shale rich in remains of sponges, hitherto unknown in these rocks, and having made known the fact to the writer, we visited the place several times and made collections of these interesting fossils, which are now in the Peter Redpath Museum. Subsequently, in the summer of 1888, more extensive excavations were made in the reefs of shale exposed at low tide, and it was found that the deposits of fossil sponges are limited, so far as could then be observed, to two thin bands, each of them scarcely more than two inches in thickness, in the black shales near the head of Little Metis Bay. From these bands, by carefully tracing them along the coast and excavating where the exposures were sufficiently good, a large quantity of material was obtained. This was first carefully worked over by the writer and subsequently submitted to Dr. G. J. Hinde, F.G.S., of London, whose results are embodied in the descriptions of the species in the present paper. Later exploration showed that there are remains of sponges in other beds ranging through a vertical thickness of about forty feet of the shales; but not so abundantly as in the layers previously explored.

Little Metis Bay presents a good section of rocks of the Quebec group, including sandstones, slates and conglomerates similar to those which characterise this series of beds along the south shore of the St. Lawrence. The distribution of these beds is shown in the accompanying map,[2] from which it will be seen that the general dips are to the south-eastward, and that there appear to be four bands of sandstone and conglomerate separated from each other by intervening shales, often of dark colours and carbonaceous, but sometimes dolomitic, and in many places showing gray and red colours. Assuming the series from the Lighthouse Point to be an ascending one, the thickness of beds exposed at the head of the bay would be more than 3,000 feet; but it is not improbable that

[1] Logan, Geology of Canada, 1863; Selwyn, Report Geol. Survey, 1877-78; Ells, *Ibid.*, 1880-82; Lapworth, Canadian Graptolites, Trans. Roy. Soc. Can., 1886.

[2] For the geographical part of the map on the following page I am indebted to Dr. Ells of the Geological Survey.

there may be repetitions by faults or folding. The sandstones and shales of Lighthouse Point contain *Retiolites ensiformis*[1] of Hall, many trails of worms, and worm castings of the type of *Arenicolites spiralis*. The sandstones of Mount Misery contain fragments of *Retiolites ensiformis*. The shales on the south side of the bay, presumably near the upper part of the series exposed, contain the sponges in question, a species of Linnarssonia not distinguishable externally from *Obolella pretiosa* of Billings, and the slender branching fucoid which I have described as *Buthotrephis pergracilis*.[2]



Sketch map of Little Metis Bay and vicinity, showing locality of Fossil Sponges.
(Scale about 2 inches to a mile.)

NOTE.—The series from the Church to Mt. Misery is probably descending and conformable; but the sandstones forming the cliff near McNider's Brook to the eastward, are not improbably those of Mt. Misery thrown to the southward by a fault, and not as would appear from the map a continuation of those near the Church, which probably pass inland of them.

In the conglomerates are limestone boulders, holding fragments of Trilobites of the genus *Solenopleura* and other fossils; but these seem to be of Lower Cambrian age, or considerably older than the beds in which they occur.

There can be no doubt, from the stratigraphical position of these beds, that they belong to the Quebec group of Sir W. E. Logan. This is, however, now known to include, on the Lower St. Lawrence, beds ranging from the Calciferous (Tremadoc) to the Trenton (Bala), and the beds are so much plicated that it is often difficult to unravel their complexities of arrangement. At Metis, the evidence of the pebbles in the conglomerates indicates that they are newer than the Lower Cambrian, and the few fossils found in the sandstones and shales would tend to place them at or near the base of the Levis division, or approximately on the horizon of the Chazy, equivalent to the English Arenig. Lapworth, in his paper on "Canadian Graptolites,"[3] suggests that the sandstones holding Retiolites may be older than this; but hitherto we have not found at Metis the charac-

[1] Identified by Lapworth.
[2] Notes on Specimens in the Peter Redpath Museum, 1888.
[3] Trans. Roy. Soc. Can., 1886.

teristic Graptolites of the older or Matane series, which occurs further east, and is probably of Calciferous or Tremadoc age.

The locality of the fossil sponges to be described, is the beach at the foot of the cliff in front of the Wesleyan church, on the south side of the bay, where a considerable thickness of black and gray shales is exposed, forming low ledges extending along the beach parallel with the direction of the coast. The dip is S. 10° W. (magn. var. 22° 33′ W.) at angles of 45° to 50°, and the beds containing the sponges are best seen opposite a huge boulder of conglomerate on the beach, and about 90 feet from the face of the cliff. The sponges were first discovered in a thin layer of tough black shale having hard gray and soft black beds associated with it. A second similar layer was afterwards found about nine feet outside the first and therefore underlying it, besides other beds holding fragmentary remains (see section below). Both these layers have Linnarssonia and *Buthotrephis pergracilis* associated with the sponge-remains.

The following is a general section of the beds in descending order :—

(1.) A thick bed of hard sandstone or quartzite and conglomerate, underlaid by coarse gray arenaceous shales, and forming the cliff immediately in front of the church. It shows in some of the beds radiating markings (*Astropolithon*).

(2.) Black and gray shales, the former thinly laminated and of fine texture, the latter harder and arenaceous, with some hard calcareous or dolomitic bands—thickness about 100 feet. The black shales of this division hold sponges and layers of sponge spicules, especially in the two bands above referred to, with fucoids (*Buthotrephis*) and valves of *Linnarssonia*. All of these fossils are usually in a pyritised state.

(3.) Flaggy sandstone and shale, gray and dark-colored, about twenty feet.

(4.) Hard gray sandstone with quartz veins, three to five feet.

(5.) Hard gray shales and calcareous and dolomitic bands, with some layers of sandstone—800 feet or more.

(6.) Apparently underlying these, and occupying a great extent of the shore, are black, gray and red shales and thick beds of gray sandstone, the latter appearing at Mount Misery and Lighthouse Point, and holding the Graptolites above referred to. These beds must be of great thickness in the aggregate, but they are possibly repeated in part by faults and contortions.

Along this coast the beds generally run approximately parallel to the shore, or slightly oblique to it, with south-easterly dip, but at intervals they are broken by transverse fractures throwing the beds, locally, into different lines of strike, and often accompanied by violent contortions of the strata. Beyond these they resume their usual course, so that the outcrops form a series of salient and reëntering angles along the coast. At the south side of Little Metis Bay there is a comparatively undisturbed portion, extending for more than half a mile along the coast, but there is one break, throwing the beds nearly at right angles to their former position, at the mouth of Little Metis River, in the head of the bay, and another to the eastward near Turriff's Hotel, where the beds, as seen on the beach, are much contorted. Beyond these breaks, beds similar to those holding the sponge-remains appear to the westward at Grand Metis Bay, and similar beds appear with like accompaniments near Bic. To the eastward they appear at several places on the coast, and have afforded graptolites of Levis and calciferous age.[1]

[1] Report of Peter Redpath Museum, no. ii; Lapworth, Canadian Graptolites.

The following is a more detailed section of part of the second division above, in descending order, measured on the surface of the outcrop :—

	INCH.
Black shale	8
Dolomitic band (weathering yellow)	3½
Gray and black shales	12
Dolomitic band	1
Black shale	6
Gray and black shales	15
Black shale	8
Gray and black shales	30
Black shale (sponges, &c.)	3
Black and gray shales, with remains of sponges in some layers	72
Dolomitic band	2
Black and gray shales	34
Dolomitic band	3
Black and gray shales	36
Black and gray shales (sponges, &c.)	
Black and gray shales, with thin, interrupted dolomitic layers as before, to base of the division.	

A third sponge-layer was found in the lower beds, about 30 feet vertically, or 50 feet measured on the shore, below the last dolomitic band. The sponges contained in the layers mentioned above, are apparently confined to a small thickness of the shale, but in this are quite abundant. They are perfectly flattened, and their spicules are replaced by pyrite; but in some cases they retain the outline of their form, and have their root spicules attached. The spicules were, no doubt, originally siliceous, but they have shared the chemical change experienced by other fossils in this bed, whereby they have lost their siliceous matter and have had pyrite deposited in its place. In some cases, also, the pyritised spicules have been frosted with minute crystals of the same substance, greatly enlarging their size and giving them a mossy appearance. This pyritisation of spicules, once probably siliceous, is not uncommon in Palæozoic rocks, and it arises from the soluble condition of the silica in sponges, and its association with organic matter, which, in some modern sponges, as in Hyalonema, enters into the composition of the spicule itself. These spicules, therefore, suffer the same change with the calcareous shells associated with them.

Many of the sponges in these beds were entire when entombed. Others are decayed and partially broken up, and there are some surfaces covered with confused patches of loose spicules arising from the disintegration of many specimens.

Some remarks are perhaps necessary here respecting the appearance of sponges in different states of preservation. Of course the original textures of sponges are different, and those which have consolidated spicules or firm external cortex, are those most likely to retain their original forms. Even the looser kinds of sponges, however, may under certain circumstances, preserve their rotundity of form. In this case they usually show external markings, but not so well internal structure, unless when sliced. On the other hand when completely flattened, which is usually the case in shaly beds, only an outline of the general shape remains, and sometimes not even this, while the forms and in part the arrangement of the spicules are usually apparent. Farther, the hollow and thin-walled species are more liable to be completely flattened, though in some cases, as in the Devonian Dictyospongiæ, they may retain their form. It was this property, and the membranous appearance of the outer coat, that for a long time sustained the belief that these last were plants rather than sponges.

In the case of the sponges procured in the shales at Little Metis, perfect flattening has occurred, and in many cases the spicules have been separated, and appear as mere

spicular patches or layers. In other instances, however, they remain approximately in their natural position, and even the general outline of the form can be observed.

The following additional remarks as to the state of preservation and characters of the specimens are from notes made by Dr. G. J. Hinde, F.G.S. :—

" The Metis specimens are specially interesting, since they throw much fresh light on the character of the earliest known forms of these organisms, and their discovery is the more opportune from the fact that our knowledge of the existing hexactinellid sponges—the group to which all, or nearly all, these fossils belong—has been vastly increased by the work of Prof F. E. Schulze, of Berlin, on the hexactinelled sponges dredged up by the Challenger Expedition, and thus we are now better enabled than hitherto to compare the fossil and the recent forms.

" In the present specimens, the amorphous or soluble silica, of which their spicular skeletons were originally composed, has entirely disappeared, and the spicules now consist of iron pyrites. This replacement by pyrites is of common occurrence, more particularly in a matrix of black shales; for example, the earliest known sponge, *Protospongia fenestrata*, Salter, from the Cambrian rocks of South Wales, is in the same mineral condition, and in a nearly similar matrix, as the specimens from the Quebec group and the Utica shale. When thus replaced, the general outline of the larger spicules is fairly distinct, but where the spicules are minute, and in close proximity to each other, their individual outlines are blurred by the tendency of the crystals of the replacing pyrites to amalgamate together so as to form a continuous film of the mineral in which the finer spicular structures are quite indistinguishable. This coalescence of the pyrites likewise makes it very difficult to determine whether the spicular elements of the sponge were organically soldered together into a siliceous mesh, or whether they were merely held in their natural positions by the soft animal structures, and owe their present union to subsequent fossilisation.

" Next to the chemical changes, we have to take into account those produced on the original structures of these sponges by what may be termed the mechanical influences of fossilisation. There can be no doubt that they were hollow sacci-form or vasi-form structures with very delicate walls of spicular tissue, supporting the soft animal membranes. They existed at the surface of the soft ooze of the sea-bottom, and their basal portions were probably embedded in it. They were furnished with elongated spicules whose extension into the mud served to anchor them in one spot. After the death of the animal, and the decay of the soft tissues, the delicate skeletal framework would be gradually buried in the accumulating sediments, until by their weight it became completely flattened. Under favorable circumstances, the outline of the sponge and the natural arrangement of the spicular skeleton would be preserved, and this is fortunately the case with the specimens of Cyathophycus from the Utica shale, and with some of the specimens of Protospongia from Metis. More frequently, however, probably owing to currents and other causes acting at the surface of the ooze, the skeletal framework is partially or wholly broken up, so that only small patches of the connected skeleton, or merely the dislocated and detached spicules irregularly scattered over the rock surface, remain for determination, and this is the present condition of the majority of the specimens from the Quebec group. For some reason, probably connected with the arenaceous character of the rock in which they occur, the nearly allied sponges belonging to the Devonian genus

Dictyophyton, Hall, usually retain their outer forms complete—that is, without being compressed—but most of these sponges exhibit only internal casts of their spicular skeleton, so that at present we know very little of their original structures.

"As already mentioned, nearly all these Quebec sponges belong to the suborder of the Hexactinellidæ, in which the fundamental type or elementary spicule of the skeleton consists of six equal rays, radiating from a common centre at right angles to each other, forming three equal axes. But this typical form is subject to great modifications through the unequal development or even suppression of one or more of the individual rays, so that spicules with five, four, three, or merely two rays only, are frequently present, and in the same species of sponge several modified forms of spicules may be found. Now, in the compressed condition in which the Quebec sponges occur, we can, as a rule, only perceive those rays of the spicules which lie in the exposed plane of the rock; these are generally the four transverse rays of the normal spicule, but the two rays forming the axis at right angles to the transverse rays, are not likely to be distinguished, for one would be concealed in the matrix immediately beneath the transverse rays, whilst the other, projecting above the exposed surface, would inevitably be broken away. Consequently it is very difficult to determine positively whether the forms with four transverse rays exposed on the plane of the sponge-wall, represent the entire spicule—in which case it would be termed cruciform,—or whether one or both of the other rays of the normal spicules were originally present. Judging by the analogy of allied recent forms, it is probable that in most cases these spicules were furnished with a fifth ray at right angles to the other four. In the examples of Cyathophycus from the Utica shale, are distinct traces of a fifth ray in some of the larger spicules, and it can also be seen in detached spicules from the Quebec group.

"In both recent and fossil hexactinellids, many of the elongated filiform anchoring spicules terminate distinctly in four short recurved rays, and are thus five-rayed spicules in which one ray is greatly developed; but in other instances they have simple blunt or pointed ends, and may thus represent only one ray or one axis of the normal spicule. With the exception of two species, all the anchoring spicules present in the Quebec sponges seem to be merely pointed at their distal ends. In one species they are complex, consisting of several filaments twisted spirally.

"In recent hexactinellid sponges, in addition to the spicules forming the regular framework of the skeleton, there are much smaller spicules of varied forms, imbedded in the soft tissues. These, generally known as flesh-spicules, are very seldom met with in the fossil condition, but it is not improbable that the delicate film of pyrites, seen in places on the surface of the Quebec sponges, may arise from the replacement of the flesh-spicules by this mineral."

The species of sponges noticed below have been submitted to Dr. Hinde, author of the British Museum, "Catalogue of Fossil Sponges," and the following descriptions are largely based on his notes on the specimens. The magnified tracings of the structures in the text have usually been drawn under the camera to one scale (about five times the natural size). The restorations are based on comparison of the more perfect specimens, some of which are represented from photographs in Plate III. It is to be observed that the smaller cruciform spicules, though usually displaced, were in the living animals symmetrically arranged in the meshes. These smaller

spicules form secondary and tertiary structures within the larger areas formed by the primary spicules.

Genus PROTOSPONGIA, *Salter.*

1.—Protospongia tetranema, S.N.[1]

(Figs. 1 to 4. Pl. III, figs. 1, 2.)

Fig. 1.—*Protospongia tetranema.* A small specimen restored.

Fig. 2.—*Protospongia tetranema.* Anchoring spicules slightly enlarged.

In the specimens in which the outline of the sponge has been preserved, the body appears to have been elongated oval or rounded, measuring about 45 mm. in length by 30 mm. in width. There was an aperture at the summit, though it cannot now be distinguished, except in a few rare instances. The wall of the sponge appears to have

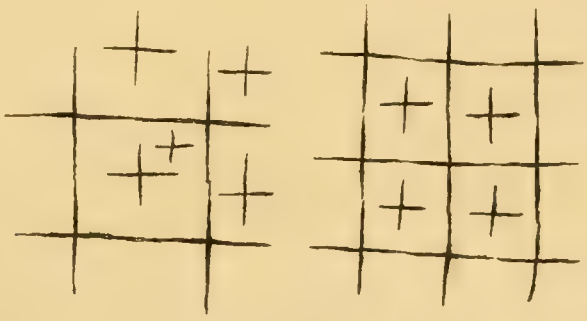


Fig. 3.—*Protospongia tetranema.* Primary, secondary and tertiary cruciform spicules, × 5.

consisted—as in the other species of this genus—of a single layer of cruciform spicules of various dimensions, disposed so as to form a framework with quadrate or oblong inter-

[1] The characters of this and several of the following species were given in "Notes on Specimens in the Peter Redpath Museum, 1888."

spaces. The rays of the larger spicules constitute the boundaries of the larger squares, and within these, secondary and smaller squares are marked out by smaller spicules. Judging by the length of the rays of the larger spicules, the larger squares would be about 5 mm. in diameter, whilst the smallest do not exceed 1 mm. The rays of the individual spicules slightly overlap, and it is probable that they may have been lightly cemented by silica at the points of contact. The rays of the larger spicules are conical, gradually tapering from the central node to the pointed extremity ; whilst the rays of the smaller spicules appear to be nearly cylindrical. For the purposes of this paper the different orders of spicules, in these sponges, may be designated as primary, secondary and tertiary spicules.

From the base of the sponge, four slender elongated filiform spicules project. They are approximately cylindrical, pointed at both ends, from 0.1 to 0.25 mm. in thickness, and from 50 to 70 mm. in length. Their proximal ends are inserted apparently in the basal

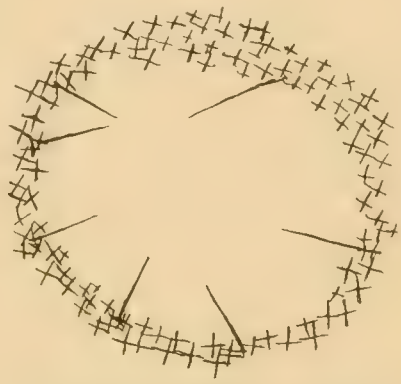


Fig. 4.—*Protospongia tetranema* (?). Osculum enlarged, and surrounded by minute spicules.

part only of the sponge, and they project in the same direction, though not in lateral apposition with each other. In perfect specimens their distal ends converge and unite terminally. The root spicules in the larger specimens are about 6 cm. in length.

This species is one of the most abundant at Metis. In some specimens the spicular framework of the body of the sponge retains in places its natural arrangement; in others the framework has been almost entirely broken up, and the constituent spicules irregularly mingled and compressed together. But in every complete specimen there are four anchoring spicules occupying the same relative position to the framework or body-wall of the sponge, thus clearly showing that they are essential to the species. In the spicules of the body-wall only four transverse rays can be distinguished, but it is quite possible, as already mentioned, that a fifth ray may have been present. On one of the rock-slabs there is a detached spicule in which the fragmentary stump of a fifth ray can be clearly seen projecting from the central node of the transverse rays. The rays in this spicule are unusually long.

There can be no hesitation in placing this form in the genus *Protospongia*, since the same arrangement of the spicular mesh-work is present in it as in the type of this genus. In no other examples of the genus, however, has the presence of anchoring spicules been

recognised, owing, no doubt, to their imperfect state of preservation, and this feature may now be reckoned as one of the generic characters. In the present species, however, these anchoring spicules were very peculiar, and seem to have consisted of a cruciform spicule of which the rays were bent upward and lengthened, forming a stalk for the sponge. This would give a firm attachment, and adapt itself to the gradual rise of the bottom to which the sponge was attached. The mechanical properties of such an arrangement of spicula are obviously well suited to effect their purpose.

Salter, in his original description of Protospongia from the Cambrian of Wales, compares it with Acanthospongia of Griffiths from the Silurian of Ireland, the original specimen of which he had seen; but says it has six-radiate spicules. He also remarks that the spicules of Protospongia seem to be all in one plane.[1] *P. Major* of Hicks is a still older species, from the Lower Cambrian or Longmynd series, and seemingly of different structure and of much more open texture than that above described. Matthew has also noticed and figured fragments of Protospongia from the Lower Cambrian of St. John, New Brunswick. The present species, though somewhat later in age than the foregoing, has the merit of presenting a better state of preservation and better illustrating the general form, and more especially the root-spicules.

The following remarks are quoted verbatim from Dr. Hinde :—"There are some differences of opinion as to the character of the spicular mesh-work and the systematic position of Protospongia, and fresh light on the points contested is afforded by these Quebec specimens. It has been doubted whether the body-wall of the sponge merely consisted of a single layer of spicules, or whether this layer corresponded to the dermal layer in other sponges of this group, and, as in these, was supplemented by an inner spicular skeleton. The evidence of the Quebec specimens favors the view that the body-wall of the sponge consisted only of a single layer of spicules. Various opinions have likewise been held as to whether the body-spicules were free, and merely held in their natural positions by the soft animal tissues, or whether they were cemented together by silica at the points where their rays are in contact. Prof. Sollas, in an able paper on the structure and affinities of the genus (Quart. Journ. Geol. Soc., Vol. XXX, p. 366), asserts that they are separate, and not united either by envelopment in a common coating or, by ankylosis;' whereas it would seem that a certain degree of organic union must have existed to have allowed even the partial preservation of the mesh-work of the body-wall in the fossil state, and I have regarded the delicate film of pyrites, which extends over the mesh-work in many specimens, as indicating a connected spicular membrane which served to hold the larger spicules in position. From the study of the Quebec specimens I still think a certain degree of organic attachment existed where the spicular rays were in contact, but I am quite prepared to admit that it was not of the same complete character as in typical Dictyonine hexactinellids. Prof. F. E. Schulze has clearly shown that a certain degree of irregular coalescence takes place in the body-spicules of undoubted Lyssakine sponges, and now that we know that *Protospongia* was furnished, like most of the sponges of this group, with anchoring spicules, there is good reason to regard this and the allied Palæozoic genera as belonging rather to the Lissakine than to Dictyonine hexactinellids. This is the position assigned to them by Carter and Sollas."

[1] Journal Geol. Soc., vol. xx.

2.—Protospongia mononema, S.N.

(Figs. 5, 6 and 7. Pl. III, fig. 3.)

General size about one inch in diameter, originally globular but now flattened. Body spicules cruciform and more slender than those of *P. tetranema.* Superficial or defensive spicules very numerous and somewhat long and slender, so as to give a hirsute

Fig. 5.—*Protospongia mononema.* Restored.

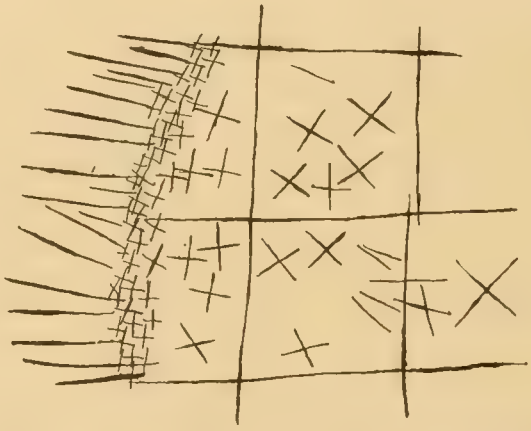


Fig. 6.—*Protospongia mononema.* Cruciform and protective spicules, × 5.

appearance and in flattened specimens often to obscure the body spicules. Root, single, stout, often three inches long, with two to four short spreading branches at base. These terminal spicules are flattened at the extremities. Hinde remarks that some specimens seem to have two or more anchoring rods; but in all or most of the specimens showing

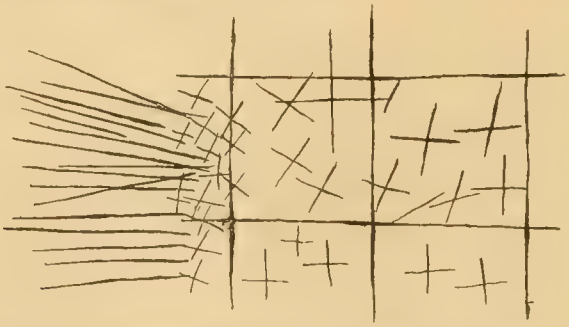


Fig. 7.—*Protospongia mononema.* Primary, secondary and tertiary spinules, × 5.

this appearance these seem to have been loose rods drifted into contact with the sponge. The anchoring rod in this species is often increased in thickness by a crust or frosting of pyrite, and this would seem to indicate that it had, like the modern Hyalonema, animal matter as well as silica in its composition.

This species is nearly as abundant as the preceding, and is often seen without the anchoring rods while the latter are also often seen detached.

In comparison with the previous species the root spicules are not only quite different, but the skeleton of the body differs in some important particulars. The cruciform spicules have somewhat longer arms and form wider meshes, while they are very slender and scarcely at all thickened at the nodes. The surface is also invested with very numerous superficial or protective needles, giving a hispid appearance at the edges, while the meshes of the central part are obscured by the superficial spicules flattened down on them. The form and character of the osculum or oscula have not been observed.

3.—Protospongia coronata, S.N.

(Figs. 8, 9, and 10. Pl. III, fig. 4.)

Fig. 8.—*Protospongia coronata.* Restored.

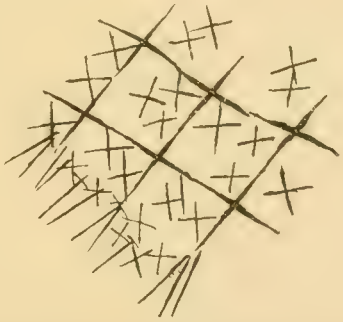


Fig. 9.—*Protospongia coronata.* Primary, secondary and protective spicules, ×5.

Body ovate, small, 2 cm. long, spicules coarse and four-rayed, so connected as to give the appearance by their obliquity of a diagonal network of rhombic openings. This may possibly be the effect of flattening. Numerous small cruciform flesh spicules. Root spicules strong, short or broken off, 2 to 4. Osculum large, terminal, covered with a conical hood made up of curved spicules converging to a point, and 1 cm. in height. A few short superficial spicules visible at the sides.

Fig. 10.—*Protospongia coronata.* Showing internal cavity.

This is a small but interesting species, remarkable not only for its conical hood, but also for the rhombic meshes and the development of the nodes of the larger cruciform spicules, as well as for the stoutness of the latter, their rays being much thickened toward the centres.

4.—Protospongia polynema, S.N.

(Figs. 11 and 12. Pl. III, fig. 5.)

This is a large sponge in great shapeless flattened patches, several inches in diameter though there are smaller individuals also. Body spicules fine and slender, making a very

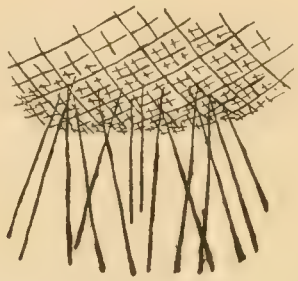


Fig. 11.—*Protospongia polynema.* Portion of base of large specimen.

open mesh. At base numerous simple root spicules, short, and, in some cases, expanded at their extremities. Young individuals seem to have been globular and probably sessile, while large individuals had a flat base, but the general form is greatly obscured by crushing, especially in the larger specimens.

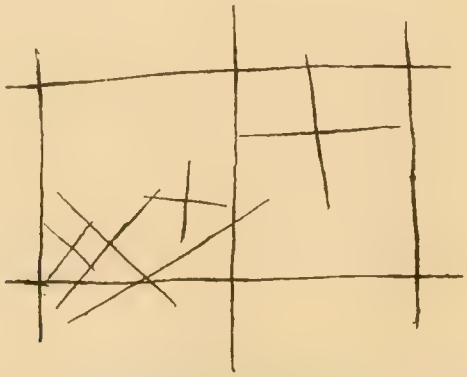


Fig. 12.—*Protospongia polynema.* Primary, secondary and tertiary spicules, × 5.

It may be a question whether two species may not be included under the above specific name. The larger specimens have much more open meshes while the smaller are more hispid. These differences may, however, depend on age. I have attempted only a partial restoration of this species in fig. 11, as the specimens do not show with certainity the form of the upper part, which I imagine, however, had long protective spicules.

Fig. 13.—*Protospongia cyathiformis.* Restored.

5.—Protospongia cyathiformis, S.N.

(Figs. 13 and 14. Pl. III, fig. 5.)

Fig. 14.—*Protospongia cyathiformis.* Primary, secondary and tertiary cruciform spicules, × 5.

General form inverted conical. When mature about 3 cm. wide at top and 5 cm. long without the anchoring spicules which are at least an inch long. Top truncate as if with a wide osculum, with a few short defensive spicules on its margin. Primary body spicules cruciform with long rays, in some 2 to 3 mm. in length, loosely attached or free, but forming large rhombic meshes, secondary and tertiary spicules numerous and delicate with slender arms. Root spicules short, simple, about five visible in the most perfect specimens and passing up to the middle of the body. Indications of many interior minute flesh spicules often constituting a pyritised mass, obscuring the meshes.

The oblique character of the transverse spicules deserves notice, but this may be the result of compression, though I think it more likely that it is an original feature.

This species is well characterised by its form, and by its multitudes of very minute cruciform spicules. These and the fact of the sponge being often represented by a dense pyritous mass indicate a thick and fleshy body-wall.

6.—Protospongia delicatula, S.N.

(Fig 15.)

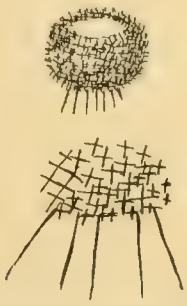


Fig. 15.—*Protospongia delicatula.* (*a*) Restored. (*b*) Portion of base enlarged.

Globular or oblong in form, from 1 to 4 cm. in greatest diameter. Body spicules cruciform, very numerous, and extremely small. Some specimens show what seems to

be a wide osculum above, and very numerous slender anchoring spicules below. There are also indications that, in mature specimens, the general form sometimes became cylindrical or inverted conical, though specimens showing these forms are too imperfectly preserved to show the details of structure.

In this species and *P. cyathiformis*, the wall of the body seems to have been denser than in the other species and sometimes to have preserved its outward form, and this, with the multitude of minute spicules and the undeveloped condition of the spicular meshes of the skeleton, may possibly indicate a generic difference.

On this species Dr. Hinde remarks :—" This sponge has a subcircular outline ; the central area is vacant and there is often a relatively wide rim of a blurred mass of iron pyrites with an outer margin of fairly large cruciform spicules. The iron pyrites evidently represents a mass of spicules too small and too closely associated together to be separately distinguished in their replaced condition. The sponge is clearly hexactinellid and quite distinct from the others described above."

Genus CYATHOSPONGIA (*Cyathophycus*), Walcott.

7.—Cyathospongia Quebecensis, S.N.

(Figs. 16 and 17. Pl. III, fig. 7.)

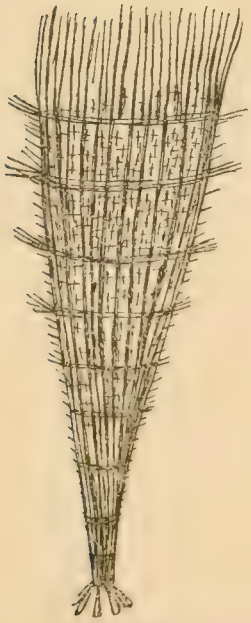


Fig. 16.—*Cyathospongia Quebecensis.* Restored.

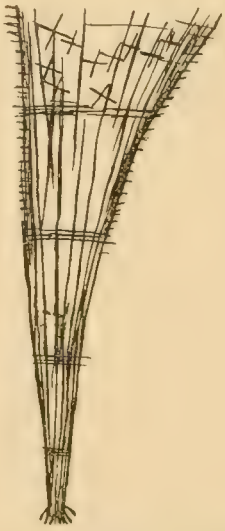


Fig. 17.—*Cyathospongia Quebecensis.* Base enlarged.

Form elongated conical, composed apparently of numerous long, vertical spicules, crossed by horizontal or annular bars, and with a few cruciform spicules in the meshes. The vertical and transverse spicules may be cruciform spicules arranged vertically. The form terminates downward in a blunt point with indications of a few short anchoring spicules. This species closely resembles *Cyathophycus* (*Cyathospongia*) *reticulatus* of Walcott

from the Utica shale, but differs in detail, especially in simplicity of the vertical rods and development of the transverse or circular bars. The largest specimens are 8 cm. long by 3 wide at top. There are signs of minute lateral defensive spicules. The general form and structure resemble those of the modern sponges of the genus *Holascus*.

The species *Cyathophycus reticulatus* was founded by Walcott on specimens from the Utica shale, but, as it has not been thoroughly described, the following notes, for much of the material of which I am indebted to Dr. Hinde, may be useful :—

In the collection of minerals of the late Mr. J. S. Miller of Ottawa, purchased for McGill University, are a few fossils, some of them Canadian, others from the phosphate deposits of South Carolina. Among the former are a few specimens of Utica slate fossils, which, from their appearance I suppose to have been collected in the beds of that formation near Ottawa, though it is possible that some of them may have been obtained from the United States. They include a specimen of the above species, which Mr. Ami, who has collected extensively in these beds at Ottawa, informs me has not yet occurred to him. The specimen is a small slab of the ordinary Utica shale, having an impression of a glabella of Triarthrus on the back, which proves its geological horizon. It has two specimens of Cyathophycus close together, nearly perfect at their bases and broken off at the height of about three inches. They are perfectly flattened and pyritised, which is also the condition of other fossils in these shales, with the exception of the graptolites, which seem to have resisted this kind of change.

The genus *Cyathophycus* was originally described by Walcott from specimens obtained at Trenton, Oneida Co., New York.[1] He regarded it as an alga, whence the termination *-phycus;* but subsequently, in the 'American Journal of Science,' 1881, corrected this error, and referred it to the sponges. Hall (35th Regents' Report) properly places it with the reticulate sponges included in his family *Dictyospongidæ*, but does not add much to Walcott's original description, to which the present specimens permit some additions to be made.

The specimens are perfectly flattened, but show distinct indications of the two sides of the originally conical form. The wall of the skeleton has evidently been thin and composed of slender bundles, each of a few long simple spicules, and increasing both by bifurcation and the introduction of new bundles, so as to preserve nearly the same distances in the wider parts of the cone. They are very regular in the lower part, where there are about nine principal, with some intermediate secondary bundles in a centimetre, but they become more irregular toward the top. This may, however, be an effect of decay and crushing. At the base these bundles become thicker, and in a specimen from the original New York locality, kindly lent to me by Mr. Ami, I have observed that they become expanded and converted into somewhat short clavate root spicules. This is, however, not apparent in Mr. Miller's specimens, which may have been broken off at the surface of the mud.

The vertical bundles are crossed at right angles by horizontal spicules much less regularly arranged, but dividing the surface into rectangular meshes. These are slightly oblique and rhomboidal in the specimens, but this is probably due to pressure. The

[1] Trans. Albany Instit., 1879.

horizontal spicules seem to be triacerate in form, and much shorter than those of the vertical system, though of very different lengths. They are sometimes in bundles and sometimes solitary.

In parts of the substance, apparently within the reticulate wall, may be seen a few cruciform spicules, and flocculent patches apparently of very small spicules, which seem to have been mostly internal and most abundant toward the base, but cannot be distinctly made out.

The wall is very delicate, and consists of quadrate or oblong areas formed by slender longitudinal and transverse strands or fibres, of which the former are the more prominent. As in Protospongia, the quadrate areas are formed by the four transverse rays of cruciform, or five-rayed spicules, but these are disposed so that their rays overlap each other, and thus form fascicles of closely opposed parallel rays. The spicules in the transverse strands of the wall are less thickly grouped together, and even in some of the larger squares they may be arranged singly, whilst the smaller squares are generally bounded by single spicules only. The longitudinal strands principally consist of cruciform (?) spicules, but it is possible that elongated filiform spicules may likewise be present. There are plain indications of a fifth or distal ray in many of the principal spicules of the wall, shown by a very minute knob or blunted process projecting from the central node of the transverse rays, which may represent a partially developed ray, or the broken stump of a complete one. In some places, also, there is a continuous film of pyrites, probably indicating a membrane of very minute spicules or an agglomeration of flesh-spicules, now replaced by this mineral.

The basal portion of these specimens is incomplete, but there are indications of an extension of the longitudinal strands of the wall downward into a spreading tuft of short anchoring spicules widening at their distal ends.

This genus is mainly distinguished from Protospongia by the fascicular arrangement of the spicular rays in the principal longitudinal and transverse fibres. The regular quadrate areas of the body-wall also mark it off from *Plectoderma* and *Phormosella*, Hinde. (See Brit. Foss. Sponges, Part. I, Pl. III, figs. 1, 2 and Part. II, p. 124-5, Pal. Soc., 1886-37.) How far it may resemble *Dictyophyton*,[1] Hall, and the other genera associated therewith by Prof. Hall (35th Report of the State Museum, 1884, p. 165, pls. 18-21), it is impossible to state, for the structural features of this genus have not been sufficiently described, and the characters assigned to the other genera are mainly those of external form, which, as regards this group of sponges, are hardly of generic importance.

The structures of Cyathophycus, as shown in these specimens, bear a great resemblance to those of the recent genus *Holascus*, Schulze (Challenger Reports, Vol. XXI, p. 85), based on sponges dredged from depths varying between 1,375 and 2,650 fathoms in the South Atlantic and in the Southern Ocean.[2] There is a striking similarity in the struc-

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[1] In the only species of the Dictyospongidæ in which I have seen structure, that named by Whitfield *Uphantenia Dawsoni*, Am. Journ. of Science, Aug., 1881, and Bulletin Am. Num. Nat. Hist., Dec., 1881, the spicules are appparently filiform and arranged in broad longitudinal and transverse bundles crossing each other, and with small, loose flesh-spicules in the meshes. The arrangement is therefore different in details from that of *Cyathophycus*, or, as it should now be called, *Cyathospongia*. The name *Hydroceras* proposed by Conrad, is liable to the objection that it was intended to indicate affinity to cephalopod shells.—J. W. D.

[2] Especially *H. fibulatus*, Schulze. Chal. Rep. xvi, fig. 9.

ture of the sponge-wall in the fossil and in the original specimens described by Schulze, now in the British Museum of Natural History.

The whole of the spicules, in the Utica as in the Quebec group specimens, are completely pyritised, and appear under the microscope to be made up of rows of cubical crystals of pyrites. They were probably originally siliceous, but this need not excite surprise, as the silica of such spicules is in a condition which facilitates solution, and in some modern sponges the spicules are not purely siliceous, but contain some animal matter. I have also noticed other cases in which siliceous Palæozoic sponges have experienced this change, while in many specimens the spicules have entirely disappeared.

This is the case with the Erian or Devonian sponges of the genus *Dictyophyton* and allied genera, which, owing to their apparently membranous character, I at one time believed to be fucoids, but abandoned this idea on seeing the specimen of Uphantænia (*Physospongia*, Hall), which Prof. Whitfield was kind enough to show me in the New York Museum in July, 1881. In a note communicated to Prof. Whitfield in August, 1881, I have made the following remarks on the pyritisation of sponges :—

" The most puzzling fact in connection with the original siliceous character of these sponges is their mineral condition, as being now wholly replaced by pyrite. Carbonaceous structures are often replaced in this way, and so are also calcareous shells, especially when they contain much corneous matter, but such changes are not usual with siliceous organisms. If the spicules were originally siliceous, either they must have had large internal cavities which have been filled with pyrite, or the original material must have been wholly dissolved out and its place occupied with pyrite. It is to be observed, however, that in fossil sponges the siliceous matter has not infrequently been dissolved out, and its space left vacant or filled with other matters. I have specimens of Astylospongia from the Niagara formation which have thus been replaced by matter of a ferruginous color; and in a bundle of fibres, probably of a sponge allied to Hyalomena from the Upper Llandeilo of Scotland (since named *Hyalostelia* by Hinde[1]), I find the substance of the spicules entirely gone and the spaces formerly occupied by them empty. It should be added that joints of Crinoid stems and fronds of Fenestella occurring in the same specimen with the Uphantænia are apparently in their natural calcareous state."

The type of structure of Cyathophycus is essentially that of the Hexactinellid sponges of the suborder *Dictyonina* of Zittel, and under this, as has already been suggested by Barrois, it belongs to the family of *Dictyospongidæ*, established by Hall for Dictyophyton and the allied sponges of the Erian rocks. This type, already known as far back as the Utica shale, is now carried a stage farther by our discoveries at Metis.

The sponges of the genus *Cyathophycus* are not abundant in the beds explored at Metis and most of them have been much broken up. Only one specimen was obtained as a tolerable state of completeness.

Genus ACANTHODICTYA, *Hinde.*

Sponges approximately subcylindrical in form, consisting of a skeletal mesh-work of longitudinal and transverse spicular strands or fibres. The longitudinal strands are

[1] I have similarly explained *Pyritonema* of McCoy and *Eophyton explanatum* of Hicks, as has Hinde also, in Geol. Mag., 1886.

composed of somewhat loosely arranged fascicles of elongated overlapping spicules, and the spicules of the slender transverse fibres are as a rule disposed in a single series. From the outer surface of the sponge, numerous spicular rays project outwards at right angles. The sponge appears to have been anchored by a basal prolongation of the longitudinal strands. Owing to the present compressed condition of the specimens it is difficult to determine the original form of the constituent spicules. Some of the elongated longitudinal spicules may be merely simple rod-like forms, others are clearly cruciform and their transverse rays form the cross-fibres. The spicular rays which form the projecting bristles of the surface may be the free distal rays of normal hexactinellid spicules, but only these projecting rays can now be clearly distinguished; the others are merged in the longitudinal fascicles.

The general structure of the skeleton resembles that of *Cyathospongia*, Walcott, but it is characterised by the presence of the projecting surface rays. The mesh is also of a looser character than in Cyathospongia and its arrangement in quadrate areas is only faintly recognisable.

8.—Acanthodictya hispida, *Hinde*.

(Figs. 18 and 19. Pl. III, fig. 8.)

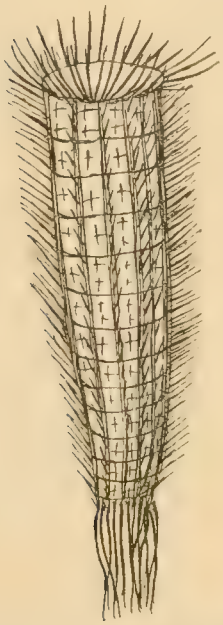

Fig. 18.—*Acanthodictya hispida*. Restored.

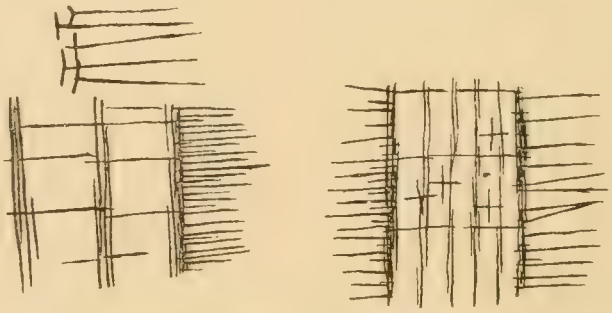

Fig. 19.—*Acanthodictya hispida*.—Portions enlarged × 5, showing framework and cruciform and protective spicules.

The examples of this species are apparently nearly cylindrical tubes from 30 to 50 mm. in length, and about 12 mm. in width. The longitudinal fascicles are about 1 mm. apart and the transverse fibres from 1 to 2 mm. distant from each other. The projecting spicular rays of the surface are only seen in these compressed sponges at the lateral margins as a sort of fringe. The free rays are somewhat thickly set; they vary from 5 mm. to 3 mm. in length; the longer forms in some instances occur at regular intervals, probably at the angles of the mesh, and between these are the shorter rays. The extremities of many of the larger forms are slightly swollen or club-shaped, but it is uncertain whether this is

an original feature or is due to an irregular deposition of the pyrites which has now in all cases replaced the silica.

This species appears as ribband-like bands composed of vertical and parallel bundles of delicate spicules with slender transverse spicules crossing them at intervals like the rounds of a ladder. It was probably originally cylindrical, but the extremities have not been seen, though fragments nearly three inches in length have been found. One of its most conspicuous characters is the possession of dense fringes of long protective spicules at the sides, and these seem to be based on a cortical structure of crutch-shaped or cruciform spicules from which the defensive spicules spring. Scattered cruciform spicules of small size appear also in the middle of the bands. The fascicles of longitudinal spicules are sometimes loosely twisted in a spiral manner, and it is probable that the root-fibres were spiral.

Sponges of the above species are sometimes associated with the larger masses of Protospongia in such a manner as to suggest a parasitic or commensal relation, but this may be accidental, and may arise from the cortical spicules of Acanthodictya becoming entangled with the surface of neighbouring sponges.

It is possible that some of the spirally twisted anchoring rods mentioned below may have belonged to this species, but its root spicules have not been seen attached.

The genus no doubt approaches to Cyathospongia, but is separated by its cylindrical form, the fascicled character of its longitudinal rods, and its cortical spicular arrangements.

Genus HYALOSTELIA, *Hinde.*

9.—Hyalostelia Metissica, S.N.

(Fig. 20.)

Fig. 20.—*Hyalostelia Metissica.* Spicules × 5, and large spiral anchoring rod magnified.

This species has not yet been seen in a perfect state or showing its general form. It seems to have been of a specially friable or decomposable character. The body appears as irregular patches of broken up skeleton, which, under the lens show a confused mass of cruciform spicules large and small, slender rods and some peculiar triradiate spicules, apparently in some cases with oblique angles, though this may perhaps be a result

of distortion, cruciform spicules with one ray curved, and minute stellate spicules. The whole somewhat resembles, though with difference in detail, the debris of the body of the modern Hyalonema, when crumbled and examined under the microscope. Associated with these patches, and also found separate, are many large anchoring rods of peculiar structure. They consist of several slender spicules twisted together spirally so as to resemble a rope. Each strand has little tubercles externally to give greater holding power, and the whole, when well preserved, constitutes one of the most beautiful of sponge structures. In one or two cases the spiral threads were seen to be unwound at their proximal ends, as if passing into the slender rods of the body of the sponge. A tendency to such spiral rolling appears in the modern glass-rope sponge (*Hyalonema Sieboldii*), and the little frills on its root spicules may represent the tubercles of the strands in the present species. A similar structure has been found by Dr. Hinde in the root spicules of *Hyalostelia fasciculus*, McCoy, from the Siluro-Cambrian,[1] and a specimen apparently of the same species in my collection shows this structure, though less perfectly than the specimens from Metis.

The connection of these anchoring rods with the patches of scattered spicules is of course inferential, but they are constantly associated on the slabs of shale, and such roots are not found attached to any of the other species, though, as already stated, similar roots may have been present in Acanthodictya.

Imbedded in some of the patches of Hyalostelia are oval bodies, about a centimetre in their longest diameter, destitute of roots or defensives and composed of crowded cruciform spicules of minute size resembling those of *P. delicatula*. I was at first disposed to regard these as gigantic ovarian capsules, but Dr. Hinde thinks they are more probably small sponges of some other species accidentally introduced.

Genus LASIOTHRIX, *Hinde.*

Sponges small, depressed oval in outline, the outer surface covered by a layer of longitudinally arranged, apparently simple, acerate spicules; beneath this is another layer of spicules disposed transversely. From the base of the sponge several simple elongated spicules extend.

The peculiar arrangement of the surface spicules in this form indicates a probably new genus, but in its present condition one cannot tell with certainty whether it is monactinellid or hexactinellid. The outer surface seems to have been invested with a sheathing of regularly arranged acerate spicules, and beneath these other spicules, disposed transversely, can be distinguished, but whether these are really acerate or modified hexactinellid spicules there is no decisive evidence to show. In one or two instances, the spicules appear to be cruciform, and the presence of the long simple anchoring spicules extending from the base of the sponge, precisely as in normal hexactinellids, is a further point in favor of its belonging to this division.

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[1] British Fossil Sponges, Pal. Soc., 1888, Pl. i. fig 3.

10.—Lasiothrix curvicostata, *Hinde.*

(Fig. 21.)

The type form is transversely oval, 8 mm. in height by 12 mm. in width, the anchoring spicules can be traced to a length of 15 mm. from the body. The summit is rounded. There are some nodular elevations of pyrites in the body portion, but it is

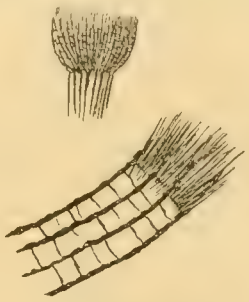

Fig. 21.—*Lasiothrix curvicostata.* Natural. size and portion enlarged

doubtful whether they represent aggregations of spicules or are merely due to the chemical deposition of the mineral, in connection with the presence of organic matter.

This curious little sponge, of which only one specimen was found, is remarkable for the strong curved spicules which support its sides, giving the appearance of a rounded basket with strong vertical ribs and very slender horizontal bars, within which and at top were quantities of slender straight spicules.

11.—Lasiothrix flabellata, S.N.

(Fig. 22.)

Fig. 22—*Lasiothrix flabellata.* Restored, and spicules × 5.

I have some doubt as to the right of this species to be placed in Dr. Hinde's new genus; but the specimens at first sight resemble the former species, and may accompany it provisionally. The surface appears to be covered with small ovoid bundles of stout biacerate spicules, diverging from the centre and sometimes in fan-shaped tufts. The specimens show indications of an external membrane, and they had somewhat strong root spicules, much larger than those of the body. It seems uncertain whether the fan-shaped bundles are really such or flattened groups of radiating spicules surrounding small oscula. In some specimens the spicules are confusedly scattered in films of pyrit-

ous matter with little indication of radiating arrangement. Dr. Hinde remarks as to this form that "the spicules do not stand out definitely, as in the case of the hexactinellid sponge spicules, but appear to be imbedded in some membrane. In two instances, anchoring spicules, like those of Protospongia, project from the base of the mass. I do not know of any monactinellid sponge furnished, as these appear to have been, with long anchoring spicules."

The sponges of this genus are very rare in the Metis collections, and are obscure and difficult to make out as to their details.

Genus HALICHONDRITES, *Dn.*

12.—Halichondrites confusus. S.N.

(Fig. 23.)

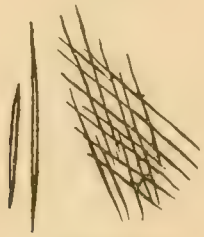

Fig. 23—*Halichondrites confusus.*
Spicules enlarged.

Oval or irregular masses of small simple spicules, imbedded in patches of pyrite, and without any definite arragement or root spicules, may indicate the presence of a halichondroid sponge. In the best preserved specimens the spicules appear to be biacerate and more slender and pointed than in the last, and they seem to be in two series, inclined at a very oblique angle to each other. In some specimens elongated spaces, with well-defined margins, are covered with thin films of pyrites, which may have resulted from the replacement or incrustation of a mass of minute spicules, of which traces remain in some places.

It is to be observed in this connection that sponges having originally much keratose or other dense animal matter would naturally aggregate in and around themselves a greater quantity of pyrite than those of a more purely siliceous character.

Miscellaneous Sponge Remains.

Under this head may be placed :—

(1) Surfaces covered with a confused mass of various kinds of spicules, probably the debris arising from the decay of numerous specimens, most of which probably belong to the species above described.

(2) Radiating groups of robust tapering spicules, some nearly an inch in length and quite thick at base. They resemble at first sight spines of Echini, but were no doubt siliceous, and belonged to sponges probably distinct from any of the species described above. The best specimen has a few small cruciform spicules at the base of the large

rods, which may indicate the character of the body of the sponge. (Fig. 24.) These spicules were probably defensive rather than for anchoring.

(3) Groups of extremely delicate simple straight spicules lying close together and parallel or more or less disturbed. They are narrow, and may have been cylindrical. One group has four long anchoring rods arranged in two pairs. They show no indication of cruciform spicules. (Fig. 25.)

Fig. 24.—Spinose sponge. Natural size.

Fig. 25.—Group of spicules enlarged.

(4) Groups of fine slender spicules either parallel or divergent. Probably root spicules of some species of hexactinellid sponge, and not unlikely *Acanthodictya hispida* though there is no certainty as to this.

(5) Large and long solitary spicules, simple and straight, sometimes 0.5 mm. in thickness and several inches in length. They seem quite smooth, but are sometimes flattened at one end.

(6) Flattened masses of irregularly coalescent fibres like those of lithistid or corneous sponges. They show no anchoring spicules and are irregular in form, and have their structures very imperfectly preserved.

Nos. 2, 3, 5 and 6 are of rare occurrence in comparison with the other forms.

Other Organisms in the Same Beds.

Obolella (Linnarssonia) pretiosa, *Bill.*

(Fig. 26.)

Fig. 26.—*Linnarsonia pretiosa*, Billings. *a*, natural size of medium specimens, *b*, ventral, *c*, dorsal valves.

In my preliminary note this was compared with *O. Ida* of Billings, but according to Prof. Hall, who has kindly examined it, it belongs to the Cambrian genus *Lin-*

narssonia of Walcott, and is not distinguishable from *Obolella pretiosa* of Billings, from the Quebec group of the Chaudière River and Cape Rouge, near Quebec. It is allied to *O. sagittalis*, Salter, from the Welsh Menevian, and which also occurs in the zone of *Paradoxides Forchammeri* in Sweden. This genus is thus, so far as known, characteristic of beds older than the Levis; but there is no reason why it might not occur thus far up in the series. Shells of this species, usually pyritised, but sometimes black and flattened in the plane of the shale, abound in the layers holding sponges. I figure (Fig. 27), from drawings supplied by Prof. Hall, the structures of this little shell as they appear in some of the best specimens.[1]

Cystidean?—A small jointed stem, 1 cm. in length, with an elongated flattened mass at one end, in which, however, no distinct plates can be seen.

Trails of Annelids, etc.—On some surfaces are flattened and rounded grooves of different sizes, but mostly small, and which may be trails of aquatic animals of different kinds. They are not pyritous and present no trace of organic matter. Some of the larger are spiral in the manner of *Arenicolites spiralis*, and these are pyritous.

BUTHOTREPHIS PERGRACILIS, *Dawson.*

(Fig. 27.)

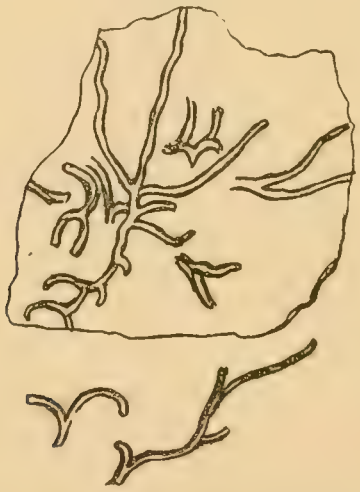

FIG. 27.—*Buthotrephis pergracilis.*

Stems very long and flexuous, about 1 mm. in diameter, and obscurely striate longitudinally; sending off at their extremities short alternate or opposite branches. Allied to *B. gracilis*, Hall, of the Siluro-Cambrian, but much more elongated and slender. These plants are replaced by pyrite and usually flattened, but the branches are occasionally cylindrical, which seems to have been the original form.

On some of the surfaces are groups of minute round pyritous spots, probably of organic origin, and perhaps ova or ovi-capsules of sponges or other animals, perhaps the vegetation or fructification of some aquatic plants. There are also a few oval or round, perfectly flat or smooth, discs resembling flattened vesicles. On some of the slabs are

[1] See appended Note.

also groups of more minute rounded bodies with no distinct structure, except in a few cases an apparent notch at the margin. They may be spore-cases or ova, but perhaps are not organic.

An interesting point in connection with these remains is the appearance of so many distinct types of siliceous sponges in one locality and formation, and this of so great age. It is also deserving of note that these sponges are of types usually occurring in deep water, and if we regard the dark shales containing them as deep-water deposits, this might account for the absence of other fossils. The alternation of these shales with coarse conglomerates and sandstones would also imply great oscillations of level at the time of their deposition.

The occurrence of so many species of sponges in very thin layers of shale, for the most part unfossiliferous, in connection with the obscure and unobtrusive character of these remains, is also an indication of the importance of thorough study of the older formations, and of investigation of even their more unpromising portions, as well as of the exhaustive exploration of those portions in which fossils occur.

NOTE.

Description of *Linnarssonia* cnf. *pretiosa*, Billings.

By Prof. James Hall, LL.D.

Shell small, subcircular or elongate transversely. Valves subequally convex, the ventral beak erect, slightly projecting and perforated at its apex. External surface covered with fine concentric lines, faint radiating striæ being visible on the interstitial lamellæ. The interior of the ventral valve bears a subtriangular or U-shaped ridge, the branches of which diverge anteriorly. The thickest portion of this ridge at the union of the branches is penetrated by the foraminal tube. In front of the foramen, and just within the cardinal line, on either side the axis of the shell is a conspicuous tubercle or boss. In the dorsal valve is a median ridge, extending half the length of the valve, and from this two short lateral ridges diverge, taking their origin at one-third the length of the median ridge from the posterior margin.

(The above description has been kindly supplied by Prof. Hall from specimens sent to him from the Peter Redpath Museum.—J. W. D.)

IV.—*On some Relations between the Geology of Eastern Maine and New Brunswick.*

By L. W. BAILEY.

(Read May 23, 1888.)

Is is now twenty-six years since the date of publication of Prof. C. H. Hitchcock's Second Report upon the Geology of Maine, a work containing descriptions and accompanied by a map illustrative of the geology of those portions of the State which are adjacent to the Province of New Brunswick. It was at about the same time that, in this latter Province, a renewed interest in its geological structure and history was being awakened by a more careful study of the formations exposed in and near the city of St. John, and the discovery of the remarkable flora and fauna which they contain. These discoveries were at that time made the basis of some interesting comparisons between the geology of St. John and that of south-eastern Maine, especially as regards the plant-bearing beds of the two districts, by Sir Wm. Dawson; but it was not until the year 1868 that, by the extension of the work of the Dominion Geological Survey to the Lower Provinces, anything like a systematic study of the actual border-region between the two countries was begun. With the progress of these investigations in New Brunswick much additional light was necessarily thrown upon the geology of eastern Maine, while actual examinations of the latter were from time to time made, when they seemed likely to be of service to a more correct appreciation of the geology of the former. In the year 1870 the author, in conjunction with Mr. G. F. Matthew, read before the meeting of the American Association in Salem, a paper entitled, "Remarks on the Age and Relations of the Metamorphic Rocks of New Brunswick and Maine," in which, after a brief review of the formations identified up to that time in the Province, the extension of certain of these formations into the State of Maine was pointed out, and their bearing upon the probable age of other groups was discussed.

The formations regarded as thus common to the two countries were these, viz.:—

(1.) A series of coarsely granitoid and obscurely gneissic rocks, crossing St. Croix River in and about the town of Calais, and which were supposed to be of Laurentian age.

(2.) Red Granites regarded as probably representing altered sediments of Upper Silurian or Lower Devonian age.

(3.) Several bands of slates and sandstones, in part micaceous, which rested upon the granites, and were regarded as including both Silurian and Devonian horizons.

(4.) To these, finally, were to be added the Red Sandstones and Conglomerates of St. Andrew's and Perry, containing a distinctively Devonian flora.

In these comparisons, however, only that portion of Maine bordering upon St. Croix River was included, the country north of the sources of the latter not having then been made, in New Brunswick, the subject of examination. Some years later, a

partial revision of the geology of northern Maine was made by Prof. Hitchcock in an article accompanying an atlas of Aroostook County; but this was based upon no new examination of the district, and in the main adhered to the views previously expressed in the report of 1862. In 1878, an Atlas of the Maritime Provinces was also published by Roe Brothers, of St. John, in which the geology of the western frontier of New Brunswick, in common with that of the entire Province, was summarized by Prof. J. Fowler, and represented in a new geological map, but like the publications previously named, this also was based upon observations previously made by others, and contained no new results of original investigation. More recently, observations of a more or less desultory kind have been made by various observers in and about Passamaquoddy Bay, by far the most important being those of Prof. N. S. Shaler, who in a preliminary report addressed to the Director of the United States Geological Survey, but published in the 'American Journal of Science' (July, 1886), details the results of several months' observations about Eastport and the adjoining bays and islands; such report, though only tentative, serving to add materially to our knowledge regarding the structure of the latter and the fossiliferous strata which they embrace. In the meantime, and at various periods between the years 1870 and 1887, the work of the Geological Survey in New Brunswick has been extended up the valley of the St. John and along the entire length of the Maine frontier, and some of the results and comparisons thus suggested have been made the basis of communications already published in the Transactions of this Society, as they have also been made the basis of a review of New Brunswick geology, by Dr. Ells, in a pamphlet published for private circulation in 1887. In the present year the last report and the last map relating to this region will be published by the Canadian Survey, and hence it would seem a fitting time in which to renew our retrospect, and, as far as possible, to correct or to extend the comparisons of twenty years ago.

The importance of these comparisons will be better appreciated when we bear in mind the peculiar position which New Brunswick holds, not only as regards the adjacent portions of Maine, but also as regards the entire State and, indeed, a large part of New England. Situated directly to the east and north-east of the State first named, the north-easterly trends, which here as elsewhere characterize most of the formations of the Atlantic sea-board, cause these necessarily to pass directly from the one to the other, so that a correct determination of the relations of these formations in either country will go far to make intelligible the structure of that which adjoins it. Moreover, in the case of New Brunswick, it would seem that the disturbances and accompanying metamorphism which have so greatly obscured the geology of much of New England, have been much less severely felt, so that a much greater number of definite fossiliferous horizons may be identified; and the relations of other non-fossiliferous formations to these being determined, a key is furnished for the elucidation of regions in which the data available are less complete and satisfactory. The fact that, in many of these fossiliferous horizons, features are presented, which are widely different from those of the more westerly portions of the continent, and point to a closer affinity with those of Europe, adds further interest to comparisons of this kind, and suggests many interesting questions regarding the early geographical and physical conditions of eastern America, a few of which it is proposed to consider in the present paper.

The subject may, for the present purpose, be best considered by a review of the

different formations as these successively present themselves, from south to north, along the international boundary.

At the point where this boundary turns northward from the Bay of Fundy, the coast line of the latter is extremely irregular, presenting in particular two deep indentations, of which the larger, Passamaquoddy Bay, lies almost wholly within the Province of New Brunswick, while the second, or Cobscook Bay, is wholly in the State of Maine. Both are themselves broken by numerous smaller indentations, but this is especially true of Cobscook Bay; while between the two is what is practically a long, narrow peninsula, the larger part of which, known as Moose Island, and supporting the town of Eastport, is separated from the mainland only by a narrow channel. Across the mouth of Passamaquoddy Bay, and separating it from the Bay of Fundy, is a chain of islands, of which Deer Island is the most considerable, while off that of Cobscook Bay, but stretching eastward and partly overlapping as a parallel belt to that of Deer Island, is the still larger Island of Campo Bello.

The geology of Passamaquoddy Bay was first worked out by the writer, in connection with Mr. G. F. Matthew and Mr. R. W. Ells, in 1870-71, at which time it was shown that this indentation is upon three of its sides, the eastern, northern and western, the latter including Moose Island, bordered by a series of but slightly inclined rocks, of which one portion, the lower, was composed of siliceous slates and sandy shales, containing fossil shells, while the upper was to a large extent of volcanic origin, embracing diorites, with associated red and purple sandstones, amygdaloids and felsites; both being at various points covered unconformably by the coarse red conglomerates of the Perry series, then regarded as Lower Carboniferous. Similar fossils were collected from Broad Cove and Shackford's Head on the west side of Moose Island, and from the latter, as identified by the late Mr. Billings, the whole series, described in the New Brunswick reports as the Mascarene series, was referred to the Upper Silurian. At the same time the rocks of Deer Island, consisting largely of slates, with intercalated masses of diorite, and which, by a fold, were supposed to be repeated in Campo Bello, were found to lie unconformably beneath the Silurian and, from the evidence of facts seen farther east, were described and represented on the maps as Pre-Cambrian. Finally, of the smaller islands between Deer Island and Campo Bello, and which differ greatly among themselves, some were referred also to the Pre-Cambrian, but the larger part to either the Silurian or the Lower Carboniferous.

In his more recent examination of Cobscook Bay, Prof. Shaler also recognizes the existence here of two separate formations, which he designates respectively as the Cobscook series and the Campo Bello series, of which the latter is regarded as lying immediately below the former. While, however, the rocks of the Cobscook series everywhere yielded to him as to us an abundant harvest of fossils—those of some localities being of a distinctly Lower Helderberg type, while at others they were rather of the age of the Clinton and Niagara—the rocks of Deer Island and Campo Bello, after the most careful search, failed to yield any. The latter are, by Prof. Shaler, compared directly with the Cambrian system, and are said to nearly resemble the rocks of that age about Cambridge and Boston; but when we recall what is now known of the Cambrian of southern New Brunswick, both as regards the persistency with which its peculiar features are retained, and the remarkable fauna which it yields, it seems hardly possible that this view can be a correct

one. Until therefore more definite evidence is obtained to the contrary, it would seem best to adhere to the view adopted in the Survey Reports that these rocks are Pre-Cambrian, and presumably Huronian, being an extension westward of beds which traverse large portions of southern New Brunswick, and which are at various points overlaid by fossiliferous Cambrian rocks. From the character of the rocks of the Cobscook (or Mascarene) series, Prof. Shaler infers that they were deposited, probably, at no great distance from land, along the eastern side perhaps of a ridge of Laurentian rock stretching up along the eastern sea-board of America and separating the Silurian rocks of this region from those formed in warmer waters on the western side of the same ridge, and north-west to Anticosti. We shall have occasion presently to refer to this conjecture again. Finally, it is important to observe that the facts are such as to indicate that the Campo Bello and Deer Island rocks were subject to extensive elevation and erosion prior to the deposition of the Cobscook series, as this in turn was largely removed before the deposition of the rocks of Perry.

As regards the so-called Perry Group, although recognized by all as the most recent of the formations bordering Passamaquoddy Bay, considerable doubt has been entertained with regard to its precise position. In its fossil flora, so well described by Sir William Dawson, its aspect is undoubtedly Devonian, but to the other rocks of that system as seen only a few miles to the eastward along the New Brunswick coast, it bears no resemblance whatever, while, both in the nature of the beds and in their relations to the subjacent formations, it does bear much resemblance to the rocks of the Lower Carboniferous system which spread so widely over other portions of the Province. For this reason it was, in the Survey Reports and Maps, represented as a part of the last-named system. On the other hand, however, it differs from the latter in the total absence of the marine limestones and gypsiferous beds usually found in connection therewith, and in this respect approaches more nearly a group of coarse sediments skirting the shores of the Bay des Chaleurs, and which have been there shown to be unconformably overlapped by the Lower Carboniferous or Bonaventure rocks. It is probable that in both instances these coarse red beds, though true Devonian, are to be regarded as representing the most recent portion of that system, and like the Catskill Group of New York, which they nearly resemble, constitute a transitional series between the two.

The great bulk of the Perry beds, their coarse character and their contained plant-remains are a further indication of the extensive erosion to which the region has been subjected; while their intersection (at Joe's Point, near St. Andrew's and elsewhere), by dykes of trap, extending across Passamaquoddy Bay, shows that, as in earlier periods, the region continued to be one subject to igneous overflows at least as late as the close of the Devonian age.

In passing northward along the western side of Passamaquoddy Bay, towards St. Croix River, the Perry rocks are found to rest upon a broad platform of granitic and syenitic rocks, extending, with few exceptions, almost to the town of Calais. On the eastern shore of St. Croix River they are more completely covered by Silurian rocks, but still rise into prominent hills, forming a portion of an extensive tract of such rocks extending eastward through Charlotte County, New Brunswick. These rocks, as seen in Maine, are regarded by Prof. Shaler as probably Laurentian. A similar view was also entertained and published as regards those of the Province (Report of Progress, Geol. Sur-

vey, 1870-71), but as there was reason to believe that much of the granite found in this region was of intrusive origin, and of much later date, while the separation of the two was extremely difficult, it was thought best to represent them upon the maps simply with reference to their lithological aspects. It is the belief of those who have studied the geology of Charlotte County, New Brunswick, that in the great axis of crystalline rocks intervening between the Bay of Fundy and the central coal basin of the Province, both Laurentian and Huronian rocks exist, the former being represented not only among the syenitic and gneissic rocks which cross St. Croix River at and below Calais, but also in the limestones and associated beds which directly skirt the Bay at Frye's Island and L'Etang; while the Huronian, besides including the rocks of Deer Island and Campo Bello (with the southern half of Grand Manan), is also represented by bands of dioritic and serpentinous rock, flanking the granites and syenites on their northern edge in the vicinity of St. Stephen. The existence of these old and firm ridges and platforms of Pre-Cambrian rock in southern New Brunswick and Maine, during the deposition of the Silurian and Devonian ages, goes far to explain the contrast which these latter here exhibit, both in character, attitude and organic remains, as compared with those of the regions farther north, to be presently noticed.

We have now to consider the rocks which either cross or are nearly adjacent to the international boundary, along that portion of the latter which lies north of Calais and St. Stephen, extending thence to the frontier of Quebec. Through this extensive tract, including a distance of two hundred and fifty miles, the rocks which actually cross the border are, so far as merely lithological characters are concerned, mainly reducible to two principal kinds, viz., granite and slate, the first named forming a belt some twenty miles in breadth, which crosses St. Croix River just north of Vanceboro, while the slaty rocks occupy the areas respectively south and north of the latter. The general structure also would, when viewed as a whole, appear to be quite simple, the granite constituting an axis on either side of which the sedimentary beds are repeated in corresponding order, rising to and including the beds of the Carboniferous system. Nevertheless, great diversity of opinion has existed, and still exists, as to the precise age of different portions of these slaty rocks, which, both in Maine and New Brunswick, have been severally referred to very different horizons. This uncertainty arises from various causes, but mainly from the fact that, the rocks being of very uniform character over extensive areas and through considerable thicknesses, the recognition of definite horizons through lithological differences is very difficult, while the fossils are but few and obscure, the slaty cleavage by which the beds have been everywhere affected having tended to obliterate them, as they have also largely the planes of sedimentation. The whole area has also been subjected to extensive plication and probably abounds with faults, the position and effects of which are not always easily ascertainable.

We may now consider somewhat further the different views which have been advanced as to the precise equivalency of different portions of these slaty rocks, beginning with those which, in New Brunswick, occupy the interval between the southern and the northern granite belts.

All observers, at least since 1862, have recognized here a division of the slates into two groups. These, in the Report and Map of Prof. Hitchcock were separated solely on lithological grounds—the one adjacent to the granite and presumably the older being

designated as mica schist, while the other, forming the centre of a synclinal, was designated simply as clay slate. The division in New Brunswick was similar, but in connection with both groups, fossils were obtained, those connected with the former, which was described as the "Dark Argillite Series," indicating a Silurian horizon, while those of the latter, though obscure, favored the supposition that they were Devonian. This latter view also received confirmation from the fact that these rocks would thus be occupying their natural position directly beneath the Carboniferous system, around both margins of which they come to the surface. No reason for doubting this determination, as regards the Devonian, has since arisen, but as regards the so-called dark argillites, while at first the view was entertained that they were wholly Upper Silurian, a question subsequently arose as to whether they might not also embrace still older or Cambro-Silurian strata. The rocks with reference to which, more particularly, this latter view was held are those which cross St. Croix River, north of Baring, and thence extend easterly through the parish of St. Stephen, in New Brunswick, to and beyond the settlement of Moore's Mills, consisting chiefly of fine-grained gneisses, micaceous, garnetiferous and staurolitic slates, black plumbaginous schists, actinolyte schists and purple fine-grained micaceous sandstones; but eventually the same view was extended to the whole of the "dark argillite" series, except such portions as could be clearly shown, upon palæontological evidence, to be Silurian. It was, however, at the same time stated that this arrangement was provisional, and it is still uncertain how much, if any, of the formation in question can really be regarded as older than the system last named. The facts which favor the general Upper Silurian age of the belt are those of its position directly beneath and in apparent conformity to the "pale argillites" or Devonian (the contacts, however, being vertical), and of a general resemblance, which it bears to the first-named group of rocks, as developed in some portions of King's County, New Brunswick, and around Passamaquoddy Bay. On the other hand, the resemblance to the rocks which occupy a similar position on either side of the northern granite axis is still more marked; while in this latter case, it has not only been shown that the argillites in question are unconformably covered by fossiliferous Upper Silurian beds, but in places themselves contain fossils indicative of a Lower Silurian horizon. That the rocks of these several dark argillite belts, as seen (1) north of Baring and St. Stephen, (2) through the parish of Prince William, and (3) in Canterbury, New Brunswick, are essentially alike, would probably be readily admitted by any one who directly compared them, and the view that they are the same formation brought up by successive geanticlinals has been taken alike by Gesner, Robb, Hitchcock, Hind, Logan, Ells and the present author. All these authorities have also regarded them in the main as older than Silurian, the two authorities first named considering them (together with the pale argillites or Devonian) as of Cambrian age, while by Hind and Logan they have been compared to the so-called Quebec Group. It should not however, be overlooked that at one point in New Brunswick (Rocky Brook, on Nashwaak River) in the very heart of the dark argillite belt, and at but a short distance from the granite, fossils indicative of a Lower Helderberg horizon were, some years ago, found by the late Chas. Robb, and more recently, in the same belt, but in its less altered portions, fossils which appear to be of Devonian type have been obtained, a few miles north of Fredericton, by Mr. W. T. H. Reed. Hence the same question arises, here as nearer the coast, whether, upon the evidence of these fossils, the age which they indicate is to be regarded as that of the entire belt in which they are obtained, or of any

considerable part of it, or whether, on the other hand, the fossil-bearing bands are not rather to be regarded as portions of newer formations enfolded among strata really of much greater antiquity. The resolution of this question, upon which some further facts will presently be stated, is one of the most important problems still demanding the attention of those interested in New Brunswick geology.

It is necessary now to refer more particularly to the grounds upon which the rocks skirting the northern side of the northern granite axis are, in part at least, held to be of Cambro-Silurian origin. Of these evidences the first, that of unconformability to the Silurian, may be seen anywhere along the line of contact between the two formations, and is evidenced alike by discordance of dip, by transverse progressive overlap, and by the composition of the conglomerates of the newer series. Within a few miles of the border are beds of coarse and highly calcareous conglomerates, conforming to the Silurian succession, and filled with pebbles derived from the Cambro-Silurian rocks near by, and across which their trends would carry them. The evidence of fossils is at present confined, so far as the western portion of New Brunswick is concerned, to the occurrence, first observed by Matthew, of linguloid shells in black calcareous and siliceous beds upon the Becaguimic River in Carleton County, and which have since been found to be associated with trilobites of the genera *Harpes*, *Trinucleus* and others, indicating an horizon which is certainly Ordovician ; while in the north-east of the Province, in what are believed to be rocks of the same group, remains of graptolites, apparently Lower Silurian, were observed by Mr. Ells. To these facts it may be added that in the occurrence of bright green and red slates, such as occur near Woodstock and Newburgh, New Brunswick, and the association with these latter of heavy beds of coarse grey grit, similar to those of the Sillery formation, a general resemblance is suggested to the rocks of the so-called Quebec Group, as seen along the Temiscouata Portage Road, and the south shore of the St. Lawrence. It is not improbable that the slates of Waterville, Maine, containing the so-called *Nereites*, etc., may be a part of the same great belt.

It has been usual to regard the granites upon which the slates last described repose as being of Devonian age, chiefly upon the ground of their evident resemblance to the granites of southern New Brunswick, and the fact that pebbles, apparently derived from the latter, are abundant in the Lower Carboniferous conglomerates, while they are rare in those of earlier formations. In neither district, however, are the granites known to actually invade undoubted Devonian sediments, whereas such invasion in the case both of the Cambro-Silurian and Silurian, has been frequently observed. The Silurian conglomerates of the north also include both granitic and syenitic pebbles.

The line of contact of the Lower and Upper Silurian, referred to above, crosses the international boundary not far from the Monument at the extreme source of St. Croix River. From this point northward in New Brunswick, the admirable section afforded by the valley of St. John River, running parallel with and for a considerable distance actually forming the boundary, has, with a single exception (that of a narrow belt of Carboniferous and possibly in part Devonian sediments, a few miles north of Woodstock), failed to show the existence of any rocks other than those of the Silurian system. At the same time it was here, as elsewhere, found very difficult, owing partly to the comparative uniformity of the beds, partly to the general and excessive plication to which they have been subjected, and partly to the paucity of fossils, to determine with any degree of

certainty either their order of succession, their thickness, or their exact horizon. In attempting to solve these questions it occurred to the author that some valuable information might be gained by instituting comparisons between the succession of beds upon the extreme southern and the extreme northern edge of the general Silurian basin, the one being found on the Beccaguimic River, in Carleton County, and the other on Lake Temiscouata, in the Province of Quebec. With a view at the same time to the more ready recognition of any Devonian strata which the region might contain, examinations were made in portions of northern Maine, more particularly in the region of the Fish River Lakes and that of Aroostook River, in both of which such Devonian strata had been represented as occurring. These comparisons proved unexpectedly interesting by showing not only that large tracts of what had, in the maps of Maine, been represented as Devonian were in reality Silurian, but that, both in the character and succession of the beds, as well as in the associated fossils, these three widely-separated localities exhibited such a close parallelism as to leave little doubt of their essential synchronism. Some of the facts bearing upon these comparisons have already been given in the Transactions of the Society, but more recently much further information relating to the same subject has been obtained, so that we are now in a position not only to correlate, with some degree of certainty, the several divisions of the Silurian system as seen through the extensive tract extending from Cape Gaspé to northern Maine, but also to compare the nature and origin of these several subdivisions with those of the same formation in southern New Brunswick.

Of the three localities to which reference has been made, the most interesting and instructive is that of Lake Temiscouata, and may well serve as a basis of comparison for the entire region of which it forms a part. As indicated in the sections given in the "Geology of Canada," the strata here exposed fall naturally into three great groups, the first consisting essentially of limestones, more or less pure, and abounding in fossils, but having at their base a considerable thickness of grey and white sandstones, with some conglomerate; the second consisting largely of sandy shales, but having beneath them over 1,000 feet of coarse conglomerate (Burnt Point conglomerates), and at their summit heavy beds of coarse somewhat epidotic sandstones (Point aux Trembles sandstones), and thirdly, an apparently great thickness of very fine slates and sandstones, the latter occupying all the lower half of the lake, and spreading widely over northern New Brunswick. The attitude of these groups is as strongly contrasted as is their character, the rocks of the first or Mount Wissick division having but a low inclination (varying from 13° to 30°), while those of the second have a much steeper, but at the same time very regular dip of about 60° to the southward, while those of the third, exhibit only a system of abrupt and complicated foldings. Actual contacts between the several divisions are not visible; but from the circumstance that in all three the general dip is to the south, and further that the rocks at the base of Mount Wissick rest directly and unconformably upon beds of the Quebec group, it was, in the author's first paper upon the subject (Trans. Roy. Soc. Can., Vol. IV) suggested that these were probably the lowest beds, and that those of the second and third divisions followed the order of their apparent succession. It was, however, at the same time stated that until a more complete examination had been made of the fossils collected, not only from Mount Wissick, but from Point aux Trembles, no definite conclusions upon this point could be reached. Since

that time, much more ample collections have been made and have been examined by Mr. Whiteaves and Mr. Ami, but with the result of showing that while the Mount Wissick rocks, as had been supposed, are in the main decidedly Lower Helderberg in age, those of Point aux Trembles indicate a lower horizon, approximating more nearly to that of the Niagara and Medina formations. This conclusion, which is confirmed by evidence seen elsewhere, is most important, for not only does it indicate that the order of succession of the strata in this vicinity is, as regards two at least of its divisions, the reverse of what had been supposed, but that a great physical break, accompanied by unconformity, exists here between the lower and upper half of the Silurian system itself. Further, from the position and low inclination of the Mount Wissick beds, and their entire absence from the region west of Lake Temiscouata, it would follow that the entire mass of this group, of nearly 600 feet in thickness, has been completely removed from an area of great extent.

Taking now the rocks of the Temiscouata section as the key to the Silurian system of eastern Quebec, no difficulty is found in identifying the rocks of Mount Wissick with those described by various observers between the latter and Cape Gaspé. Thus, the peculiar white sandstones, which form so conspicuous a feature at the base of the eminence named, though apparently wanting in the typical section at Cape Gaspé, are readily recognizable at many other points in the Gaspé Peninsula, such as the sources of the Chatte and Matane Rivers, at Lake Metapedia, Grand Metis River, the Valley of the Neigette and Rimouski River, and in each instance are directly overlaid by a great body of limestones, of which the fossils in the lower part belong to the upper portion of the Niagara formation, and from this range up to and through that of the Lower Helderberg Group. They also rest, as at Mount Wissick, directly but unconformably upon the rocks of the Quebec Group, with no trace beneath either of the heavy conglomerates of Black and Burnt Points, or of the fossiliferous slates and sandstones of Point aux Trembles and Tuladi River. On the other hand, in a westerly direction, while these inferior beds may be followed for several miles from Lake Temiscouata, the higher calcareous members in turn disappear, being apparently cut off abruptly in the eminence of Mount Wissick. The third or slaty division of the system is more persistent, and may be seen with essentially the same characters on Metapedia River, on the Patapedia, the Quatawamkedgewick, the Restigouche, the Madawaska and the upper St. John. Over these extensive areas, the position of the beds is usually that of broad and low undulations, but in places these are replaced, and often quite abruptly, by a high dip or by sharp and complicated foldings. Very similar rocks, with similar variations of attitude, are also spread over a large part of northern New Brunswick and Maine, where their soft and highly calcareous character, combined with a strongly developed cleavage, have determined a district remarkable for the depth and productiveness of its soils. Here, however, in connection with the movements to which reference has been made, there are a few points in which strata resembling the inferior beds of Lake Temiscouata are brought to the surface, and are found to contain a similar assemblage of fossils. One of these is near the mouth of Siegas River in Victoria County, New Brunswick, and directly on the border, where a nearly vertical series of strata consists in part of conglomerates, holding (like those of Burnt Point on Lake Temiscouata) pebbles of limestone, serpentine and jasper; in part of hard grey sandstones, holding besides Orthis and Strophomena (*S. rhomboidalis*) a Zaphrentis resembling a form found in the Point aux Trembles sandstones, and

thin beds of limestone. Through the latter, which are quite peculiar in having the thin layers of which they are composed, not only separated by thin shaly partings, but divided across the layers into numerous partly separated blocks, as though disjointed by the pressure to which they have been subjected, this locality is easily connected with another, in which a similar association of strata may be seen, viz., that of the Aroostook River between Ashland and Presqu'isle. Here again, a series of coarse conglomerates, carrying fragments of serpentine and jasper, in addition to a variety of metamorphic and igneous rocks, is succeeded by heavy beds of sandstone, somewhat dioritic and vesicular in aspect, and these by slates holding limestone layers in every way similar to those of the Siegas. In the sandstones, besides carbonized vegetable remains, are impressions of a coral, resembling Favosites, a Bryozoon, probably a Callapora, Orthis, *Strophomena rhomboidalis*, Rhynchonella, Spirifera (like *S. radiata*, Sow.), *Atrypa reticularis*, Lin., and Cornulites (like *C. flexuosus*, Hall)—the whole indicating an horizon about that of the Niagara formation. Similar conglomerates and sandstones are widely spread over northern Maine, and in the reports upon that State have been regarded as Devonian, but there would now seem to be but little doubt that they are the equivalents of the Burnt Point and Point aux Trembles rocks of Temiscouata Lake, and, with the latter, hold a position which is quite low in the Silurian system. In the same portions of Aroostook County, Maine, the higher members of this system are again represented by limestones, and are remarkable for the number and fine preservation of the organic relics which they hold, the well known beds of Square Lake or Lake Sedgewick having yielded not less than forty-two species, mostly new, while similar beds near Ashland are but little less prolific.

Finally, on Beccaguimic River, in Carleton County, New Brunswick, and on the extreme southern edge of the great Silurian tract of that Province, strata are again met with, which, though highly disturbed, exhibit much the same aspect as those which have been described, with similar relations and organic remains.

It will now be of interest to institute a comparison between the succession of Silurian rocks as thus made out in northern New Brunswick, Quebec and Maine, with the succession of the regions nearer to the Bay of Fundy.

In so doing, one of the first facts to attract attention is the almost entire absence, in southern New Brunswick, of the great belts of limestone which constitute so marked a feature in the north, and more particularly in the Province of Quebec. Indeed no undoubted equivalents of these Lower Helderberg rocks are known to occur in the former, though apparently met with, to a limited extent, in south-eastern Maine, as observed by Prof. Shaler. On the other hand, between the lower members of the system in the two cases a very striking parallelism may be drawn. Thus, taking the section afforded by the Mascarene peninsula, in Passamaquoddy Bay, as typical of the southern coastal region, the grey felspathic and siliceous slates, which constitute its first two divisions, apparently find their counterpart in the great body of slates, often also highly siliceous, which border Lake Temiscouata between Burnt Point and Point aux Trembles, already described as holding a fauna low down in the Silurian system. With the conglomerates of Burnt Point, the latter a local accumulation, they may be regarded as the probable equivalents of the Oneida, Medina and Clinton Groups of New York, of Divisions II and III of the Anticosti series, or of Groups B and B' of Arisaig in Nova Scotia. Division III of southern New Brunswick consists of sandstones, of greenish and purplish colours and

more or less amygdaloidal; and similarly, in the north, the beds of Point aux Trembles, on Lake Temiscouata, with their supposed equivalents on Siegas River, New Brunswick, and on the Aroostook, in Maine, occur in similar relations and present much the same aspect, including in both instances the occurrence of much comminuted vegetable matter. Division IV of the Mascarene section, consists of red and green slates and sandstones, with diorites and felsites, and so, again, similar rocks are found in this position at Cape Gaspé, Cape Chatte, Metapedia Lake, Rimouski, and near the base of Mount Wissick. The felsites and associated trappean rocks of Aroostook County, Maine, as well as those of Restigouche County, New Brunswick, may possibly represent this and the succeeding division (V); but the facts at present known, rather favor the idea that the former are Cambro-Silurian. The absence of the higher members of the system in southern New Brunswick may be accounted for upon the supposition that the barrier of Laurentian rocks, alluded to on a former page, as extending along the coast subsequently to the close of the Archæan age, continued to exist in Silurian times, and that while, in the north, the later half of the Silurian age was a period of subsidence, in the south it was chiefly one of elevation, excluding the access of pure sea-water, and hence, of such forms as are dependent on its presence.

Of other strata observed in northern Maine and New Brunswick, it is more difficult to speak with confidence, their stratigraphical relations not having been fully worked out, and fossils being as yet wanting. Of these the most important consist of a mass of fine grained slaty felsitic and siliceous rocks, associated with dioritic and amygdaloidal sandstones, quartz-porphyries and agglomerates, which appear to stretch in parallel belts across a considerable portion of Aroostook County, and in places rise into prominent hills. One of these belts is conspicuously exposed about Churchill, Umsaskis and Spider Lakes on Allegash River, and apparently extends thence past the head-waters of the Aroostook, forming the Aroostook Mountains, and eastward to the Valley of Fish River, separating the Silurian basin of Square and Eagle Lakes from that of Ashland and Presqu'isle; while a second, as yet only seen at a few points, lies to the south of the latter, here including the steep and conspicuous conical peak known as the Haystack. No fossils have yet been observed in the slates of this group (referred to in the Maine reports simply as trappean rocks), and we are hence without definite proof of their age, but the nature of many of the pebbles in the Silurian conglomerates would seem to indicate that the former was the source from which these were to a large extent derived, while there are also points in which conglomerates, apparently Silurian and similarly constituted, have been seen to rest unconformably upon the siliceous and felsitic rocks. On the other hand, these latter, in their fine-grained flinty texture and banded aspect, as well as in their dark purple to black colours, recall the similar beds which, in southern New Brunswick, mark the base of the Silurian system. If really more ancient than the latter—as seems most likely,—their true position is probably that of the Cambro-Silurian formation, to some portions of which they also bear much resemblance. The same remarks will also apply to a series of fine grained micaceous and gneissic sandstones and slates, of dark purplish and lilac colours, which accompany the beds above described on the Allegash River. These latter are peculiar in being filled with imperfectly developed crystals, apparently of staurolite, and are quite similar to some of the beds referred to on a former page, as occurring along the course of St. Croix River, both near St. Stephen, and again in the western

part of York County, New Brunswick. A further examination of these doubtful beds is greatly to be desired.

Of true Devonian, none is known to occur in the immediate vicinity of the frontier, unless it be a small band of dark grey and reddish conglomerates and shales, holding remains of Psilophyton, which crosses St. John River, a few miles above the town of Woodstock. While, however, as has been stated, much of what, in the Maine reports, has been described and mapped as Devonian, is now known to contain a fauna quite low down in the Silurian, the determinations of Mr. Billings of the collections submitted to him would appear to indicate that strata bearing true Oriskany forms do occur at various localities (such as Parlin Pond and elsewhere), in the northern part of the State, while an outlier of similar age has been observed by Mr. W. McInnes, near the head of Tobique River in New Brunswick.

Upon the roads leading south from the town of Presqu'isle, in Aroostook County, and not far from the border, the Silurian rocks are unconformably covered, over a small area, by a series of bright red and rather soft sandstones and conglomerates. It is possible that these may also be Devonian, the equivalents in that case of the beds of Perry, but in the absence of fossils it seems altogether more probable that they are Lower Carboniferous, representing the very similar beds of that age, which occur in a like position in the valley of Tobique River, in New Brunswick. The absence, so far as known, of strata of like age and origin from points further westward in the State of Maine, would appear to indicate that the area of marine submergence in the later Devonian and Lower Carboniferous ages, the westward extension of the great St. Lawrence or Acadian Basin, had its western limit not far from the boundary line now separating New Brunswick from the United States.

V.—*On Fossil Plants collected by Mr. R. A. McConnell, on Mackenzie River, and by Mr. T. C. Weston, on Bow River.* By SIR J. WILLIAM DAWSON, LL.D., F.R.S., &c. [Plates X & XI.]

(Read May 7, 1889.)

I.

SPECIMENS FROM MACKENZIE RIVER.

The fossil plants collected on the Mackenzie by Dr. Richardson, were described by Heer in the "Flora Fossilis Arctica", Vol. I, in 1868. Subsequently, in 1880, in the continuation of the same work, he published descriptions of additional specimens collected by Dr. Rae, Messrs. R. H. Scott and W. Hardesty and Bishop Bompus. In the same publication Schroeter describes fossil woods collected on Mackenzie River.

The species described in these papers are not numerous, being twenty-three in all, inclusive of a minute parasitic fungus, besides three species of fossil wood. A list of these species is given in my paper on Laramie Plants (Trans. Roy. Soc. Canada, Vol. I, 1882, p. 32), and which I repeat here for reference, with some emendations :—

1. Xylomites borealis, *Heer* (growing on leaves).
2. Glyptostrobus Ungeri, *Hr.* *
3. Sequoia Langsdorffi, *Brongt.* *
4. Taxodium distichum, (Miocenum.) *
5. Smilax Franklini.
6. Populus arctica, *Hr.* *
7. P. Richardsoni, *Hr.* *
8. P. Hookeri, *Hr.* *
9. Salix Raeana, *Hr.* *
10. Betula macrophylla, *Gpt.*
11. Corylus McQuarrii, *Forbes.* *
12. Quercus Olafseni, *Hr.*
13. Platanus aceroides, *Hr.*
14. Juglans acuminata, *Brongt.*
15. Viburnum Nordenskioldiii, *Hr.*
16. Pterospermites spectabilis, *Hr.*
17. Pt. dentatus, *Hr.*
18. Tilia Malgreni, *Hr.*
19. Phyllites aceroides, *Hr.*
20. Hedera MacClurei, *Hr.*
21. Magnolia Nordenskioldii, *Hr.*
22. Carpolithes seminulum, *Hr.*
23. Antholithes amissus, *Hr.*

On referring to my notices of plants of the Laramie in Dr. G. M. Dawson's "Report on the 49th Parallel," 1875, and to my paper in the Transactions of this Society in 1887, it will be seen that these plants are in great part identical with those of the Upper Laramie series of our Northwest Territory. I have, in the above list, added an asterisk to each species found in the Lignite Tertiary, Fort Union or Upper Laramie series on the 49th parallel, and at the Souris River, Calgary, etc. It is also just possible that some of the others may be species found in these places, though known by different names.

The present collections furnish little that is new; but the specimens are in a fine state of preservation. As the Upper Laramie or Fort Union Group is still held by some palæobotanists to be Miocene, and as it is equivalent to beds in Greenland, Alaska, etc., also until recently called Miocene, it may be interesting to note the localities of the spe-

cies collected by Mr. McConnell, and which certainly represent the more abundant trees of the region in this period.

The matrix of most of the plants is a light-coloured shale or indurated clay, resembling that of the Laramie in many other localities. In the case of some slabs, however, the heat of burning lignite has converted the clay into a sort of terracotta of reddish and yellowish colours.

In the present paper I shall refer merely to the geographical distribution of the species in connection with the evidence for the Laramie age of the Mackenzie River beds, which will be described more in detail by Mr. McConnell in his forthcoming Report.

PTERIS SITKENSIS, *Heer.* (Pl. X, Fig. 1.)—This fern, not previously collected on the Mackenzie, was originally collected near Sitka in Alaska, and constitutes another link of connection between the flora of the Pacific coast and that of the interior region in the early Eocene age.

GLYPTOSTROBUS UNGERI, *Heer.*—If this species be the same with *G. Europæus* and *G. Œningensis,* which seems probable, it is very widely distributed in Europe and America. It is found in Alaska, Greenland and Spitzbergen; also in the Upper Laramie of Porcupine Creek (G. M. D.) and in the Fort Union group of Dakota. (Newberry).

SEQUOIA LANGSDORFII, *Brongt.*—This species is very widely distributed in time and space, if all the forms referred to it are really of one species. It ranges from the Upper Cretaceous into the Miocene, and in reality is not very remote in its characters from the living *Sequoia sempervirens* of California, which may be a modern variety. It occurs in Greenland, in the Laramie of various places in the United States, and is widely distributed in Europe. Both leafy twigs and remains of cones occur in the Mackenzie collections. In the Belly River Group of Canada, the species *S. Reichenbachii*[1] replaces it, and the species referred to *S. Langsdorfii* from the Upper Cretaceous of Nanaimo, Vancouver Island, appears to be *S. Smithiana,*[2] which also occurs in the Kootanie of the Rocky Mountains. It seems therefore uncertain if in Canada it is as old as the Cretaceous, and it may in any case be regarded as specially characteristic of the Upper Laramie or Eocene flora.

TAXITES OLRIKI, *Heer.*—This large and beautiful Taxine plant occurs in the Eocene of Europe, and is found also in Alaska and in Greenland. It is abundant in the collections of Dr. Selwyn from Souris River, described by me in the Report of the Geological Survey of Canada (1879-80).[3] It does not seem as yet to have been recognized in the United States, and is probably a distinctively northern form. It is said by Schimper to resemble closely a species of Cephalotaxus found in China and Japan.

PLATANUS ACEROIDES, *Heer.*—This is the Eocene representative of the modern *Platanus occidentalis* of America, to which it is very nearly allied. It occurs in the Tertiary

[1] Flora of Cretaceous of British Columbia and Northwest Territory, Trans. R. S. C., 1882.

[2] Mesozoic Flora of Rocky Mountains, Trans. R. S. C., 1885.

[3] Fossil Plants of Laramie, Trans. R. S. C., 1886.

of Europe as high as the Miocene of Oeningen, and is found in the leaf beds of Mull, that is if, as seems likely, the *P. Hebridicus* of Forbes is this species. It also occurs at Atanekerdluk in Greenland, in Iceland and in Spitzbergen.

It seems probable that *P. Gulielmæ*, Goept, is merely a variety. It occurs with the former in Switzerland and Greenland. Farther, Schimper suggests that *P. Raynoldsii* and *P. Haydenii*[1] of Lesquereux, both Upper Laramie species, and found plentifully in the sandstones on Bow River, near Calgary, may be varieties of this somewhat variable species.

POPULUS ARCTICA, *Heer*. (Pl. X, Figs 2, 3 & 4.)—This is much the most abundant species in Mr. McConnell's collection, and seems to show that then, as now, this genus was dominant. This is an European as well as American and Greenland species, and presents a great variety in the size and forms of the leaves, which have given rise to the formation of several species. Mr. McConnell's specimens show a great number of gradations in form, from broad oval to a very broad reniform, and in size from one inch to four in diameter. Its occurrence in the Laramie of Western Canada is noticed in my paper as Laramie Plants, (Trans. Roy. Soc. Can., 1886).

There seems to be some uncertainty as to the reference of this leaf to *Populus*. Saporta, thinks that it may really be a Menospermum allied to the modern *M. virginicum*. If a poplar, it is remarkable that its nearest living ally seems to be *P. Euphratica* of the banks of the Euphrates and Jordan.

POPULUS HOOKERI, *Heer*. (Pl. X, Fig. 5).—This species, found thus far only at Mackenzie River, has small leaves, resembling those of *P. arctica* in form, but differing somewhat in venation, in which it approaches slightly to *P. tremuloides*, the common aspen.[2]

POPULUS RICHARDSONII, *Heer*.—A large and fine species, quite different from the preceding, and allied to the modern aspens. It is found in the Fort Union Laramie of the United States, and in the Greenland and Spitzbergen collections, also in Canada in the Upper Laramie, on Bow River. Its nearest relation in modern Canada is *P. grandidentata*, the great-toothed aspen, the leaves of young shoots of which species greatly resemble those of the ancient form.[2]

CORYLUS MCQUARRII, *Forbes*.—This species is found in the Mull leaf-beds and elsewhere in Europe, also in Alaska, Iceland, Spitzbergen and Greenland, and in the Upper Laramie of the western plains, both in Canada and the United States, though it seems to be less common than further north. Further south than Mackenzie River, this species is associated with leaves not distinguishable from those of the modern hazel, *C. rostrata*.[2]

NORDENSKÖLDIA BOREALIS, *Heer*. (Pl. X, Fig. 6).—This is a beautiful fruit, divided into lobes at top, and supposed to be allied to Tiliaceae. These fruits occur in Greenland and Spitzbergen, and have been discovered by Mr. McConnell for the first time in Canada. It is by some referred to the genus *Cistus* or to *Diospyros*.

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[1] Fossil Plants of Laramie, Trans. R. S. C., 1886. [2] *Ibid*.

In connection with the reference of this fruit to Tiliaceae, it is worthy of note that Saporta inclines to the belief that the previous species may belong not to a hazel but to a *Tilia* or linden.

CARPOLITHES.—Oval, flattened bodies, probably seeds or fruits, about one centimetre in length, and without distinct markings. They may be seeds possibly of Taxites, but their affinities for the present must remain uncertain, and I do not give them a specific name, in hope of additional facts being discovered.

PYRITIZED AND FERRUGINOUS WOOD.—The collection contains several branches and portions of stems evidently of Exogenous trees, but in a state of preservation which does not admit of distinct determination. Schroeter, as already stated, has described fossil wood from these beds, one species of which, his *Sequoia Canadensis*, may be the wood of *Sequoia Langsdorffii*, another is not improbably that of *Platanus Ungeri*. Another of his species of fossil wood is referred to the genus *Ginkgo*, but it may have belonged to *Taxites Olriki*.

LEGUMINOSITES (?) BOREALIS, *S. N.* (Pl. X, Fig. 7).—Pods of unequally obovate form, apparently arranged on the sides of a stem. They are grooved or ribbed longitudinally, and resemble *L. arachioides*, Lesq., except in their smaller size and broader form. One shows what seems to be the remains of a sheath or calyx.

CALLISTEMOPHYLLUM LATUM, *S. N.* (Pl. X, Fig. 8).—Leaf entire, obovate, without petiole. Midrib distinct, secondary veins obsolete; indications of delicate reticulation. This is probably a Myrtaceous leaf and may, provisionally at least, be placed in the genus above named. It seems quite different from the other described species.

II.

MR. WESTON'S COLLECTIONS FROM THE LARAMIE OF BOW RIVER.

With the above specimens from Mackenzie River, there have been placed in my hands some interesting leaves collected by Mr. Weston in the Upper Laramie sandstones, near Calgary. They belong to two species, *Populus Richardsonii* and *Quercus platania* of Heer, (Pl. XI, Fig. 7). The leaves of the former species are chiefly remarkable for their large size, but in other respects are similar to those of Mackenzie River. The latter species is represented by leaves of great size. One of them must, when perfect, have been at least ten inches in length without the petiole. This species has not yet been found at Mackenzie River, but is one of those common to the United States Laramie and that of Canada, and found also in Greenland. As the species seems to be variable, and Heer had only fragments in his collections, I figure a small, but perfect, specimen in Mr. Weston's collection. Schimper regards the place of this species in the genus *Quercus* as "fort contestable", and it is quite possible that when its fruit shall be known, it may be found to have different affinities. It was evidently one of the most magnificent of the Laramie species in point of foliage. Its leaves are in some points not unlike those borne on vigorous, young shoots of *Tilia Americana*, though narrower in proportion to their breadth.

III.

General Remarks.

The general conclusion indicated by the above facts is the strong resemblance of the flora of the Mackenzie River beds with that of the Laramie of other parts of Canada and of the United States, and also with the Tertiary of Greenland, Spitzbergen, Alaska and the Hebrides. They thus confirm the inferences as to this similarity, and as to the Lower Eocene age of the Upper Laramie, stated by the author in "The Report on the 49th parallel" in 1875, in subsequent 'Reports of the Geological Survey,' and in previous volumes of these Transactions.

It is to be observed, in connection with this, that recent observations in the western parts of the United States by Mr. Whitman Cross and others, lead to the conclusion that, locally, plants of Middle Tertiary age have been inadvertently mixed with those of the true Laramie, and that this has tended to mislead palæobotanists. Farther, it seems probable that due attention has not been paid to the distinction of the Lower Laramie and the Upper, or to the separation of the former from the Belly River series of the Upper Cretaceous, which has a very similar flora. It is also quite possible that the line between the Eocene and the Upper Cretaceous may ultimately be drawn, as I have suggested in a previous paper, between the Upper and Lower Laramie. The intervention, in the Northwest Territories of Canada, of a thick series of barren beds of red clay, and the affinities of the Lower Laramie flora with that of the Upper Cretaceous, certainly tend to this conclusion. In the mean time there can scarcely be any doubt that the flora of the Upper Laramie, of the Atanekerdluk series in Greenland, and of the Spitzbergen and Alaskan Tertiaries, corresponds with that of the Eocene in Europe, and is also identical with the Fort Union flora of the Missouri region, formerly regarded as Miocene. On these points and as to the evidence of the stratigraphical position of the Laramie between the Cretaceous and the Lower Miocene, I would refer to previous papers in these Transactions.

Lastly, it is worthy of note that while the Greenland flora of this age is temperate, that of the temperate regions of America is of the same character and closely allied to that now extant, showing that the conditions of temperature were those of great uniformity over a wide range of latitude rather than of excessive heat in the north. This leads to the inference that the causes of the mild Arctic temperature were geographical rather than astronomical, a conclusion which I have elsewhere stated and maintained.

NOTE.

While the above paper was in the press, I received the memoirs of Nathorst on the Tertiary Flora of Japan, and of Ettingshausen on that of New South Wales. These suggest some very interesting comparisons. The early Tertiary Flora of Japan coincides in many species with the Upper Laramie Flora of the Hebrides, Greenland, Northern Canada, Alaska and Saghalien, indicating the prevalence in later Cretaceous and early Eocene times of a similar flora throughout the Northern

Hemisphere. Even in Australia the early Tertiary flora includes many types now foreign to that country, but resembling those of Upper Cretaceous age in the North, and thus indicating a much greater uniformity in those times than at present, or perhaps that a flora originating in the North had already in the Eocene spread into the Southern Hemisphere. In generalizing on these subjects, Ettingshausen regards them too much from the point of view of local evolution rather than of migration, and does not sufficiently recognize the great antiquity of modern types in the Northern Hemisphere, and the certainty that, in the vicissitudes of climate in geological time, there have been many great transportations of floras from north to south, and from south to north. The time is rapidly approaching when these great questions will meet with adequate answers; but the accumulation of facts is scarcely as yet sufficient. Ettingshausen's specimens were unfortunately somewhat fragmentary, but I have received from Baron von Mueller a small collection of fossil fruits which show some curious American affinities in the Tertiary period.

VI.—*Descriptions of eight New Species of Fossils from the Cambro-Silurian Rocks of Manitoba.* By J. F. WHITEAVES. [Plates XII to XVII.]

(Read May 8, revised Oct. 26, 1889.)

GASTEROPODA.

MACLUREA MANITOBENSIS. (N. Sp.)

(Plate XII, and Plate XIII, figs. 1 and 2.)

Shell large, attaining to a maximum diameter of eight inches and a half, and consisting of about five somewhat slender volutions which increase rather slowly in size: outer volution nearly always distinctly angulated at the periphery. Left side almost flat, but faintly depressed in the centre in some specimens and as faintly raised in others: volutions, as viewed on the flat side, very shallowly concave in the centre and slightly raised on their outer margins: suture lightly impressed. Right side moderately convex (the greatest thickness or depth varying in different examples from two fifths to one third the maximum diameter): somewhat conical or subhemispherical, the outer volution obliquely flattened and narrowing very rapidly, but in a few specimens somewhat convexly, from the periphery to the umbilical margin: umbilicus deep, conical, and apparently about equal in breadth to one fourth of the maximum diameter, though in all the specimens collected the test is either imperfect or absent at the umbilical margin: aperture obliquely and rather narrowly subtrapeziform: outer lip apparently simple: test thick.

Surface of the test on the left or flat side marked with irregularly disposed, but for the most part distant, transverse linear grooves or periodic arrests of growth, each of which curves gently backward in a very shallowly convex curve, and occasionally with a few striations which run parallel to them. In one of the specimens figured (Plate XIII, fig. 1) which is a little less than four inches in its greatest diameter, and in which the whole of the test is preserved on the flat side, there are six of these periodic arrests of growth on the outer volution, while the inner whorls are perfectly smooth. In larger but similarly preserved specimens these arrests of growth, which are not sufficiently deep to produce any impressions on the casts, are somewhat more numerous and disposed at still more unequal intervals. On the right or convex side the test is ornamented with rounded spiral ribs of nearly equal size, and these are crossed by similarly shaped, straight and transverse costæ, in such a way as to present a somewhat nodulous appearance. The spiral ribs, however, seem to be rather broader than the narrow furrows between them, while the transverse costæ are apparently equal in breadth to the regularly concave grooves which alternate with them.

The foregoing description is intended to apply only to those specimens in which the greater part of the test is preserved. The condition in which the species is usually obtained is that of mere casts of the interior of the shell. In these, the slender early whorls are often broken off, the suture, on the flat side, is deeply excavated or channeled, and, on the convex side, a large portion of the inner whorls is visible in the umbilicus. The whole of the thick test between the volutions is sometimes naturally removed in these casts, in which case the volutions are completely separated.

In Appendix 1 to the Narrative of Franklin's Second Expedition to the Shores of the Polar Sea, under the heading "Limestones of Lake Winnipeg," the discovery, among other fossils, of specimens of a Maclurea which is most probably identical with the present species, on the western shore of that lake, in 1825, is thus referred to by Sir John Richardson:—"Professor Jameson enumerates terebratulæ, orthoceratites, encrinites, caryophyllitæ and lingulæ, as the organic remains in the specimens brought home by Captain Franklin on his first expedition. Mr. Stokes and Mr. James De Carle Sowerby have examined those which we procured on the last expedition, and found amongst them terebratulites, spirifers, maclurites and corallines. The maclurites belonging to the same species with specimens from Lakes Erie and Huron, and also from Igloolik, are perhaps referable to the *Maclurea magna* of Le Sueur."

A few casts of the interior of shells which are certainly referable to *M. Manitobensis* were collected by Mr. John Fleming in 1858 at Limestone Point, Lake Winnipeg, eleven miles north of the Little Saskatchewan, and by Prof. H. Youle Hind, in the same year, at Deer Island, near Grindstone Point and at Punk Island, on the same lake. These specimens, which are still in the Museum of the Survey, are referred to by Mr. E. Billings, in chapter 20 of Prof. Hind's report, as belonging to a species of Maclurea, "allied to *M. Logani*, Salter, but with more slender whorls."

Since then the species has been collected at the following localities, but the first specimens known to the writer in which any considerable portion of the test is preserved were obtained in 1884, by Mr. T. C. Weston at Pike Head and Kinwow Bay, Lake Winnipeg, and by Mr. McCharles at East Selkirk. Between Fort Alexander and the mouth of the Red River, Dr. R. Bell, 1874. At the second and third rapids of the Nelson River, Keewatin, Dr. R. Bell, 1879. Elk Island, Big Island, Grindstone Point, Washow Bay, Bull Head Bay, Dog's Head, Pike Head or Jackfish Bay, and Kinwow Bay, all in or on Lake Winnipeg; T. C. Weston, 1884. East Selkirk, Manitoba, T. C. Weston and A. McCharles, 1884. North end of Big Island, Big Grindstone Point and Swampy Island, Lake Winnipeg, J. B. Tyrrell, 1889.

In the writer's judgment, *M. Manitobensis* is much more nearly allied to the *M. Bigsbyi* of Hall (from the lower part of the Buff limestones of the Trenton group at various localities in southern Wisconsin) and to the *M. cuneata* of Whitfield (from the upper portion of the Trenton group, or Galena limestone of Wisconsin and Iowa) than it is to either *M. magna* or *M. Logani*. Still, the oblique flattening of the convex side of the outer volution in the present species and its distinctly angulated periphery would seem to separate it sufficiently from *M. Bigsbyi*, while its comparatively broad umbilicus and more slender volutions would apparently prevent its reference to *M. cuneata*. The surface of the shell of *M. Bigsbyi*, too, as seen in the matrix, is described as being marked only with "strong revolving striæ."

CEPHALOPODA.

Poterioceras nobile. (N. Sp.)

(Plate XIV, fig. 1.)

Shell very large, attaining to a length of upwards of seven inches, straight, subturbinate, about one third longer than broad and broadest a little in advance of the mid-length, considerably inflated but slightly compressed, one side being flatter than the other, so that the outline of a transverse section through the broadest part would be nearly elliptical, and the dorso-ventral diameter about one fourth greater than the lateral. Septate portion increasing rather rapidly in size from the apex: body chamber rather large, occupying more than one third but less than half the entire length, and narrowing gradually and somewhat convexly to the aperture: characters of the aperture unknown, though, as far as can be made out in the most perfect specimen collected, it appears to have been simple and entire, as well as apparently rather large and subovate in outline.

Sutures, or outer edges of the septa, nearly straight all round, parallel, and, in the specimen figured, placed at a distance of eight millimetres apart at or near the (imperfect) posterior end, while the four nearest to the body chamber appear to have been about fourteen millimetres apart. In places where the test has been broken off and the cast of the interior exposed, the septa are often seen to be coarsely crenulated. Surface markings and shape and position of the siphuncle unknown.

Dimensions of the most perfect specimen known to the writer (in which, however, about two chambers are broken off at the posterior end):—length, 177 millimetres; maximum dorso-ventral diameter, 124 mm.; greatest lateral diameter (approximately) about 98 mm.

East Selkirk, Manitoba, T. C. Weston, 1884: one badly preserved and somewhat distorted but otherwise nearly perfect specimen, and a large fragment of another, consisting of the greater part of the septate portion of the shell. Lower Fort Garry, Manitoba, T. C. Weston, 1884: one very imperfect specimen, consisting also of most of the chambered portion of the shell.

This species is provisionally referred to *Poterioceras*, on account of its supposed simple and entire aperture, but it may prove to be a true *Gomphoceras*.

The genus *Poterioceras* was thus originally defined by M'Coy:—"Shell fusiform, short; mouth contracted; siphuncle dilated between the chambers, eccentric. Distinguished from the true *Orthoceratites* by its short fusiform contour, and contracted mouth." This diagnosis is accompanied by a small diagram, which shows that although the body chamber narrows rapidly from its commencement up to the aperture, yet that the aperture itself is simple and entire, and neither T-shaped or lobate as in Gomphoceras, nor contracted in the middle and expanded at both ends as in Phragmoceras.

The validity of the genus *Poterioceras* is not recognized by Barrande, Fischer, Zittel and others, who place the name among the synonyms of *Gomphoceras*. On the other hand, in the first part of his Monograph of the British Fossil Cephalopoda, the Rev. Prof. Blake accords full generic rank to *Poterioceras* on the ground that "the only species described by M'Coy, as well as his diagram, indicates a genus with the form of a *Gomphoceras* without its peculiar aperture." In the same volume, Prof. Blake contends

that *Oncoceras*, Hall, is synonymous with *Poterioceras*, and states that Prof. Hall's "actual type, as well as others which have been referred to the genus, in no respects differ from M'Coy's genus." To this contention the present writer feels compelled to demur, as the statement by which it is supported seems to be at variance with the known facts of the case. If the genus *Poterioceras* is to be retained at all, in the sense in which it was defined by M'Coy, the name will probably have to be restricted to those straight, *Gomphoceras*-like shells in which the aperture is simple and entire, and it is in accordance with this definition of its characters that the name will be used in the present paper. In Oncoceras, on the other hand, the shell is always distinctly curved and inflated in a peculiar manner in advance of the mid-length, while its body chamber is transversely constricted just behind the aperture. According to Prof. Hall, the aperture of Oncoceras is constricted, but as Mr. E. Billings asserts that it is oval,[1] the constriction referred to by Hall may have been meant to refer to that immediately behind the aperture.

In the outline drawing of the species on Plate XIV, although the contour and exact dimensions of the original are correctly represented, the sutural lines are slightly restored and the supposed outline of the aperture, on one side of the specimen, is indicated by a dotted line.

Poterioceras apertum. (N. Sp.)

(Plate XIV, figs. 2 to 4.)

Shell much smaller than that of the preceding species, straight, though in some specimens there is a scarcely perceptible curvature at the apical end, varying in contour from ovately subfusiform to rather narrowly subovate, about one third longer than broad, slightly compressed, but a little flatter on one side than the other, so that the outline of a transverse section through the broadest part would be elliptical or ovately subelliptical, the venter being sometimes slightly broader than the dorsum: body chamber truncated anteriorly. Septate portion narrowly rounded at the apex in some specimens but more pointed in others, and increasing rather rapidly in size, especially in the dorso-ventral direction: body chamber occupying about one third of the entire length, and narrowing very gently and in some cases somewhat convexly towards and up to its anterior termination: aperture simple, open, not much narrower than the posterior part of the body chamber, and narrowing apparently into a short, shallow and backwardly directed sinus a little on or to one side of the middle of the venter.

The surface markings are very imperfectly preserved, but the test appears to have been nearly smooth and marked only with a few faint lines of growth.

Sutures straight and parallel, the last two septa, at least, being coarsely crenulated; siphuncle inflated between the septa, placed near the outer margin, and a little on one side of the centre of one of the flattened sides.

The dimensions of the largest specimen collected (fig. 2) are as follows:—length, 124 millimetres (or nearly five inches); maximum dorso-ventral diameter, seventy-four mm.; greatest lateral diameter, fifty-eight mm. In the other specimen represented on Plate XIV

[1] Geol. Surv. Can. Rep. Progr. 1853-56, p. 311.

(fig. 3), the length along the median line is sixty-six millimetres, the maximum dorso-ventral diameter forty-seven mm., and the greatest lateral, forty.

Dog's Head, Lake Winnipeg, T. C. Weston, 1884, and Swampy Island, in the same lake, J. B. Tyrrell, 1889 ; three nearly perfect but badly preserved specimens from each of these localities.

The siphuncle seems to have been placed a little nearer to the dorsal than to the ventral side, but the only specimen in which any remains of this part of the shell can be detected is so much worn that its relative position is uncertain.

This species possesses many characters that are common to it and to the brevicone Orthoceratites for which Professor Hyatt has constituted the genus *Rizoceras*, but it differs materially from that group or genus in the circumstance that its body chamber always narrows distinctly from its commencement to the aperture. From *P. nobile* it seems to be readily separable by its much smaller size, more slender contour, and more compressed sides.

Oncoceras magnum. (N. Sp.)

(Plate XV, fig. 1.)

Shell very large, attaining a length of at least eight inches,[1] slightly but distinctly curved, somewhat fusiform but much more convex on the dorsal than on the ventral side, and contracted at both ends ; sides compressed, though one side is flatter than the other, so that the outline of a transverse section through the thickest part would be nearly ovate, the dorsum being broader than the venter ; maximum dorso-ventral diameter about twice as great as the lateral, and nearly equal to one half of the entire length. Septate portion increasing rather slowly in size from the posterior end to a little in advance of the mid-length, after which it narrows somewhat more rapidly, especially on the dorsal side ; its dorsal margin not only uniformly convex, but distinctly gibbous anteriorly, while its ventral margin is shallowly concave behind and slightly convex in front. Body chamber oblique, short and occupying about one third the entire length ; at its commencement posteriorly, it is broad, especially in a dorso-ventral direction, and bounded by a deep oblique groove, which is broader on the dorsum than on the venter, and parallel to the septa nearest to it ; in front of this groove the chamber narrows rapidly, but at first convexly, towards the aperture, behind which there is a broad and shallowly concave constriction. In the most perfect specimen known to the writer, the characters of the aperture are very imperfectly shown, but it appears to have been simple, entire, rather narrow and subovate, with its lateral margins obliquely truncated ; there are also some indications that it narrowed into a short sinus on the ventral side.

Sutures oblique, the septa being broader on the dorsum than on the venter, nearly straight on the sides but faintly convex on the dorsum, and slightly concave on the venter ; siphuncle inflated between the septa, nummuloidal, endogastric, and placed very near to the ventre, but not quite marginal.

Surface markings unknown.

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[1] In an imperfect and water-worn cast of a shell collected by Mr. Tyrrell at Swampy Island this summer, which is probably referable to this species, the length is fully eleven inches.

Approximate dimensions of the most perfect specimen collected :—actual length along the median line of the most convex side, 179 millimetres, or about seven inches and a half (but as a considerable piece is broken off the posterior end, its entire length when perfect was probably an inch longer than this) ; maximum dorso-ventral diameter of the same, 106 mm. ; greatest lateral diameter, 55 mm.

The beautiful specimen figured, which is a well preserved cast of the interior of the shell, collected by Mr. U. Chesterton at East Selkirk, was recently presented to the Museum of the Survey by the President (Mr. Charles N. Bell) and members of the Manitoba Historical and Scientific Society. A similar but less perfect specimen was obtained at the same locality in 1884 by Mr. T. C. Weston.

Oncoceras gibbosum. (N. Sp.)

(Plate XV, figs. 2 and 3.)

Shell resembling that of the preceding species in external form and apparently also in the characters of its interior, but differing therefrom only in its much smaller size. Thus, the smallest specimen of *O. magnum* known to the writer must have been a little more than eight inches in length, when perfect, and the largest fully eleven, whereas in the present species, out of fourteen specimens collected, the smallest could not have been more than three inches and a half long when perfect, and the largest four and a half. These two series of specimens, too, do not seem to be connected by any intermediate gradations in size.

In one of the specimens of *O. gibbosum* from Swampy Island, the surface of the test of the septate portion is faintly costulate transversely, as represented on fig. 3.

Big Island, Washow Bay, Bull Head Bay, and Jack Fish Bay or Pike Head, Lake Winnipeg, T. C. Weston, 1884 : three specimens from Jack Fish Bay, and one from each of the other localities.

Swampy Island, Lake Winnipeg, J. B. Tyrrell, 1889 : seven specimens.

Cyrtoceras Manitobense. (N. Sp.)

(Plate XIII, figs. 3 and 4, and Plate XV, fig. 4.)

Shell very slightly curved, slender, elongated and narrowly subfusiform, moderately inflated a little in advance of the mid-length, though the dorsal margin, in a full lateral view, is much more convexly curved than the ventral ; posterior extremity narrower and more pointed than the anterior ; body chamber short, occupying less than one third of the entire length, and narrowing gradually to the somewhat obliquely truncated anterior end ; aperture rather large, simple and open, with a broad and shallowly concave constriction immediately behind it, but only on the ventral side ; outline of a transverse section through the broadest part ovate, the dorsum being narrower than the venter.

Surface of the test on the septate portion longitudinally ribbed.

Sutural lines concavely arched on the sides, produced into moderately elevated and simple saddles on the dorsum, and into similar but less prominent saddles on the venter.

Siphuncle exogastric, and placed very near to the dorsum, but not quite marginal. In the original of fig. 4 on Plate XV, which is an artificial and longitudinal section through the centre of a specimen from Bull's Head, the siphuncle is nearly cylindrical, but very slightly expanded between the septa and as slightly contracted where it intersects them.

Dimensions of the most perfect specimen collected:—actual length along the median line of one of the sides, 129 mm.; estimated total length of the same, when perfect, 133.5 mm.; maximum dorso-ventral diameter of the same, 34.5 mm.; greatest lateral diameter, 31.5.

Big Island, Deer Island, Punk Island, Big Grindstone Point, Bull's Head, Dog's Head, and Pike Head or Jackfish Bay, Lake Winnipeg, T. C. Weston, 1884. One nearly perfect specimen is from Big Island (Plate XIII, fig. 3) and another from Bull's Head (Plate XV, fig. 4) the rest being for the most part only pieces of the posterior and septate portion of the shell.

Deer Island, Lake Winnipeg, J. B. Tyrrell, 1889: the most perfect specimen known to the present writer, the original of fig. 4 on Plate XIII.

Trochoceras McCharlesi. (N. Sp.)

(Plate XVI.)

Shell very large (the only specimen known to the writer, which is septate throughout, having a maximum diameter of ten inches and a half) and composed of about three apparently separate but closely contiguous volutions, which are circular in transverse section and which increase rather slowly in size: they are also slightly asymmetrical and enrolled on very nearly but not quite the same plane, the spire being sunk a little below the highest level of the outer whorl.

Surface of the outer volution marked by very numerous, close-set, rounded and flexuous ribs, which are rather narrow but unequal in size, with an average breadth of about three millimetres. Across the sides the ribs curve obliquely and more or less convexly backward, and on the periphery they form a series of broad, shallowly concave and backwardly directed sinuses.

The sutural lines run parallel with the ribs on the test, but are placed much further apart, the average distance between the septa being about nineteen millimetres. Position of the siphuncle unknown.

The writer has much pleasure in associating with this fine species the name of its discover, Mr. A. McCharles, formerly of Winnipeg, to whom the Survey is indebted for many choice and some apparently unique specimens of fossils from that part of the Red River valley which runs through Manitoba. The specimen figured, which is represented as slightly smaller than the natural size, and which is now in the Museum of the Survey, was collected by Mr. McCharles in 1884 at East Selkirk. About one third of this specimen has been broken off, but the part remaining presents a very instructive transverse section of the shell at a right angle to the direction of the volutions. A considerable portion of the test is well preserved on the outer volution, and in those places where the test has been accidentally removed, the characters of the septa are well shown. The two

inner whorls are not nearly so well preserved as the outer volution, and the asymmetry and separation of all three are best exhibited in the transverse section afforded by the specimen.

Apsidoceras insigne. (N. Sp.)

(Plate XVII.)

This name is proposed for a large fragment, consisting of a cast of the interior of nearly one half of the outer volution, of a huge nautiloid shell from the Hudson River formation at Stony Mountain, Manitoba, which evidently belongs to the genus *Apsidoceras* of Hyatt.[1] The specimen is nearly a foot in length, as measured in a straight line, or sixteen inches, if the curvature of the abdomen be followed, and the dorso-ventral diameter of the tube of which it is composed is five inches at the larger end. At its anterior extremity a portion of the body chamber is preserved and in the rest of the specimen twenty septa can be counted.

The whorls appear to have been just in contact, and they were evidently coiled on the same plane: the umbilicus is broad and deep, its breadth in the actual specimen being about five inches: and, although not a vestige of the shell is preserved, the surface appears to have been smooth. The periphery or abdominal region is broad and flattened, the lateral angles are tolerably distinct, and the sides, which are convex near these angles, narrow rapidly to the inner edge or dorsum. As far as can be ascertained, in the imperfect and somewhat distorted state of the specimen, the outline of a transverse section of the outer whorl at its thickest end, and probably that of its aperture also, would be very broadly subovate, with the larger end of the ovoid truncated, the dorso-ventral and lateral diameters in this region being nearly equal.

The septa are about twelve millimetres apart in the centre of the periphery or abdominal region, and about five millimetres apart on the narrow dorsum. Each suture has a broad and angular sinus or lobe on the abdomen or venter and a corresponding and similar saddle on both of the outer and lateral angles. On the sides, the sutures are nearly straight or very faintly concave, while those on the dorsum are so imperfectly preserved that it is scarcely possible to trace them throughout their entire course, though each suture in this region seems to have been shallowly curved in such a way as to form a small and feebly developed saddle on each side, with a similar lobe or sinus in the middle. The angularity of the lobes and saddles on the venter and ventro-lateral angles is most marked near the body chamber. All the lobes and saddles, too, are of the simplest type, their margins being entire throughout.

The fine specimen upon which the preceding description is based was presented to the Museum of the Survey in the spring of 1889 by the President and members of the Manitoba Historical and Scientific Society.

A. insigne is more nearly related to the *Nautilus Hercules* of Billings,[2] from the Hudson River formation of Anticosti, which is probably an *Apsidoceras*, than to any other species known to the writer. Still the two forms appear to be totally distinct, for *N. Hercules* is

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[1] Bost. Soc. Nat. Hist. Proc. 1883, xxii. 289.

[2] Described Geol. Surv. Can., Rep. Progr., 1853-56, pp. 306, 307.

a much smaller shell (the maximum diameter of the type of that species being only a little over six inches) its aperture is broadly reniform, with a lateral diameter nearly double that of the dorso-ventral, its volutions have no ventro-lateral angulation, and its sutural lines are nearly straight, not only on the sides but also upon the abdomen or venter.

The exact stratigraphical relations of the subdivisions of the Cambro-Silurian rocks of Manitoba have yet to be ascertained. On purely palæontological evidence, the highly fossiliferous deposits at Stony Mountain were referred to the Hudson River formation by the present writer, in 1880,[1] and the fossils of the pale buff-coloured limestones or dolomites of East Selkirk and Lower Fort Garry have long been supposed to show that these rocks are the equivalents of the Galena limestone or upper portion of the Trenton formation, of Wisconsin and Iowa. On the same evidence, the somewhat similarly coloured and fossiliferous limestones of the islands and shores of Lake Winnipeg, appear to be of the same age as the Trenton Limestone proper, or, at any rate not older than the Birdseye and Black River Group of Eastern Canada and the State of New York. It is possible that the fossiliferous rocks on the shores and islands of Lake Winnipeg may be a little lower down in the series than those at East Selkirk and Lower Fort Garry, but the whole of these deposits, apart from those at Stony Mountain and elsewhere in Manitoba which can be somewhat confidently referred to the Hudson River group, probably represent only one well defined horizon in the Cambro-Silurian system. However this may be, in the writer's judgment, there is at present no satisfactory palæontological evidence for the existence of the Chazy formation or its equivalent, in Manitoba.

[1] Geol. Surv. Can., Rep. Progr., 1878-79, p. 50 c.

VII.—*Fresh-water Sponges of Canada and Newfoundland.* (Plate IV.)

By A. H. MACKAY, Principal of Halifax Academy, N. S.

(Read May 20, 1889.)

In this synopsis, nothing beyond the merest outline is intended, just sufficient to indicate the extent to which the Spongillidæ of Canada have been observed, and to facilitate further investigation.

Twenty-six years ago, Bowerbank described (Proc. Zool. Soc. London, Nov. 1863) a sponge, collected by the present Sir J. W. Dawson in the St. Lawrence, under the name *Spongilla Dawsoni.* In the same year, he also described another species from a lake in the Cascade Mountains, under the name *Spongilla Lordii.* Twelve years later, Dr. G. M. Dawson described (Canadian Naturalist and Geologist, Sept., 1875) several species from the Lake of the Woods, the Ottawa and the St. Lawrence, which made in all six Canadian species. These are now reduced to three, the others being classed as varieties. In 1887 Prof. Ramsay Wright published "The Systematic Position of the Spongidæ." Since 1883, the author has been observing the fresh-water sponges in their habitats in Nova Scotia and eastern Newfoundland, and has examined a few small collections from the central and western provinces of the Dominion. The warmest acknowledgments of inspiration and scientific aid received are due from the author to Messrs. Henry J. Carter, of England, and Edward Potts, of Philadelphia. Much of our common work has been published from time to time by the former in 'The Annals and Magazine of Natural History,' London; and by the latter in the 'Proceedings of the Academy.'

GENERAL APPEARANCE AND HABITAT.—The Spongillidæ grow in still or flowing fresh water, usually as greenish masses attached to some basis of support such as submerged timber, branches, stones, firm gravel, or grass culms. They may appear as minute specks, colorless when beneath cover from the light; or as thin encrustations; or more massive, over an inch in thickness and some feet in extent; or bearing lobular processes; or branching erect; or in flaccid filaments. At a distance, their position and form distinguish them from bunches of green Algæ. Close at hand, they are seen to be masses of a slimy kind of flesh investing a friable meshwork structure built up out of siliceous needles averaging the one-hundredth part of an inch. Their animal character is suggested by a peculiar though not unpleasant odor when fresh, and especially by a fetid putrescence if not rapidly dried or put into some preservative fluid. Turbidity of water is unfavorable to their development. The greatest luxuriance is observable where such a condition seldom exists. The injurious effect is probably due to the fouling of their system of water circulation. The quantity of pure water, if sufficient, appears to make but little difference. They are found not only in our great lakes and rivers, but in mill-

dams and in streams which can be stepped across. They are found in the stagnant pool and breasting a strong current. They encrust with green the surfaces of pebbles in the margins of our lakelets, or speck with patches of dull cream or gray or white their undersides. The author dredged some from a depth of forty feet in Grand Lake, Nova Scotia, and from nearly as great a depth in Newfoundland. More time and patience might doubtless have been rewarded by specimens from a greater depth, had a pebbly or rocky bottom or a water-logged timber been scraped in our course. The deeper bottoms (in a few cases over two hundred feet) were generally characterized by extensive deposits of diatomaceous slime or mud. Dybowski, when dredging in Lake Baikal, Central Asia, brought up some specimens, stunted and nearly colorless, from as great a depth as 300 feet; but only from an area of the bottom not mud-covered.

Collecting.—Sponges should be collected attached to their base of support whenever possible. They may be preserved by immediate transference to alcohol; or in just as serviceable a manner for most purposes, and more conveniently, by immediate and thorough drying in the sun or by artificial heat. When thoroughly dry, they can be preserved for an indefinite period. Care should be taken to protect them from dust, and if the natural green color is to be retained, from the light also.

General Characters.—Without attempting any outline of the histology, physiology or development of the Spongillidæ, it may be desirable to call attention to a few conspicuous characters. In connection with all the Porifera, their spicule-supported flesh is traversed by a system of incurrent and excurrent canals, through which there is a circulation of water from which is derived the material for the growth of their definitely organized sarcode, their spicules and their reproductive elements. In winter, as a general rule, this sarcode disappears. The skeletal and dermal or flesh spicules are thus set free, and are eventually deposited by the water where sediment is accumulating. They are often carried by the water currents into the substance of different species, and may thus give rise to errors if their extraneous origin is not detected. In the diatomaceous muds and earths found in more or less abundance in all our lakes, these spicules are generally found. Sometimes they form quite an appreciable percentage of the siliceous organic remains in these so-called infusorial deposits. The spicules are of colloidal silica—mineralogically considered, opal,—the silica of which ultimately came from its solution in the water, from which it was secreted and built up by special cells into transparent, flinty, symmetrical forms. The skeletal spicules of the more abundant species in Canada are Oxeas (the sharp-pointed form of Prof. Sollas's *Monaxon diactine*)—needles sharp at both ends—the one-hundredth of an inch in length, or slightly more or less, smooth or variously microspined, straight or slightly curved, slender or robust, separate or overlapping each other in linear fascicles, and slightly cemented together.

Dermal or flesh spicules are found in some species, while they are absent in others. They are very much smaller than those of the skeleton—in one species as short as 0·0006 inch. They are found free at the dermal surface or within the flesh. In our species they are either minute acerates or birotulates.

During the summer and autumn, clusters of elementary cells appear at points within the sarcode. They soon become invested with more or less spherical chitinous capsules,

which become further protected by firm cellular crusts in which is embedded, in dense and orderly array, a third class of very peculiar and distinctive siliceous spicules. These are of two types, the spined Monaxon and the birotulate Monaxon. The "seedlike" capsular bodies are variable in size, averaging about the one-fiftieth of an inch in diameter. There is a small round aperture in the capsule communicating with the central cavity. The aperture has generally a short tubular extension outwards and is called the "foramen." The internal cavity is filled with a cellular protoplasmic matter which comes out next spring with an amœboid movement, and develops into a new sponge. These well-protected capsules of germinal plasm have been called by various names, such as "ovaria," "statoblasts," "statospheres," or "gemmules." The statoblasts are found often in layers near the base of the sponge, sometimes scattered, or in loose clusters, or in minute, compact, spherical aggregations throughout the sarcode. The character of the spiculation of the statoblast forms the artificial basis of our genera as originally determined by Carter.

Some of our sponges are thought to be perennial; but there is no doubt that the statoblast is the special agency for propagating the life of the fresh-water sponge beyond the generally lethal chill of winter. The Spongillidæ have been considered to be distinctly separated by this peculiarity from the marine sponges, which, from their habitat, are not so much affected by the annual variation of temperature. But their close phylogenetic affinity is strikingly suggested by the following observations. In the four species of fresh water sponges (*Lubomirskia*) found by Dybowski so abundantly in Lake Baikal, no statoblasts have as yet been discovered. Possibly, for anything we know as yet, the marine habit may coëxist in the deep waters of our own greater lakes. On the other hand, capsular bodies, having a close resemblance to the statoblast, have been described in three genera of the marine Silicispongiæ, namely Chalina, Cliona, and Suberites. (M. E. Topsent, Comptes Rendus, CV. 1888, pp. 1298-1300). The enclosing capsules in these are, however, much more simple than those in the fresh-water sponges, as they are wanting in the foramen, the massive cellular crust and the siliceous armature.

The position of the fresh-water sponges in Prof. Sollas's system of classification is as follows:—

The Phylum.—**SPONGIÆ** (*Sponges*).
Branch B.—MICROMASTICORA.
Class II.—*SILICISPONGIÆ.*
Sub-Class ii.—**Demospongiæ.**
Tribe *A.*—MONAXONIDA.
Order 1.—MONAXONA.
Family 7.—SPONGILLIDÆ (*Fresh-water Sponges.*)

PROVISIONAL CONSPECTUS
OF
CANADIAN SPONGILLIDÆ.

Genus I.—SPONGILLA. Statoblast spicules, one class of spined monaxons, tangential.

Species	1.—*Spongilla fragilis.*	A. Dermal spicules, absent.	
"	2.—*Spongilla MacKayi.*		
"	3.—*Spongilla lacustris.*	Dermal spicules,	acerates.
"	4.—*Spongilla Terræ-Novæ.*		birotulates.

Genus II.—Meyenia. Statoblast spicules, one class of birotulate monaxons, radial.
Species 5.—*Meyenia Everetti.* Dermal spicules, birotulates.
" 6.—*Meyenia fluviatilis.*

Genus III.—Heteromeyenia. Statoblast spicules, two classes of birotulate monaxons, radial.
Species 7.—*Heteromeyenia argyrosperma.*
" 8.—*Heteromeyenia Ryderi.*
" 9.—*Heteromeyenia Pictovensis.*

Genus IV.—Tubella. Statoblast spicules, one classe of inequibirotulate monaxons, radial.
Species 10.—*Tubella Pennsylvanica.*

The spiculation of the genera and of most of the species is illustrated in the accompanying Plate of eight diagrammatic drawings. A small segment of a statoblast shows, below, the cellular germinal matter, bounded above by an arc of the enclosing chitinous capsule. The statoblast spicules come next, and when in position are generally embedded in the "crust" which is not sketched, but which immediately invests the chitinous coat. Next above are the skeleton spicules, and above them the dermal spicules when they occur. They are all magnified on the same scale—200 diameters.

Synopsis.

For the sake of brevity, the author here takes the liberty of condensing or modifying the original descriptions as suggested by his own observations. He feels that many of the synonyms have been based on varietal distinctions; but he cannot at present attempt the delimitation of Canadian varieties. There are very many species, not to speak of varieties, which are yet to be discovered in this country. With more extensive collections and closer investigation, data for a more complete treatment of our fresh-water sponges may be hoped for in the near future.

Genus I.—SPONGILLA, *Carter.*

Statoblasts more or less spherical; separate, in dense layers, or aggregated in compound, subglobular, minute masses; invested with siliceous spicules more or less linear, straight or curved, cylindrical or acerate, variously spined, and arranged tangentially to its inner, chitinous, capsular coat.

A.—*Dermal Spicules Absent.*

1.—Spongilla fragilis.

1851. *Spongilla fragilis*, Leidy.
1863. " *Lordii*, Bowerbank.
1870. " *contecta*, Noll.
1875. " *Ottawaensis*, G. M. Dawson.
1878. " *Siberica*, Dybowski.
1880. " *Morgiana*, Potts.
1880. " *Calumeti*, Thomas.
1880. " *fragilis*, var. *minuta*, Potts.
1880. " " " *minutissima*, Potts.
1880. " " " *irregularis*, Potts.

1880. *Spongilla segregata* Potts.
1883. " *contecta*, Retzer.
1884. " *fragilis*, Vejdovsky.
1885. " *fragilis*, MacKay.
1885. " *Lordii*, Wierzejski.
1885. " *fragilis*, "
1885. " " Peter.
1886. " *glomerata*, Noll.
1887. " *fragilis*, Potts.

Sponge greenish, encrusting, thicker towards the centre of its area—sometimes an inch or more. Pores and osteoles numerous, the latter large. Skeleton spicules slightly curved, cylindrical, acerate, smooth, about 0.008 of an inch long. Statoblasts about 0.02 inch in diameter, generally in "pavement layers" at the base of the sponge, with their foramina extended into short tubules and directed upwards; sometimes in compact subglobular clusters, the foraminal tubes always opening outwards. Cellular crust of statoblasts charged with spined spicules about 0 003 inch long, nearly cylindrical, truncate or cone-pointed and slightly curved.

Habitat.—Still or flowing water. The third in point of commonness, everywhere. Nova Scotia and Newfoundland.—*MacKay.* The St. Lawrence, the Ottawa and the Lake of the Woods.—*G. M. Dawson.* Lake Osogoos, Cascade Mountains, British Columbia.—*Bowerbank.*

2.—Spongilla MacKayi.

1885. *Spongilla MacKayi*, Carter.
1885. " " MacKay.
1887. " " Potts.

Sponge green, encrusting, thin, charged with large subglobular compound bodies about one-twelfth of an inch in diameter, made up of 16 or 20 statoblasts, more or less. Skeleton spicules acerate, slightly curved, sharp-pointed about 0.009 by 0.0004 inch. Statoblasts globular, with short flaring foraminal tubules all opening inwards into the central cavity of the compound body formed by them, which body is supported by densely spined statoblast spicules of various sizes which, intercrossing, form a nestlike, globular covering around the whole. Statoblast spicules, much like those of the skeleton, but becoming much shorter and more strongly spined as they approach the chitinous coat, where they may be reduced to nearly 0.004 inch in length, but may increase to 0.0007 inch in breadth, with very strong and irregular spines, so that the spicule sometimes appears nearly as broad as long.

Habitat.—Virginia Pond, St. John's, and lakelets between Conception Bay and Trinity Bay, Newfoundland; lakelet, Pictou Co., Nova Scotia.—*MacKay.* Spicules of, in diatomaceous deposits in the lakes which supply the waterworks of Halifax. N.S.—*Prof. Lawson.*

B.—*Dermal Spicules Present.*

3.—SPONGILLA LACUSTRIS.

1745. *Spongia lacustris*, Linn.
1788. " *canalium* (?), Gmelin.
1816. *Spongilla ramosa*, Lamarck.
1842. " *lacustris*, Johnston.
1853. " " Lieberkühn.
1863. " *Dawsoni*, Bowerbank.
1863. " *paupercula*, "
1866. " *lacustris*, "
1870. " *Lieberkhuenii*, Noll.
1875. " *flexispina*, G. M. Dawson.
1877. " *lacustris*, Vejdovsky.
1877. " *Jordanensis*, "
1879. " *lacustroides*, Potts.
1880. " *abortiva*, "
1880. " *mutica*, "
1880. " *montana*, "
1881. " *multiforis*, Carter.
1882. " *lacustris*, Dybowski.
1883. *Euspongilla lacustris*, Vejdovsky.
1883. " *Jordanensis*, "
1883. *Spongilla lacustris*, var. *ramosa*, Retzer.
1883. " " " *Leiberkuehnii*, Retser.
1884. " *Lehighensis*, Potts.
1884. *Euspongilla lacustris*, Wierzejski.
1884. *Spongilla lacustris*, var. *Americana*, Carter.
1885. " *lacustris*, var. *Dawsoni*, MacKay.

Sponge green, generally branching, texture loose. Skeleton spicules fasciculated, smooth, curved, fusiform, gradually pointed, about 0.011 inch long. Dermal or flesh spicules fusiform acerates, curved, entirely microspined, generally less than one-third the length of the skeleton spicules. Statoblast about 0.02 inch in diameter. Granular crust variable in thickness, sometimes even absent. Foraminal tubule infundibular. Statoblast spicules nearly the same length as the dermals, generally cylindrical. Curved in various degrees, sparsely and strongly spined, especially towards their ends, where the spines are frequently recurved. The number and position of spicules vary with the thickness of the crust.

Habitat.—The most common of fresh-water sponges. Most luxuriant in running water. Newfoundland and Nova Scotia.—*MacKay.* River St. Lawrence (1863).—*Sir J. W. Dawson.* Ottawa River.—*H. M. Ami.* Elgatches Lake.—*Sir J. W. Dawson.* Tuladi Lake, near Lake Temiscouata.—*H. M. Ami.* Chilukweyuk Lake, British Columbia.—*Carter.* Nimpkish River, Vancouver Island, British Columbia.—*G. M. Dawson.*

4.—SPONGILLA TERRÆ-NOVÆ.

1886. *Spongilla Terræ-Novæ*, Potts (Proc. Acad. Nat. Sci., Phila., 1881, p. 228).
1887. " " MacKay.

Sponge greenish, encrusting, thin, traversed by filaments of fascicled spicules forming a loose tissue with few connecting spicules. Skeleton spicules, slender, cylindrical, generally smoothish, gradually pointed, about 0.0067 inch long. Dermal or flesh spicules, minute birotulates of varying size, about 0.0007 inch in length, and very abundant Statoblasts globular, large, about 0.037 inch in diameter, having no crust enveloping the chitinous capsules. This capsule is covered with a layer of spicules which are robust, fusiform, variable, but averaging 0.0015 inch in length, with from one to twelve strong spines irregularly projecting from them, so that each has a different configuration of spinous processes.

Habitat.—Lakelets near Heart's Content, Trinity Bay, Newfoundland.—*MacKay.*

[NOTE.—Dr. A. Wierzejski found near Lemberg, in Galicia (Verk. K. K. Zoöl.-Bot. Gesell, 1888, pp. 529-36), a form of sponge which he thinks resembles this species. He argues that both forms are probably deformed varieties of *Meyenia Mulleri*, Lieberkühn. The statoblast spicules of *S. Terræ-Novæ* can easily be imagined in many particular instances to be more like deformed birotules than like the more extreme forms of those of *S. MacKayi.* And Mr. E. Potts has shown (Proc. Acad. Nat. Sci. Phila., 1887, p. 222) that the birotulates of *Meyenia fluviatilis* var. *acuminata*, Potts, have the rotules deformed and the axes produced beyond them; and as the crust usually surrounding the chitinous capsule is absent, they are compelled to assume the tangential position of Spongillas instead of the radial position of Meyenias. But on the other hand, the statoblast spicules of *S. lacustris*, when the crust is very thick, may in some instances assume nearly a radial position; and the spines are stronger towards the two ends, so that we can easily think of them as deformed, long-shafted, birotulates of the Meyenia type. But we might as well call all the Meyenias by their original name *Spongilla*, and a great deal better, than call the original *Spongilla lacustris* by the name *Meyenia.* No doubt a close phylogenetic relationship exists between the genera, but the degree of this relationship cannot probably be guaged accurately by the variability of a single element in the species in question. General morphology is the safer criterion. Now, the dermal spicules would indicate a close relationship to *M. Everetti*, as would also the unusually large-sized statoblasts and the filamentous structures of fascicled, skeleton spicules; only the statoblast spicules have no close resemblance in this case. But *S. Terræ-Novæ* has rather the general appearance of *S. MacKayi*, the statoblast spicules are tangential as in the whole genus generally, and it has dermal spicules as has its congener, *S. lacustris.* On the whole it appears to the author to have much more of the complexion of Spongilla than of Meyenia, and especially more so than of *M. Mulleri* (*Spongilla Mulleri*, Lieberkühn).]

Genus II.—MEYENIA, *Carter.*

Statoblasts generally surrounded by a minutely cellular crust charged with birotulate spicules in a radial position, their axes normal to the chitinous capsule.

5.—Meyenia Everetti.

1884. *Meyenia Everetti*, Mills.
1885. " " MacKay.
1887 " " Potts (Proc. Acad. Nat. Sci., 1887, pp. 230-3).

Sponge green, consisting of numerous, slender, straggling filaments, little more than the one-sixteenth of an inch in diameter, made up of centre lines of closely fasciculated skeleton spicules about 0.008 inch, with short, thin lines of the same, diverging at acute angles. Dermal spicules, minute birotulates, about 0.0006 inch long, with slender, cylindrical shafts and cap-like rotules notched at the margins into five or six hooks. Statoblasts large, about 0.027 inch in diameter, its birotulate spicules averaging 0.0025 inch in length, shafts smooth, slender, widening towards the rotules, which are formed of five or six recurved, acuminate hooks.

Habitat—Mackay's Lake near watershed of Nova Scotia in Pictou County. A few dermal birotulates (if not those of *S. Terræ-Novæ* or some other species) have been found in the diatomaceous deposits from Ben's Lake, Pictou County; and also from sediment from the lakes supplying the water works of Halifax, which the author received from Prof. Lawson.

[Note.—There are three interesting sponges known with minute birotulate, dermal spicules nearly identical. They are *S. Terræ-novæ*, *S. Bohmii*, Hilgendorf, and *M. Everetti*. The first has been found in Newfoundland alone by the author, if Wierzejski's Galician sponge is not identical with it. The second has been found in Ugalla River, near Lake Tanganyika, Central Africa. And the third has been found only in a pond on Mount Everett, 1,800 feet above the sea, in the south-west corner of Massachusetts, and in the localities above named in Nova Scotia.]

6.—Meyenia fluviatilis.

1745. *Spongia fluviatilis*, Linn.
1788. " *canalium*, Linn.
1816. *Spongilla pulvinata*, Lamarck.
1842. " *fluviatilis*, Johnston.
1849. " *Meyeni*, Carter.
1856. " *fluviatilis*, Lieberkühn.
1863. " " Bowerbank.
1867. *Ephydatia fluviatilis*, Gray.
1875. *Spongilla asperrima*, G. M. Dawson
1875. " *stagnalis*, "
1877. " " Vejdovsky.
1880. " *astrosperma*, Potts.
1880. " *polymorpha*, "

1881. *Meyenia fluviatilis*, Carter.
1882. *Ephydatia fluviatilis*, Dybowski.
1882 *Meyenia fluviatilis* var. *acuminata*, Potts.
1883. *Ephydatia fluviatilis*, Vejdovski.
1883. *Spongilla fluviatilis*, Retzer.
1884. *Ephydatia fluviatilis*, Wierzejski.
1885. *Meyenia fluviatilis*, var. *Mexicana*, Potts.
1885. " " " *angustibirotulata*, Carter.
1885. " " " *gracilis*, Carter.
1885. " " MacKay.
1886. *Ephydatia fluviatilis*, Petr.
1887. *Meyenia fluviatilis*, Potts.

Sponge greenish, in massive cushionlike encrustation, often extensively lobular but never decidedly branching. Pores and osteoles conspicuous, surface often showing canals covered by the dermal film only. Texture rather firm. Skeleton spicules fasciculated, about 0.01 inch long, curved, fusiform, gradually pointed, varying from smooth to entirely or centrally spined. No dermal or flesh spicules. Statoblasts numerous, especially towards the base, spherical and variable in size. Crust thick to thin or even none, embedding one, two or more concentric layers of short birotulates with their large, flat, irregularly-rayed rotules tangential to the chitinous capsules, that is, with their axes normal to the chitinous coat—in the radial direction. Length of birotules 0.0005, diameter of rotules 0.0007 inch.

Habitat.—In lakes, ponds and flowing water. Very common. Next to *S. lacustris* in its universality. Nova Scotia and Newfoundland.—*G. M. Dawson.* Paquette Rapids, Ottawa River.—*H. M. Ami.* The Nimpkish River, Vancouver Island —*G. M. Dawson.*

Genus III.—HETEROMEYENIA, *Potts.*

Statoblasts as in Meyenia only having two classes of birotulate spicules, generally differing in shape and in length.

7.—Heteromeyenia argyrosperma.

1880. *Spongilla argyrosperma*, Potts.
1881. *Heteromeyenia* " "
1885. " " MacKay.

Sponge minute, pale greenish, encrusting. Skeleton spicules rather slender, subfusiform, abruptly pointed, sparsely spiniferous, about 0.01 inch long, statoblasts rather large. The greater birotulates are very robust, over 0.005 inch in length, shafts long, often bent, and occasionally bearing strong irregular spines. Rays of the rotules one to four, assuming the form of strong, claw-like hooks, recurved and incurved. The lesser birotules are nearly 0.003 inch in length, abundantly spined, rotules flatter and irregularly hooked.

Habitat.—On submerged sticks, Garden of Eden Lake, Pictou Co., Nova Scotia.—*MacKay.*

8.—Heteromeyenia Ryderi.

1882. *Heteromeyenia Ryderi*, Potts.
1885. " " MacKay.

Sponge greenish, in massive encrustations, texture loose, surface more or less lobed. Skeleton spicules non-fasciculate, nearly 0.013 by 0.0006 inch, fusiform, spined except at the extremities. Statoblasts with inconspicuous tubular foramina. *Greater* birotulates, about 0.0023 by 0.00025 inch; diameter of rotules 0.0006 inch. Shafts with spines hooked towards their centers. Rotules of three to six short recurved hooks. *Lesser* birotulates, 0.0012 inch long. Diameter of rotules 0.0009. Shafts sometimes spined, enlarging towards the rotules which are flat disks with lacinate margins.

Habitat.—Lakelets and old millpond, Pictou Co., Nova Scotia.—*MacKay.*

9.—Heteromeyenia Pictovensis.

1885. *Heteromeyenia Pictovensis*, Potts.
1885. " " MacKay.
1887. " *Ryderi*, var. *Pictovensis*, Potts.

Sponge green, massive, encrusting. Texture very compact. Surface smooth. Spicules non-fasciculated, 0.0075 by 0.00075 inch. Short, robust, cylindrical, curved, with spines diverted towards the ends which may be round and spined or sharply conical. Statoblasts scarce. *Greater* birotulates, about 0.0021 inch with fusiform shafts often spined near the middle, and rotules of three to six irregularly placed rays recurved at their extremities. *Lesser* birotulates, about 0.0012 inch. Diameter of the disk-shaped rotules 0.0009 inch, umbonate, with lacinulate margins.

Habitat.—Lakelets in Pictou County drained to the Atlantic by St. Mary's River, On stones in a small stream flowing into the North-West Arm, Halifax. Spicules of, in sediment of Dartmouth lakes, etc., all in Nova Scotia. In lakes between Conception Bay and Trinity Bay, and at Harbor Grace Junction, in Newfoundland.

This is the firmest and most beautiful of our fresh-water sponges. So distinctive is this character that it can generally be recognised at sight. Although its texture and statoblast spiculation bear a degree of resemblance to those of *H. Ryderi*, the skeleton spicules are so different from those of that species, its varieties, and all other known fresh-water sponges, that it appears to have a clear claim to specific rank. The statoblast spiculation has very judiciously been taken as an artificial criterion for generic delimitation. But to make its morphology the chief factor in specific grouping, against so thoroughly distinctive a skeleton spiculation, looks like forsaking the phylogenetic idea of classification for an artificial one which has no practical advantage. The palæontologist finding these sponge spicules in his geological formations would be likely to go to the other extreme, and make *H. Pictovensis* generically distinct from *H. Ryderi.*

Genus IV.—TUBELLA, *Carter.*

Granular crust of statoblasts charged with trumpet-shaped, or inequibirotulate spicules, the larger rotule resting upon the chitinous capsule.

10.—Tubella Pennsylvanica.

1882. *Tubella Pennsylvanica*, Potts.
1885. " " MacKay.
1887. " " Potts.

Sponge minute, incrusting, greenish when growing in the light. Surface of mature specimens often found bearing parallel skeleton spicules not arranged to form cell-like interspaces. Skeleton spicules variable as to length and curvature, averaging 0.0066 by 0.0003 inch, subfusiform, acuminate or rounded, entirely spined; spines large, conical; terminations of spicules more often round than acuminate. No dermal spicules. Statoblasts small. The diameter of the distal rotule may vary from that of the shaft to that of the large rotule. Margin of large rotule generally entire. Dimensions of inequibirotulates 0.00035 by 0.0001 inch. Diameters of rotules 0.0007 and 0.00015 inch.

Habitat.—On stones in margin of Quidi Vidi Pond, St. John's, Newfoundland, and in lakelets, Pictou County, Nova Scotia.—*MacKay.*

The rotules of the Newfoundland species differ from the Nova Scotian by having the rotules of the statoblast spicules distinctly crenate-rayed.

VIII.—*Notes on the Geography and Geology of the Big Bend of the Columbia.* [Plate XVIII.] By A. P. COLEMAN.

(Communicated by Dr. G. M. Dawson, May 15, 1889.)

The River Columbia rises about eighty miles north of the boundary of the United States, and, after flowing about two hundred miles in a north-westerly direction to the "Big Bend," suddenly turns south, or a little east of south, toward the fjord-like Arrow Lakes and the State of Washington. The great curve thus made encloses on three sides the Selkirks, one of the most rugged parts of British Columbia. Maps of this part of the Province appear to be so defective as to serve only as very general guides to the traveller, who is indeed beset by many difficulties not found in most other regions. It is proposed to give in this paper a brief account of some portions of the region visited by the writer; touching first on some points of geography and statigraphy, and ending with the results of a microscopic examination of a number of rock specimens.

I.—GEOGRAPHY AND STRATIGRAPHY.

(1.) THE SPILLIMICHENE REGION.—About fifty miles from its source, the Columbia is joined by an important tributary, the Spillimichene,[1] rising in the Selkirk Mountains. This river has two main forks, one flowing out of a wild region to the west or south-west, and a longer one rising twelve or fifteen miles south of the mouth of the Kicking Horse (Wapta) and flowing thirty or forty miles nearly parallel to the Columbia, though in the opposite direction. The southerly trend of this and other tributaries is sometimes considered proof that the Columbia, or at least its upper part, once flowed in the reverse direction. It is certain that a slight lowering of the south-eastern end of the valley would allow the lakes in which the Columbia rises to empty southwards into the Kootenay. A careful study of the relative heights of the numerous "benches" (terraces) along this part of the river would throw much light on the subject.

Mountains between the Spillimichene and the Columbia.—The two rivers are separated by a small range of mountains, rising well above the tree line (6,000 to 7,000 feet) toward the head of the main branch of the Spillimichene and gradually sinking to wooded hills at its point of junction with the Columbia. From the higher summits a magnificent view may be obtained of nearly the whole Spillimichene valley, as well as of more than one hundred miles of the broad valley of the Columbia. Their front toward the latter river is very steep, so that one looks down as on a map upon miles of the valley with the winding river, numerous half-choked channels, and crescent-shaped lakes representing abandoned portions of its bed.

[1] This name is variously spelled. The form chosen is that used by Dr. G. M. Dawson in his Mineral Wealth of British Columbia.

Rocks Observed.—This range consists chiefly of quartzites, soft slates weathering into clay, and limestones, the latter sometimes black and seamed with small ramifying veins of calcite, so that they would probably form handsome marbles. These rocks are probably Palæozoic, and of the same age as those described by Mr. McConnell from the western part of Bow Pass.[1] Veins of quartz and calcite are common, and a few dykes of eruptive rock occur. The strata dip at low angles away from the Columbia.

Mountains south-west of the Spillimichene.—The mountains west and south of the longer fork of the Spillimichene are loftier than those just described, and often rise above the snow-line. From the top of one which was ascended, the scene in its confusion of snow, ice and naked rock, reminded one strongly of views from the loftiest points of the Norwegian fjelds. Scores of glaciers were in sight, one toward the head of the west fork of the river appearing much larger than the well-known glacier near the Canadian Pacific Railway. Patches of snow where the ascent was made were of a rosy color, probably caused by the growth of *Protococcus nivalis.*

Rocks Observed.—The rocks observed were chiefly slates, harder than those of the previous range, and with a very perfect cleavage; and also some quartzites. The cleavage cut the lines of stratification of the slate, as shown by bands of lighter and darker grey, at all angles, but did not pass into the quartzite.

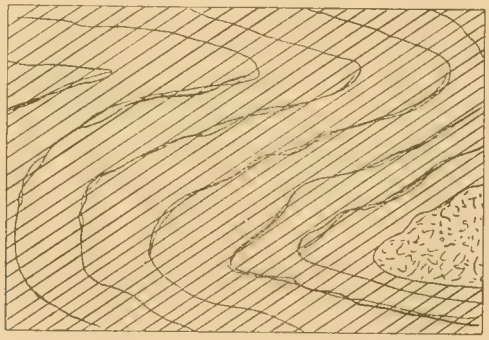

Fig. 1.—Folds of Slate showing cleavage which does not pass into the quartzite. Summit of a mountain south-west of the Spillimichene.

A vein, from 1½ to 5 feet wide, was found to be largely charged with copper pyrites (chalcopyrite.)

(2.) From the Kicking Horse to Beaver.—From the mouth of the Kicking Horse to Donald, the Columbia preserves its gentle character, and, though sometimes divided by low, wooded islands into several channels, follows the wide and straight valley in which it set out. It receives several tributaries from the Rocky Mountains, beside the Kicking Horse; for instance, the Blaeberry and Bluewater, but no large ones from the Selkirks. About half way between Donald and Beaver, the Columbia leaves the broad valley to a tributary and turning west, breaks through walls of slate in a series of rapids and sharp curves. The rocks found in this part are chiefly lustrous slates, and are well

[1] Geological Features of a Portion of the Rocky Mts., Geol. Sur. Can., 1886.

exposed along the railway cuttings following the Beaver valley up the Roger's Pass into the Selkirks.

(3.) From Beaver to Surprise Rapids.—Below Beaver the Columbia flows twenty or twenty-five miles uninterrupted by rapids, though sometimes split into numerous channels by low islands of alluvium. Old channels, dammed at the upper end by masses of driftwood and silt, have the character of bayous, and were formerly greatly frequented by beavers, as shown by the numbers of trees cut by these animals. Some cottonwood stumps displaying the marks of their teeth were more than two feet in diameter. Their numbers are at present much diminished by the work of trappers.

For some distance above Surprise Rapids, the river, which here receives a considerable stream from each side, forms narrow, lake-like expansions. In this part of its course there is only a comparatively low, wooded ridge separating the Columbia from a wider valley to the north-east, occupied by a tributary flowing in the opposite direction and joining the Columbia just below Donald. This is perhaps another hint that the upper Columbia once flowed south-east, before it had dug its way through the walls of slate above Beaver.

In this region, rock was observed by the writer only once, and was found to be slate like that near Beaver.

(4.) Surprise Rapids.—These rapids are well named, since they are almost unseen until one is just upon them, though their roar may be heard a mile or two above. The valley is much narrowed here, and the rapids are caused by barriers of steeply inclined mica schist.

A comparison of barometer readings with those at Donald gives a fall to the head of the rapids of 138 feet; while in the four or five miles of the Surprise Rapids, we found a fall of about 140 feet,[1] of which 55 or 60 belong to the first mile. The first fall will some day afford a magnificent water-power, since a canal of about half a mile through a low, wooded point would render nearly the whole of it available. The engineering difficulties would probably not be serious, and suitable steamers could ply up the river to Beaver, the nearest point on the railway. There is a vast supply of forest within reach, chiefly black and white spruce, with a considerable amount of giant cedar and some white pine.

Mountains north-east of the Rapids.—The nearest summit of the Rockies, four or five miles from the rapids, was ascended, and named Lookout Point. Its height, determined barometrically, is 7,754 feet. A very rugged, triple-peaked mountain, a few miles north of this, bears several glaciers, and was estimated to be 12,000 feet at least in height. It was judged to be Sullivan's Peak or possibly Mount Forbes, and is the highest point in the neighborhood.

Rocks Observed.—Soft, greenish slates and quartzites make the exposed portions of Lookout Point. The quartzites are evidently metamorphosed sandstones, since some of them show traces of ebb and flow structure. The beds dip slightly away from the

[1] Travel along shore is much obstructed, hence the readings of the barometer were often some hours apart, rendering the results less certain than could be wished, though probably not much astray.

Columbia. A massive horizontal bedding, like that of Castle Mount in Bow Pass, is seen on the face of Sullivan's Peak three or four miles away; but the horizontal look is probably only apparent, the strata dipping more or less steeply away from the point of observation. The rocks examined appear to be of the same character as those described by Mr. McConnel from the western part of Bow Pass,[1] though perhaps more indurated.

Mountains to the south-west.—The nearest summit of the Selkirks, three or four miles from the rapids, was also ascended, and its height found, by comparison of barometer readings with those at Donald, to be 8,366 feet. From this point, precipices, snowy mountain tops and glaciers can be seen in all directions. Several peaks of the Selkirks are much higher than the one ascended, at least 2,000 or 3,000 feet. A large glacier in the valley west of the mountain climbed, reached about 2,000 feet lower than the point on which we stood.

The view from the top of Surprise Mountain, as I named it, is wide and interesting. The rapids lie 6,000 feet below, and the river may be traced for about forty miles, from a point a little below Beaver on the south-east to Lake Timbaskis on the north-west. Beyond the river valley, unnumbered summits of the Rocky Mountains are seen, the of highest all, fifty miles to the north, being probably Mount Hooker.

Rocks Observed.—The rocks exposed at Surprise Mount are typical mica and hornblendic schists dipping about 40° to the S. S. W. and with a strike of E. S. E. and W. N. W.[2] In this they differ from the mica schists at the rapids, the latter dipping 50° to 70° toward the S. S. E. These rocks are probably Archæan in age, although they stand several hundred feet higher than the (supposed) Palæozoic slates and quartzites of Lookout Point, less than ten miles away. There must be a great fault separating the two.

(5.) Surprise Rapids to Lake Timbaskis.—From the head of Surprise Rapids to Lake Timbaskis[3] is a distance of perhaps eighteen or twenty miles in a straight line, though not less than twenty-five by the route followed—an old trail along the north-east bank of the river, now almost impassable in many parts from the fall of trees and the growth of bushes and young forest. We saw no trace of inhabitants during the six weeks after leaving Beaver, yet at one point a forest fire was found raging. This may have originated from lightning, as in a case actually witnessed by the writer a few years before on the Gold Range opposite Revelstoke.

Rocks Observed in the Region.—For about ten miles down the river from the head of Surprise Rapids, the rocks observed are pearly, lustrous mica (sericite) schists, sometimes containing small garnets, and dipping at high angles toward the south-east or south. Then follow a few miles of grey, finely banded, schistose limestones, whose boundaries appeared to be hidden by loose materials. From the river bank to the highest point reached, about 3,000 or 4,000 feet above the river, they remained of the same character, being often excessively folded, crumpled and contorted, and containing a few scales of mica. They dip at varying, usually high, angles, and strike about E. S. E. and W. N. W. A stream flows at one point out of a subterranean channel in the solid rock, and empties

[1] Geol. Sur. Can., 1886, p. 25, D.

[2] The bearings given are magnetic. Mr. Carpmael, Director of the Meteorological Office, Toronto, gives the deviation as about 23° 30′ east, in southern portions, and 25° east in northern portions of the Selkirks.

[3] Name as given by Old Uncle, a trapper at Beaver.

into the river a short distance away. Large deposits of travertine have been made by this and other streams.

About eight or ten miles from the last schists, similar rocks are once more found, rising as an abrupt hill. With the exception of a portion of limestone just at the head of Lake Timbaskis, we find only schists for the rest of the way. They appear to be more thoroughly crystalline than those at Surprise Rapids, where a few specimens looked like highly metamorphosed conglomerates, and contained blebs of quartz and felspar. The Timbaskis schists are light, lustrous grey, and usually contain innumerable garnets, small and large, and often large prisms of staurolite, less frequently crystals of disthene.

These schists dip 50° to 80° toward the N.N.E. and north; that is, in the opposite direction from the Surprise Rapids' schists.

From the foregoing it is clear that the boundary between the (Archæan ?) schists and the Palæozoic limestones, slates and quartzites of the Rockies, for the greater part of the distance between Surprise Rapids and Lake Timbaskis, lies north-east of the Columbia. The general course of this portion of the Columbia corresponds to the usual strike of the rocks.

(6.) Lake Timbaskis to Death Rapids.—The trail appears to end at Lake Timbaskis, and since a tributary entering from the north-east at the head of the lake proved difficult to cross, being too wide to be bridged with a tree, I went no farther. The lake is probably ten miles long by two broad, and is nobly placed among lofty mountains rising in forest covered slopes from its margin. It is the home of innumerable wild geese, which kept up a constant turmoil at the time of my visit.

Prospectors who have rounded the bend, report eighteen miles of canyon and rapids just below the lake, so that only staunch boats can make their way down safely. A little beyond is the Big Bend, where the Columbia receives the Whirlpool and Canoe Rivers before starting southward.

The first point visited by the writer on the other side of the bend is Death Rapids,[1] about fifty miles above Revelstoke, where the Canadian Pacific, coming down the Illecillewaet out of Roger's Pass, crosses the Columbia for the second time.

(7.) The Big Bend Gold Region.—Two rivers find their way into the Columbia from the Selkirks near Death Rapids, Gold Creek a little above, and Downie Creek, which would be counted a considerable river in most regions, five miles below the rapids. About two miles above the mouth of Downie Creek is Laporte, the gateway to the once famous mining region of the Big Bend.

From this point a fairly good trail strikes into the Selkirks to a point on Gold Creek where it is joined by McCulloch Creek flowing from the north. Four miles further inland, French Creek empties into Gold Creek from the same side. The placers of these two small creeks afforded at least a quarter of a million dollars' worth of gold during the Big Bend excitement a quarter of a century ago.[2] The trail follows Gold Creek up into the mountains and probably crosses the divide to meet the trail ending at Lake Timbaskis.

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[1] "Dalles de Mort," so named from sixteen men having been drowned there years ago.

[2] See Dr. Geo. M. Dawson's Mineral Wealth of British Columbia, which contains a large store of valuable information on this and other regions of British Columbia.

Rocks Observed.—At McCulloch and French Creeks, green, finely wrinkled schists occur, containing, especially toward the head of the former creek, auriferous quartz veins, which may be looked on as the source of the gold of the placers. Boulders of grey granite and gneiss found along the creeks originate higher up the valley or at the watershed, though none were seen *in situ* by the writer. Similar boulders, some of porphyritic granite, are found on the trail between Laporte and Revelstoke and come probably from higher parts near the axis of the range.

Rivers of the Selkirks.—The streams flowing west out of the Selkirks are larger as a rule than those flowing east, a fact accounted for, perhaps, by the greater rainfall on the slope toward the Pacific, enabling the rivers fed by it to excavate their supply basins more rapidly than those on the other slope, and thus to shift the watershed slowly eastward of the centre of the range. At Donald, where the Canadian Pacific Railway crosses the Columbia for the first time, the level of the river is 2,500 feet above the sea; but at Revelstoke, the second crossing, it is only 1,625—a difference of nearly 900 feet. The streams flowing westward from the Selkirks must therefore have on the average a steeper slope, which no doubt acts in the same way as the increased rainfall in hastening the excavation of their valleys.

Glaciers of the Selkirks.—Perhaps in no part of the world are glaciers more numerous than on this range and the mountains northward toward Alaska and the Arctic Ocean. From many summits of the range, dozens of them may be seen of all sizes from tiny ones with a few acres of *nevé* ending in a tongue of ice, to masses of snow and ice several miles across and covering many square miles of surface. There is evidence showing retrogression of the ice in some cases. Cirques are common just below snow level, and are due perhaps to the erosive power of former glaciers, though it does not seem impossible that they may have been excavated by converging streams. A number of glaciers examined by the writer show signs of recent retrogression in the bareness of the rock of the valley just below the front of the glacier. There appears not to have been time since the withdrawal of the ice for lichens, mosses and other plants to form even the beginning of a bed of soil. A retrogression of the glaciers does not necessarily imply a rise in the annual temperature, since a diminished snow-fall resulting from a change in prevailing winds would have the same effect.

Difficulties of Exploration.—Every one who has attempted exploration in the Selkirks will agree that few mountain ranges offer so many obstacles to the explorer and the geologist. The moist and comparatively mild climate causes an immense growth of forest and underbrush, much greater than that of the Rockies, for instance, so that up to about 7,000 feet[1] the rock is largely hidden by vegetation, except along the watercourses. Unclothed precipices are much more common, according to the experience of the writer, in the Rocky Moutains, perhaps because, from their later origin, they have not suffered so much from erosion. Their drier climate must work in the same direction of limiting erosion.

Travel through the forests of the Selkirks is very laborious. In most cases all necessaries must be carried on the back—no light matter when a trip of two weeks is undertaken, up steep inclines, through second-growth evergreens so thickly planted that

[1] The tree line is at 6,700 feet on Surprise Mount, and about 7,300 on the southern side of Lookout Point.

they must be parted with the hands; or among the tangled box-alders along river margins, or the jungles of prickly "devil's-clubs" that rise as high as one's head in swamps. Windfalls and snow-slides, where great trunks of spruce or *Thuja gigantea* lie heaped upon one another, also form most disheartening obstacles at times. On the western slope, continued rains and swollen creeks add frequently to the difficulties of travel.

II.—Microscopic Petrography of Rock Specimens.

(1.) *The Spillimichene Region.*

Slates.—The soft clayslates of the range between the Spillimichene and the Columbia belong in all probability with the Palæozoic slates of the Rocky Mountains and need not be described here. They readily crumble to clay and so are not easily made into sections thin enough for microscopic work. The harder, somewhat more crystalline slates south-east of the northern branch of the Spillimichene are more easily handled and are more characteristic of the Selkirks.

Macroscopic Description.—These slates are very fissile, the cleavage crossing at varying angles the planes of stratification indicated by bands of lighter and darker grey. They often contain cubes of pyrite, sometimes distorted by the pressure that formed the cleavage. In a crystal measured, the angles between the faces meeting in edges exposed to compression were enlarged from 90° to 93° 30′.

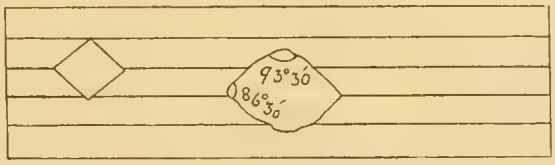

Fig. 2.—Distorted Crystals of Pyrite in Slate.

Microscopic.—Thin sections show a micro-crystalline or crypto-crystalline structure with many opaque, dusty looking particles, especially in the darker bands. Splinters of the rock grow lighter in color when heated in a Bunsen burner, showing that at least part of the dark substance is carbon. The transparent parts have not a clastic look. Quartz may form a part of the obscurely anisotropic substances, but chlorite or some related fibrous or scaly mineral seems more important. The vague fibres and oblong sections seem to have extinction parallel to the chief sections of the nicols. A scaly, slightly dichroic mineral, occurring in larger particles, is perhaps muscovite. Immense numbers of minute rutile needles are scattered through the rock, often in groups with roughly radiating points, and sometimes with characteristic knee-shaped twins.[1] Between crossed nicols the rutile needles gleam out as brilliantly-colored threads. Small portions of a yellow brown, slightly translucent substance scattered here and there may be hydrous sesquioxide of iron.

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[1] See plate xviii, fig. 1.

A Transition Form.—*Macroscopic.*—One specimen is of a different type, not so fine grained, and banded with greenish and brownish layers cut through by a very perfect cleavage.

Microscopic.—Little or no carbon or other amorphous substance can be seen, but many small grains of quartz of clastic origin and containing cavities with libellules. A little plagioclase is observed, badly weathered, and some muscovite. Yellowish, and also pale greenish substances, which are plentiful, may be considered varieties of chlorite. Scales of the latter have sometimes a roughly radial arrangement about grains of quartz. The brown bands contain much hydrous sesquioxide of iron.

(2.) *Region near Beaver.*

Slates.—*Macroscopic.*—A well known series of slates is found near Beaver, along the railway, the rocks ranging in color from light grey to dark iron-grey, lustrous in surface, sometimes almost as if polished with graphite. They have usually a well marked cleavage, sometimes two, cutting at an angle of 100° to 120°. They are often finely corrugated and may even show two sets of wrinklings. Some have the speckled appearance of the German Knotenschiefer. Cubes of pyrite are common inclusions.

Microscopic.—In general the components of the slates are the same as those of the Spillimichene, carbon particles and perhaps other amorphous material of clastic origin, with quartz in small quantities, much of a chloritic substance and numberless fibres of rutile. In addition a little muscovite and also biotite with brown oxide of iron. In some specimens, however, the quartz increases greatly in quantity, and calcite also plays an important part. The Knoten or Garben in the spotted slates are nearly opaque, so that their composition could not be determined. They are perhaps of a concretionary nature.

Rocks Intermediate between Slates and Quartzites.—*Macroscopic.*—A few light greenish rocks from Beaver seem related to slates and quartzites, but with a leaning toward mica schist. One specimen contains blebs of quartz and felspar, as though a metamorphosed conglomerate with small ovoid pebbles.

Microscopic.—The allogenous portions are much more important in size and amount than in the slates. Fragments and blebs of quartz, containing fluid cavities with bubbles, form much of the rock; and greatly weathered felspar is also found. The autogenous elements form larger and far more distinct individuals than in the slate. The quartz fragments are often surrounded in a roughly radial way by confused scales of colorless or blue-green chlorite. Mingled with it are secondary quartz, a few lamellæ of muscovite and biotite, and grains of magnetite, sometimes rectangular in cross section.

The finer grained varieties remind one somewhat of the last specimens described from the Spillimichene.

(3.) *Surprise Rapid.*

Mica Schist (Sericite Schist).—*Macroscopic.*—Most of the rocks exposed near the rapids are very fine-grained, greenish grey and with pearly, lustrous cleavage surface. The schistose structure seems to correspond to the bedding. Small garnets and oblong portions of dark biotite are abundant.

Microscopic.—Clastic looking fragments of quartz form a large part of the rock, and mixed with or folded about them is a pale green mica-like mineral, probably the variety of muscovite called sericite, or possibly chlorite. Irregular masses of brown biotite, garnet, magnetite, and small quantities of titanite, may be looked on as accessory minerals.

In addition to the minerals described, one bluish grey specimen contains a considerable amount of plagioclase, long crystals of hornblende (greenish blue and yellow dichroism) bordered with biotite, and slender colorless prisms, with a rough basal cleavage and parallel extinction, perhaps sillimanite.

SCHISTOSE CONGLOMERATES.—*Macroscopic.*—A few greenish schistose rocks are filled with small round or angular fragments or pebbles of quartz and felspar. They remind one of a rock described from Beaver.

Microscopic.—The quartz is of the kind usual in granites; the felspar sometimes shows the plagioclase structure, but often appears to be orthoclase, though too badly weathered to be unmistakably so. The enclosing layers consist of green and brown biotite, muscovite (sericite) and blue green chlorite, with many grains of magnetite. The autogenous minerals are much more highly individualized than in similar rock from Beaver.

(4.) *Surprise Mountain.*

MICA SCHIST.—*Macroscopic.*—The medium-grained, brownish-grey mica schist from the summit of Surprise Mountain, differs much in habitus from the fine grained sericitic schist from the rapids at its base. Unlike the latter, it shows little or no evidence of a clastic origin of any of its constituents.

Microscopic.—The rock contains large quantities of quartz, primary in appearance, with cavities showing libellules in motion, probably a little felspar, and much brown biotite with optic axes rather wide apart. There is also a considerable amount of muscovite in well defined individuals very unlike the confused, wavy masses found in the Surprise Rapids schists. There are some yellowish and greyish decomposition products, much magnetite and a few garnets.

HORNBLENDIC SCHIST.—*Macroscopic.*—Interstratified with the mica schist is found a fine grained, dark grey, almost black, hornblendic schist.

Microscopic.—It proves under the microscope to be thoroughly crystalline and autogenous in look; and consists chiefly of quartz in small, clear individuals, and green hornblende showing no crystalline forms, but clean edged and of a primary appearance. A little biotite and many sharply-outlined black grains, probably of magnetite, are also found.

(5.) *Lake Timbaskis Region (Rocky Mountain side of the Columbia)*

QUARTZITES.—*Macroscopic.*—These rocks occur near the Timbaskis schists, but are very distinct in habitus. They are white, yellowish white or light grey, always show a few scales of mica on cleavage surfaces, and sometimes enough mica to form a transition toward mica schist.

Microscopic.—Nearly the whole of the rock proves to be made up of quartz in larger or smaller fragments, sometimes looking as if clastic in origin. These are often surrounded and wedged in by small, probably secondary, individuals as a tesselated border. The larger grains have the usual inclusions, cavities containing water and also liquid carbonic acid. In addition we find a few scales of muscovite, a fragment or two of hornblende, and some minute yellow grains, probably of titanite.

Mica (Sericite) Schists.—*Macroscopic.*—These are lustrous, pearly or reddish grey schists with wavy micaceous lamellæ folded about various minerals, such as garnet, staurolite and disthene. All of these minerals sometimes occur in crystals an inch or more in length, and they may be so crowded as to make up fully half the rock, garnet being commonest and staurolite next in order. In such cases the rock should perhaps be named garnet, staurolite or disthene schist.

Microscopic.—Quartz occurs of the usual kind, but is variable in amount and at times quite absent. The chief constituent is sericite in wavy, confusedly parallel scales; but a considerable amount of biotite is also found. The garnet is of a pale flesh-color in thin sections. The staurolite displays a magnificent dichroism, orange red parallel to the longest axis and yellow perpendicular to it. The less common disthene shows no pleochroism, but has brilliant polarization colors. Small red brown grains and crystals of titanite are very common.

Gneiss.—*Macroscopic.*—A specimen obtained from a boulder, found near the trail on the north east shore of the Columbia, appears to be gneiss, though none was seen *in situ.* It is the only specimen of the kind known to the writer from the Canadian Rocky Mountains. Could it have been transported, by glacial action, for instance, from the Selkirks across the river? The rock is slightly schistose in appearance, medium grained, and light-brownish grey in color, with patches of black mica.

Microscopic.—It contains little quartz, much microline and plagioclase and a quantity of green, and also brown, biotite. Oxides of iron and epidote occur in small amounts as decomposition products.

(6.) *French Creek (Big Bend Gold Region).*

Chlorite (?) Schist.—*Macroscopic.*—The only specimen at command was obtained at Frenchtown four years ago. It is a finely-corrugated lustrous schist of a grey-green color much darker than that of the sericite schist of Surprise Rapids on the other side of the Selkirks.

Microscopic.—It consists of quartz in small, clear portions, a very little plagioclase, and much of a blue green mineral, probably chlorite, in irregular, slightly dichroic, scales. A little green biotite seems also to occur; and innumerable, small, greenish yellow crystals of rutile are imbedded in the minerals first mentioned. The rutile crystals have sharp relief, frequently form knee-shaped twins, and are almost always associated with grains of a black, opaque mineral that seems to be magnetite.[1] Rhombohedra of calcite are found scattered through the rock.

[1] See plate xviii, fig. 2.

HORNBLENDIC GNEISS.—*Macroscopic.*—A specimen from a boulder at Frenchtown is of medium grain, rather dark grey, and slightly schistose in appearance.

Microscopic.—It consists of quartz with fluid cavities containing salt cubes; much orthoclase, some of it microperthitic, with trichites and other inclusions, much hornblende of dark green and yellow tones, and a little brown biotite. Apatite and magnetite are found in small quantities, and epidote is a decomposition product.

GRANITE.—*Macroscopic.*—Several specimens of granite were obtained from boulders at French Creek and at points on the trail between Laporte and Revelstoke. They are light grey, medium to coarse-grained rocks, often porphyritic, containing oblong white cross sections of felspar sometimes an inch in length. The smaller felspars are yellowish white and more weathered than the larger ones.

Microscopic.—Quartz of the kind usual in granite is abundant; also orthoclase, where not replaced by microcline, which is often the case. Microperthite and plagioclase are less important. The porphyritic crystals are of microcline, so far as observed. Biotite and hornblende occur in considerable amounts, replacing one another. Apatite is frequent, and epidote, the latter a product of decomposition.

(7.) *Roger's Pass* (*C. P. R.*)

MICA SCHIST.—*Macroscopic.*—The mica-schists are chiefly white or light grey, consisting of quartz and muscovite. They sometimes approach the quartzites from the small quantity of mica they contain. A distinct variety, dark iron grey, with metallic lustre, occurs at Albert Canyon on the Illicillewaet.

Microscopic.—The quartz has often a clastic appearance. The colorless muscovite is of the usual kind, not sericite. No chlorite has been observed in my specimens, which however are only three in number, excluding the rock from Albert Canyon. The last mentioned rock gets its black color from the large number of dark, amorphous looking particles it contains in addition to quartz and mica. That the black substance is carbon, or some carbon compound, is proved by the fact that a fragment readily burns white in the blowpipe flame; and the gases formed, when it is heated in a glass tube in a current of oxygen, give with limewater a milky precipitate, which is re-dissolved by continued passage of the gas.

GNEISS.—*Macroscopic.*—The two specimens in my collection (one from the "summit" of the pass) are fine grained, very light colored, and not very schistose. They are far from typical specimens as compared with Laurentian gneiss from Ontario.

Microscopic.—They contain quartz, some orthoclase and microcline, and plagioclase; also a little microperthite, and biotite and muscovite in small quantities.

III.—CONCLUSION.

An attempt has been made in the first part of this paper to give by brief descriptions some idea of parts of the Selkirks not easily reached from the railway, and hence rarely visited. When the region has been rendered more accessible by means of trails

it should become interesting, not only to the sportsman, botanist and geologist, but to every one who loves wild alpine scenery, glaciers and torrents, beautiful valleys and rugged mountain tops.

In regard to the geological features of the region, the extent to which metamorphism has gone on becomes important. Are the slates southwest of the Spillimichene and those of Beaver older than the Palæozoic slates of the Rockies? Or are they of the same age but modified by more intense compression and more complete recrystallization of the sedimentary materials? A certain answer to this would demand a large amount of stratigraphical work or the finding of fossils.

The slates near Beaver are associated with greenish, highly schistose rocks that seem connecting links to the mica schists; and also with what appear to be greatly metamorphosed conglomerates. All the thin sections examined from Beaver appear to contain considerable quantities of clastic material. The sericite schists of Surprise Rapids are much more crystalline, but yet contain grains of quartz apparently of allogenous origin; and one associated rock much resembles the metamorphosed conglomerate of Beaver. The schists of Lake Timbaskis seem still more thoroughly crystalline than those just mentioned, but yet show traces of clastic materials. It is possible that all these rocks may be of Cambrian age, though they are more probably Huronian, at least those that are more highly crystalline. The Timbaskis sericite schists are interesting for the number and size of the included crystals of garnet, staurolite and disthene.

The mica and hornblende schists of Surprise Mountain appear thoroughly autogenous and crystalline, and without evidence to the contrary, must be looked on as Archæan, perhaps equivalents of the eastern Laurentian.

On the other side of the Selkirks the green schists of French Creek are perhaps to be ranked with the sericite schists of Surprise Rapids, though rather more crystalline and devoid of evidently allogenous substances.

The black schist of Albert Canyon, again, appears to be largely of clastic, perhaps partly of organic, origin, since the quartz looks fragmentary and the carbonaceous matters can hardly be accounted for without life. From the ease with which the coaly matter burns we may conclude that metamorphism has not gone so far as to form the allotropic form, graphite, as has been the case in the Laurentian of Ontario. It is probable then that the rock of Albert Canyon, twenty miles east of the second crossing of the Columbia, is not Archæan, but of considerably later age.

The gneisses from the central parts of the range are not, so far as examined by the writer, typical, when compared with those of eastern Ontario. On the other hand the granites are quite characteristic, containing the minerals found in the same rock from eastern localities, especially the microcline so common in most Ontario granites. In habitus, the granites of the Selkirks differ much from those of the eastern Laurentian, being light grey, instead of red, in color, and much more apt to be porphyritic.

IX.—*The Yield of Spring Wheat, Barley and Oats, grown as Single Plants.*

By WILLIAM SAUNDERS.

(Read May 31, 1889.)

The percentage of yield obtainable from well cultivated plants of the more important cereals is much larger than is generally supposed, and the results obtained by farmers in the ordinary cultivation of their land give no correct idea of the possible yield. Under varying conditions of soil, cultivation, and season, the yield of wheat in Canada varies from about 12 to 40 bushels per acre, barley from 20 to 50 bushels, and oats from 25 to 80 bushels. Estimating the quantity of wheat and barley used as seed at two bushels to the acre and oats at two and a half bushels, we have in the above results the following percentages from ordinary field-culture:—Wheat, 7½ to 22 fold; barley, 10 to 25 fold; oats, 10 to 32 fold.

During the summer of 1888 a large number of different sorts of cereals were grown on the Central Experimental Farm as single plants, for the purpose of ascertaining the relative productiveness of the several varieties. Fifty grains were planted in each instance in two rows of twenty-five each, placed one foot apart each way, with two feet of space between every sort, so that each plant had ample room for its full development. One of the most promising looking plants was selected from each plot and threshed separately to ascertain the maximum yield. Three or four of the next best plants were harvested together, and the yield ascertained, while the entire number of the remaining unselected plants formed a third grade which was also separately threshed.

The number of experimental plots was 265, of which 114 were spring wheat in 74 varieties, 56 of barley in 49 varieties, and 95 of oats in 80 varieties. Of some of the leading sorts, two or three plots were sown with seed obtained from different localities in the endeavour to gain information as to the influence of climate and cultivation on fertility. The land selected for these experiments was a rather light sandy loam, which had for many years been under crop, and appeared to be in a very uniform condition but somewhat impoverished. After the grain was well up, a top dressing was given of a mixture of nitrate of soda, bone dust and unleached wood ashes in the following proportions per acre: 200 lb. nitrate of soda, 500 lb. bone dust, and 1,000 lb. ashes.

WHEAT.

The highest yield of wheat obtained from the plants of the first selection was from the Ladoga which gave 1,292 fold, the lowest was from the Eldorado which gave 207 fold, the average from the 114 selected plants being 631 fold. From the second selection the largest was from Pringle's Champlain 1,400 fold, the lowest from Medea, a European

sort, 123 fold, and the average from 326 plants was 610 fold. From the third grade of plants, which usually included more or less weakly ones, the highest yield was 852 from the Fern wheat, and the lowest from the Greek Summer, from Russia, 124 fold, the average of 3,142 plants being 406 fold.

The following were among the varieties of wheat which gave the largest yield:—

Varieties.	Yield of Single Selected Plants.	Yield of 3 or 4 Selected Plants.	Average Yield of Unselected Plants.
Ladoga	1,292	688	674
Kubanka	1,254	1,019	830
Victoria de Mars	1,245	769	467
Bearded Summer	1,224	1,149	698
Saxonka	1,107	861	554
Bearded March	1,079	833	426
Pringle's Champlain	1,045	1,400	668
White Fife	1,034	842	634
Fern	1,029	993	852
Herison's Beardless	1,020	967	534
The average of three plots of Red Fife gave	905	859	597

Barley.

The highest yield of barley obtained from among the first selected plants was that of the Imperial Improved American, which gave 1,892 fold. This, however, is a six-rowed barley of light weight and inferior quality. The heaviest yielders among the six-rowed barleys were as follows:—

Varieties.	Yield of Single Selected Plants.	Yield of 3 or 4 Selected Plants.	Average Yield of Unselected Plants.
Imperial Improved American	1,892	1,365	806
Six-rowed wheat barley	1,705	1,131	745
Small blue naked	1,326	614	578
Six-rowed from Northwest Territories	1,309	597	628
Spring	1,075	840	637
Rennie's Improved six-rowed	980	895	592

The largest yield among the two-rowed sorts was that of the Danish Chevalier, which produced 1,203 fold. The smallest yield of barley from the plants of the first selection was 125 fold. In the second selection of 3 or 4 plants, the largest yield among

the six-rowed sorts was that of the Imperial Improved American, which gave 1,365 fold; the most productive of the two-rowed sorts in this class being the New Zealand, which gave as the average of three plants 918 fold, the average yield of the 198 selected plants being 764 fold. From the unselected plants which comprised the entire remainder, numbering 2,146 in all, the average yield was 442 fold. The best yielders of the two-rowed sorts were:—

Varieties.	Yield of Single Selected Plants.	Yield of 3 or 4 Selected Plants.	Average Yield of Unselected Plants.
Danish Chevalier	1,203	733	512
New Zealand	1,114	918	692
Screened French	1,014	672	390
Italian	962	490	452
Swedish	943	939	591
Peerless White	913	777	540

Oats.

The highest yield of oats from among the 98 selected plants was from a variety known as Scotch oats, from British Columbia, which gave 3,539 fold, the lowest was from an unnamed variety obtained from Oregon, which gave 355 fold, the average of the plants of the first selection being 1,458 fold. From the second selection, containing 379

Varieties.	Yield of Single Selected Plants.	Yield of 3 or 4 Selected Plants.	Average of the Unselected Plants.
Scotch from British Columbia	3,539	1,483	996
Hopetown	2,878	1,990	1,524
White Oats from Lincolnshire	2,700	1,313	1,221
Russian Black	2,628	1,315	
Black Oats from Lincolnshire	2,600	1,575	1,092
Egyptian	2,578	1,148	848
Red Crowned	2,459	2,406	1,023
North Dakota	2,450	1,524	1,621
Bohemian Hulless	2,445	1,816	874
Georgia Early White	2,382	1,852	1,079
Rust Proof	2,262	1,796	1,133
Clydesdale	2,251		1,180
Welcome	2,233	1,168	728

plants, the average was 1,272 fold, and from the unselected plants, numbering in all 3,384, the average obtained was 817 fold. The table on the previous page gives the varieties that yielded best.

The seed obtained from these single plants, when compared with the seed from which they were grown, was found to be larger and heavier; the increase in some instances amounting to from 25 to nearly 50 per cent. The grain used for seed in the experiments for a similar series in 1888 was of an average character unselected: that chosen for experiments in 1889 has been carefully selected, only the largest and plumpest grains being chosen. It is expected that, if the season is favorable, this will result in a more uniform yield throughout the entire series, and it is hoped that, by continuing this process of selection, a high grade of grain will in some instances be obtained which shall be impressed with a tendency to produce grain of larger size and in increased quantity.

X.—*Some Remarks on the Classification of the Trilobites, as influenced by Stratigraphical Relations: with Outline of a New Grouping of these Forms.* By E. J. CHAPMAN, Ph.D., LL.D., Professor in the University of Toronto.

(Read May 8, 1889.)

(1.) It may be taken as an undoubted fact that palæontological classification has been very greatly influenced of late years by stratigraphical considerations. This is seen not only in the current subdivisions of the Trilobites, but in those also of the Ammonites and other extensive groups. These stratigraphical classifications have the advantage of being readily effected. They save trouble, by requiring little or no thought for their construction, and they are of course useful to the geologist as palæontological lists: but there their value ceases. Structural affinities become by this plan more or less unrecognized; and forms with but few characters in common, if occurring at the same geological horizon, are thus often forced into false relationship, rendering even moderately rigid definitions of families and other groups practically impossible.

(2.) It might be thought, in opposition to this view, that contemporary forms of a given order or family must be more nearly related to each other than to forms of the same order or family occurring at earlier or later periods. But this conception is certainly in the main erroneous. Forms of the same geological horizon should naturally offer fewer points of generic agreement than forms of different horizons. The latter may be connected by more or less direct evolution: whereas forms of the same horizon can only be related generically, if at, all, through some remote ancestral type, from which, also, other distinct orders and classes may have sprung. In one case, there may be direct relationship: in the other, the connection can be little more than indirect.

(3.) An impression prevailed widely at one time, and perhaps still prevails, that the so-called "Primordial Trilobites" are distinguished from the Trilobites of higher horizons by a combination of characters peculiar to themselves, by which a marked "primordial aspect" is imparted to them. These characters, as commonly formulated, comprise:—A large, typically horned or spiny head-shield, with numerous body segments and a very small pygidium. This definition fails, of course, completely in the case of the eminently Cambrian family, the Agnostidæ. But setting aside these still somewhat problematical forms, and looking only to the typical Trilobites, it is found to be equally inapplicable in many other cases. Whilst, for example, it holds good in Paradoxides, Olenus, Eurycare, and some few other Cambrian genera, we find the same combination of characters—the large and horned head-shield, the long thorax, the small pygidium—present also in Harpes, an essentially Upper Silurian and Devonian genus, unknown in Cambrian strata. The imaginary primordial aspect is sufficiently well marked in the Cambrian Olenus; but in the Silurian and Devonian Arethusina or Aulacopleura we see a combination of characters very similar to those of Olenus, among which may be specially cited the comparatively short glabella, spiny head-shield, open facial suture, small eyes connected

by a ridge or band with the glabella, narrow body-axis with numerous or comparatively numerous segments, and small, short pygidium. Again in the Cambrian Dikelocephalus, and in Ctenopyge (Linnarsson), the pygidium is very large—thus presenting a marked departure from the so-called primordial type. Other examples might be cited to prove, (1) that these imaginary primordial characteristics are present in various post-primordial genera, and (2) that they are not always present in primordial or Cambrian types.

(4.) Nothing, perhaps, shows more forcibly the arbitrary, unnatural character of stratigraphical groupings, than the collocation in recent classifications of Neseuretus, Hicks, side by side with Paradoxides in the family of the Olenidæ. In all its leading characters, Neseuretus is simply a Cambrian Calymene, probably the ancestral source of the latter type; but in the classifications referred to, these genera are placed in different families and widely apart. To show these points in all their distinctness, viz., the close agreement of Neseuretus with Calymene, and its remote relations to Paradoxides, a comparative view of their more characteristic structures is given in the following table :—

	Neseuretus.	Calymene.	Paradoxides.
Glabella	Contracted anteriorly, 3 lateral furrows.	Contracted anteriorly, 3 lateral furrows.	Expanded anteriorly. Transverse and lateral furrows.
Thorax	13 segments	13 segments	16 to 20 segments.
Pygidium.	Comparatively wide, with furrowed sides, and 8 to 10 rings in its axis.	Of moderate width, with furrowed sides and 6 to 11 rings in its axis.	Very small and narrow, with rarely more than 2 or 3 rings in its axis, the sides forming merely a smooth border.

In these recent classifications, also, we find Dikelocephalus arranged under the Olenidæ, whilst Arethusina and Harpides, which agree very strikingly with Olenus in their more salient characters, are placed far apart from the latter under the Proetidæ, evidently upon purely stratigraphical grounds. The structural relations of these genera are briefly indicated in the annexed tabular view :—

	Dikelocephalus.	Olenus.	Arethusina.
Glabella	Comparatively large,	Comparatively small.	Quite small.
Facial sutures .	Forming a point above the glabella	Open anteriorly.	Open anteriorly.
Eyes	Large. Unconnected with the glabella.	Comparatively small. Connected by a band with the glabella.	Comparatively small. Connected by a band with the glabella.
Body-axis.	Comparatively broad.	Narrow.	Narrow.
Pygidium.	Very large, with comparatively short axis.	Small, but with extended axis.	Small, but with extended axis.

(5.) As the Trilobites have no known Post-Palæozoic representatives, and are practically confined to strata representing the earlier and middle periods of the Palæozoic Age, broad distinctions, such as those which separate the Palæozoic Crinoids and Echinida from Mesozoic and higher forms of these orders, cannot obviously be looked for in any classification. Added to this disadvantage, there are other drawbacks which beset at present, and render difficult, the systematic grouping of the Trilobites. Briefly stated, these comprise, first of all, the very lax manner in which fragmentary examples have been referred to known types, or placed, as new genera, in families with which they have but few points of resemblance. Definitions, applicable enough in the first instance, become thus, after a time, of almost impossible application—the original definition being so extended as to include forms of very dissimilar structure. Mathematically rigid definitions in the grouping of organic forms cannot, of course, be strictly enforced without, at least, greatly multiplying our classification groups ; but better an undue multiplication of orders and families, than this license of indefiniteness that now so habitually prevails. Another source of difficulty lies in the remarkable dissimilarity of aspect which exists in the case of many species commonly referred to one and the same genus, as seen in Asaphus, Proetus, Cheirurus and other forms. This has led to the creation of numerous sub-genera, by which, however, the difficulty is in no way lessened—family definitions still remaining vague and diffuse.

(6.) In the classification shown, as regards its leading features, in the annexed synopsis, the Trilobites, considered as an order of Crustacea, are arranged under four sub-orders, or primary groups, founded on general structure and configuration, with subordinate sections based, as far as possible, on some striking or typical character. This latter, however, is to be taken in connection with the general characters of the sub-order to which the section may refer. The names attached to these sections refer necessarily to single characters, and they are thus to be regarded as names only, not as definitions. It is thought, however, that they may serve to bring rapidly before the mind's eye the more salient or special features of the types to which they refer. In the collocation of the families, an attempt is made to place them in as connected a sequence as possible, so that each family shall present relations to the family which follows it, whether placed in the same section or under contiguous sections ; but in a linear system of arrangement, and especially where the objects to be classified are not very numerous, it is not possible to avoid occasional breaks in the continuity of the series.

In offering this new classification, I am not sanguine enough to expect that it will meet with general acceptance. In its subdivision of genera, and the recognition of these subdivisions in one or two cases as the types of new families, and in its disregard of stratigraphical considerations, it will necessarily ruffle existing prejudices. But it may tend to bring under more immediate notice the indefinite and hence unsatisfactory character of our commonly received subdivisions, and so lead eventually to a more successful grouping of these ancient forms.

Order **TRILOBITA.**

Sub-Order I.—PUSILLIFORMES.—Small, aberrant trilobites, with typically two thoracic segments, and head-shield and pygidium of nearly equal size.

Fam. 1. *Agnostidæ.*—Typical genus, *Agnostus*, Cambrian, Lower Silurian.

Sub-Order II.—LATIFORMES:—More or less broad, often large, trilobites, with head-shield, thorax and pygidium of nearly equal dimensions. Body-segments typically 8 to 10 in number. Surface of shell commonly marked with wavy marginal lines.

§ 1. Levati.—Broad-formed or oval trilobites, with essentially smooth shell, and inconspicuous or feebly elevated glabella.

Fam. 2. *Illænidæ.*—Pleuræ unfurrowed. Pygidium with smooth sides and smooth or feebly furrowed axis. Typ. gen.: *Illænus*, Up. Cam., Sil.; *Bumastus*, Sil.; *Nileus*, Lr. Sil.; *Stygina*, Lr. Sil.

Fam. 3. *Asaphidæ.*—Pleuræ furrowed. Pygidium with smooth sides and smooth or feebly furrowed axis. Typ. Gen.: *Illænurus*, Cam.; *Niobe*, Lr. Sil.; *Asaphus*, Lr. Sil.; *Psilocephalus*, Cam.; *Barrandia*, Lr. Sil.; *Bathyurellus*, Lr. Sil.; *Bathyurus*, Cam., Lr. Sil.; *Megalaspis*, Lr. Sil.

Note.—The two families of this section, although widely separated in the classification of Barrande, are very closely allied, and are commonly united in more recent systems, principally from the fact that certain genera—Illænurus, Niobe and Stygina, more especially—appear to form an intermediate or transition group. But the typical representatives of each family are clearly characterised, and connecting points of this kind are abundantly traceable in the case of other families universally regarded as distinct. In the present classification, indeed, the collocation of the families is based, as far as this can be carried out, on the existence of these connecting or transitionary forms.

As regards Family 3, I have separated from the Asaphidæ proper the forms with horned head-shield and strongly furrowed pygidium, and have placed these in a distinct family under the generic name of Basilicus, already applied to them, as a sub-genus of Asaphus, by Salter. This is warranted by the very marked contrast presented by these strongly furrowed, lobate and conspicuously horned forms, to the smooth Illænidæ and Asaphidæ. The horned genus, Megalaspis, forms the connecting link.

§ 2. Sulcati.—Broad-formed or oval trilobites with horned head-angles, pointed pleuræ, and large, strongly-furrowed pygidium.

Fam. 4. *Basilicidæ*—Glabella with short side-furrows, or smooth. Typ. gen.: *Basilicus* (=*Asaphus* in part), Lr. Sil.; *Oxygia*, Lr. Sil.; *Homalotopeon*, Lr. Sil.

Fam. 5. *Dikelocephalidæ.*—Glabella strongly developed, with transverse or side furrows. Number of body-segments unknown. Typ. gen.: *Dikelocephalus*, Cam.; *Dorypyge*, Cam.

Note.—Dikelocephalus, as a Cambrian type, is commonly placed with Parodoxides and other Cambrian forms under the family of the Olenidæ. But from these it is distinctly separated by its large pygidium. This latter character, together with its horned head-shield and the meeting of its facial sutures in a spade-like point above the glabella, connects it far more closely with the horned and furrowed Asaphidæ or Basilicidæ, in many of which, as well as in many species of the Asaphidæ proper, the course of the sutural outline is the same. The greater number of body-segments may

prove to be a divergent character, but the actual number of these is at present uncertain, and in the closely related Dorypyge the thorax is entirely unknown.

§ 3. Palmati.—Broad-formed trilobites, with large, short-axed, radiately-furrowed pygidium.

Fam. 6. *Lichasidæ*.—Pleuræ furrowed. Pygidium with short, broad axis and deeply indented margin. Typ. gen.: *Lichas*, Sil.

Fam. 7. *Bronteidæ*.—Pleuræ with slightly raised surface-band. Pygidium with very short axis and entire margin. Typ. gen.: *Bronteus*, Lr. Sil., Dev.

§ 4. Columnati.—Trilobites of more or less oval form, with large pygidium, the axis of which is typically long, prominent and many-segmented.

Fam. 8. *Phaetonidæ*.—Glabella short, conical. Body-axis comparatively narrow. Pygidium in some cases with digitated outline. Typ. gen.: *Phaeton*, Sil., Dev.; *Dechenella*, Dev.; *Brachymetopus*, Carb.

Fam. 9. *Proetidæ*.—Glabella large, smooth or furrowed. Body-axis comparatively broad. Axis of pygidium typically with 10 or more pseudo-segments. Typ. gen.: *Proetus*, Sil., Dev.; *Phillipsia*, Dev., Carb.; *Griffithides*, Carb.

Note.—The family of the Proetidæ, as commonly recognized, includes under the genera Proetus and Phillipsia forms of marked dissimilarity of aspect, so far, at least, as regards the glabella and to some extent the relative width of the body-axis. Whilst in Proetus proper the glabella is very large, reaching quite, or very nearly, to the anterior margin of the headshield, in the forms referred to the sub-genus Phaeton (= *Proetus striatus*, Barr.) it is remarkably short and small. The digitated margin of the pygidium, sometimes referred to as a sub-generic distinction, is a character of quite subordinate value. In Dechenella and in Brachymetopus, commonly placed under Phillipsia, there is a similar departure, as regards the glabella, from the typical generic form [1]. I have, therefore, separated these types with short glabella from the genera with which they are commonly associated, and have placed them in a distinct family.

Sub-Order III.—CONIFRONTES.—Trilobites of more or less elongated form, tapering downwards. Body-axis of 13 or more segments, not distinctly separated from the pseudo-segments of the axis of the pygidium. The latter, typically, of moderate size, or small. Glabella: coniform, contracted (or not expanded) anteriorly.

§ 1. Longiconi.—Glabella comparatively large, extending to, or nearly to, the anterior margin of the head-shield. Facial sutures terminating at the genal angles.

Fam. 10. *Homalonotidæ*.—Longitudinal furrows feebly indicated. Glabella: flat, typically unfurrowed. Typ. Gen.: *Homalonotus*, Sil., Dev.; *Burmeisteria* (= *H. armatus* and other spinose forms), Dev.

Fam. 11. *Calymenidæ*.—Thorax, pygidium and glabella, strongly lobed. The glabella tapering anteriorly. Typ. gen.: *Calymene*, Sil.; *Neseuretus*, Cam.

Fam. 12. *Triarthridæ*.—Glabella of nearly uniform width, with side furrows. Body segments 14 to 15 in number. Typ. gen.: *Triarthrus*, Lr. Sil.

Note.—Homalonotus, commonly placed under the Calymenidæ, is here separated on account of

[1] No doubt a series of intermediate varieties might be found in which the distinction becomes gradually lessened or obscured; but connecting series of this kind may be traced more or less everywhere, and if rigidly followed out would render generic distinctions practically impossible.

its very distinct aspect. In some of its forms it looks almost like a transition type between the Calymenidæ and the Asaphidæ. Triarthrus, which much resembles Calymene in its facial suture, pleuræ and pygidium, forms the connecting link between this section and the Conocephalidæ.

§ 2. Curticoni.—Glabella typically short, smooth or lightly furrowed. Body-rings 12 to 17 in number, typically over 13. Pygidium small or comparatively small, with typically 2 or 3 (more rarely 6 to 8) rings in its axis.

Fam. 13. *Conocephalidæ.*—Eyes present. Typ. gen.: *Ellipsocephalus* (?), Cam.; *Cyphaspis*, Sil., Dev.; *Angelina*, Cam.; *Conocephalites*, Cam., Lr. Sil.; *Agraulos* (= *Arionellus*), Cam.; *Liostracus*, Cam.; *Ptychoparia*, Cam.; *Solenopleura*, Cam.; *Sao*, Cam.

Fam. 14. *Conocoryphidæ.*—Eyeless forms of *Conocephalidæ.* Typ. gen.; *Conocoryphe*, Cam.; *Ctenocephalus*, Cam.

Note.—The genus Ellipsocephalus, as regards the character of its glabella, is a somewhat aberrant type; but in its general structure and aspect it is closely related to the Conocephalidæ and cannot very well be placed in any other family. The separation of the eyeless forms, typified by Conocoryphe, is a convenient, if not strictly necessary, subdivision. Cyphaspis connects the Conocephalidæ with Arethusina.

§ 3. Vittati.—Eyes connected by a narrow band with the glabella. The latter short and small. Body-segments numerous, with narrow axis. Pygidium, typically, very small.

Fam. 15. *Olenidæ.*—Body-segments 12 to 15 or 16 in number. Head-shield straight or flattened along its anterior margin, and prolonged posteriorly into spines or horns. Typ. gen.: *Olenus*, Cam.; *Eurycare*, Cam.

Fam. 16. *Arethusinidæ.*—Body-segments 22 in adult forms. Head-shield semicircular, terminating in points or spines. Typ. gen.: *Arethusina* (= *Aulacopleura*), Sil., Dev.; *Harpides*, Cam., Lr. Sil.

Fam. 17.—*Harpesidæ.*—Head-shield very large and horned, with broad, finely punctured border. Typ. gen.: *Harpes*, Up. Sil., Dev.; *Harpina*, Lr. Sil.

Note.—The section in which these families are placed is named after one of their more striking characters, the band or fillet which connects the eyes with the sides of the glabella; but they have also other points of agreement, as seen more especially in their numerous body-segments, their narrow axis and small pygidium. Through Harpides, the Harpesidæ proper are connected both with Arethusina and with Olenus.

Sub-Order IV.—FRONTONES.—Trilobites with large or strongly pronounced glabella, widening as a rule anteriorly. Pygidium very small or of moderate size, the many-ringed body-axis extending quite or nearly to its extremity.

§ 1. Annulati.—Many-ringed, comparatively elongated forms, with pygidium obscurely separated from the thorax. Body-segments typically 11 in number. Facial sutures terminating at the sides of the head-shield.

Fam. 18. *Phacopsidæ.*—Pleuræ furrowed. Eyes coarsely facetted. Pygidium rounded or spinose. Typ. gen.: *Phacops*, Up. Sil., Dev.; *Dalmanites*, Sil.; *Odontocephalus*, Dev.

Fam. 19. *Encrinuridæ.*—Pleuræ with raised band. Pygidium long, narrow, with many-ringed axis. Typ. gen.: *Encrinurus*, Sil.; *Cybele*, Lr. Sil.; *Cromus*, Up. Sil.; *Amphion*, Lr. Sil.

Fam. 20. *Cheiruridæ.*—Pleuræ with raised band. Eyes finely facetted. Pygidium horned, spinose or digitated. Typ. gen.: *Cheirurus*, Up. Cam., Dev.; *Deiophon*, Up. Sil.; *Sphærexochus*, Sil.; *Staurocephalus*, Sil.; *Placoparia*, Lr. Sil.

Note.—The families of this section are more or less closely connected by the peculiar course of the facial sutures, alike in all, and by their typically eleven body-segments. The Encrinuridæ and Cheiruridæ, are connected by their "bourreletted" pleuræ; and this same condition—as well as their spinose character generally—connects the Cheiruridæ with the Acidaspidæ of the next section.

§ 2. Armati.—Essentially broad-headed, spinose forms, with pointed or spiny pleuræ, and small to very small (commonly spine-bearing or digitated) pygidium. Body-segments 9 to 20.

Fam. 21. *Acidaspidæ.*—Head, pleuræ and pygidium, all spine-bearing. Body-segments 9 to 10. Pleuræ with "bourrelet." Typ. gen.: *Acidaspes*, Sil., Dev.

Fam 22. *Paradoxidæ.*—Head-shield very large and broad, with horned angles and large, anteriorly expanded glabella. Body-segments 12 to 20; pleuræ, furrowed, terminating in spines; pygidium very small. Typ. gen.: *Paradoxides*, Cam.; *Hydrocephalus*, Cam.: *Telephus* (?) Lr. Sil.

§ 3. Globosi.—Glabella large and prominent, oval or globular, and unfurrowed. Thorax short, with 5 to 6 segments.

Fam. 23. *Trinucleidæ.*—Head-shield very large, terminating in horns, and surrounded by a broad, perforated border. Eyes commonly absent. Typ. gen.: *Trinucleus*, Lr. Sil.; *Dionide*, Lr. Sil.; *Microdiscus* (?), Cam.

Fam. 24. *Ampyxidæ.*—Head-shield without perforated border. Glabella extended anteriorly into a strong spine. Eyes absent. Typ. gen.: *Ampyx*, Sil.; *Endymionia* (?), Up. Cam.

Fam 25. *Æglinidæ.*—Glabella very large and globular, extended anteriorly, in some species, into a stout spine. Eyes abnormally developed. Typ. gen.: *Æglina*, Lr. Sil.

Note.—This latter family forms a connecting link between the Globosi and the Oculosi. It should, perhaps, be placed under the last-named section; but it would appear to be very closely allied to the Ampyxidæ (notwithstanding the absence of eyes in that family) by its 5-6 body-segments, its triangular pygidium, and its enormously developed glabella, which in some of its forms (e.g., *Æ. armata*, Barr.), extends forward into a distinct point or spine, much as in Ampyx. Whilst Barrande makes Æglina the type of a distinct family, Zittel places it under the Asaphidæ.

§ 4. Oculosi.—Eyes enormously developed. Head-shield with horned angles. Pygidium very small, with 2-3 rings in its axis.

Fam. 26. *Bohemillidæ.*—Body-segments 5 in number. Typ. gen.: *Bohemilla*, Lr. Sil.

Fam. 27. *Remopleuridæ.*—Body-segments 11 to 13 in number. Typ. gen.: *Remopleurides*, Lr. Sil., *Caphyra*, Lr. Sil.

Summary.

Retrospective view of the Sub-Orders, Sections and Families of the preceding classification.

Order **TRILOBITA.**

Sub-Order I.—PUSILLIFORMES.
Fam. 1, Agnostidæ.

Sub-Order II.—LATIFORMES.

§ 1. Levati.
Fam. 2, Illænidæ.
Fam. 3, Asaphidæ.

§ 2. Sulcati.
Fam. 4, Basilicidæ.
Fam. 5, Dikelocephalidæ.

§ 3. Palmati.
Fam. 6, Lichasidæ.
Fam. 7, Bronteidæ.

§ 4. Columnati.
Fam. 8, Phaetonidæ.
Fam. 9, Proetidæ.

Sub-Order III.—CONIFRONTES.

§ 1. Longiconi.
Fam. 10, Homalonotidæ.
Fam. 11, Calymenidæ.
Fam. 12, Triarthridæ.

§ 2. Curticoni.
Fam. 13, Conocephalidæ.
Fam. 14, Conocoryphidæ.

§ 3. Vittati.
Fam. 15, Olenidæ.
Fam. 16, Arethusinidæ.
Fam. 17, Harpesidæ.

Sub-Order IV.—FRONTONES.

§ 1. Annulati.
Fam. 18, Phacopsidæ
Fam. 19, Encrinuridæ.
Fam. 20, Cheiruridæ.

§ 2. Armati.
Fam. 21, Acidaspidæ.
Fam. 22, Paradoxidæ.

§ 3. Globosi.
Fam. 23, Trinucleidæ.
Fam. 24, Ampyxidæ.
Fam. 25, Æglinidæ.

§ 4. Oculosi.
Fam. 26, Bohemillidæ.
Fam. 27, Remopleuridæ.

XI.—*The Iroquois Beach: a Chapter in the Geological History of Lake Ontario.*[1]

By PROF. J. W. SPENCER, M.A., PH. D., F.G.S.

(Communicated by Dr. T. Sterry Hunt, May 5, 1889.)

(1.) INTRODUCTION.—The gravel-ridges, at high elevations above the modern surface of Lake Ontario, attracted the attention of the aboriginal tribes of Indians, on account of their affording dry pathways through an otherwise often muddy country, composed of clay soil. These trails were used as long as the great Iroquois confederation were masters of the lake region, and subsequently, they were replaced by the roads of the early white settlers. Fragments of the old shore lines received local names. Thus we find that that salient portion of the greatest of the old beaches, Burlington Heights, —a spit at the extreme western end of the lake—was a strategic point in the last Anglo-American war of 1812-15, during which a battle was fought upon it. But the earliest scientific recognition, recording, as far back as the writer knows, that these high gravel ridges were regarded as lake beaches, was by DeWitt Clinton, who, in 1811, described the ridges from Lewiston to Rochester,[2] and by William Dewey,[3] a civil engineer, who in 1836 proposed to locate upon it the Rome and Watertown Railroad. Many miles of the railway were subsequently constructed along its foot.

In the "Geology of New York," published in 1842, Prof. James Hall describes the ridge roads following the beach from Great Sodus Bay to Niagara River, and refers to his having heard of this ridge extending around the end of the lake. He even ascertained that the beach was not of uniform height, but he did not explain the variation by the theory of the more recent warping of the earth's crust. In 1859, Mr. Sandford Fleming,[4] described the spit south-west of Toronto, called "Davenport Ridge," and distinguished that portion of the so-called ridge, which was of beach structure from the terraced shores. In 1863, the Geological Survey of Canada suggested that the Davenport Ridge was an equivalent of the somewhat lower ridge roads of New York. This happy hit, I have more recently found to be correct. But elsewhere, on the northern side of the lake, beaches occur at approximately the same heights, at distances apart, which of itself, in this warped region, is usually proof of dissimilarity of age. The Canadian Survey did not define the Burlington Heights as a lake-beach, or identify its position.

But the most important observations upon the old beach have recently been made by Mr. G. K. Gilbert, in tracing and identifying as belonging to the same series its various portions upon the southern and eastern sides of the lake. In doing so, he found that

[1] A short abstract of this paper appeared in Science, Jan. 1888.

[2] Discourse before the N. Y. Historical Society, 1811, p. 68.

[3] Dr. Hough quotes Wm. Dewey in History of Jefferson Co., N. Y.

[4] Canadian Journal, Toronto, 1859.

the large amount of differential elevations in their heights indicated great warping in recent geological times. Only a note upon the subject was published[1] by Mr. Gilbert,[2] but I have here to acknowledge my indebtedness to him for the measurement of many points and other information.

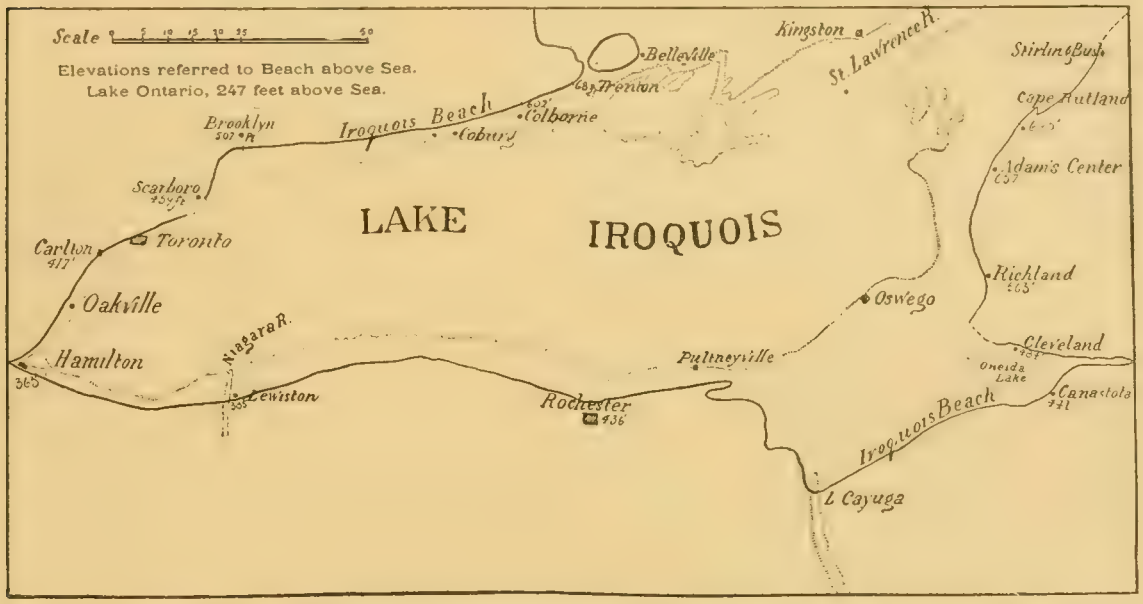
The writer has followed the beaches on the Canadian side of the lake, and in north-eastern New York beyond the region of Mr. Gilbert's observations. The discoveries made are of great importance, especially in the study of origin of the Great Lakes—a study commenced by the writer ten years ago. In the investigation of this subject, there are two great questions: the origin of the valleys, and the cause of the valleys being closed to form water-basins. With the first of these, this paper has nothing to do. With regard to the latter, Gen. Warren was the first to propose the hypothesis of warping towards the north and east (1875)[3] in explanation of the closed basin of Ontario, as well as other basins of the Great Lakes. I accepted the hypothesis—now a theory—and defined the St. Lawrence valley as only a broad continuation of the ancient Ontario valley. The discovery of differential elevations in the region of the present outlet, was the first definite proof that most of the warping, assumed by the author, had been produced since the waters of the lake were confined to a basin separated from the other great lakes. In the sea-cliffs, east of Watertown, the inscription of older and greater differential changes of level can be read, so that the closing of the Ontario basin is no longer a mystery or an hypothesis. Lake Ontario was formerly included in the union of Lakes Huron, Erie etc., which, as pointed out long ago by the writer, formerly existed as one sheet of water, out of which rose the highlands of Ontario, now standing 1,700 feet above the sea, surrounded by elevated beaches. As reference will be made to this sheet, when all the lakes, in an expanded and united form, stood at the same level, I will name it LAKE WARREN, in honor of the late Gen. G. K. Warren, Corps of Engineers, U. S. A.; whose discovery, in 1875, that Lake Winnipeg was formerly of great size, occupying the Red River valley in Minnesota and Manitoba, and explaining its existence by differential elevation or warping of the earth's crust—which explanation he extended to the Great Lakes—entitles him to be regarded as the father of lacustrine geology in America. The limits of Lake Warren are here defined as that body of water which existed in the Great Lake region from the time that there was the barrier between it and Hudson Bay, sufficiently high to have held in the waters on the northern side (even though an outlet in that direction should be found), and the time when Lake Ontario was separated from it by a change of level in its surface. The name of GULF OF WARREN is here given to the enlarged body of water, before its more complete separation from the sea. The barriers to the south will be explained in a subsequent paper. Since the separation of Lake Ontario from Lake Warren, there has been only one great epoch of rest in the subsidence of its waters—marked by the beach (or a small series of beaches) under consideration. In designating geological features, I am averse to giving names, necessarily non-descriptive. But the better method of using geographical names ought not to be adopted arbitrarily. In this case, there are but two local names that seem to have claim for preference

[1] At time of writing this paper, Jan. 1888.

[2] Report of Proc. A. A. A. S., Science, Sept. 1885.

[3] Appendix J, Report of Chief of Engineers, U. S. A. 1875. See also "Surface Geology of the Region about the Western End of Lake Ontario," by J. W. Spencer, in Canadian Naturalist, Montreal, 1882.

—Burlington Beach (a name preoccupied by a modern spit) in place of Burlington Heights, which is the lowest part of the great beach at the western end of the Lake Ontario; and Mohawk, a name connected long since with a supposed outlet of the lake to the south-east. The amount of overflow in this direction during the epoch of this beach formation did not cut a great gap through the mountains; therefore a geographical name in this region is objectionable, even if not involving unsettled theoretical question. The north-eastern limit of the beach is not known as yet. Consequently, I have adopted a historical name and carried the priority of its use as far back as practicable, and here propose for the best developed beach of the Ontario basin the name of the great aboriginal confederation which dominated the lake region at the time of the European encroachments—the IROQUOIS BEACH. The lake, which was accordingly much larger than the modern Lake Ontario, is called LAKE IROQUOIS.



MAP OF THE WESTERN PORTION OF LAKE IROQUOIS SURROUNDED BY THE IROQUOIS BEACH, as identified by the author, author, upon the Canadian side of the lake and at the northern end in New York; and by Mr. Gilbert from Niagara River to Adam's Centre.

(2.) LOCATION OF THE IROQUOIS BEACH.—This beach skirts the Canadian shores of Lake Ontario at a distance of usually from two to four miles. From the head of the lake, it may be followed for 150 miles to near Belleville. It then sweeps around into the embayment north of Oak Hills. To the northward and eastward, the lake of this epoch covered the great triangular area between the Ottawa and the St. Lawrence Rivers, sending an arm far up the valley of the former river. The lake in this region contained many islands of Laurentian rocks. The marginal shores of this portion of the lake have not been followed, although many fragments, doubtless belonging to it, have been seen; but the difficulties of tracing any beach among islands of crystalline rocks, through a country covered with very little drift soil, dotted with numerous swamps and lakes, and still mostly wooded, is readily appreciated. The boundary of the western part of Lake Iroquois is shown on the above map.

The Iroquois Beach enters New York at Lewiston, on Niagara River, and extends as far east as Great Sodus Bay, at only a few miles distant from the modern shore. Thence, it swings round, passes under Cayuga Lake (Gilbert) and skirts an embayment from 26 to 35 miles wide, which encloses Oneida Lake, and turns northward to a point about five miles east of Watertown, near Black River Station, where on the side of a great promontory, which may be called Cape Rutland (a spit of Cambro-Silurian limestone, bounding the interesting Rutland Hollow), it bends eastward, and becomes difficult to follow. I have traced it to a point about twenty-five miles east of Watertown, near Stirling Bush, amongst the Laurentian ridges, upon the flanks of the Adirondacks.

(3.) Table of differential elevations along the Iroquois Beach.—In the following table, all of the elevations were on the summits of the ridges. Sources of error, at each place of observation, occur, owing to variations in height, arising from the former different intensity of wave-action upon the shore, either exposed or protected, and from subsequent washes on or off the beaches; and along spits, which are generally a little lower than the adjacent barrier-form of the beach. Besides these errors, others arise in the subsequent deductions, on account of taking measurements from the maps. However, as these local errors, incident to each place of observation, do not produce a greater variation in our calculations than a small decimal of a foot per mile, they may be omitted [1]:—

	Feet above sea.	
Hamilton	363	(Spencer.)
Burlington Heights	355	"
Watertown Station	365	"
Cooksville Station about	400	"
Carlton Station	417	"
Kingston Road, at railway crossing, 12 miles east of Toronto	459	"
Whitby, 6 miles north of the lake at	507	"
Colborne Station, 2 miles north of	602	"
Trenton Station, 2½ mile north of	682	"
Lewiston, N. Y	385	(Gilbert.)
Rochester	436	"
Canastota	441	"
Cleveland	484	"
Constantia	489	"
Richland	563	"
Adam's Centre	657	"
Cape Rutland	700	(Barometer.)
Great Bend Station, above	685	"
On Laurentian Islands, near Stirling Bush	667	"

(4.) Area and depth of the Lake during epoch of the Iroquois Beach.—The area of the western portion of lake, as defined by the Iroquois Beach, was not much greater than that of the modern Ontario, except towards the south-eastern portion, as shown on the map. The extension of the lake towards the north-east, between Ottawa River and the foot of the Adirondack Mountains, beyond the limits of the map, was

[1] The author's elevations were levelled from the nearest railway stations, the barometer being used only where expressed; those of Mr. Gilbert were obtained by use of hand levels to adjacent known points.

greater in size than the area of the modern lake, but its margins have been less fully explored than those given upon the map.

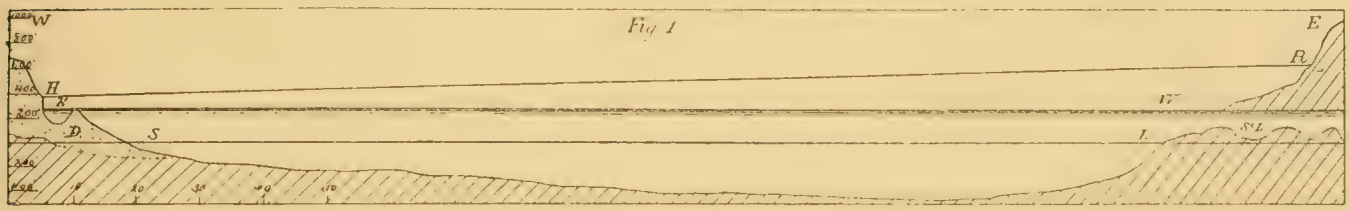


Fig. 1.—Longitudinal Section of Lake Iroquois between Hamilton (*H*) and Cape Rutland (*R*).—The differential elevation of the eastern end over that of the western, now amounts to about 337 feet. *H R*, surface of Lake Iroquois; *B W*, surface of Lake Ontario, with outlet at *St L*; *S L*, sea-level; *D*, buried channels at the mouth of the Erigan River (ancient outlet of the basin of Lake Erie.)

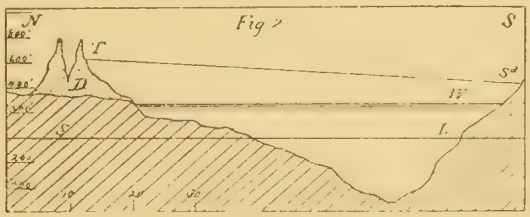


Fig. 2.—Section across the centre of the lake from Trenton southward.—*T* and *Sd*, surface of Lake Iroquois *D W*, surface of Lake Ontario; *S L*, sea-level; *D*, hills of drift.

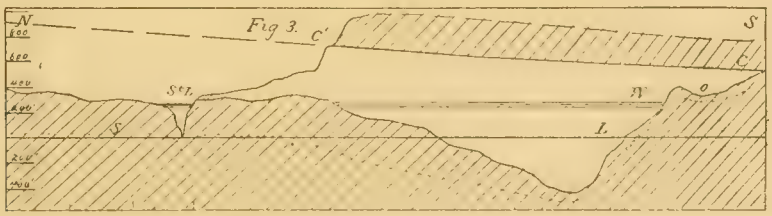


Fig. 3.—Section across the lake showing the Escarpment at the eastern end of the basin, upon the flank of which the now sloping Iroquois Beach (*C′C*) rests. *St L*, the modern outlet; *S L*, sea-level; *O*, position of Oneida Lake; *C*, position of the bed of Mohawk valley. The dotted line represents the relative position of the floor of the St. Lawrence valley, compared with the lowest part of the bed of the basin—now occupied by the modern lake; at the commencement of the Iroquois epoch. Thus, what is now the rocky barrier, closing Ontario into a basin, was then only from 150 to 250 feet above the deepest part of the lake; and this was still further reduced by something between 120 and 240 feet in the ancient channel of the St. Lawrence, which was thus nearly or quite as low as the lowest part of the lake floor.

The north-eastern extension of the lake was filled with islands, and had an average depth of, probably, not over 250 or 300 feet. The rest of the lake, free from islands, was deeper than at present, with a maximum sounding of 1,000[1] feet, in place of 728 feet as at present found north-east of Pultneyville, N. Y. North of Cape Rutland the deepest sounding was 24 miles distant, amongst what are now the Thousand Islands of the modern

[1] 738 ft., deepest modern sounding; 210 ft., measured height of beach, south of sounding, above lake, *plus* 52 ft. calculated elevation of water-level, at the position of the deepest sounding, above its beach to the south.

St. Lawrence River, and must have had a depth of from 680 to 800[1] feet, in place of from 120 to 240 feet of the present day.

(5.) Characteristics of the Beach.—In form, most typical and easily followed, especially in Canada, the beach consists of a coastal barrier (fig. 4, *b'* and fig. 5 *a*), behind

Fig. 4.—Horizontal plan of a barrier beach (*b*) in front of a lagoon, back of which there are coastal hills.

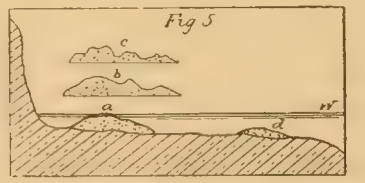


Fig. 5.—Vertical section of ancient beaches in different forms (*a,b,c,*) with outlying sand bar (*d*). *W*, former surface of water.

which there are depressions, once filled by the waters of some swamp or lagoon. The barriers often pass into spits and bars, and cross old valleys. Again the barriers give place to terraces of construction, (fig. 6 *a*). The material is invariably gravel, rich in sand, well stratified, but often showing false bedding, of various forms. At both the eastern and western ends of the lake, there may be seen three distinct ridges (fig. 5 *b*) with a maximum difference in height of about 25 feet at the eastern end, and somewhat less at the western. But these ridges commonly run together, and form one or two crests, or may be furrowed into a dozen (fig. 5 *c*). The face of the beach slopes gently to the the subaqueous coastal plain, descending five, ten, or even twenty feet (when all the ridges are united into one).

The depressions behind the barriers are much more abrupt, and the slopes greater than in front. Following the beach, it is only at occasional capes that the surface does not appear level, and then the variation is due to the waves that were exceptionally high. Ordinarily I should not place the water margin more than five feet below the tops of the ridges, and usually less—rarely ten. There are several transverse sections cut through the ridge (or combined ridges) which, when best developed, measure 500 to 600 feet across. The depth of this beach deposit, upon clay beds, is ordinarily from twelve to fifteen feet thick, except in the spits, where it even reaches to a hundred feet or more. The beach may be upon or against the shore bank, or at some distance lakeward, but in front of it, there is invariably a great broad plain from hundreds to thousands of yards wide. The plain is usually covered with a lake-deposit of silt which forms the best soil in the region. But upon it, at some distance lakeward of the beach, there is commonly found a sand ridge (fig. 5 *d*), representing the fine deposits borne outward by the undertow of the sorting waves. The plain is the floor of the cut terrace, typically bordered by the gravel beach in front of the higher shores.

The beach itself is often wanting (fig. 7) for distances of a few hundred yards or even a few miles, but it may be replaced by rows or pavements of boulders. However, it is

[1] 120–240 ft.—120 feet being depth of modern soundings in channel, excavated out of limestone below Kingston, and 240 being depth of channel excavated out of Laurentian rocks, at a point north of Cape Rutland; 450 ft., height of beach above river at Cape Rutland, *plus* 110 ft., the calculated increased elevation of water-level above the river between Cape Rutland and the places of sounding.

always reached again by following the margin of the old shores, which are generally well defined. In front of the ridges, there is often a very heavy pavement of boulders (fig. 6 *P*). The blocks seldom reach a length of more than from three to five feet (the largest seen had a volume of 150 cubic feet), and they are generally smaller. The smaller stones may have been arranged by the waves, but the larger were stranded in the shallow waters by the coast-ice—no heavier than that seen to-day—or were left just below water-level, as the finer materials were washed out of the shores composed of boulder clay owing to wave action. The pavement is most widely developed, when the subaqueous plains descend very gradually, where it may be hundreds of yards wide, although generally it is only as many feet. The boulders upon the hill-sides or within the beach, are more scattered, and do not form a pavement.[1]

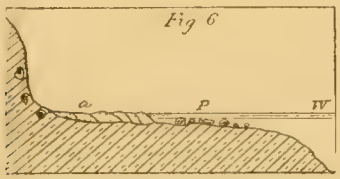


Fig. 6.—Vertical section showing a beach in the form of a terrace of construction (*a*), in front of which there is a pavement of boulders (*P*); former water-level (*W*).

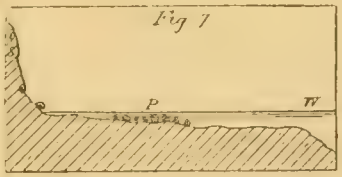


Fig. 7.—Vertical section showing a cut or erosion terrace floor, with the true beach wanting, but replaced by a pavement of boulders (*P*).

(6.) Difficulties in following the Beach.—There are several large river valleys, especially in the country composed of drift, so modifying the topography as to render the following of the beach often uncertain, or locally impossible. In front of exposed clay bluffs, and indeed of rocky shores, along which, in water that was deep enough to allow the free action of coastal currents, there was no beach formed, as all the material was carried out into the lake with very little assortment. The gravel-beach often ends abruptly in clay banks. When the conditions are favorable there may be considerable gaps in the beach of even several miles (fig. 4.), but still the cut-terrace is there, and along its foot the shore may be followed. The occurrence of islands in front of the coast complicates observations. Where the shores have been steep and the gravel deposits have been left upon their flanks, the highest part of the beach cannot always be recognized, as the older gravels may be mistaken for those of the beach. Again, when the beach is a constructed terrace against the shore, it is apt to be obscured by overwashes from the hillsides. One last cause may be added to these difficulties: there is often a covering of clay and cobble stones, unlike the rest of the beach, to a depth of two or four feet. This deposit has a significance as pointing to a temporary submergence, yet it is no deeper than frost action may have been.

(7.) Sources of the Beach Materials.—The boulders, gravels, and sands are alike almost entirely derived from the drift hills of stony clay, or these capped with stratified sand and gravel with boulders, forming the shores of the lake. The gravel is mostly

[1] For the fuller study of ancient beach-structure, see Ancient Beaches, Boulder-Pavements, etc., by the author, in Bull. G. S. A., i. 71—86, 1889.

composed of limestone derived from older gravel of the hills, or from the rounding of stones washed out by the boulder clay. There is only a small proportion of pebbles of crystalline rocks, although the boulders mostly belong to this class. Along the western end of the lake from Toronto, and round to Niagara River and eastward, the old shore line consisted of bluffs of Hudson River or Medina rocks, only occasionally having any drift-clay upon their flanks. Yet, there, upon the southern side of the lake, all the gravels of the beach have come from the northern side of the lake—the finer material, at least all west of Niagara River, having been transported by coastal currents and ice, and the larger blocks by ice, such as are found every winter upon the present stormy shores. The boulder pavements are here replaced by only occasional erratics of smaller size (having, however, similar relation to the beach) as the source of supply was more distant. At the eastern end of the lake, in New York, the deposits are of similar origin, essentially derived from the drift, or older gravels, upon the Cambro-Silurian escarpment, which there bounds the valley.

(8.) Study of the differential elevation of the Beach and the Foci of Uplift.—In order to understand the character of the warping of the earth's crust, it is necessary to ascertain the directions of the axes and the amount of maximum elevation for a vast number of triangles, and calculate the meridianal and oriented equivalents, as the movement has been complicated, and the rate of change variable; for general resultants covering the whole area would be of little value in understanding the terrestrial warpings. Along with triangulations relative to points about Lake Ontario, I have correlated some in the Lake Erie and Georgian Bay regions which bear directly upon the study of Lake Ontario. A few of the most important deductions will be here recorded.

The eastern equivalent of the uplift, along the southern side of the lake, does not differ in any important degree from its mean value between its western end and Rochester, which is 0.75 feet per mile. But from Rochester to Oneida Lake, the mean value of the eastern rise is only 0.20 of a foot per mile, and thence a downward movement is indicated.

At the western end of the lake, the maximum elevation is 2 feet per mile (along an axis N. 28° E.), of which 1.40 foot per mile is the northern equivalent. This amount is increased to 2.5 feet per mile in the region of Toronto. About Georgian Bay, the meridianal uplift amounts to 4 feet per mile.[1] To the south-west of the Ontario basin, about the eastern end of Lake Erie, the northern equivalent of the warping is nearly two feet per mile.[2] For twenty miles north of Oneida Lake, the mean northern uplift is 3.5 feet per mile, and thence, to Cape Rutland 4.5 feet. On the northern side of Lake Ontario, the eastern equivalent of the uplift is greater than upon the southern side of the lake, increasing from an average of 1.5 feet, west of Scarboro, to nearly three feet per mile at Trenton. Sixty miles farther eastward, this eastern uplift disappears, for there begins to be manifested an equivalent of elevation slightly to west of, in place of east of, north, as the axis of simple northward uplift is passed. The passage of the axis of simple northern

[1] The Algonquin beach of the Georgian Bay, from which this measurement is derived, is not connected with, and is both older and newer than, the Iroquois Beach.

[2] No triangulation can be made on the beach referred to, but its eastern uplift is assumed at the same rate as that of the Iroquois Beach, and deductions therefrom made.

uplift, and a descent of the beach to the eastward, were first indicated by the reduced barometric measurements (see table p. 124); which, although the result of several observations were not accepted as evidence, for the amount was small, yet with it should have been included the loss of the former rate of rise. But the indication of the Iroquois Beach beginning to descend to the east is strengthened by Mr. Gilbert's measurements about Oneida Lake. This observation is of great importance, for henceforth we may hope to be able to compare the beach with the marine terraces of Lake Champlain, or those of the St. Lawrence, as at Montreal, where the Saxicava sand occurs at 520 feet above the sea, and other unfossiliferous deposits at still greater elevations.

If the axes of maximum elevation for the various triangles about Lake Ontario and Georgian Bay be produced, they meet in or near lat. 51° N. and long. 74½° W., a few miles west of Lake Mistassini, and east of the southern end of James' Bay.

Although mainly radiating from the focus, the axes of maximum elevation for the different triangles is not uniform, and are locally modified, as along the north-western side of Lake Ontario, where there is found a secondary axis of uplift to the east. Combining the more western axes with those at the eastern end of the lake, another focus of uplift appears near the "height of land" between Lake Ontario and Hudson Bay, in about lat. 48° N. and long. 76° W. From the double foci, it may be inferred that the uplift reached its maximum along a line joining the foci, or that the axis of the maximum regional uplift was meridianal and located along the eastern end of Lake Ontario, increasing in amount until near the "height of land," and thence with a diminishing ratio, or even depression, towards the north. Still it is hardly probable that the increasing ratio is constant, as there are local transverse folds on both sides of the western portion of the Ontario basin. At any rate, it is in the region south-east of James Bay that the maximum differential elevation of the earth's crust, which involved the Iroquois Beach, is to be looked for.

(9.) The absence of Elevation of the Lake during the Iroquois Epoch.—The recent warpings of the earth's crust in the region of the lakes have been those of elevation to the north and east, not subsidence in the opposite direction. The general subsidence was at an earlier period than that of the beaches, and did not produce the warpings involved in the beach epoch. The elevated condition of the lake, during the epoch of the Iroquois Beach is opposed by the fact that the lake would have required an unknown barrier forty miles or more across, and six or eight hundred feet higher than that of the present time; also, in subsiding 700 feet—the best known and measured amount of differential change between the extreme eastern end of Ontario and the southern end of Lake Michigan—the drainage of the adjacent rivers would have been so greatly changed as to become apparent. Moreover, such subsidence is not indicated by the elevated marine terraces of the St. Lawrence. The elevation of the lake during the Iroquois epoch is known to have been at sea level. Its lowest portion, at the western end of the lake, is now 363 feet above the ocean, and at Cape Rutland about 700 feet, but it is necessary to go outside the basin to learn the additional elevation which has affected the whole basin. The differential uplift, however, between the south-eastern side of Michigan and the western end of Ontario, amounts to 360 feet;[1] as measured upon beaches somewhat older than the Iroquois, but

[1] At Crittenden, N.Y., Mr. Gilbert found an Erie beach at 860 feet above the sea. At Cleveland, Ohio, this is 673 feet. Again, another beach at Cleveland is 743 feet, and is traceable to the eastern side of Lake Michigan, where I found it at 627 feet above tide. Thence to the south-western part of the lake there is further indication of a depression of 60 feet more.

all of which movement belonged equally to the whole basin of Ontario; therefore it is certain that Ontario was at sea-level. Then, the Iroquois Beach enclosed a lake with a very broad outlet, 700 or 800 feet deep in places.

At Smith's Falls, about seventy-five miles north of Adam's Centre, the remains of a whale (belonging to a species that is now sometimes seen in the Lower St. Lawrence River) were found in a gravel bed, at a height of 450 feet above the sea.[1] Its occurrence indicates that to this point there was free communication from the sea, to which level it was depressed, when the region was 450 feet lower than now—an amount of change that equally affected the Iroquois Beach, about the eastern end of Lake Ontario, although the effects diminished towards the west. Yet, westward of the present outlet of Ontario, no marine shells have been discovered; and there is no proof that the beaches belonged to brackish water. Nor have fresh-water shells been found in them. The waters, which admitted the whales, extended far up the Ontario basin, without leaving anything to enable us to trace to what extent they were freshened, as they were distant from the sea.

The outlet of Iroquois Lake was deep—seven or eight hundred feet below sea-level. If any barrier existed between the Ontario basin and the Gulf of St. Lawrence, it certainly was neither rock or dirt.

(10.) Glacial Dams Theory.—This has been posited by Mr. Gilbert and others owing to the supposed necessity of barriers to keep out the sea-water. Now, if anywhere upon the American Continent such existed, it was here, between Lake Ontario and the sea, for there were mountains on either side of the St. Lawrence valley, between which, glaciers, if such existed, could form dams. Furthermore, the Iroquois Beach was at sea-level, so that there would be no hydrostatic pressure to force the water out beneath the glacier. Yet the glacial dam is not established, for I have found the beaches, where the supposed glacier was located; and our knowledge of the old shores, down the St. Lawrence valley, is still too imperfect to necessitate the existence of a dam. Nor does the absence of the discovery of marine shells tell anything in favor of a glacier holding back the waters, of what we call Lake Iroquois, any more than their absence, when the level of the region was 450 feet lower than now, proves the existence of an ice barrier west of the gravel bed, which contained the whale remains referred to in the last paragraph.

The Gulf of Obi is to-day the counterpart of old Lake Iroquois. The Gulf of Obi is from 40 to 60 miles wide, and 650 to 700 miles long. Its waters are fresh, and the discharge from it so sweetens the Arctic Ocean that the water 60 miles beyond its mouth, in the open sea, is almost potable.[2] The old Gulf of St. Lawrence and Lake Iroquois—its continuation—had once similar dimensions.

The foundation of the glacial dam hypothesis is the occurrence in the Alps of some small glacial lakes. These are of two kinds:—One, where the glaciers, carrying lateral morains, cross river-valleys and form permanent lakes, on account of the earth-dams thus made; the other, where glaciers unite at the foot of hills, between which and the ice, lakelets are formed, or where the glaciers pass the mouths of ravines, in which there are no considerable streams. The latter class of glacial dams is always evanescent. When glaciers, not bearing lateral moraines, cross considerable streams, the rivers simply flow

[1] Sir Wm. Dawson in Canadian Naturalist, vol. x, no. 7, p. 385.

[2] Nordenskjold's, Voyage of the Vega around the North of Europe and Asia, p. 140.

under the ice. Some small lakes are known in Greenland, at sea-level, where the glaciers choke out the sea-water. Upon the flank of Mount St. Elias, there are several glacial lakes, the lowest at something less than 175 feet above the sea, which is fifteen miles distant. There, the waters are held in the lakes, when their outlets get choked with icebergs, for only a few hours or days, until the accumulated hydrostatic pressure breaks away the barrier, whereupon the waters flow beneath eight miles of the glacier, to emerge from under 500 feet of ice (Topham).[1] It seems impossible to believe in the existence of great glacial dams, above sea-level, sufficiently permanent to develop such regular beaches and terraces as the Iroquois, which indicates a wave action of as long duration as that upon the modern beaches of Lake Ontario. This last represents a time period of many centuries, if not of millenniums. Of course, had morainic dams been formed, these would still remain, more or less intact, across the St. Lawrence valley.

Consequently, we have no proof, as yet, of the existence of glacial barriers closing the St. Lawrence valley, nor should we assume the necessity for them, any more than in the Gulf of Obi, until such is proved by future investigation into the physical structure of the north-eastern portion of Lake Iroquois.

(11.) The Climate and Life.—From the boulder pavements, associated with the beach upon the northern side, the power of the ice is seen to have been no greater than that of to-day either in that region, or along the lake expansions of the St. Lawrence.

The occurrence of mollusks tells us nothing as to the temperature of the waters, as they are not found in the beach. But this beach contains remains of mammoth, elk, and beaver,[2] found in the Burlington Heights at Hamilton; and similar remains are said to have been found in New York. Whether these animals came down upon the spit to drink and died there, or whether their remains drifted to it from the streams of the old Dundas valley we have no means of conjecture. Whilst the range of these animals is wide, they are such as belong to the climate of the present day.

I have seen fresh-water shells only in the deposits about the lake of more recent date (not more than fifteen or twenty feet above its surface) associated with lagoons or former swamps.

(12.) Lower Beaches.—These are of frequent occurrence about Lake Ontario. But they are all too fragmentary to form the basis of study offered by the Iroquois Beach. The time occupied in their formation was too short for the old shore lines to be straightened. From the examination of the lower beaches at the eastern end of the lake by Mr. Gilbert, and that of others seen upon the northern side of the Ontario basin by the writer, it appears that the elevations since they were formed have been less differentiated than those first lifting the Iroquois Beach, which has also been involved in all subsequent changes. The tilting of the basins has caused a submergence of the lower beaches, and narrow valleys of erosion, upon the southern and western sides of the lake. Such evidence is not seen upon the northern side of the lake. The effects of submergence have, however,

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[1] Proc. Roy. Geo. Soc. 1889, p. 424.

[2] Not only were these found thirty to forty feet below the top of the Heights, in the Cutting of the Desjardins Canal (Geological Survey of Canada, 1863), but remains of another mammoth were found in an adjacent railway cutting through the same beach in 1878-9, at a depth of between twenty and thirty feet.

been modified by the drawing off of the waters, which process has lowered the lake level 116 feet below the lowest point of the Iroquois Beach, at Hamilton.

(13.) Age of the Iroquois Beach.—While the valley of Ontario antedates the Pleistocene period, although broadened by the waves of the lake itself, there is no evidence pointing to the age of Lake Ontario being anterior to the epoch of the Drift. Nor do we know that a smaller separate body of water existed when the barrier of the lake was less than at present. Lake Warren, itself, is older than Lake Iroquois yet it is more recent than the deposit of the stony drift clays of the last great Ice epoch, and of the stratified clays and sands, of the so-called Modified Drift, except such as have been deposited from its waters.

The Iroquois Beach marks the boundary of Lake Ontario, at the time of its most perfect development, at which time there was probably a shallow overflow to the sea by way of the Mohawk and Hudson valleys.

The valley of the Mohawk had not been a pre-Pleistocene outlet for the ancient basin of Lake Ontario, as it is a narrow rock-bound gorge over 900 feet above the bottom of the basin, whilst the bed of the St. Lawrence channel was 700 or 800 feet lower.

This additional outlet by the Mohawk valley was only a coincidence, as the continent was rising, like many other similar southern overflows of the more ancient Lake Warren.

It is difficult to assign an exact age in years. Yet the commencement of the Iroquois epoch does not date back very many millenniums. We know the rate of terrestrial elevation upon the coast of Scandinavia, where the maximum is five feet per century. The coast of the Bay of Naples is sinking at four feet per century. At other places the rate of movement is known to be less. Since the Iroquois epoch, the beach has been lifted up 700 feet near Watertown, N.Y., where is to be found the maximum amount of elevation. Assuming the rate to be that of the maximum known change upon coast of Sweden viz., five feet per century, Lake Iroquois commenced a separate existence about 14,000 years ago. Still, we may have to largely increase this time. Again, Niagara Falls commenced their history after the beginning of the Iroquois epoch, but then with a fall of only 200 feet, as the Iroquois Lake level was 138 feet higher than that of the modern lake, when the waters of the Erie basin were precipitated directly into it. Hence, the recessions of the cañon would be slower than now with the modern difference of level between the lakes amounting to 326 feet. The mean modern recession[1] is 2·4 feet per annum. This would indicate a lapse of about 15,000 years. But owing to the slower recessions of the shallower cañon (if the volume of water has been constant), on account of the diminished fall, and the relatively smaller amount of underlying shales, the age will have probably to be increased to 24,000 years. Thus we get two rough approximations of the lowest age of the birth of Lake Iroquois at 14,000 or 15,000 years with a probable increase to nearly double this term.

As the precipitation in the lake region is in excess of evaporation, as the deepening of the outlet of Ontario is very slow, and as the elevating forces in the region of the

[1] Computed from the Surveys of 1843, 1875, 1885. See Report of R. S. Woodward's paper, before A. A. A. S., Science, 1886.

closing barrier are not yet at rest, Lake Ontario, still young, is likely long to survive the successors of the species of animals contemporary with its youth, some of which are already extinct.

(14.) Directions for use of those who wish to follow the Beach.—In Hamilton, all the ridges are united into one beach with a height of 363 feet above the sea. It crosses the Dundas valley as a spit—the Burlington Heights—at eight feet lower, and beyond, near Watertown Station, its height is 365 feet. Thence, it extends north-eastward parallel to the lake, in front of the shaly bluffs of the Medina and Hudson series. The beach is conspicuous near Burlington. It is well developed at the crossing of the Twelve-Mile Creek, north of Bronté; but just beyond, it is replaced by a cut-terrace, on the floor of which there are a few boulders. North of Oakville Station, it is broken into three ridges. Dundas Street (an old military road) follows it from Cooksville, where there is a great gravel pit at about 400 feet above tide, to Islington, and near the latter place there is a great development of the frontal sand-ridge. Thence, it is interrupted to beyond the Humber, where there is a spit at Lambton; from this place it passes into the Davenport Ridge, where, at Carlton Station (G. T. R.) west of Toronto, it is 417 feet. North of Toronto, the Iroquois shore is in part represented by a gravel beach, and in part by a cut-terrace at the foot of a bold sand-ridge. For several miles, across the Don Valley, it is broken, but at York Station it is represented by a long spit. Near this, it abruptly ends against Scarboro' Heights, upon the eastern side of which it is again seen at the intersection of the G. T. R. and the Kingston (old military) road with an elevation of 459 feet. Thence it swings round to six miles north of Whitby, crossing the Midland Railway (507 feet). It passes north of Bowmanville, at Stephens Mills, there crossing a large creek, as also near Orono. The Kingston road follows it for several miles on either side of Clarke Village; and thence the beach is easily followed to a ridge north of Port Hope, behind which it swings round, and skirts an abayment, being modified by a large valley. North of Cobourg, it is again broken in a very rough country, near Baltimore, but it is found on the sides of a long clay ridge and elsewhere. Two miles north of Colborne, it occurs at a height of 602 feet. Between this place and Brighton, there is a point where the beach is unusually high, owing to its exposure to extraordinarily high waves during its formation. Also, at this locality, the beach is broken up into an unusual number of crests and spurs. The frontal boulder pavement throughout this region, and especially east of Brighton, and extending to north of Trenton, is more strongly developed than to the westward. Between Brighton and Trenton, the country is very much broken by great valleys, and long detours are necessary to follow the beach. The height, two and a half miles north of Trenton Station, is 682 feet. Above this, however, there is a spit across a small ravine, and yet higher a delta-cone. The beach rests upon the flank of the Murray Hills, which rise still higher to about 850 feet above the sea. In this region, the Trent River cuts through these drift hills to the limestone floor, 500 feet or more below their summits. This excavation by the Trent River was during and since the epoch of the Iroquois Beach. A few miles farther east, the drift hills, near Belleville, become broken down, much below the beach level, and as such disappear or are replaced by lower detached ridges. Hence, the beach swings round, back of the Oak Hills, to near Campbellford, and thence stretches north-eastward towards the Ottawa River. In that

region the country is occupied by barren Laurentian ridges, woods and lakes, but at various places, beaches, probably belonging to the Iroquois system, may be seen, as as well as a little beyond the Ottawa River. From Hamilton, at the western end of the lake, the beach is along the foot of the Niagara escarpment, and parallel to the modern lake shore. At Lewiston, it is 385 feet above the sea; at Rochester, 436 feet, and at Sodus, 458. But eastward of this place it bends round, passes under Cayuga Lake (Gilbert), encloses an archipelago and Oneida Lake valley, and then skirts the foot of the Cambro-Silurian escarpment northward to Cape Rutland (near Black River). At Canastota, the elevation it 411 feet; at Cleveland, 484; at Constantia, 489; at Adam's Centre, 657: at CapeRutland, 700 feet (barometric). Eastward of this region, the beach rests against drift ridges or rocky ledges, crosses the Black River, above Great Bend (at 678 feet, barometric), rests upon the broad Pine Plains, a sort of terrace of construction, and thence it may be followed among the Laurentian ridges or islands (at 667 feet, barometric) to near Stirling Bush, in front of which there is a kind of cutterrace in flat Palæozoic rocks. As the work was discontinued, it has not been followed beyond this point, and it still remains to be seen how far it can be explored. The Iroquois Beach, at the eastern end of the lake, is composed of three ridges, with an extreme difference of height of from twenty-two to twenty-five feet, and this difference is still seen amongst the Laurentian ridges to the eastward.

The above elevations from Lewiston to Adam's Centre are from Mr. Gilbert's observations, and the remainder, where not otherwise stated, have been obtained, by the writer, from levels run to adjacent known points upon the railways. The list is far from complete, but the work promises a rich harvest in return for future labor. The barometric determination should be corrected by instrumental measurements.

XII.—*On Cambrian Organisms in Acadia.* [Plates V to IX.]

By G. F. MATTHEW, M.A.

(Read May 30, 1889.)

A.—*Remarks on the Stratigraphy and Correlation of the Basal Series.*

The writer's previous contributions to the knowledge of the Cambrian rocks in Acadia, as published in the Proceedings of this Society, have referred to the Fauna of the St. John group, and chiefly the Paradoxides beds, but as he has found evidence of an older fauna than that with Paradoxides, he has in this paper given a brief outline of the relations of the group of beds containing the older fauna and descriptions of the organisms which compose it.

It seems better to regard these rocks as a lower series of the Cambrian system, for in Wales the corresponding slates and sandstones have long been called Cambrian, whether we take the authority of Sedgwick, Murchison or Hicks; and, although no physical break between the Paradoxides beds and these older Cambrian rocks has been established in Europe, there is such a break at the base of the St. John group in Acadia, and if we accept as correct the observations of Mr. A. Murray, a similar discordance exists in Newfoundland.

In the section given in my first paper on the Paradoxides fauna,[1] this part of the Cambrian has but an insignificant thickness; and further west, along the north side of the Cambrian basin of St. John, this thickness is further reduced, and the St. John group may be seen to rest directly upon the Laurentian limestones. But in tracing the red rocks of the section cited eastward, they are found to exhibit a much greater thickness and, at the furthermost Cambrian exposures in St. John county, have an apparent thickness of about 1,200 feet.

The importance of these older Cambrian rocks is better understood by a study of their relations in these eastern exposures than about St. John, as they are not only thicker there, but they contain a fauna which, though not extensive, is distinct and important.

In the report on the geology of Southern New Brunswick, 1865 (p. 24), this mass of sediment was spoken of as the upper member of the Coldbrook group, and thus distinct from the St. John group; later[2] it was joined to the latter formation, because the want of conformity between the two could not then be established. But it is now found that this red series is unconformable, not only to the St. John group, but also, as had already been discovered, to the underlying Coldbrook group.

In the Kennebeckasis River valley, which is the next important valley containing

[1] See Trans. Roy. Soc. Can. vol. i. sec. iv. p. 88.

[2] Report of Progress, Geol. Survey Can. 1870-1, p. 59.

Cambrian rocks north of the St. John basin, no trace of this part of the Cambrian system has been discovered, though there are several areas of Cambrian rocks belonging to the St. John group: these rocks may be seen to rest on the Laurentian gneisses and limestones at several different localities.

In the next valley to the north, that of the Long Reach of St. John River, the red rocks of the lower series of Cambrian measures are well displayed, being brought to the surface by an anticlinal fold running along the north side of St. John River in that part of its course. These underlying measures, both here and in the St. John basin, are thus of considerable importance.

Mr. Alexander Murray, in his report on the geology of Newfoundland (p. 238), has described a mass of red, green and gray sandstones, with slates of similar color, which lie at the base of the Paradoxides beds on that island. He estimates their thickness at 1,500 feet, and states that while they are present in the Cambrian basins of Trinity, St. Mary's and Placentia Bays, they are absent from those of Conception and Fortune Bays. Hence we may infer that these lower sandstones, etc., form a lower series unconformable to the beds carrying Paradoxides. The only fossils reported from these rocks are "obscure forms like fucoids and peculiar markings resembling annelid tracks."

Between the beds of this lower portion of the Cambrian system in New Brunswick and those which lie at the same horizon in Norway and Wales there is a strong resemblance in mineral character. In these countries feldspathic sandstones, often of a red color, with some conglomerate and more or less of red and green shales or slates, make up the initial part of this basal formation.

The late Prof. Theodore Kjerulf has very carefully investigated this part of the Cambrian in Norway, where it is known as the Sparagmite formation. He divided it into two parts, viz., (1) Upper: blue quartzite and quartziferous sandstone, 310—500 metres (about 1,000—1,600 feet) thick; and (2) Lower: grey and red sparagmite; also conglomerates and sandstones, 630—910 metres (2,000—2,900 feet) thick. In this formation (*terrein*) no fossils are known in the lower division, but they are found at the base of the upper division. The genera found there correspond to those of Bands *b* and *c* of Division 1 of the St. John group, and therefore the upper division of the Sparagmite formation is of Primordial age, and the lower will correspond, in part at least, to the underlying series of red rocks of the St. John basin.

It seems doubtful if this lower part of the Cambrian system is fully represented in Sweden. In this country, the oldest beds were first described as the "fucoidal sandstone;" but as the greatest thickness of this sandstone at several localities, where it was measured by Hisinger, Wallen and Sidenbladh, did not exceed eighty feet, it is not likely that it represents in full the great mass of sediments which in Norway, Britain, Newfoundland and Acadia, lie at the base of the Cambrian system. This sandstone corresponds in part to the grey sandstones and dark grey shales of Bands *a* and *b* of Division 1 of the St. John group, which in their eastern exposures have a thickness, the former of about 200 feet, and the latter of some 140 feet.

In Wales there is a series of beds, which, perhaps, more nearly than any others, corresponds in mineral character, and the relics of once existing life which they contain, to the lower Cambrian rocks of Acadia. To the zeal and acumen of Dr. Henry Hicks, above all others, science is indebted for the discovery of a somewhat varied fauna in

these very ancient rocks, previously known to have only worm burrows. By the organic remains which they contain, consisting of brachiopods, crustaceans, etc., he was able, on palæontological grounds, to divide the obscure slates of the lowest Cambrian at St. Davids into the Solva group (upper) and the Caerfai (lower). The upper group has a thickness of 1,800 feet, and by its fauna corresponds with that of Band *c* of Division 1 of the St. John group. But the thickness of the Solva group is such that its lower measures may correspond to Band *b* in the St. John as well. This being the case, it is probable that the Caerfai group may represent the lower or basal series of Cambrian rocks in Acadia.

Norway, Britain, Newfoundland, and the eastern provinces of Canada, afford unusual facilities for the study of the Cambrian system, and in the following table an attempt has been made to correlate the older members of this system, which are found in the countries mentioned :—

	Canada.	Newfoundland.	Great Britain.	Norway.	Sweden.
Division 1 of St. John group.	Band *d*.	Limestone of Chapel Arm, Trinity Bay, and No. 7, Zone *b* at Manual's Brook.[1]	Menevian group.	Etage 1 *d*.	Upper Paradoxides Beds
	Band *c*.	No. 7, Zone *a* and No. 6, Zone *b* at Manual's Brook.	Solva group, part.	Part of Upper Sparagmite formation — Etage 1 *c*.	Lower Paradoxides Beds.
	Band *b*.	No. 6, *a* at Manual's Brook.	Solva group, part (?)	Same, Etage *b*, part.	*O.* (*M.*) *Kjerulfi* beds, Fucoidal sandstone, part.
	Band *a*.	Nos. 3, 4 and 5 Manual's Brook.	?	Part of Up'er Sparagmite formation—Etage *a*.	Fucoidal sandstone part, Eophyton sandstone.
Basal Series.	Upper part.	Nos. 1 and 2 at Manual's Brook.	Caerfai group, part.	Part of lower div'n of Sparagmite formation.	?
	Lower part.		Caerfai group, part (?)	Part of lower div'n of Sparagmite formation.	?

It may be remarked that the Basal series in Acadia, though unconformable to the St. John group, is closely related to it in its distribution. It has at its base a conglomerate, which rests in some places on the diorites, agglomerates, etc., of the Coldbrook group and

[1] These are inserted as an estimate based on Mr. Walcott's observations in Newfoundland, in American Jour. of Sci., July, 1889.

in others on the Laurentian rocks. A good section may be seen at Hanford Brook, St. Martin's, where it presents the following succession (roughly estimated) :—

	Thickness in Feet.
1—*a*. Coarse purplish red conglomerate resting on an amygdaloidal greenstone (toadstone) of the Coldbrook group	60
b. Grey and purplish flags and sandstones with worm-casts, sea-weeds (*Palæochorda* and *Buthotrephis*), and numerous spicules of sponges	70
c. Purplish red sandstones, with greenish layers. Remains of sea-weeds (*Phycoidella*), animal tracks (*Psammichnites* and *Helminthites*), worm-burrows (*Arenicolites*), etc	240
2—*a*. Purplish red conglomerate, more friable than 1 *a*	35
b. Soft purplish red shales, with green glauconite grains, the upper part firmer and more sandy, greenish grey layers interspersed especially towards the base. *Platysolenites*, *Obolus*, *Volborthella*, etc	175
c. Purplish sandy shales, with a few bands of greenish shale. Worm-casts (*Scolites*)	300
Measures concealed, probably of this series	320
	1,200

In this series of one thousand or more feet of beds, the very oldest layers which are fine enough to preserve organic markings, have trails and casts of marine worms, and also contain seaweeds, one a Palæochorda or allied genus, the other a weed with a flat frond similar to Buthotrephis. That these beds are marine is clearly shown by the great numbers of spicules of hexactinellid sponges which they contain.

About three hundred and fifty feet above the base, where the measures are flaggy, tracks of annelids are again abundant. Besides the smaller trails and burrows, there are frequent tracks of a marine animal, possibly a worm, similar to the markings on the Fucoidal sandstone of Sweden, which, by Prof. O. Torrell, have been referred to the genus Psammichnites. A very similar track, with corresponding casts, occurs on the surfaces of the purple streaked sandstones (*Assise* 3) of Band *b* in Division 1 of the St. John group, and a similar trail occurs as high up as the lower Band of Division 2 of that group. Above this point, such markings have not been found, though the kind of rock—flags and slates—is favorable to their occurrence. The flags of the middle of Division 2 of the St. John group seem to be the horizon of *Cruziana semiplicata* (Salter) and *C. similis* (Billings) ; but I have not found them here

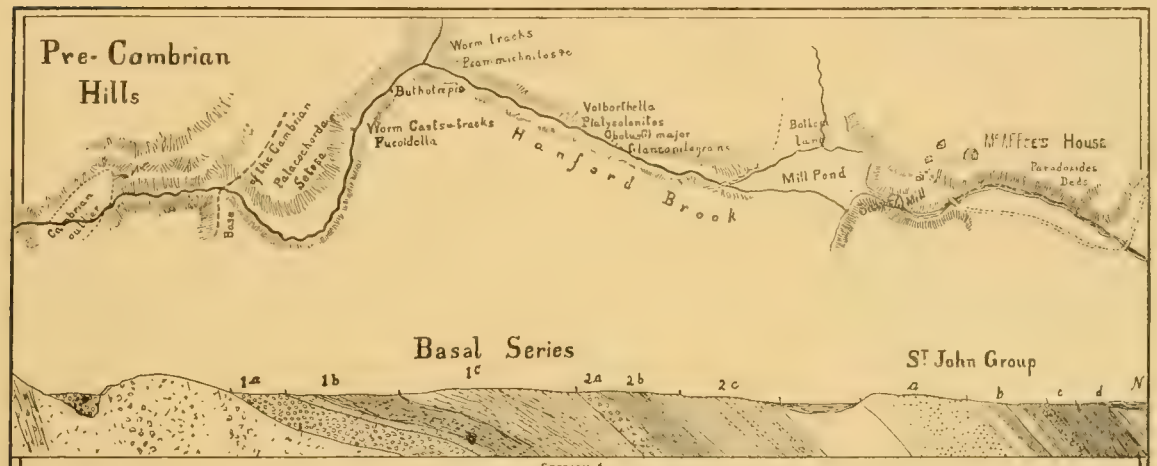
About one hundred feet or more above the horizon where Psammichnites appears, separated from it by a conglomerate, indications of the Olenellus fauna show themselves. These consist of *Volborthella*, (a chambered cell resembling an Orthoceras), the cystidean genus *Platysolenites*, Pander, and a large Obolus, allied to *Michwitzia* (formerly *Obolus?* or *Lingula?*) *monilifera*, Linrs, of the Eophyton sandstone of Sweden and the upper part of the "Blue Clay" of Russia. Some of the layers in this part of the series abound in soft green grains similar to the glauconite grains of the Cambrian rocks in Russia. The paste enveloping them is red.

A number of beds between this point and the top of the Basal series contain worm-casts and burrows, and some have remains of small strap-like seaweeds.

A sketch map showing the whole of the Basal series exposed on Hanford Brook is given herewith, and the localities of the most important fossils indicated. By the section given below it, the dip of the beds may be seen to be at a low angle in the lower division. At the base of the upper division the dip increases considerably, and a change of

strike also occurs at this point. This might suggest a repetition of the measures by a fault and overlap. But we do not find any evidence elsewhere to sustain such a view, unless it be the thinness of the measures in other parts of the field. A difference in the strike is also found at the base of the St. John group, where the two series meet at the millpond, but here the dip of the two series coincides.

Fig. 1.



Section A

Sketch Map and Section of Cambrian Rocks at Hanford Brook.

Scale 700 feet to an inch.

The contact of these two series (the Basal series and the St. John group) is not visible on this brook, being concealed under the low ground around the milldam of McAfee's mill, but several miles west on Radcliff's millstream, a branch of Mispeck River, it is apparent in the bed of that stream. There the first layers of the grey sandstones at the base of the St. John group are seen to be mingled with red sand derived from the beds of the lower series.

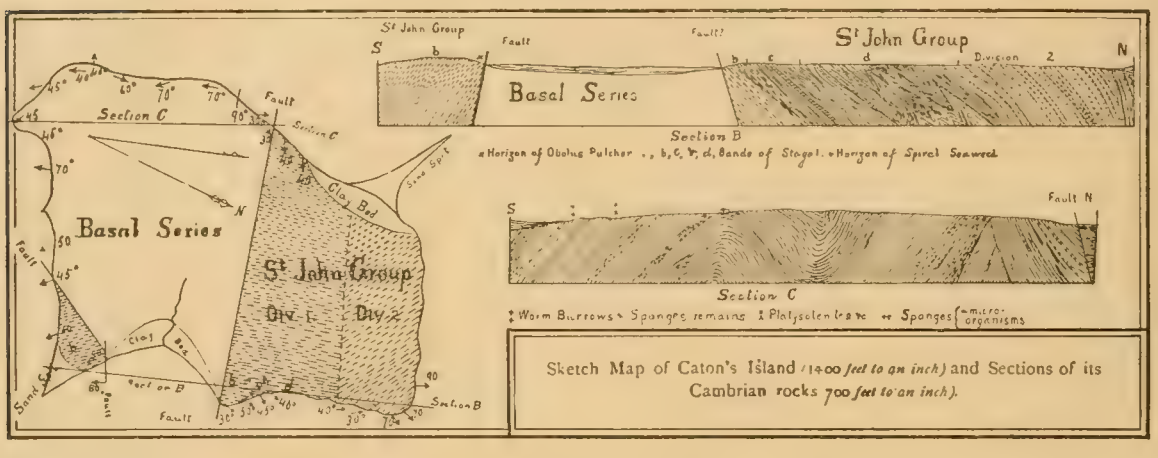
The grey sandstone (*a*) at the base of the St. John group is a very persistent deposit, being found in all the basins of Cambrian rock near St. John. It appears to have been formed not far from shore, but the actual shore line of this band has been preserved only at one place on the "Straight Shore" in the upper part of the harbor of St. John, where a small area of pebbly beach, the equivalent of this sandstone, has been let down by faulting among the other rocks on the margin of the Laurentian area. The pebbles in this conglomerate are small and are mostly composed of fragments of quartz and greenish slates, with a few pebbles of Laurentian limestone. Ledges of Laurentian limestone are found on both sides of this little patch of conglomerate, and the locality is an interesting one, as showing the irregular contour of the seabottom in this region in early Cambrian time.

The Basal series of Cambrian rocks is well exposed in the valley of the Long Reach, in King's county, though here the rocks are more disturbed than at Hanford Brook, and the thickness and succession of the measures is not so clear, but judging from the dip and the areas exposed, the former must be considerable.

Caton's Island, a small island of the St. John River in this valley, gives the clearest

exposure of the relations of this series to the St. John group, and has afforded some fossils which help to fix the age of the Basal series. Unfortunately faults occur at the contact of this series with the St. John group, so that the first layers of the latter are not visible, but the relation of the one series to the other is unmistakable.

FIG. 2.



A sketch map of the island with two sections across it will serve to make clearer the relations of the different members of the Cambrian system that occur there, and the horizons at which the fossils are found. In this map the unshaded portion of the island is occupied by the Basal series, and the shaded part by the St. John group, of which only Divisions 1 and 2 are found on the island. The upper section taken on the eastern side of the island (lower side of the map) shows only the St. John group, which is divided into two portions by an area where the measures are concealed. The lower section was taken on the western side of the island (upper side of the map), and shows the Basal series, with a small portion of the St. John group at the northern end, divided off by a fault. Band *a* of Division 1 of the St. John group does not appear anywhere on this island, but at a point about seven miles south-west of this island, on the north side of St. John River it is found at the contact of the two series, being a band of grey sandstone about twenty feet thick.

I have remarked above that the Basal series affords indications of the fauna which accompanies the trilobite genus Olenellus and its kindred genus Mesonacis,[1] but indications of a similar fauna are also found in the two lowest bands of the St. John group. A few words, therefore, on the organisms of these bands in support of the parallellism suggested in the preceding table may with advantage be added here.

There is in all the Cambrian basins in this province, just below the oldest beds which are known to hold Paradoxides, a bed of shales of considerable thickness (1*b*, 5), which though apparently no coarser or more siliceous than the beds below, stands out in the sections with peculiar massiveness. It contains some fragments of trilobites, many Dictyonine sponges and other low organisms, and the brachiopods lie entombed in it at

[1] See note at the end of this article in reference to Mesonacis and Holmia.

all angles. This bed marks the close of the peculiar physical conditions which caused the fauna below to differ from that found in the Paradoxides beds. Possibly one of these conditions was a difference in the temperature of the sea-water in which these animals lived. Rapid accumulation of sediments, instability of the sea-bottom, and possibly volcanic eruptions at no very distant point, added their influence in giving the lower beds a distinct fauna. In and below this bed, the remains of trilobites are rare, and, except as regards the brachiopods, the known fauna differs entirely from that in the beds above. In the middle "assise" ($1b^3$) we have been able to recognize an Agraulos, and at the base ($1b^1$) an Ellipsocephalus, both recalling forms which in Europe are associated with *Mesonacis Kjerulfi*.

In the Cambrian basin on Long Reach, King's county, a fine Obolus was collected on Caton's Island near the base of Band *b*, which helps to link this fauna with that of the fucoidal sandstone in Sweden. In its peculiar ornamentation, and in the way in which its radular sculpture is confined to the half of the shell nearest the umbo, it closely resembles the *Lingula* (?) or *Obolus* (?) *favosa*, of that arenaceous deposit.

In the same basin, but at a locality further west, Band *b* in its upper part contains the curious little cephalopod, Volborthella, heretofore known only from the Blue Clay of Russia. It occurs there in the upper part of the Blue Clay in association with Mesonacis, Mickwitzia, Platysolenites, etc.

The relation of the Paradoxides beds to those beneath will be better understood by a comparison of the Acadian measures at the several localities with the typical Cambrian series of Sweden. So nearly alike were the physical conditions during the early period of Cambrian time in those two countries that the symbols, originally used in New Brunswick to designate the groups of beds in the Paradoxides division, have served to distinguish nearly similar subdivisions in Sweden and Norway.

In the Acadian sections the base of the Paradoxides beds has been taken as the datum line, and the thickness of the beds above and below this horizon indicated on a scale of 100 feet to an inch.

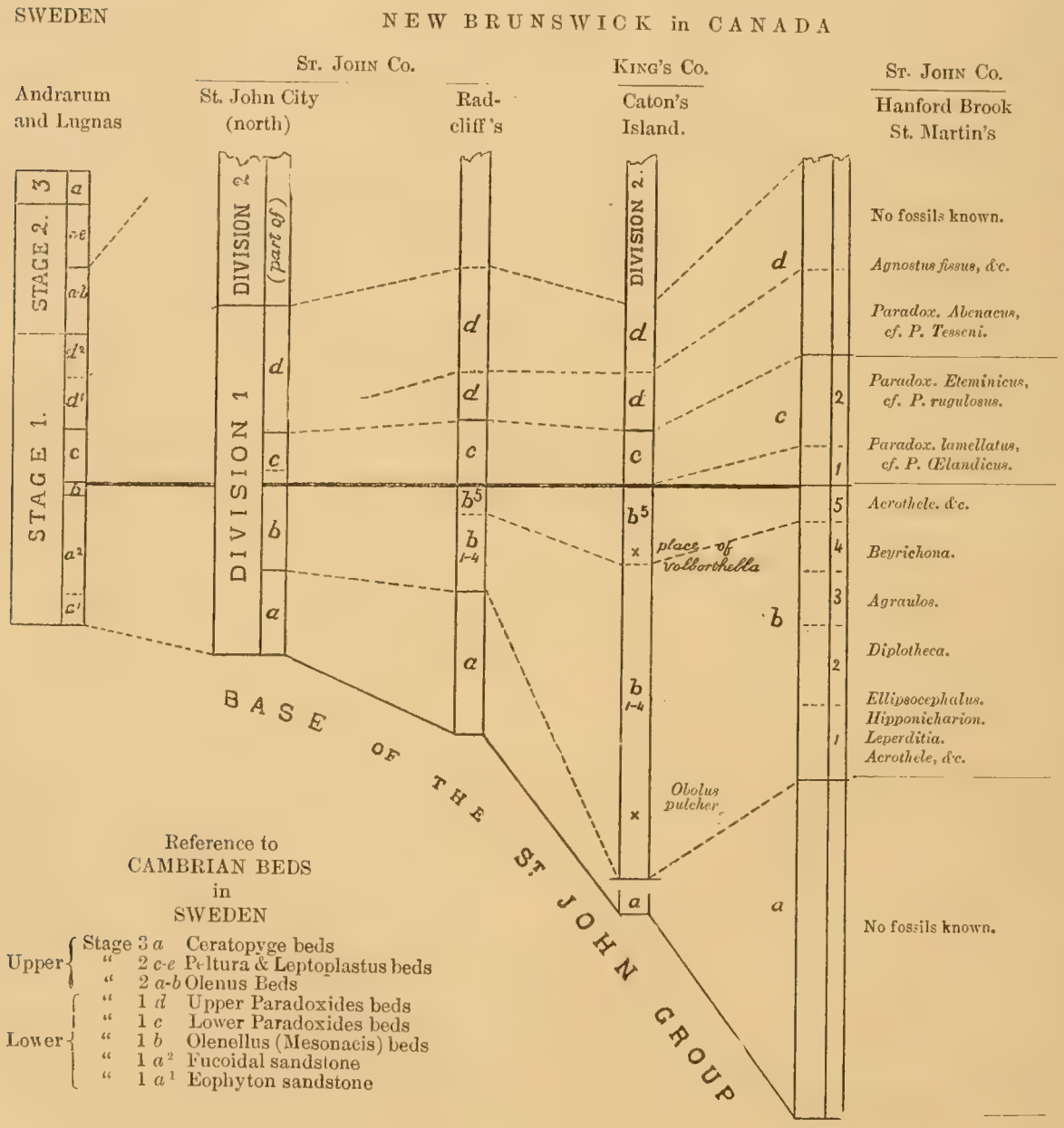
In Sweden the beds which belong to the lower part of the column, and are marked *b*, are the "Olenellus beds" of that country; those marked *a* are the Fucoidal and Eophyton sandstones which by the discoveries of F. Schmidt in Western Russia are also to be counted as a part of the "Olenellus" beds, since, as already observed, the corresponding beds in Russia contain a Mesonacis. The brachiopod *Lingula* (or *Mickwitzia*) *monilifera*, which is found with this trilobite, and is common to the Cambrian of Russia and Sweden, occurs in the latter country at the base of the Eophyton sandstone, and this sandstone appears to correspond in position to the white-weathering sandstone *a* at the base of the St. John group or to the upper part of the Basal series immediately below.

Of the sections of Cambrian rocks in Acadia exhibited in the above table, three are from the St. John basin, and the fourth from the Long Reach basin in King's county, and they show clearly the varying thickness of the deposits of Division 1 in the different districts. This feature is much more noticeable in the lower Bands (*a* and *b*) than in the upper (*c* and *d*).

The most continuous and complete section found is that on Hanford Brook, which drains a small Cambrian basin now separated from the rest of the St. John basin by a low ridge of pre-Cambrian rocks; and from the differences that are observable in the details

of the sections on the two sides of the ridge, it is probable that the dividing ridge existed in Cambrian times (compare the third and fifth sections). Band *b* has its greatest thickness in the more distant basin in King's county (see fourth section), but does not show so much variety in the sedimentation as at the easterly exposures in the St. John basin.

FIG. 3.



In this district at Hanford Brook the fauna of 1*b* presents itself in considerable variety. At the base, forty feet of dark grey sandstone contains Ellipsocephalus and fragments of other trilobites, three entomostracans, viz., Hipponicharion and two species of

Leperditia remarkable for their thick tests and pitted surfaces, and six species of brachiopods of the genera, Acrothele, Acrotreta, Linnarssonia and Lingulella.

These sandstones are followed by fifty feet of comparatively barren dark grey sandy shales, and they by thirty feet of hard, purple-streaked sandstones (the streaks due to oxide of iron), in which occur an Agraulos of the form of *Arionellus primævus* of the bed *b* in Sweden, and the hyalithoid shell, Diplotheca, as well as numerous tracks of Psammichnites. The olive grey shale, thirty feet thick, above the sandstone, is comparatively barren, but has yielded the two species of Beyrichona, a genus which has points of resemblance to Aristoze of Barrande. The upper bed of *b*, twenty feet thick, has numerous shells of the genera Acrothele, Lingulella and Linnarssonia, and worm burrows, and the brachiopods are the same as those found in the Paradoxides beds above.

In treating of the equivalency of these several beds of the Lower Cambrian, owing to the scantiness of the faunas, the comparison, bed for bed, cannot be made with the same confidence as where an abundant fauna, makes an exact comparison easy. Hence the physical aspect of the beds must necessarily be largely depended on in making these comparisons. This affords good indications in basins so close to each other as these, but even here may not be used with entire confidence. It may, for instance, be observed that Band *a*, in the basin of Long Reach, Caton's Island, etc., is only about twenty feet thick, and Band *b*, 200 feet thick, while at Hanford Brook the corresponding bands are respectively 200 and 170 feet thick. Band *a* is a shallow-water and beach deposit, and Band *b* was formed in deeper water, which gave opportunity for the growth of calcareous organisms; and there is a possibility that part of Band *b* of King's County (Long Reach) basin may be contemporary with the upper part of Band *a* of the St. John basin, and that *Obolus pulcher*, which we here represent as being of the same age as Hipponicharion and the Leperditiæ, may in reality be somewhat older. This may not be a matter of any importance, as the range of both sets of organisms may be found to be greater than it is now known to be, but I direct attention to the actual facts.

In summing up the facts bearing on the comparative age of this part of the Cambrian rocks in Acadia we get no aid from the typical genera of this horizon, Olenellus and Mesonacis, but the Acadian rocks contain other genera of this fauna which serve to fix their age with a certain degree of accuracy. Some of these genera, however, are such as may have a wider range of existence in time than the trilobites, and therefore are not of of the same homotaxial value. The trilobites that do occur are not so definitive as some others.

ACADIA.		SWEDEN AND RUSSIA.	
SPECIES.	HORIZON.	SPECIES.	HORIZON.
	St. John Gr.		
Agraulos articephalus	1 *b*	Arionellus primævus	1 *b*
Ellipsocephalus, *sp*	1 *b*	E. polytomus	1 *c*
Volborthella tenuis	1 *b*	V. tenuis	*Blue clay*
Obolus pulcher, *n. sp*	1 *b*	Lingulella favosa	1 a^2
	Basal series		
Obolus (?) major, *n. sp*	2 *b*	Mickwitzia monilifera	1 a^1
Platysolenites antiquissimus	2 *b*	P. antiquissimus	*Blue clay*
Volborthella tenuis	2 *b*	V. tenuis	*Blue clay*

B.—*Flora and Fauna of the Basal Series, and Additional Species of Band* b, *Div.* 1, *St. John Group.*

I.—ALGÆ.

In describing objects under this head, the writer has limited himself to such as shows organic structure, or by a carboniferous film, give evidence of organic matter in their composition. It is true that some writers (Nathorst and others) do not consider the presence of this film as proof that such objects were plants; and we have seen it stated that seaweeds are such perishable objects, that even where abundant, they leave no trace of their presence in the solid rocks. This however appears to be a misconception. It is true that, where they are imbedded in sand, they may dissolve to a shapeless mass of jelly and become diffused in the matrix; but when buried in clay the result is different. In the Till and Leda clays of the Acadian coast, which have a considerable antiquity, the writer has been Polysiphonias and other delicate seaweeds, as well preserved as the ferns and Asterophyllites of the shales of the Carboniferous system.

BUTHOTREPHIS, *Hall*, 1847.

Buthotrephis antiqua, *Brongn.* (Pl. V, figs. 1–3.)

Fucoides antiquus, Brongn., Hist. de Veg. Foss. Vol. I, p. 63.
Fucoides antiquus, Brongn., Torrell. Bidrag till Sparagmit, 1868.

Brongniart's description of this species is as follows:—"F. fronde compressa, dichotoma, ramis planis æqualibus, patentibus, apice subrotundis, non incrassatis."

Seaweed, having a compressed forked frond; branches flat, equal, spreading, with a tip that is rounded, but not thickened.

Torrel's note of the locality is "Funnen i Vestergothlands Fucoid sandstein."

The horizon is, therefore, that at which several fragments of flat-leaved, branching sea-weeds have been found in the Acadian measures. As Bongniart's old genus *Fucoides* has been broken up, this plant will fall into Prof. Jas. Hall's genus *Buthotrephis*. I have reproduced Brongniart's and Hisinger's original figures, partly to show the general aspect of the plant, and partly to indicate the place of the fragments found in our shales.

Size.—Width of branches, 2 to 4 mm.; length, 2 to 4 mm. Length of plant unknown.

Horizon and Locality.—Shaly layers in the sandstone beds of Div. 1, Bands *b* and *c* in the Basal series.

PHYCOIDELLA, n. gen.

Phycoidella stichidifera, n. sp. (Pl. V, figs. 5 *a–d.*)

Barren fronds (or branches) strap shaped, often showing irregular rows of a few darker spots or granules which have a transverse arrangement on the stem. Fertile fronds (or branches) bearing an enlarged extremity like a stichida, and also having along

the sides projecting points which appear to mark the points of attachment of similar enlargements of the frond. The stichida has transverse rows of dark spots, some of which grow out into projecting sporangia, ovoid, and pointed at the upper end. There are about a dozen of these spots in each row on the stichida.

Size.—Width of branches (or frond), $1\frac{1}{2}$ to 2 mm.; length, 40 mm. or more. Length of stichida about 12 mm.

Horizon and Locality—In the green and purple shales of Div. 1 *b* in the Basal series at Hanford Brook. Also in olive grey bands in the red sandy shales of Div. 2, in the same series at Caton's Island.

This plant may be related to *Fucoides circinnatus*, Brongn., (Pl. V, fig. 4) which he characterized as follows:—

"F. fronde ramosa, subpedali, ramulis elongatis, subsimplicibus, cylindricis, arcuatis et eodem latere subcircinnatim deflexis."

Seaweed having a branched, somewhat stalked frond; branches elongated, rather simple, cylindrical, arched, and bent to one side in a subcircinate manner.

Torrell's note of the locality is "Afvenledes funnen i Vestergothlands fucoid-sandsten."

If it were not that Brongniart says that the branches of this plant are round, I should be disposed to think it of the same genus as the species above described, as it is always found bent to one side; and occurring in such a way in the shale as to give the impression that it formed a compound frond, such as that figured by Brongniart. But our plant is always flat and does not seem to have received this form by pressure in the shale. I therefore feel it necessary to provide for this species a separate name, more especially as the fruitage appears to be peculiar.

PALÆOCHORDA, *McCoy*, 1849.

PALÆOCHORDA SETACEA, n. sp. (Pl. VI, figs. 1 *a–g*.)

To this genus of McCoy is referred a marine plant from the lowest sandstone beds (1 *b*) of the Basal series.

The stem or frond is long, cylindrical, flexuous, and was composed of open cellular tissue, more closely compacted at the walls of the stem, where there are elongated cells, closely set. The stem has a rough cuticle, marked by faint, transverse, closely set grooves (about 2 or 3 mm. apart, or in some $1\frac{1}{2}$ mm. apart.) Attached at the nodes formed by these furrows are long jointed setæ, 2 cm. or more in length, about $\frac{3}{4}$ mm. in diameter, and having diaphagms about 1 mm. apart.

Size.—Length, unknown; thickness, from 7 to 10 mm.

Horizon and Locality.—In greyish layers among the purplish sandstones of Div. 1, Band *b*, in the Basal series at Hanford Brook, St. Martin's. Occurring in tangled masses spread over the surface of the beds.

This plant has the general aspect of a Palæochorda. The large setæ are perhaps antheridea. It evidently was a marine plant, for the purple sandstones in which it is found abound in the debris of sponges. The best examples are found in clayey layers where some of the stems have been flattened and others preserve their oval form having

been injected with silica. To this mode of replacement also we owe the preservation of some of the delicate setæ which clothed the stem.

This and *Buthotrephis antiqua* which occurs with it, are the two oldest organisms of the Cambrian rocks in Acadia.

HYDROCYTIUM.

Among the microscopic forms in the Cambrian shales are some minute oval bodies which by their black color are shown to have been composed of dense organic matter. They appear to have been held together by a strong epidermis, as the contents are often found shrunken together so as to leave irregular cavities near the centre. Until better known, they may be referred to the above confervoid genus.

Hydrocytium (?) silicula, n. sp. (Pl. VI, fig. 2.)

Minute, oval bodies, with a strong cuticle, and having a pedicel-like knob at one end.

Size.—Length, $\frac{1}{2}$ mm.; width, $\frac{1}{4}$ mm.

Horizon and Locality.—In soft green shale of 1 *b* of the St. John group.

These organisms are not abundant; they are large enough to be visible to the naked eye. Other detached and scattered minute black bodies are more common. These may be the spore cases of algæ; they are intensely black, and gave tuberculated surfaces; they are usually globular or oval in form. Two of these are figured in the accompanying plates. (Plate VI, fig. 3.)

MICROPHYCUS, n. gen.

Microphycus catenatus, n. sp. (Pl. V, figs. 6*a*–*b*.)

Minute, reticulated organism, forming a net-like expansion on the sea bottom; with enlargements or nodes at intervals. The connecting threads are nodulose, composed apparently of chains of single cells. The nodes are tuberculated as though they consisted of an aggregation of cells. The cells are filled with a dense organic matter, appearing of a black color in contrast with the fine, greenish grey shale in which they are imbedded.

Size.—The nodes have a diameter of about $\frac{1}{12}$ mm., and the connecting threads a length of about $\frac{1}{8}$ mm.

Horizon and Locality.—In the fine grey shales of Div. 1 *b* $^{1\text{-}4}$, St. John group at Ratcliff's millstream.

This microscopic alga is a most interesting object. The horizon of the Cambrian where it is found is the same as that which in the northern basin (Long Reach) is sandy and coarse and comparatively barren. Here it is a fine soft shale, which, to judge from the perfect condition of the most delicate sponges and the erect position of many of them in the shale, was deposited in the still waters of a sheltered bay. Through this mud, and even into the tissues of the sponges, this alga extended, forming an intricate network.

II.—MONERA & RADIOLARIA (?)

Among the micro-organisms found in cavities of the sponges of the Basal series are some which appear to belong to these divisions of the animal kingdom.

On removing the calcite infilling which now conceals them, they may be found attached to the walls of the cavities of the sponge. Many of the siliceous concretions in these cavities are amorphous, but among these are found solitary individuals or groups of organisms which have a definite shape. Some of these are here figured and described.

These objects (except the fourth described) are amber-colored, and hyaline, and have been preserved by silicification. They are placed here, awaiting fuller information on their nature.

MONADITES n. gen.

Minute spherical or oval bodies, with or without pedicels. Cuticle horny or membranaceous (?) covered with minute pores or hairs.

Monadites globulosus, n. sp. (Pl. VII, fig. 1 *a–b.*)

Little spherules covered with minute pores. These little bodies occur scattered or are aggregated in cavities of the sponge. Sometimes they show pedicels, and have connecting threads. These are much more abundant than the other minute forms herein described, and may have an organic relation to the sponge.

Size.—About $\frac{1}{8}$ of a mm.

Horizon and Locality.—Red sandy shales of Basal series at Caton's Island.

Monadites pyriformis, n. sp. (Pl. VII, figs. 2 *a–b.*)

Pyriform, stalked, with a dark spot or opening at the extremity; surface covered with minute pores (and hairs ?)

Size.—Length, about $\frac{1}{7}$ mm.; width, about $\frac{1}{12}$ mm.

Horizon and Locality.—Same as the preceding.

These are found attached to the sides of the sponge cavities, and sometimes one appears to have grown from the side of another.

Monadites urceiformis, n. sp. (Pl. VII, fig. 3.)

Broadly urn-shaped with a closed (?) distal extremity beset with minute spines. The swollen part of the body has on each side a group of dark spherules implanted on the surface. On the narrow part of the base is a projection which may be the shrunken representative of a pedicel. The contracted distal extremity is a hyaline, and of a different texture from the rest of the body.

Size.—Length, about $\frac{1}{4}$ mm.; width, about $\frac{1}{6}$ mm.

Horizon and Locality.—As the preceding.

RADIOLARITES, n. gen.

RADIOLARITES OVALIS, n. sp. (Pl. VII, fig. 4.)

Oval, bluntly pointed at the ends, covered with a raised hexagonal ornamentation.

Size.—Length, about $\frac{1}{2}$ mm.; width, about $\frac{1}{5}$ mm.

The epidermis of this form and of *Monadites globulosus* may have been of a horny consistency as parts of the amber-colored skin are indented as though it had possessed elasticity before it was silicified. This and *M. urceiformis* were found in cavities from which the calcite had been removed by natural causes, and may be recent.

III.—**SPONGIDA.**

Of sponges, there are in this part of the Cambrian system many representatives of the hexactinellid order and the scattered spicules of their skeletons may be observed in great numbers on many of the layers of the shales, or scattered through the coarser beds; those in the sandstones are generally much broken, but in the shales they are more perfect, enabling us to recognize several kinds of sponges of this order.

None have been found which possess a regular cup-shaped cavity, one has irregular passages, and appears to belong to Mæandrospongidæ of the following genus.

PLOCOSCYPHIA, *Reuss.*

PLOCOSCYPHIA (?) PERANTIQUA, n. sp. (Pl. VII, figs. 5*a*–*b*.)

Outline and general form unknown. Composed of a calcareous or keratose skeleton traversed by irregular loculi which show on their walls small oscules in which usually the order of arrangement is not traceable, but in which it may sometimes be observed to have a quincunx order. The loculi are seen to have around their sides simple needle-shaped spicules; in some of the loculi may be found groups of the monad-like organisms represented in figs. 1*a* and 1*b* of Plate VII, nestling among the spicules or attached to the surface of the locule.

Horizon and Locality.—The red sandy shales of Div. 1 of the Basal series at Caton's Island, Greenwich.

Among the sponges having a calcareous skeleton holding siliceous spicules, are two characterized by simple needle-like spicules. They are placed among the Lithistid sponges until better known.

ASTROCLADIA, *Zittel.*

ASTROCLADIA (?) ELONGATA, n. sp. (Pl. VII, fig. 6.)

Upright, cylindrical, sinuous or curved, with small lobes along the sides, loculi few, not conspicuous, no cloaca. Spicules simple, needle-like. A few larger ones observed that penetrate the body of the sponge from the outer surface to the inside of the locule.

Size.—Length, 40 mm.; width, about 5 mm.

Horizon and Locality.—Sandy shales of Div. 1 *b*, St. John group, at Belyea's Landing, Westfield.

ASTROCLADIA (?) ELEGANS, n. sp. (Pl. VII, fig. 7.)

Slender, cylindrical, curved, with central loculi, but no continuous cloaca. Only small needle-like spicules observed.

Size.—Length, 40 mm. or more; width, about $1\frac{1}{2}$ mm.

Horizon and Locality.—Same as preceding.

ASTROCLADIA (?) VIRGULOIDES, n. sp. (Pl. VII, figs. 8 *a–c*.)

Small, slender, erect, rod-like, (branched?). Larger examples or parts with a hollow core, the smaller pieces showing no cavity. Apparently the body is composed of closely aggregated spherules, which sometimes are found almost detached or loosely connected.

Size.—Length, 10 mm. or more; width, $\frac{1}{2}$–1 mm.

Horizon and Locality.—Fine, soft, olive-grey shales of Band *b* in Div. 1, St. John group at Ratcliff's Stream and Hanford Brook, St. Martins.

A very prevalent type of sponge is that in which the body was supported by a siliceous skeleton only. Such are common in the shales of both the Basal series and St. John group, chiefly in non-calcareous parts of these terreins.

The organic matter of the sarcode in these sponges had given smooth surfaces to the layers on which their skeletons have been spread, and where the mass of these sponges is great, and the beds clayey, the spots where these sponges lie are black and glossy. At this horizon, in the Cambrian, one type of these sponges is especially prevalent.

DICHOPLECTELLA, n. gen.

Spicules crossing at various angles. Some forking, others simply crossing, and showing no evidence of being cemented or connected, otherwise than by the sarcode. This genus appears to be related to Askonema and Lanuginella, but differs in having forked spicules.

DICHOPLECTELLA IRREGULARIS, n. sp. (Pl. VII, figs. 9 *a* and *b*.)

Spicular skeleton, fine, almost invisible to the naked eye. Spicules differing in size, the forking spicules larger than the others.

Size.—Length of crossbar spicules, 2 mm. Distance apart, 0·1 to 0·2 mm.

Horizon and Locality.—Fine, olive grey shales of Divs. 1 and 2 of the Basal series, also the fine shales of Div. 1 *b* of the St. John group.

HYALOSTELIA, *Zittel.*

Hyalostelia minima, n. sp. (Pl. VII, fig. 10.)

A tuft of spicules. Elongate, ascending, branched, consisting of groups of cemented spicules, ending in pointed or recurved extremities, or a loose open mass of aggregated spicules. Having root-like branches at the foot of the tuft of spicules.

This appears to be an anchoring group of spicules which terminated upward in the body of the sponge.

Size.—Length, 4 mm.; width at the branches, $1\frac{1}{4}$ mm.

Horizon and Locality.—Red shales of Div. 1 of the Basal series at Caton's Island, Greenwich, N.B.

IV.—**CRINOIDEA.**

PLATYSOLENITES, *Pander.*

Platysolenites antiquissimus, *Eichw.* Sp. (Pl. VII, figs. 11 *a–c.*)

1851. *Platysolenites,* Pander in Bull., Soc. Geol. de France, 2 sér., vol. 8, p. 253.
1858. " Ehrenberg in Monatsbericht, Berl., Akad, p. 329, 336.
1860. " *antiquissimus,* Eichw., Leth. ross. auc. per p. 678, T. 33, F. 19.
1881. " F. Schmidt, Revision der ostbaltischen silurichen Trilbiten, abtheil. I, p. 13, F. 1.
1888. " " Mem. Acad. Imp. des Sci. St. Petersburg, VII., XXXVI., No. 2, p. 26.

F. Schimdt, in the last named publication, gives a full description of this "Encrinite stalk," and of the opinions of several naturalists who have examined it. Being the oldest fossils known in the Lower Cambrian beds of Russia, they have attracted much attention. Pander, who first described these "minute, hard, flattened little reeds," could not decide upon their place in the system of nature. Ehrenberg, who studied them microscopically, could find no structure in their hard shells, and was inclined to regard them as similar to the mineral crust that encloses the stems of certain Algæ. Eichwald referred them to the Annelids, considering their hard calcareous shells to be similar to those of Serpulæ. F. Schmidt says that he was brought to consider them parts of Cystidians, because of their articulated appearance. He also states that in 1870 Gümbel could find in them nothing but "crinoid stalks." They have been found by Mickwitz in abundance on the sea shore, near Reval and Kostifer on the Baltic, where they have been washed out of the Cambrian "Blue Clay." Herr Schmidt describes those from the lower Glauconite sand (in the Blue clay) as "somewhat flatly compressed little reeds with transverse divisions and joints, about 2 mm. broad and 15 mm. long. The thickness of the shell about $\frac{1}{4}$ mm., and the length of the joints about $\frac{1}{2}$ mm. The structure of the shell is plainly crystallo-calcareous as with other crinoid stalks."

In the examples from Caton's Island the crystalline structure of the shell is preserved, and the interior is occupied by a black mass which appears to be the carbonized contents of the cavity. The fossil is inclined to split readily along the middle, where the two sets of plates meet, and here the edges of the plates are rounded, where probably there was a connecting cartilage. On referring to F. Schmidt's figures of the Russian examples of this species,[1] it will be seen that the half of the stem, or arm is often thus preserved.

[1] *Ibid.* Pl. ii. 33 *a* and *b.*

Size.—The longest example preserved was 12 mm. long. Width, 2 mm. Length of joints, ½ mm. Diameter of the canal, about 1½ mm.

Horizon and Locality.—In grey layers of the red sandy shales of Div. 2 of the Basal series at Caton's Island, Greenwich, N.B.

Dr. Schmidt thinks these fossils may be compared to the long arms of the American species, *Eocystites longidactylus*, Walcott, of the Middle Cambrian of Nevada, U. S., but I have found no body plates of cystids with the Canadian Platysolenites.

V.—BRACHIOPODA.

OBOLUS, *Eichwald*, 1829.

Obolus pulcher, *Matt.* (Pl. VIII, figs. 1 *a–m* and 2 *a–c*.)

Can. Record of Sci., Jan., 1889, p. 303.

The original description of this species was as follows:—

General outline nearly orbicular; the valves gently, but rather flatly and evenly arched downward from the centre all around, except that the dorsal is flatter at the back than elsewhere, and the ventral valve runs out into a short, acuminate umbo.

Dorsal valve somewhat wider than long; more strongly arched toward the front than elsewhere; somewhat elevated at each end of the hinge line.

Ventral valve about as wide as long; the front evenly rounded; back produced into a short pointed beak, angle of incidence of the two sides 110° to 120°.

Sculpture of the posterior half of the valves, consisting of minute tubercles, sloping forward and arranged in rows, which arch forward across the mesian line from each lateral margin, giving the surface a cancellated appearance, like that of *Lingula* (?) *favosa* and *Kutorgina pannula*. Sculpture of the anterior part on the front and sides in the adult shell consisting of concentric lines of growth, with faint, interrupted, radiating striæ.

One of the most interesting species among the early brachiopods of the St. John group is the one named above. On account of its antiquity and because of its peculiar form in the embryonic stages, the writer now gives considerable space to the description of its characters. It is the oldest species of brachiopod belonging to the St. John group, of which good material has been obtained, and the following extended account is based on this material.

The ventral valve is evenly and moderately arched, except that the sides are depressed toward the beak; the beak itself is prominent only toward the tip, and runs out horizontally from the middle of the valve.

Interior of the Dorsal Valve (Figs. 1 *i* to *m*).—The most noticeable feature of the interior of this valve is the three ridges which radiate from the hinge line toward the anterior end of the valve. The mesian ridge begins with a small tubercle near the umbo, is longer than the two lateral ridges, and divides into two outward arching forks; including these, it extends about two-fifths of the length of the valve from the hinge line; its posterior part divides the pits of the hinge line where the posterior adductor muscles were attached. The two lateral ridges extend forward from the two ends of the hinge line; and at the end of each, where it joins the hinge line, are situated the pits due to the attachment of the two

branches of the cardinal muscle; outside of these two ridges are a pair of elongated semilunar scars, where the posterior adjustor muscles were attached. There is a -shaped ridge flatter than those described and broader, in front of the space between the forks of the mesian ridge ; this probably divides the anterior adductor muscles.

Interior of the Ventral Valve (Figs. 2 *h* to *l*).—There is much resemblance in general aspect between the interior of the dorsal and ventral valves. The latter differs in the more elongated callus of the visceral cavity, the narrower scar of the posterior adjustor muscle, the absence of the strong lateral ridge beside this muscle, and the want of a division along the mesian line. This valve also exhibits indications of the attachment of the pedicel, and of the central adjustor muscles. The ventral valve also possesses a smaller, pointed depression in the front of the visceral cavity, which probably marks the attachment of the anterior adductor muscle. From this point, a somewhat depressed band extends to the front of the shell. If we assume that the small round scar, near the centre of the visceral cavity, was made by the central adjustor muscles, a small scar behind it, having its opening directed backward, will mark the starting point of the pedicel. This organ in its backward course has made a slight groove on the axial line. There are indications that the pedicel then passed through a foramen in the hinge, coming on the hinge area below the beak, but this point is not clearly determinable.

Sculpture.—The younger part of the shell is covered with minute tubercles, sloping forward, and arranged in curved rows which arch forward to the mesian line from each lateral margin of the valve, thus giving the surface a cancellated appearance ; this cancellated or rasp-like surface does not cover the valve continuously, but is interrupted by arching bands of ridges concentric to the umbo. The anterior part and the outer lateral parts of the valves have the concentric ridges only, with a few faint, broken, radiating lines, visible at intervals. The cancellated lines do not always cover so large a space on the dorsal as on the ventral valve, but the former valve shows more distinctly the radiating lines outside the visceral cavity.

Growth and Development.—The growth and development of this species as recorded in its shelly covering are very instructive. Beginning with a shell which is comparatively tumid in form and nearly semicircular in outline, it finally becomes orbicular in outline, and with valves flattened to the form of saucers.

By the varied sculpture, the outlines of the valves and the surface markings, several phases in the life of this brachiopod may be distinguished.

(1.) The first is that marked by the embryonic shell. This shell, now preserved in the umbo of the adult, shows in the markings on its surface faint indications of additions to its size, but these are hardly discernible. A remarkable feature about this is the form which is entirely different from that of the adult, for it (in the dorsal valve especially) is nearly semicircular in outline, and is quite tumid when compared with the adult shell ; it looks more like an Orthis or a Linnarssonia (see figs. 1*a* to *c*) than an Obolus or a Lingulella, the two genera which the adult most nearly resembles. The embryo ventral valve also differs quite as much from the adult as does the dorsal, for in its high umbo and straight hinge line it recalls species of the genera Acrotreta and Kutorgina (see figs 2*a* to *c*.)

In the embryonic shell of the dorsal valve, which is narrowly semicircular, the straight outline of the hinge was scarcely broken by the rounded projection of the umbo.

As viewed from above, this valve presents a hollow more or less obvious in the front of the visceral cavity. This hollow is sometimes a deeper depression, and corresponds to the outside of a tubercle within the shell, which continued throughout the life of the occupant to be a marked prominence of the interior of the valve, and forms the initial point of the mesian ridge of the shell. The longest diameter of this hollow is about equal to one-half of the length of the embryonic shell, and in some examples it contains four little pits, which appear to mark the points of attachment of muscles (fig. 1*d*). The two lateral pits appear to answer to the anterior adductors, and the posterior pit to the anterior retractor. The anterior adjustors in this stage of growth seem to have been at the margin of the shell, and outside of the large depression above referred to, for a series of pits can be traced on the adult shell from the margin of the embryonic shell well out toward the outer edge of the valve (fig. 1*f*.) The posterior adjustors are probably indicated by a depression on each side of the umbo.

The space occupied at this time by the visceral cavity was large in proportion to the size of the shell, and extended quite out to the margin ; and no indication of the existence of a marginal area for the protection of a mantle and setæ can be seen. The outer posterior angles of the embryonic shell were turned upward, giving it somewhat of a saddle-shaped relief (fig. 1*d*.) In some examples the shell is crossed by a raised band due to the strengthening of the hinge line during the subsequent growth of the shell (fig. 1*a*.)

Already, at this very early period, we find clearly, though very minutely displayed, the rasp-like surface, which is so marked a feature of this species during the next period of its growth.

(2.) In the second phase of growth there is a decided change in the form of the shell. There was also an extension of the hinge line, and a transfer outward of the muscles along that line to accommodate the growth of the animal ; but although the hinge line is actually much longer than in the embryonic shell, owing to the more rapid enlargement of the sides and front it appears to be shorter. This we may regard as the larval stage of the shell, as by its form and features it exhibits indications of the possession of organs for the capture of food (fig. 1*f*.)

The overlapping outer layers of the shell are ridged up around the posterior angles at the ends of the hinge line of the embryonic shell, showing that the agency of the mantle was exercised in adding to the margins. In this stage of growth the shell was still quite thin, and the several stages of growth are clearly marked by the impression of the gradually enlarging previsceral depression, now less distinctly indented than in the embryonic shell ; we can trace the growth of the shell by the anterior and posterior points of the pre-visceral depression, as well as by the two series of scars, diverging from the posterior margin that mark the periodical change in the position of the adjustor muscles (figs. 1*f* and *g*.)

Owing to the thinness of the shell at this early period of growth, the frequent enlargements of the shell are shown by the defined margin of each shell layer ; of these about six can be distinguished on the inner half of this zone of the shell. The surface of the shell in this part bears the rasp-like ornamentation characteristic of the species, on all except the last one or two layers, where the growth is indicated only by ridges concentric to the umbo, and here there is no radulated surface. The rasp-like ornament on these shells is not unlike that on Acrothele, to which this species is related ; but in Acrothele

the markings are more distinct near the margin than toward the umbo, while the reverse is the case with this Obolus.

This larval part of the shell is sometimes divided by one or two concentric lines into two parts, of which the outer is distinguished by an enlarged pattern of the radular ornamentation; and the margin of this zone has a more rounded outer margin than the inner zone, owing to the more rapid extension of the margin at the sides and front. In this outer half of the larval zone there is a more decided thickening of the shell, for the lines of growth are not so delicately marked as in the inner half, nor is the impression of the features of the interior of the shell so clearly apparent, except as regards the outlines of the visceral cavity. These features, however, may be inferred from the rounded ridges on the surface and by the lines of scars left by the anterior adjustor muscles, which give evidence of about six stages of growth in this outer zone of the larval shell.

Outside of this zone the radular ornamentation is exchanged, on a narrow band of the shell, for concentric ridges, indicating an arrest of growth preparatory to the next phase in the life history of the individuals of this species.

The close of the larval period is marked by the fixation of the hinge line, which no longer lengthens, and consequently the position of the posterior adductor and the proximate end of the cardinal muscle do not materially change after this.

(3.) The advent of the next phase in the history of this shell, which may be called the adolescent phase, is indicated by a return to the radular ornamentation, which now is of a still coarser pattern than previously, and is not always well preserved; in fact dorsal valves are not uncommon, and ventral valves are occasionally found, which show no radular ornament at this period, but have concentric lines only. This peculiarity, however, may be due to imperfect preservation.

This part of the valve, like the larval, is not unfrequently found to be divided into two zones by a few concentric lines; in the outer of these zones the radular ornament is usually very irregular.

At this period one does not find the lines of growth so distinctly marked as in the earlier period, nor the scars of the anterior adjustor and adductor muscles; but the outline of the visceral cavity, owing to the thickening of the callus formed there, stand out with greater distinctness (fig. 2*e*.)

The adult shell presents, in both valves, a nearly round contour, and on it also is rather prominently indicated the outline of the visceral cavity, which becomes proportionately narrower in the adolescent and adult stages, than at an earlier period. The marks of the muscles in the previsceral area of the shell also continue to be faintly visible on the outer portion of the shell.

This species, then, is marked by four stages of growth and development, of which the most prominent features are the following:—

(1.) *Embryonic.*—Formation of the embryonic shell.

(2.) *Larval.*—Lengthening of the hinge line and acquisition of mantle-margins.

(3.) *Adolescent.*—Fixation of the hinge line, otherwise as the last, except that the radular ornament becomes irregular.

(4.) *Adult.*—Absence of radular ornamentation on the valve, and great expansion of the mantle margin.

The species of brachiopod which most nearly approaches this is *Lingula?* (or *Obolus?*)

favosa, Linrs, of the Fucoidal sandstone in Sweden; but in that shell the sides meet behind at an angle of 90°, and the shell is said to be pitted. Another resembling species is *Lingulella cælata*, Hall, of the Olenellus beds of New York; and a third is *Kutorgina pannula*, White, of the Nevada Cambrian rocks, but both are much smaller, and in these two species the cancellated markings cover the whole surface.

Obolus (?) major, n. sp. (Plate VIII, fig. 3.)

Only the dorsal valve known. This is transversely oval, flattened near the umbo, and deep within the edges toward the back of the shell.

The interior markings seem those of an Obolus. The mesian line is strongly marked just within the umbo, and at the middle of the shell, in front of which it appears to fork. The scars of the posterior laterals only are distinct.

The example known shows the interior of the shell and a little of the external surface. The shell was thin, and is changed to iron-oxide. The outer surface near the edge of the shell was covered by fine radiating lines or ridges.

A trace of the beak of the ventral valve is preserved and is indicated by a dotted line in the figure.

Horizon and Locality.—In the sandy shales of Series A, (Basal series) Div. 2 *b*.

This species is found in beds which are nearly or quite equivalent in age to the Eophyton sandstone of Sweden, from which, in 1869, Linnarsson described *Lingula* (?) *monilifera*.[1] With this species I should be inclined to identify ours, although it is larger and wider, for it has a similar ornamentation; but further developments regarding the form of the interior of *Lingula* (?) *monilifera* based on numerous examples found by the Russian engineer Mickwitz, near St. Petersburgh, and described by Dr. F. Schmidt, show it to be an entirely different shell. Dr. Schmidt finds in the interior of the dorsal valve an extraordinary horn, rising from its centre and directed into the beak of the ventral valve. The existence of such a structure certainly is not indicated in the Acadian species above described, the interior of which resembles that of the genus Obolus. We have, therefore, felt compelled to refer it provisionally to that genus under a new name. It will be observed however, that our species possesses the peculiar flattening of the dorsal valve, so remarkably exhibited in *Mickwitzia monilifera*.

LINGULELLA, *Salter*, 1861.

Lingulella Martinensis, n. sp. (Plate VIII, fig. 4.)

Orbicular, ovate, broadly rounded in front, somewhat ventricose. Beak of the ventral valve prominent. No other sculpture than that of concentric and radiating striæ has been observed.

Size.—Length of ventral valve, about 10 mm.; width, about 8 mm.

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[1] See also Geol. Mag. London, 1868, p. 398, tab. xi, figs. 1 and 2, and Geognostiska och Palæontologiska iakttagelser ofver Eophyton sandston, Stockholm, 1871, J. G. O. Linnarsson, where it is called *Obolus* (?) *monilifera*.

Horizon and Locality.—Dark grey sandstones of Band b^1 Div. 1, St. John group at Hanford Brook.

This species in its deep and round valves approaches to Obolus in aspect. It is larger than the other Lingulellæ found with it.

VI.—CEPHALOPODA.

VOLBORTHELLA, *Schmidt* (1888.)

A number of years ago, Dr. A. Volborth mentioned the occurrence near Reval, in Estland, Russia, of some very small examples of Orthoceras in the "Blue Clay." These have since been found at other localities in the same region, notably at Strietberg and Kunda, but always in the upper layers of the Blue Clay. Dr. F. Schmidt has made a careful study of these peculiar little organisms, the oldest of their kind known, and seems to be fully convinced that they are Orthoceratites. He has recognized a series of closely set partitions, and a narrow, reed-like siphon of about one tenth of the diameter of the shell.

In the occurrence of this genus in the Cambrian rocks of Southern New Brunswick we are again reminded of the closely similar conditions which accompanied the deposition of the oldest Cambrian measures in Russia and New Brunswick. The organism is found with us in Band *b* of the upper part of the Basal series, and in the upper part of Band *b* of Division 1 of the St. John group. It occurs in clusters, as though of a gregareous habit. I do not observe any notable difference of aspect between our examples, and so describe them under the same specific name as the Russian species, the description of which is here reproduced.

VOLBORTHELLA TENUIS, *Schmidt.* (Pl. VIII, figs. 5 *a–d.*)

Memoirs Imp. Acad. Sci. St. Petersburg. Series VII, Vol. XXXVI, No. 2, p. 25, Taf. II, figs. 27-31.

"Body small, only a few lines long, similar in form to Orthoceras. They are conical, have chambers which are short and conical, arched (downward), drawn forward somewhat in the middle, and perforated for the passage of a slender siphon, which occupies about $\frac{1}{10}$th of the shell ['s width ?] In the longitudinal section, the siphon is indicated by a hollow reed-like mark, but its shell substance is wanting; and also on the outside of the body itself all trace of a shell is wanting, although it has retained the appearance of a delicate cross-striation on the outside surface.

"A living chamber cannot be clearly distinguished, but by washing out the top of the shell a depression appears which corresponds to such a cavity.

"Although I now can produce no positive evidence against the Orthoceras-like character of these small bodies, still it appears to me that their extreme smallness and their thin shell, which is entirely destroyed, while other fossils as Platysolenites and Olenellus have preserved theirs, establishes a decided generic distinction, which I propose to mark by the name *Volborthella*, in honor of the discoverer."

Dr. Schmidt gives the dimensions of a number of what he calls broken pieces of the large end of the shell, none of which exceed 5 mm. in length; but he figures an example showing the smaller end, which is about 10 mm. long. I have found no specimens of

this part of the shell, but of the larger end quite a number. Some of these slightly exceed the dimensions of the Russian specimens. They show traces of the cross-striation mentioned by Dr. Schmidt, but no satisfactory evidence of a siphon was obtained.

Size.—Length of the part of the shell preserved, 5½ mm. Width at large end, 3 mm.; at small end, 1½ mm.

Horizon and Locality.—Collected from Band *b* of Div. 2 of the Basal series at Hanford Brook; and for the Geological Survey of Canada, in calcareous grey sandy shale in the upper part of Band *b* of Div. 1 of the St. John group at Belyea's Landing, Westfield, N.B. Scarce. Occurring in clusters, buried at all angles in the mud.

VII.—ANNELIDA.

Under this class may provisionally be placed certain tracks which are very characteristic of the lower part of the Cambrian system in this part of Canada.

These appear to be essentially the same as those described by Prof. O. Torrell from the rocks of the Sparagmite Stage (=Fucoidal and Eophyton sandstone) of the Cambrian rocks of Sweden, under the name of *Arenicolites gigas*. Torrell found that Mr. Salter had used Arenicolites for markings of a different kind, and says also that Salter's name *Helminthites* does not apply to these tracks. He therefore proposed the name

PSAMMICHNITES, [*Torrell*, 1870?]

To include these peculiar trails of a large size found at this horizon of the Cambrian. This word is intended to apply to "such vermiform, flexuous, linear tracks as are made either by worms, by crustaceans or by molluscs."

Psammichnites gigas, *Torrell*. (Pl. XI, figs. 1 *a–k*.)

Torrell's description of *Arenicolites gigas* is as follows[1]:—

Elevated, arched-flexuous, linear, convex bodies, with obscure transverse lines and ridges, obscurely sculptured, marked by a narrow median nerve, imitating remarkably the vermiform excrements of the lob-worm, met with on shores. Length of the largest fragment, 187 cm.; width, 24 cm. Found in a boulder of sandstone from the Lower Cambrian near Cimbrishamn in Scania.

Dr. Torrell says that the fossil was found in a large block of the same kind of rock as the Cimbrishamn sandstone, and there can be scarcely any doubt that it is *in situ* in the neighborhood. He also remarks that these fossils cannot be algæ, and that this great winding figure can hardly spring from anything else than a worm. He says that the objection made that they are much greater [tracks] than [are made by] any living animals of the same type, loses its force since Geinitz described a Silurian worm (*Phyllodocites Thuringiacus*) which in size at least approaches this. Torrell regards it as much

[1] Lunds Univ. Arsskrift. tom. vi, p. 34, 1869. Lund, Sweden.

more difficult to decide how these objects are produced; whether they are the petrified remains of real worms, or only tracks of worms in sand, bored and then filled up passages, or finally worm casts of the intestinal canal, such as one can see everywhere on the beach that *Arenicola piscatorum* inhabits. Such an animal cements together the sand which it swallows, by the mucus of the intestinal canal; so it may happen that the worm-like excrement may thus be held together in the fossil state. Probably the worm from which this fossil was produced was one whose way of life resembled that of Arenicola.

From this description it is evident that Prof. Torrell at first regarded this track as that of a worm; subsequently when describing it under the name of Psammichnites, he considered the possibility that it might have been made by a mollusc or crustacean.

It is also clear that he includes in the description the casts of large size, similar to those large tracks of worms which he found in the same sandstones.

By comparing the figures *Arenicolites* (or *Psammichnites*) *gigas*, given by Torrell, it will be seen that the fossil agrees in all essential particulars with that which I have herein referred to his genus Psammichnites. It may, however, be remarked that the full-sized figure of the species, given by Torrell (Plate XI, fig. 1*k*), represents the form as much more convex than it usually is found. But there is so much variety in the configuration of the surface of the cast of the track, that Torrell's figure only imperfectly represents its features. These vary according to whether the track runs over the top of a wave-ridge in the sand, or extends along a hollow between the ridges; when traversing the ridges the animal moved more rapidly and formed a deep round furrow, set off by a narrow sharp ridge on each side, which is separated from the main furrow by a small groove (fig. 1*b*.) Elsewhere we find the central furrow represented by a nearly flat band with three small furrows, one central and the other two at the sides; this track appears much narrower than the typical track, but outside of the three furrows are lighter traces of another pair of furrows, defining a slightly raised swelling, which mark the full limit of width of the track (fig. near 1*e*.) This track has pittings along the centre, and when the centre is raised, appears to bear depressed irregular hollows along the side.

The usual form of Psammichnites has two broad raised convex ridges with a narrow channel between them; when badly preserved, this channel seems to be wider and the ridges narrower, owing to the channel being filled partly with mud. In some well preserved tracks, the ridges are seen not to be continuous, but to be a series of long spindle-shaped swellings, with the summits of the swellings about one and a half inches apart, and with one end having a longer slope than the other (fig. 1*d*.) In others the ridges are traversed by shallow diagonal depressions turning inward and backward from each side, and about one inch apart (fig. 1*a*.)

ARENICOLITES, *Salter*.

DIPLOCRATERION, Torrell.

Burrows of worms referable to this genus are common at several horizons of the St. John group, and notably in Division 2. Those of the Basal series are not so conspicuous but have some interesting forms. Such casts of worm tubes were arranged by Salter under the above name. Salter's description is as follows:—

"Impressions which were once evidently the burrows of marine annelids. Like those of the ordinary Arenicolæ of our coast they had both entrance and exit holes, so that the hollows (and the corresponding tubercles which are the casts of these on the lower surfaces of the beds) are always in pairs."

Mr. Salter says that these hollows occur in such multitudes, and through so great an extent of strata in the Longmynd (a full mile in vertical thickness) as to impress us with the belief that annelid life was abundant in Cambrian times.

We cannot see that there is any generic difference between the forms described by Mr. Salter under the name Arenicolites and those which Torrell calls Diplocraterion. Torrell relies upon the funnel at the orifice of the tube as distinguishing Diplocraterion from Arenicolites, but such vertical burrows could hardly exist without an enlargement at the orifice, and Salter plainly depicted *Arenicolites sparsus* as having such a funnel. Moreover Torrell admits that his *Diplocraterion parallelum*, *majore* (fig. 4*b*) and *minore* (fig. 5*b*), agree plainly with Salter's *Arenicolites sparsus* and *didymus* (figs. 4*a* and 5*a*).

ARENICOLITES LYELLI, *Torrell*, var. MINOR. (Pl. XI, figs. 2 *a–c*.)

Twinned worm burrows having the orifices distant from each other about 30 to 50 mm. Diameter of the orifice, 10 to 15 mm.

Horizon and Locality.—Purplish flags of Div. 1*c* of the Basal series on slabs with *Psammichnites gigas*.

This burrow has larger and more distant openings than *Arenicolites sparsus*, Salter (fig. 4*a*), but not the great funnel-shaped cups of *A. Lyelli*, Torrell (fig. 3.)

CHONDRITES. (Pl. XI, fig. 6.)

Numerous worm casts which by their round form and continuousness would come under this head, are found in the flags and sandstones of the Basal series, many large ones in connection with the tracks of Psammichnites, but they do not call for special description.

VIII.—CRUSTACEA.

After the wealth of trilobites found in the Paradoxides beds, it seems strange to find this type of crustacean so scarce in the Cambrian measures beneath. Only doubtful fragments referable to this order have been met with. The beds of Band *b*, as has been remarked, contain a few. In the lower part of this band were found two bivalve entomostracans belonging to the genus below.

LEPERDITIA, *Rouault*.

LEPERDITIA VENTRICOSA, n. sp. (Plate VII, figs. 12 *a–d*.)

Oval, ventricose, hinge-line short.

Ventral valve bent inward at the hinge, and having a faint transverse ridge within,

near the anterior end. Marginal furrow rather broad, strongest near the anterior end, fading out towards the posterior, where the edge of the shell is bent outward. Dorsal valve less ventricose, showing an eye-spot faintly elevated on the upper anterior part.

Sculpture.—Closely set, strongly marked pits, which are most distinct on the ventricose part of the shell. The pits along the margins, and around the eye spots are smaller than elsewhere.

Size.—Length, 11 mm.; height, 8 mm.; depth, 4 mm.

Horizon and Locality.—In the dark grey sandstones of Div. 1 a^1 at Hanford Brook, St. Martins.

LEPERDITIA STEADI, n. sp. (Plate VII, figs. 13 *a–c.*)

Oval, lenticular, rather flat, hinge line more than two-thirds of the length.

Marginal furrow sharp and the rim well marked at the anterior end, where it is crossed diagonally by a branch of the marginal furrow.

Sculpture.—As in the preceding species.

Size.—Length, 9 mm.; width, about 7 mm.; depth, 1½ mm.

Horizon and Locality.—As the preceding species.

Found by Mr. Geoffrey Stead.

NOTE.—Since writing the above article, I have learned that a suggestion made by me, in reference to *Olenellus Kjerulfi*, has met with acceptance from a number of naturalists. Some time since in speaking of the work done by Dr. Gerhard Holm, in developing the remarkable characters of this species, I suggested that his name should be commemorated in connection with it.

I am satisfied that, when other species now ranged under Olenellus and Olenoides are treated as Dr. Holm has treated *O. Kjerulfi*, a reärrangement of these forms will be found necessary. One may see for instance the mixture of characters by comparing the lately discovered Russian species *Olenellus Mickwitzi*, Schmidt, with *Olenoides typicalis* and *Mesonacis Vermontiana*. Olenoides, originally based by Mr. Meek on a part of a thorax (and pygidium?)—*O. Nevadensis*,—assumes an entirely new aspect when referred to *O. typicalis*, Walcott, and the original Olenoides may be quite a different trilobite from the latter. While I appreciate Mr. Walcott's loyalty to the originator of the name, it seems to me that he might with advantage, have left this name in abeyance, based as it is on such a defective example.

The four-spined hypostome of *O. Kjerulfi* is different from any known hypostome of an Olenellus or a Paradoxides. The four points are perhaps the analogues of the four spines at the back of the head-shield in this species. Such a hypostome and the absence of an enlarged third segment of the thorax, separates this species from all the American Olenelli. *Mesonacis* differs from it in several important respects, e.g., the enlarged third segment and the great spine on one of the posterior segments. I propose therefore to use hereafter for *O. Kjerulfi* the generic name *Holmia*.

Explanation of Plates.

Plate V.

Figs. 1-3.—*Buthotrephis antiqua*, Brongn.—1. From Brongniart's original figure.—2. Example figured by Hisinger.—3. Example of this species from Div. 1*b*, Basal series, Hanford Brook. **See p. 144.**

Fig. 4.—*Fucoides circinnatus*. Brongn. Brongniart's figure to illustrate the succeeding species. **See p. 145.**

Fig. 5.—*Phycoidella stichidifera*, n. gen. et sp.—5*a*, Part of barren frond (or branch).—5*b*, Part of fertile frond (or branch).—5*c*, Stichidium, mag. $\frac{2}{1}$.—5*d*, A sporangium (?) further magnified. All from Div. 1*b*, Basal series at Hanford Brook. **See p. 144.**

Fig. 6.—*Microphycus catenatus*, n. gen. et sp.—6*a*, Portion of frond showing branches and nodes.—6*b*, Fragments of frond showing triangular enlargements at the forks of the branches. From Div. 1*b*, St. John Group Mag. $\frac{30}{1}$. **See p. 146.**

Plate VI.

Fig. 1.—*Palæochorda setacea*, n. sp.,—1*a*, Group of fronds, reduced $\frac{1}{2}$.—1*b*, Fragment of three fronds to show the annulation of the tubes, and the attachment of the setæ.—1*c*, Transverse section of frond, natural size.—1*d*, Same enlarged $\frac{2}{1}$ to show the ends of fusiform cells under the cuticle, and the irregular cells of the interior.—1*e*. Portion of frond, natural size, to show rough granulated surface with transverse ribs.—1*f*, Portion of frond decorticated, showing the fusiform cells beneath the cortex.—1*g*, Portion of a seta Mag. $\frac{2}{1}$. All from Div. 1*b*, Basal series, Hanford Brook. **See p. 145.**

Fig. 2.—*Hydrocytium* (?) *silicula*, n. sp., Frond showing contracted parenchyma. Mag. $\frac{30}{1}$. From Div. 1*b*, St. John group. **See p. 146.**

Fig. 3.—Sporangia (?) of sea weeds. Mag. $\frac{30}{1}$.—From Div. 1*b*, St. John group. **See p. 146.**

Plate VII.

Fig. 1.—*Monadites globulosus*, n. gen. et sp., 1*a*, Group in a spicular network. Mag. $\frac{30}{1}$.—1*b*, Similar organism racemed (perhaps recent). Mag. $\frac{30}{1}$.—From Div. 1, Basal series at Caton's Island. **See p. 147.**

Fig. 2.—*Monadites pyriformis*, n. sp.—2*a*, Single example.—2*b*, Budded (?) example. Both mag. $\frac{30}{1}$. From Div. 1, Basal series, Caton's Island. **See p. 147.**

Fig. 3.—*Monadites urceiformis*, n. sp., Mag. $\frac{30}{1}$.—From Div. 1, Basal series, Caton's Island. **See p. 147.**

Fig. 4.—*Radiolarites ovalis*, n. gen. et sp., Mag. $\frac{30}{1}$—From Div. 1, Basal series, Caton's Island. **See p. 148.**

Fig. 5.—*Plocoscyphia* (?) *perantiqua*, n. sp.,—5*a*, Section of the sponge, natural size; to show the form of the cavities.—5*b*, Cuticle of loculus showing oscules. Mag. $\frac{30}{1}$. All from Div. 1, Basal series, Caton's Island. **See p. 148.**

Fig. 6.—*Astrocladia* (?) *elongata*, n. sp., Nat. size. From Band *b*, St. John Group. **See p. 148.**

Fig. 7.—*Astrocladia* (?) *elegans*, n. sp., Nat. size. From Band *b*, St. John Group. **See p. 149.**

Fig. 8.—*Astrocladia* (?) *virguloides*, n. sp.,—8*a*, Part of large branch, natural size.—8*b*, Same enlarged $\frac{10}{1}$.—8*c*, Same enlarged to show spherules. From Band *b*, Div. 1, St. John Group. **See p. 149.**

Fig. 9.—*Dichoplectella irregularis*, n. gen. et sp.—9*a*, Part of skeleton showing dichotomous spicules. Mag. $\frac{20}{1}$.—9*b*, Part of skeleton showing long slender spicules. Mag. $\frac{20}{1}$. From Div. 2, Basal series, Caton's Island. **See p. 149.**

Fig. 10.—*Hyalostelia minima*, n. sp., Mag. $\frac{20}{1}$. From Div. 1, Basal series, Caton's Island. **See p. 150.**

Fig. 11.—*Platysolenites antiquissimus*, Eichw.—11*a*, Interior of one half, showing the joints. Mag. $\frac{2}{1}$—11*b*, Transverse section of the fossil, Mag. $\frac{2}{1}$.—11*c*, Transverse section of a flattened specimen. Mag. $\frac{2}{1}$. All from Div. 2, Basal series, Caton's Island. **See p. 150.**

Fig. 12.—*Leperditia ventricosa*, n. sp.—12*a*, Interior of right valve, natural size.—12*b*, Longitudinal section of same.—12*c*, Transverse section of same.—12*d*, Surface of the crust enlarged to show the sculpture. From Band *b*[1] in the St. John Group. **See p. 159.**

FIG. 13.—*Leperditia Steadi*, n. sp.—13*a*, Right valve, natural size.—13*b*, Longitudinal section.—13*c*, Transverse section. From Band b^1, St. John Group. **See p. 160.**

PLATE VIII.

FIG. 1.—*Obolus pulcher*, n. sp., (dorsal valve). 1*a*, Embryonic shell seen from above. Mag. $\frac{15}{1}$.—1*b*, Same, view of the hinge area.—1*c*, Same, seen from the side.—1*d*, Another embryonic shell with deeper previsceral depression. Mag. $\frac{15}{1}$.—1*e*, Same in section.—1*f*, Larval shell, inner half shaded. Mag. $\frac{5}{1}$.—1*g*, Adolescent shell, inner half shaded (with larval and embryonic shell included.) Mag. $\frac{3}{1}$—1*h*, Adult shell showing all the stages and the outline of the visceral cavity. Mag. $\frac{2}{1}$—1*i*, Interior of dorsal valve showing the median and lateral ridges, and the muscular scars. Mag. $\frac{2}{1}$.—1*k*, Another example less perfectly preserved, shortened by pressure. Mag. $\frac{2}{1}$.—1*l*, Mould of the dorsal valve showing the muscular scars and the internal layers of the shell partly broken away. Mag. $\frac{2}{1}$.—1*m*, Another mould narrowed by pressure, with the internal layers more completely removed, and showing the vascular lines more distinctly. Natural size. All from Band b^{1-4}, Caton's Island. **See p. 151.**

FIG. 2. *Obolus pulcher*, n. sp., (ventral valve).—2*a*, Embryonic shell seen from above. Mag. $\frac{15}{1}$.—2*b*, Same, showing the hinge line.—2*c*, Same seen from the side.—2*d*, Complete larval shell (with embryonic shell in outline). Mag. $\frac{5}{1}$.—2*e*, Complete adolescent shell (with embryonic and larval shell included). Mag. $\frac{3}{1}$. 2*f*, Adult shell showing all the stages of growth and the outline of the visceral cavity.—2*g*, View of the hinge in the larval stage showing a tube (?) and foramen. Mag. $\frac{5}{1}$.—2*h*, Interior of the ventral valve, showing the place of the pedicle, the vascular groves and the scars left by the muscles. Mag. $\frac{2}{1}$.—2*i*, Ventral Valve partly decorticated, revealing the outline of the ventral cavity. Mag. $\frac{2}{1}$.—2*k*, Mould of the ventral valve laterally compressed, showing points of attachment of the pedicel, the foramen, the vascular striæ and scars left by the muscles. Mag. $\frac{2}{1}$.—2*l*, Another mould showing variations in the internal markings. Mag. $\frac{2}{1}$. All from Band b^{1-4}, Caton's Island. **See p. 151.**

FIG. 3.—*Obolus major*, n. sp., Interior of dorsal valve. Natural size. From Div. 2*b*, Basal series, Hanford Brook. **See p. 155.**

FIG. 4.—*Lingulella Martinensis*, n. sp., Interior of ventral valve. Natural size. From Band 1*b*, ^{1}, St. John Group. Hanford Brook. **See p. 155.**

FIG. 5.—*Volborthella tenuis*, Schmidt.—5*a*, Large example.- 5*b*, Smaller specimen showing the septa. Both mag. $\frac{2}{1}$. From Band *b*, St. John group, Belyea's Landing.—5*c*, Example, with shell replaced by hematite.—5*d*, Same in section to show siphuncle (?) Both mag. $\frac{2}{1}$. From Div. 2*b*, Basal series. Hanford Brook. **See p. 156.**

PLATE IX.

FIG. 1.—*Psammichnites gigas*, Torrell.—1*a*, Track crossing a sand ridge. Reduced $\frac{1}{2}$.—1*b*, Transverse section of same. Reduced $\frac{3}{4}$.—1*c*, Track showing cross furrows. Red. $\frac{1}{2}$.—1*d*, Track showing paired lobes. Red. $\frac{1}{2}$.—1*e*, Track with lateral furrows. Red. $\frac{1}{2}$. (N.B.—The track is between 1*e* and 2*c*.)—1*f* and 1*g*, Same in section. —1*h*, Track with two ridges only. Red. $\frac{1}{2}$.—1*i*, Same in section.—1*k*, Track from the Eophyton sandstone. Natural size; after Torrell. **See p. 157.**

FIG. 2.—*Arenicolites Lyelli* (Torrell) var. *minor*.—2 *a.a.*, *b.b.*, *c.c.* Mouths of three pairs of burrows. Reduced $\frac{1}{2}$. From Div. 1*c*, Basal series. Hanford Brook. **See p. 159.**

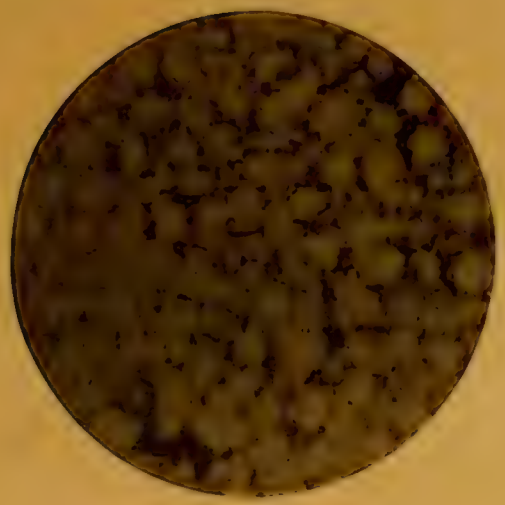
FIG. 3.—*Arenicolites Lyelli*, Torrell. Constructed from his description. The two legs of the burrow show the extremes of dimensions given by him. **See p. 159.**

FIG. 4.—*Arenicolites sparsus*, Salter, after Salter. Reduced $\frac{1}{2}$ (?)—4*a*, Burrows in sandstone of the Stiper stones. —4*b*, *A. parallellus*, Torrell. Constructed from his description; the two legs of the burrow show the extreme dimensions he gives. **See p. 159.**

FIG. 5.—*Arenicolites didymus*, Salter, after Salter. Reduced, $\frac{1}{2}$ (?)—5*a*, Burrows with those of *A. sparsus*—5*b*, *A. parallellus*, Torrell. Small variety constructed from his description. **See p. 159.**

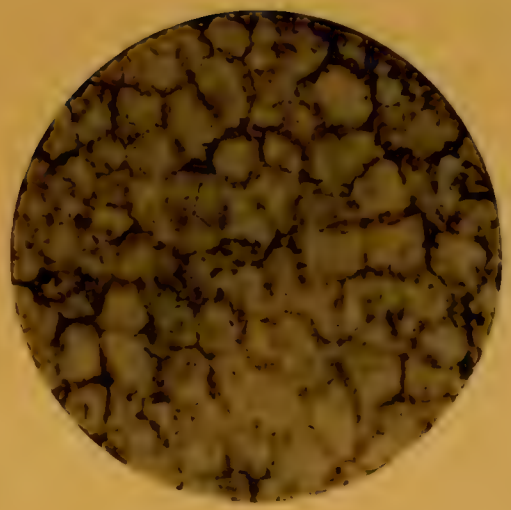
FIG. 6.—*Chondrites* from Cambrian sandstones of Wales (Harlech ?) After Salter. **See p. 159.**

Fig. 1.



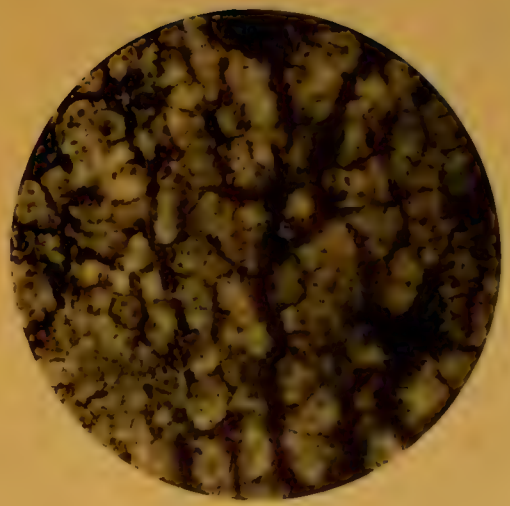
Nematophyton Logani. Dn.

Fig. 2.



Nematophyton crassum? Pen.

Fig. 3.

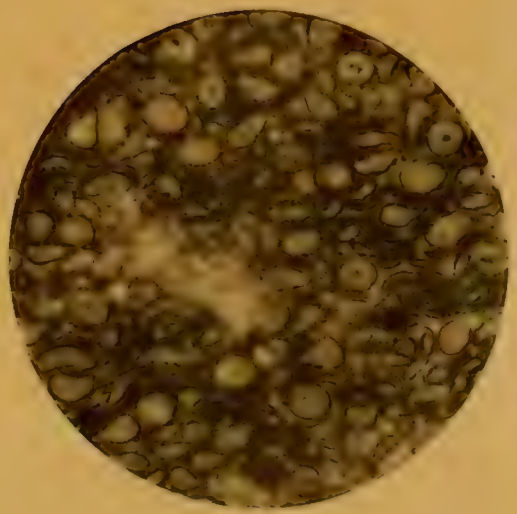


Nematophyton crassum? Pen.

Fig. 4.

Nematophyton Logani. Dn.

Fig. 5.



Nematophyton crassum. Pen.

Fig. 6.

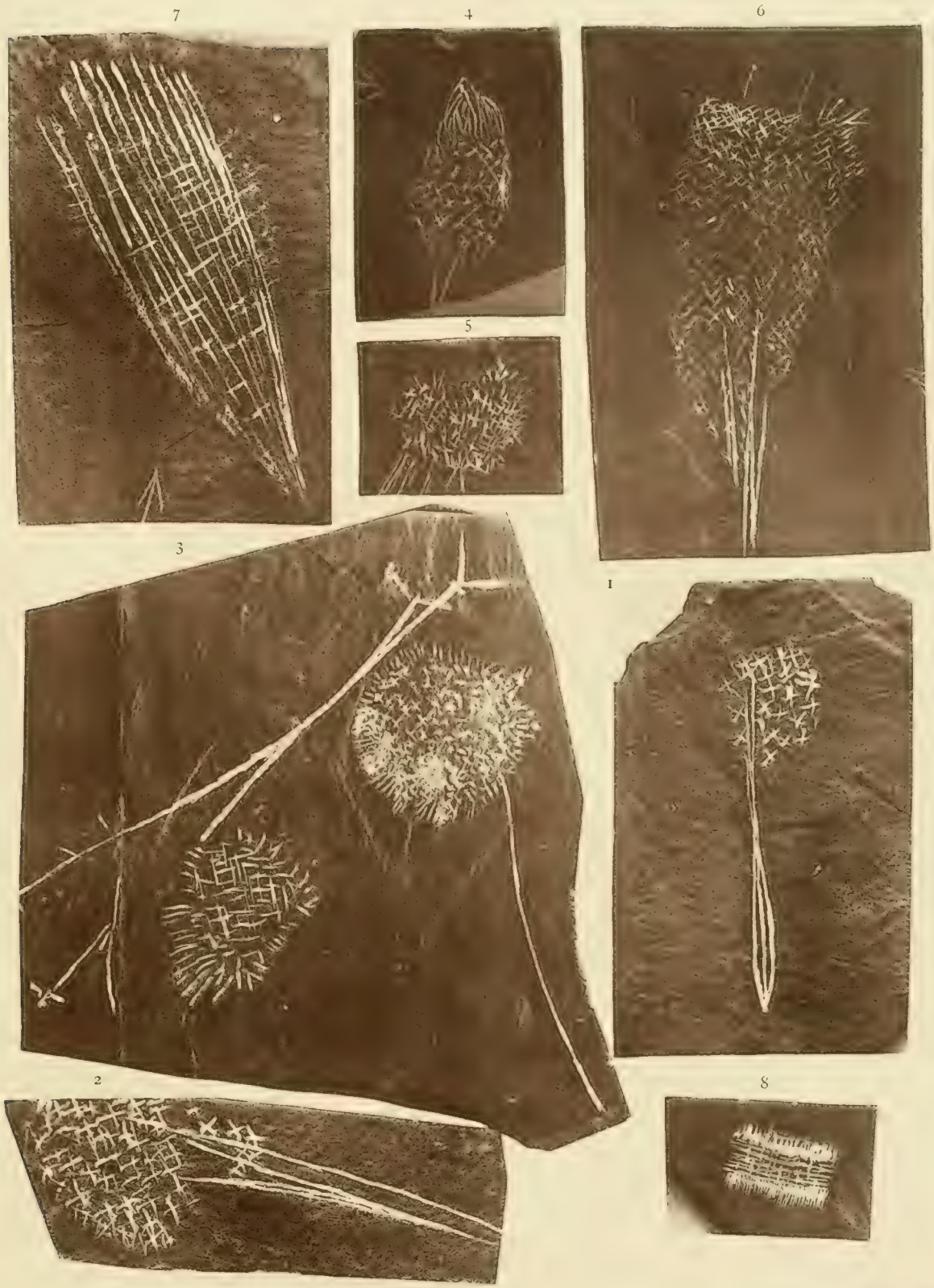
Nematophyton crassum. Pen.

To illustrate Mr. D. P. Penhallow's Paper on Nematophyton.

Fig. 1. Nematophyton Hicksii. Dn.

Fig. 2. Nematophyton tenue. Pen.

To illustrate Mr. D. P. Penhallow's Paper on Nematophyton.

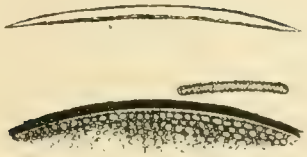


(From Photographs.)

Figs. 1 and 2. Protospongia tetranema, 3. P. mononema, 4. P. coronata, 5. P. polynema, 6. P. cyathiformis, 7. Cyathospongia Quebecensis, 8. Acanthodictya hispida.

TO ILLUSTRATE SIR WILLIAM DAWSON'S PAPER ON FOSSIL SPONGES.

ARTOTYPE, PATENTED CANADA BANK NOTE CO., LIMITED MONTREAL



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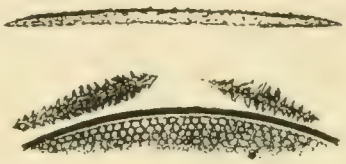
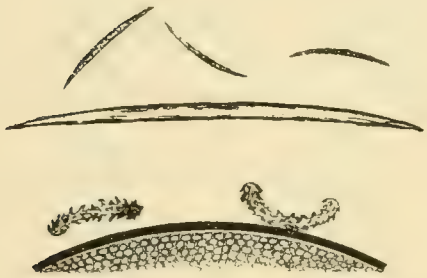
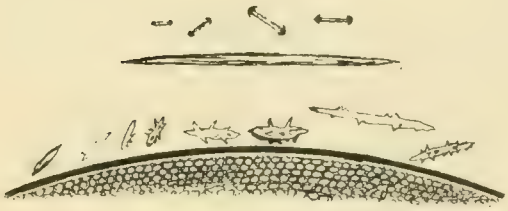


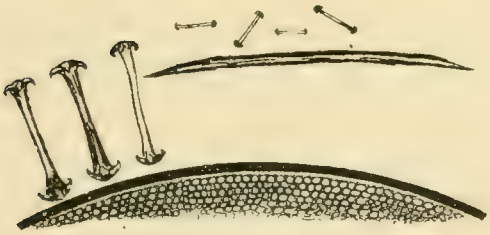
(2) *Spongilla MacKayi* X 200.



(3) *Spongilla lacustris* X 200.

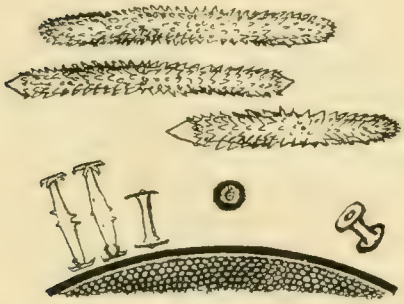


(4) *Spongilla Terrae Novae* X 200.

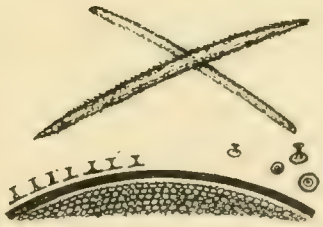


(5) (5) *Meyenia Everetti* X 200.

(6) *Meyenia fluviatilis* X 200.

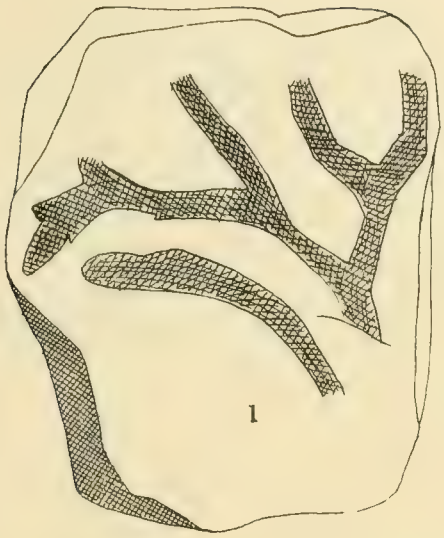


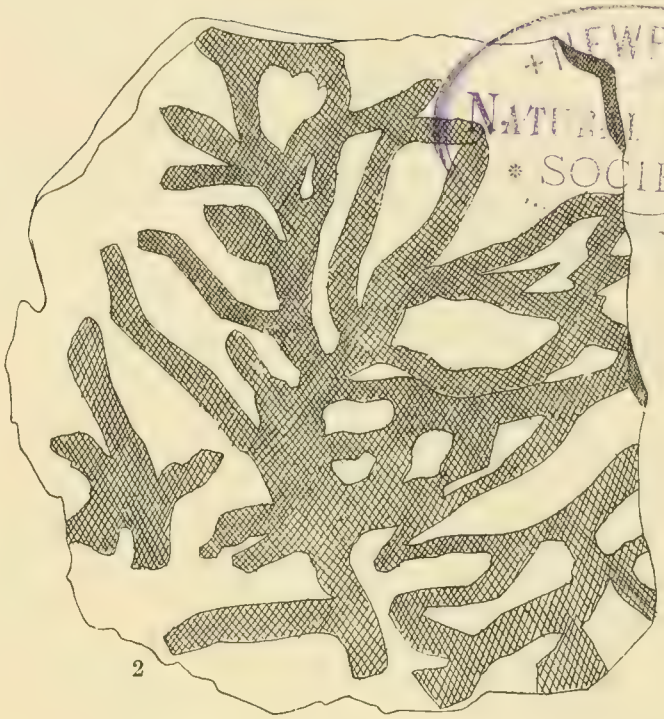
(9) *Heteromeyenia Pictovensis* X 200.

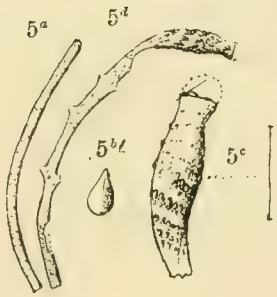


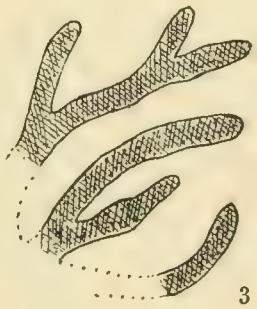
(10) *Tubella Pennsylvanica* X 200.10.

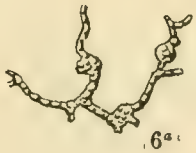
To illustrate Mr. A. H. MacKay's paper on Fresh-water Sponges.

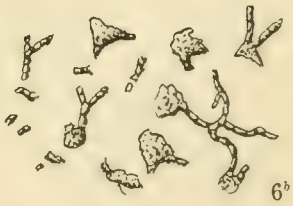




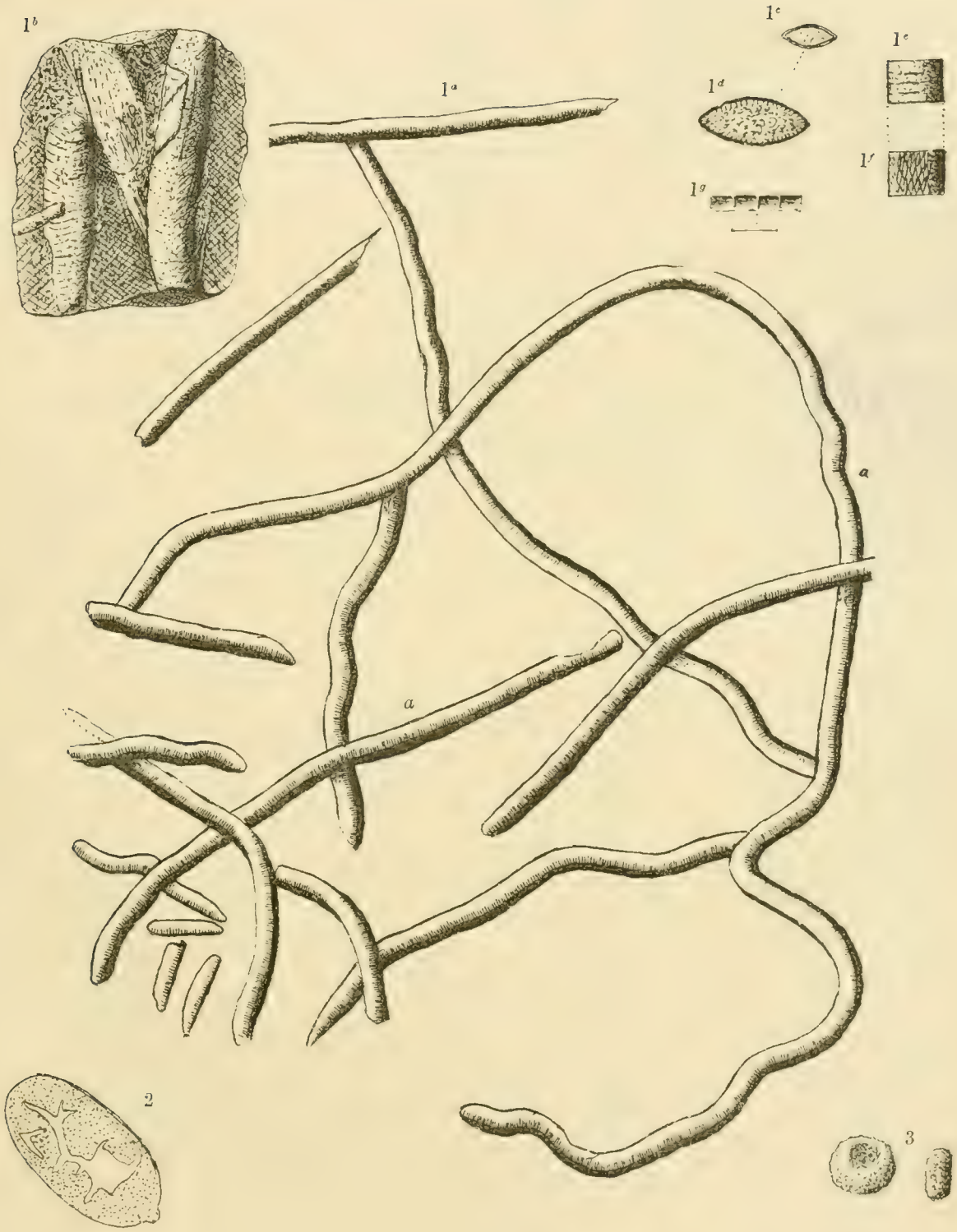








To illustrate Mr. G. F. Matthew's paper on Cambrian Organisms.



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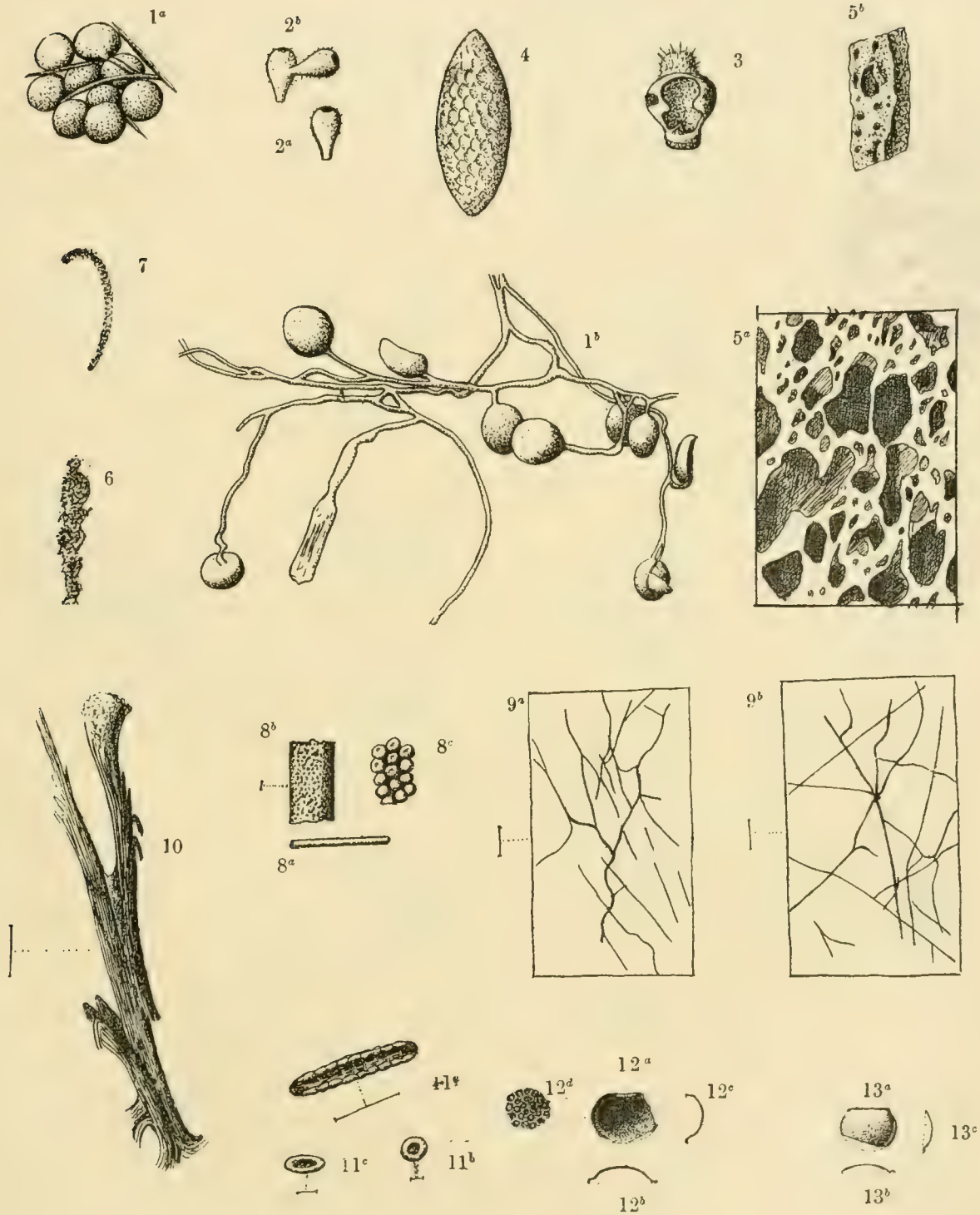
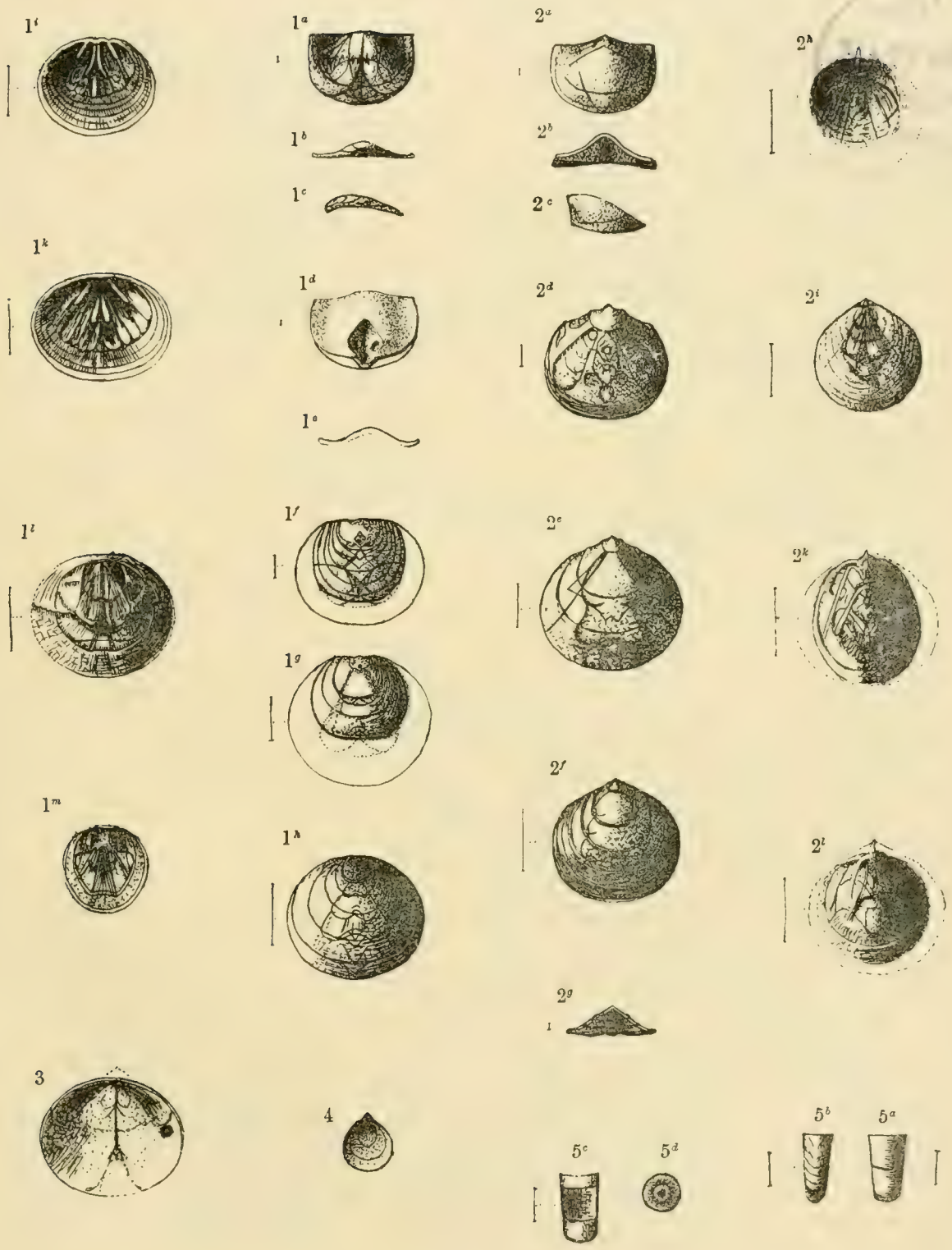
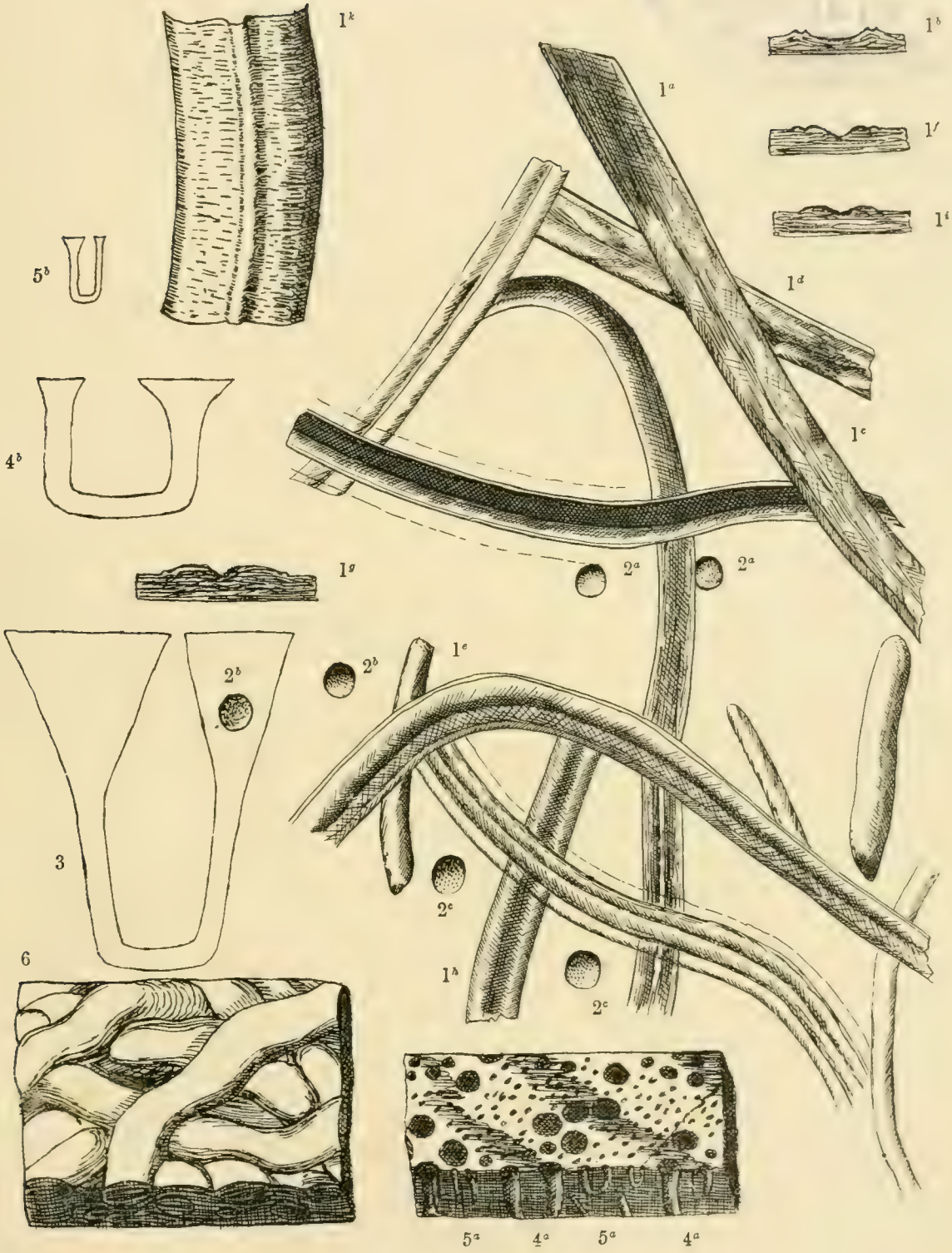


To illustrate Mr. G. F. Matthew's paper on Cambrian Organisms.



To illustrate Mr. G. F. Matthew's paper on Cambrian Organisms.



To illustrate Mr. G. F. Matthew's paper on Cambrian Organisms.

Fig. 1.—*Pteris Sitkensis*, Heer. 2, 3, 4.—*Populus arctica*, Heer. 5.—*P. Hookeri*, Heer. 6.—*Nordenskioldia borealis*, Heer. 7.—*Callistemophyllum latum*, Dn. 8.—*Leguminosites borealis*, Sch.

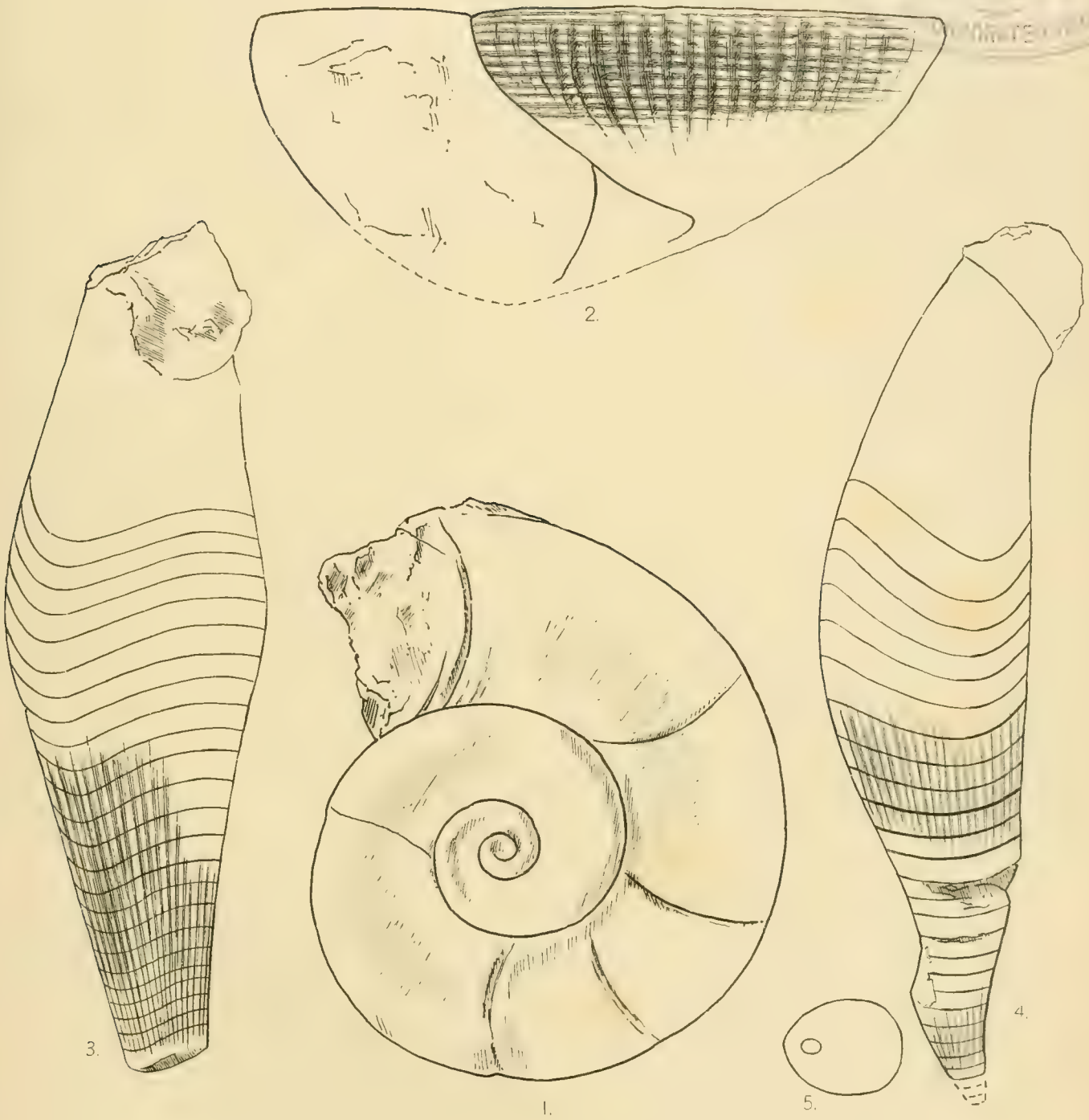
To illustrate Sir William Dawson's Paper on New Fossil Plants from the Northwest.

Quercus platania, Heer.

To illustrate Sir William Dawson's Paper on New Fossil Plants from the Northwest.

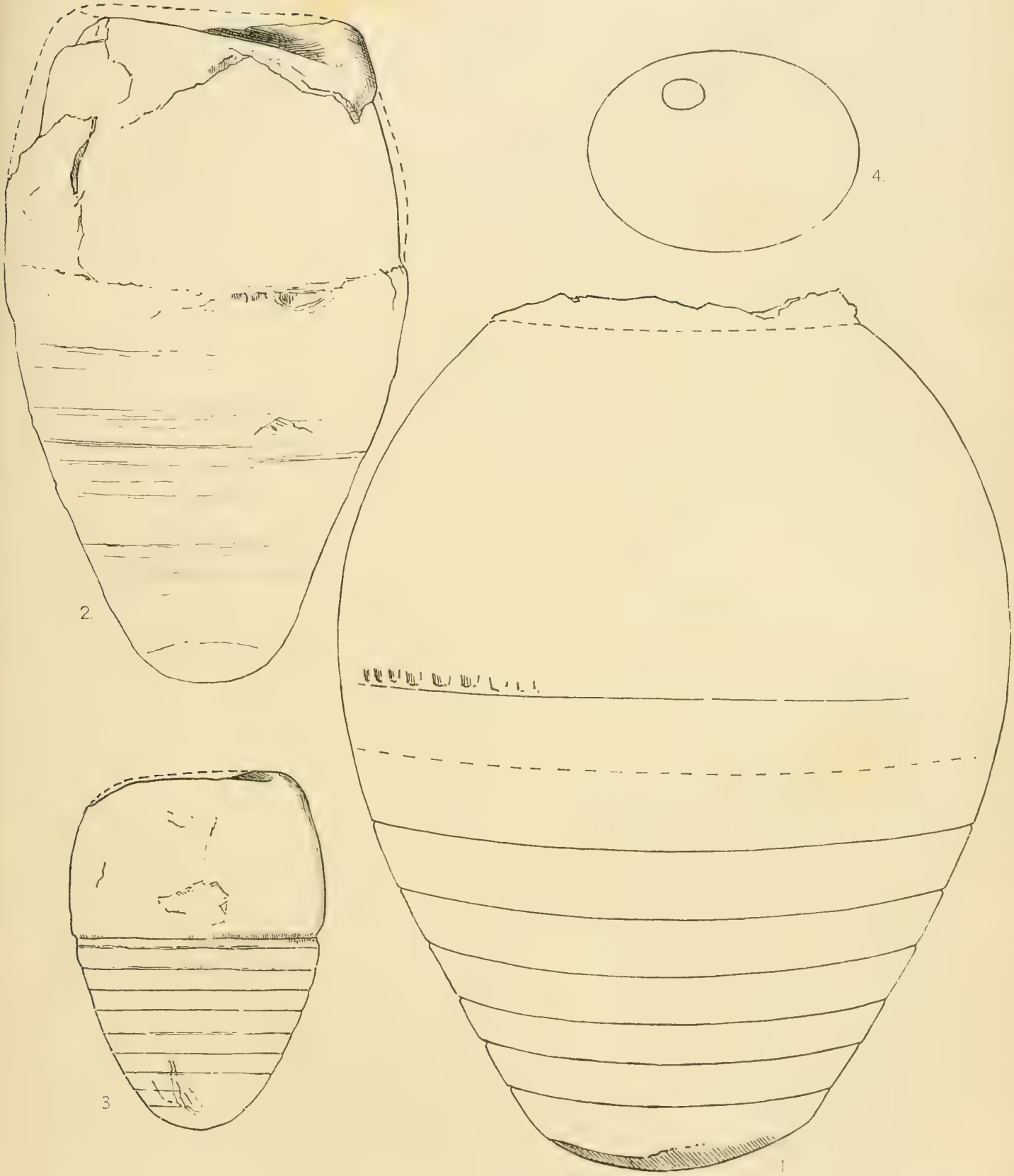
L. M. LAMBE, DEL.

Machurea Manitobensis.—Left side of a specimen from East Selkirk. Natural Size.



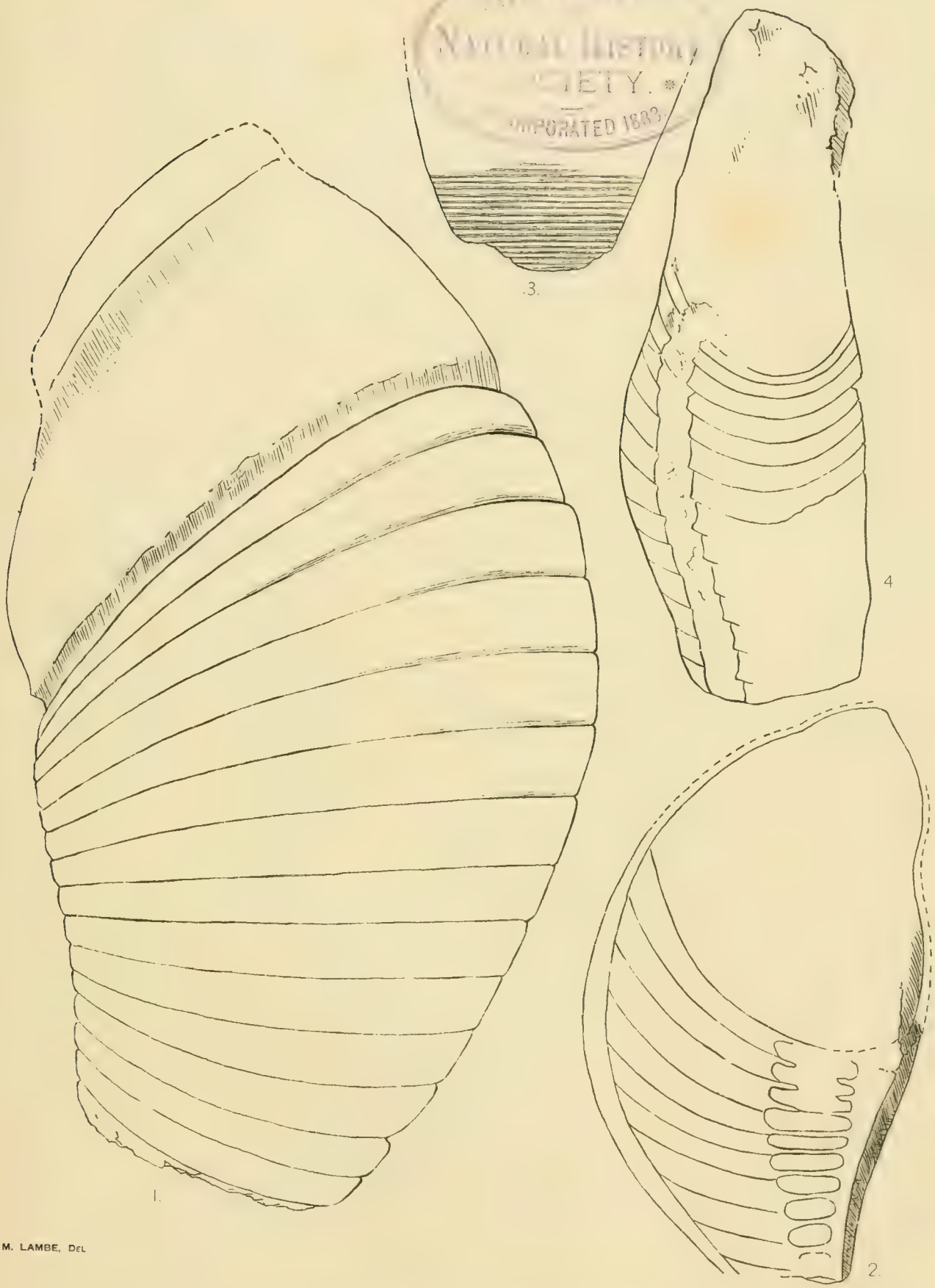
L. M. LAMBE, DEL.

1 and 2.—*Maclurea Manitobensis.*—(1) Left side of a specimen from Pike Head; and (2) Front view of another from Kinwow Bay.
3—5.—*Cyrtoceras Manitobense.*—(3) Distorted example from Big Island; (4) Specimen from Deer Island; and (5) Septum of a specimen from Bull Head. All the figures are of natural size.



1.—*Poterioceras nobile.*—Side view of a specimen from East Selkirk.

2, 3 and 4.—*Poterioceras apertum.*—(2) Side view of a specimen from Swampy Island; (3) Similar view of a specimen from Dog's Head; and (4) Outline of transverse section of another specimen from Dog's Head. All the figures of natural size.



L. M. LAMBE, DEL

1.—*Oncoceras magnum.*—Side view of a specimen from East Selkirk.

2 and 3.—*Oncoceras gibbosum.*—(2) Longitudinal section of a specimen from Pike Head; and (3) Part of the test of another from Swampy Island.

4.—*Cyrtoceras Manitobense.*—Longitudinal section of a specimen from Bull's Head.

Trochoceras McCharlesi.—(1) Side view of the type of the species, slightly reduced in size; (2) Outline of transverse section of same to show the asymmetry of the volutions.

Apsidoceras insigne.—(1) Side view of the type of the species, slightly reduced in size; (2) Outline of transverse section of the same at the larger end.

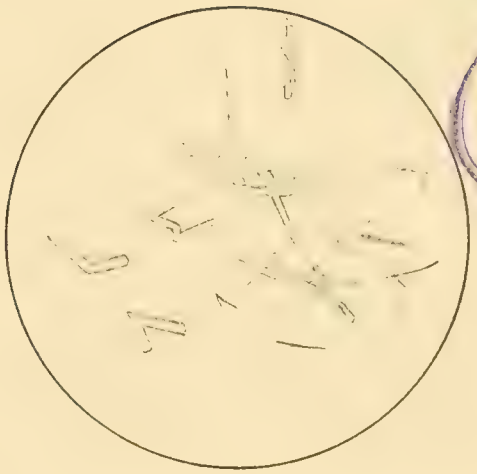


Fig. 1.—Rutile x 500.
Slate from the Spillimichene.

Fig. 2.—Rutile x 500.
Chlorite Schist—French Creek.

To illustrate Prof. Coleman's Paper on the Big Bend of the Columbia.