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GEOLOGICAL SURVEY OF CANADA.

REPORTS

OF

EXPLORATION AND SURVEYS.

1875-76.

GEOLOGICAL SURVEY OF CANADA,

MONTREAL, *April*, 1877.

SIR,—I have the honour to transmit, for the information of His Excellency the Governor-General in Council, the accompanying Reports relating to the Surveys and Investigations of the Geological Corps during the season of 1875–76.

I have the honour to be,

Sir,

Your obedient servant,

ALFRED R. C. SELWYN,

Director of the Geological Survey.

To

The Honorable DAVID MILLS, M.P.,

Minister of the Interior,

OTTAWA.

160 J.B. Tyrrell

GEOLOGICAL SURVEY OF CANADA.

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

REPORT OF PROGRESS

FOR

1875-76.

PUBLISHED BY AUTHORITY OF PARLIAMENT.

1877.

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ILLUSTRATIONS AND MAPS ACCOMPANYING THIS REPORT.

The publication of the map referred to, page 348, report of Messrs. Bailey and Matthew, has been deferred pending further examination and survey.

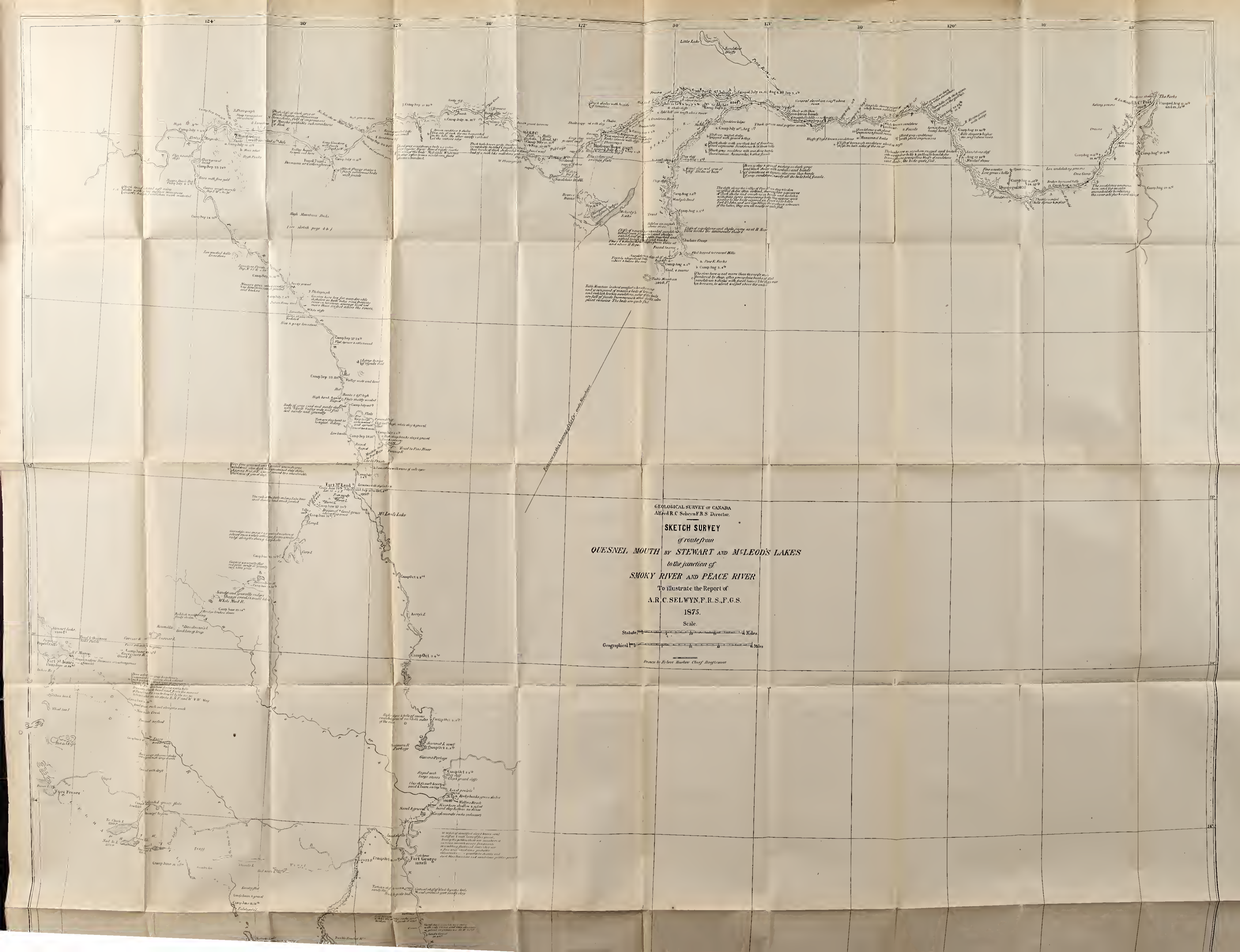
ERRATA.

Page 26, line 8 from bottom, *after* Chemistry *read* second supplement.
" " " 10 " *for* Stover *read* Storer.
" 27, " 4 from top, *for* Newman *read* Neumann.
" 30, " 11 from bottom, *for* Naase read Nasse.
" 31, " 15 " *for* develope *read* develop.
" 32, " 17 " *for* Chilaccoh *read* Chilacco.
" 41, " 7 " *for* reconoitre *read* reconnoitre.
" 43. *After* line 7 *read* lines 17 to 19.
" 48, line 6 from bottom, *for* agreable *read* agreeable.
" 70, " 11 " *for* Naas *read* Nasse, and same in side note.
" 83. *Before* line 9 from top *read* FOSSILS.
" 85. " " 19 from bottom *read* HEIGHTS AND DISTANCES.
" 88, line 14 from bottom, *for* chuttes *read* chutes.
" 89, " 13 " *for* chuttes *read* chutes.
" 113, in plant list, *for* Balsamorhisa *read* Balsamhoriza.
" 118, lines 11 and 13 from top, *leave out* commas *after* Woodsia and *after* Spiræa.
" 119, *read* Pentstemon for Penstemon.
" 121, in plant list, for Oxytropus *read* Oxytropis.
" 128, line 14 from bottom, *for* Carabiadæ *read* Carabidæ.
" 131, " 6 from top, *for* Taraxicum *read* Taraxacum.
" 139, " 14 " *for* Henchera *read* Heuchera.
" 141, " 9 " *for* Canapensis *read* Canadensis.
" 156, " 19 from bottom, *for* Assinaboine *read* Assineboine.
" 157, in plant list, *for* arundinacæ *read* arundinacea.
" 159, line 7 from top, *for* perseverence *read* perseverance.
" 167, " 12 from bottom, *for* Potamageton *read* Potamogeton; and for natanis *read* natans.
" 175, line 10 from bottom, *for* Vacinnium *read* Vaccinium.
" 192, *for* Ramnaceæ *read* Rhamnaceæ.
" 196, *for* Onagracea *read* Onagraceæ.
" 208, *for* Polygonacea *read* Polygonaceæ.
" 246, line 17, *read* Tatlayoco *for* Tatlayoca.
" 252, " 2 from bottom, *for* igneous *read* aqueous.
" 259, paragraph 10 from bottom, *for* J. Bilinica *read* J. bilinica.
" 294, in title, *for* 1865 *read* 1875.
" 295, line 7 from bottom, *for* Abittibbe *read* Abittibe.
" 301, side note, *for* rap dykes *read* trap dykes.
" 312, " *for* uronian *read* Huronian.
" 376, " *for* ourinot *read* Bourinot.

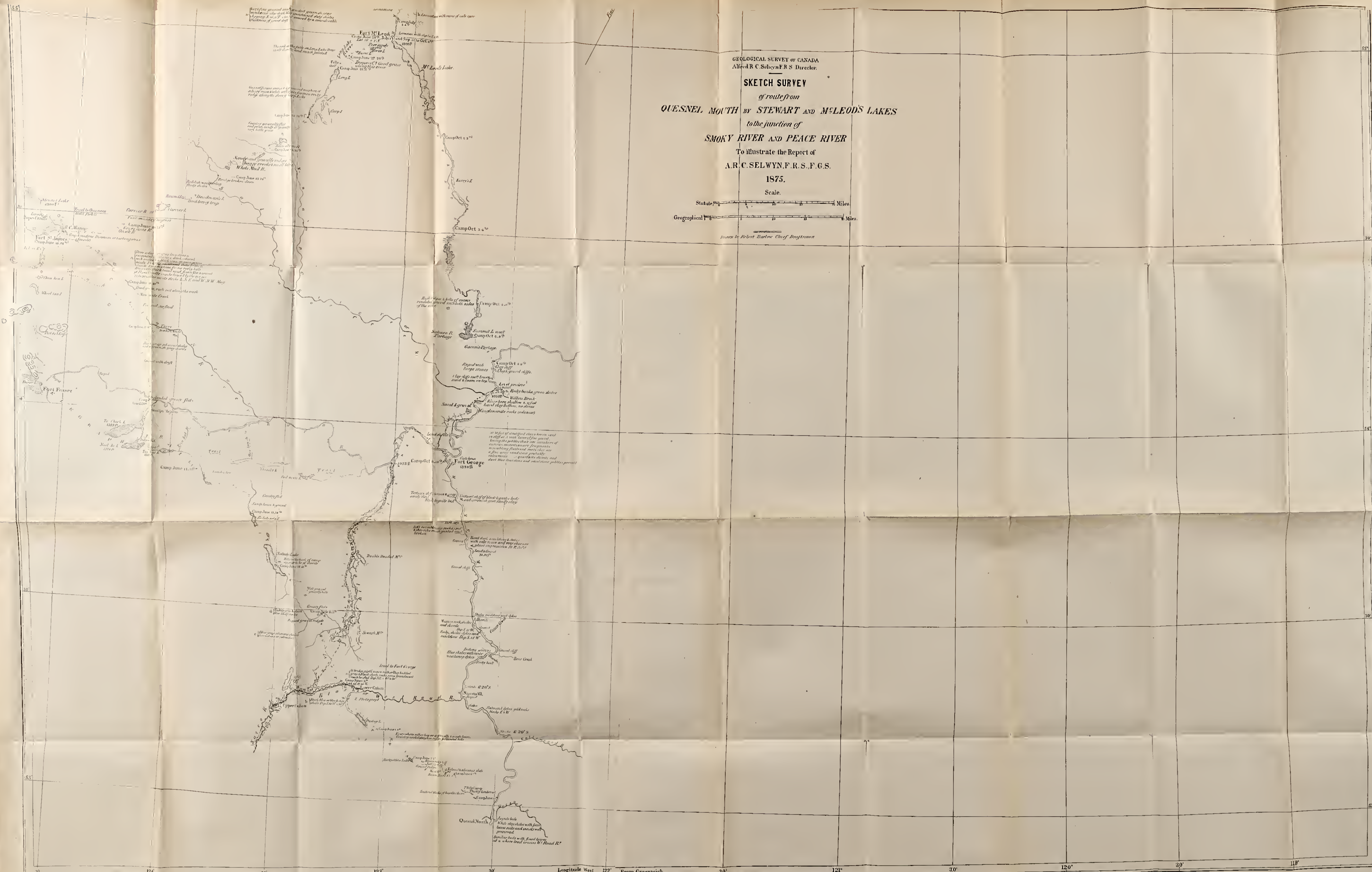
Lacrosse has been adopted instead of a-la-crosse, as the name is, probably, derived from the Indian game of Lacrosse.

ADDITIONAL ERRATA IN PLANT LIST.

No. 20, *for* stagnatalis *read* stagnalis.
33, " Laponnicus *read* Lapponicus..
72, " Achyls *read* Achlys.
115, " Sinipisastrum *read* Sinapistrum.
142, " cuculata *read* cucullata.
162, " acualis *read* acaulis.
240, *insert* XXII A. CELASTRACEÆ, *before* Pachystima Myrsinites.
for XV *read* XXV ; *for* XXII, RAMNACEÆ, *read* RHAMNACEÆ.
330, " Cytissus *read* Cytisus.
714, " auræus *read* aureus.
867, " scutettata *read* scutellata.
925, " Eritrichum *read* Eritrichium.
1033, " Erigonium *read* Eriogonum.
" XXXV *read* LXXV.
1089, " pyriofolio *read* pyrifolia.
1179, " elegano *read* elegans.
1197, " Amplectrum *read* Aplectrum.
1276, " Eliocharis *read* Eleocharis.
1318, " trisperna *read* trisperma.
1411, " Aleopecurus *read* Alopecurus.
1419, " exarrata *read* exarata.
1420, " verticallata *read* verticillata.
1441, " sitigeræ *read* setigera.
1457, " Brizophrum *read* Brizopyrum.
1458, " Catabioza *read* Catabrosa..
1506, " Hystriæ *read* Hystrix.
1547, " Chilanthes *read* Cheilanthes.
1687, " Grimnia *read* Grimmia.
1724, " megapolitina *read* megapolitana.
1742, " senatum *read* serratum.
1764, " Lescivianum *read* Lescurianum.
1781, " senata *read* serrata.
1833, " confervoidcs *read* confervoides.
1919, " Jungermania *read* Jungermannia.
1920, " divariacatus *read* divaricatus.
2006, " Jugermanniæ *read* Jungermannia.
2024, " rangerifina *read* rangiferina.
2032, " pycidata *read* pyxidata.



GEOLOGICAL SURVEY OF CANADA
Alfred R.C Selwyn F.R.S Director.
SKETCH SURVEY
of route from
QUESNEL MOUTH BY STEWART AND McLEOD'S LAKES
to the junction of
SMOKY RIVER AND PEACE RIVER
To illustrate the Report of
A.R.C. SELWYN, F.R.S., F.G.S.
1875.
Scale.
Statute Miles
Geographical Miles
Drawn by Robert Barlow Chief Draftsman
Fort McLeod
McLeod's Lake
Fort George
Fort Fraser
St. Johns
Dunvegan
The Forks
Table Mountain
Little Lake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1875.
Scale.
Statute Miles.
Geographical Miles.
Drawn by Robert Barlow Chief Draftsman
Fort McLeod
McLeod's Lake
Fort St. James
Fort Fraser
Fort George
Quesnel Mouth
Camp Oct 3rd
Camp Oct 4th
Salmon R. Portage
Giscome's Portage
Willow Brook
Lower Cañon
Upper Cañon
Longitude West
From Greenwich
124°
125°
122°
121°
120°
119°
30'

SUMMARY REPORT

OF

GEOLOGICAL INVESTIGATIONS,

BY

ALFRED R. C. SELWYN, F.R.S., F.G.S.

ADDRESSED TO

THE HONORABLE DAVID LAIRD, M.P.,

MINISTER OF THE INTERIOR.

SIR,—I have the honor with this to submit for the information of His Excellency, the Governor-General-in-Council, the reports of myself and of the members of the Geological Corps under my direction, relating to the operations undertaken, and to the progress which has been made during the year ending 30th of April, 1876, in investigating the geological structure and the mineral resources of the Dominion.

Progress during the year.

Notwithstanding some adverse and melancholy events affecting the Survey, which will be again referred to, it may be stated that the progress of the work during the year has been on the whole satisfactory, and that a considerable amount of valuable information, geological, botanical and geographical, has been secured.

The field of observation and research has embraced portions of every province in the Dominion, as well as large sections of the North Western Territories, from the Assineboine River, in latitude 50° N., to Peace River, in latitude 56° 30′ N.

Centennial Exhibition.

Shortly before the commencement of the year to which this report refers, I was requested by the Dominion Commissioners for the Philadelphia Centennial Exhibition, to secure and to prepare for transmission to Philadelphia, an adequate representation of the mineral resources and of the geology of Canada. I was likewise requested to inform the Commissioners what funds would be required to carry out the object in view. After carefully considering this question, aided by the detailed records of the expenditure by my predecessor, the late Sir W. E. Logan, on previous similar occasions in London, Paris and Dublin, I reported that from eight to ten thousand dollars would be required.

The communications which ensued on this subject between myself and the Commissioners, terminated at that time by their placing at my disposal the wholly inadequate sum of five thousand dollars, but with a verbal intimation that if more was required a further appropriation would be made. This appeared satisfactory, and I thereon proceeded to make every necessary arrangement for securing specimens from all parts of the Dominion, and especially from localities and of kinds which could not be furnished from the collection already in the Museum of the Survey.

On the 26th of April I left Montreal for British Columbia, and did not return from my exploratory work there till the 29th of November following. In the interval my colleagues, besides attending to the season's explorations, the reports of which are now submitted, had all worked ably and energetically on behalf of the Exhibition, and the result was that a very fine collection of Canadian minerals had already been brought together at the offices of the Survey, while many more had been arranged for, to be sent direct to Philadelphia.

Collections from British Columbia.

As regards the exhibits from British Columbia, I may say that but for the exertions of Mr. Richardson, Mr. G. M. Dawson and myself, the very valuable and interesting, but as yet little known resources, mineral, vegetable and animal, of this important Province, would have been almost, if not wholly unrepresented.

Shortly after my return to Montreal, I found that the $5,000 which had been placed at my disposal was already exhausted. Repeated communications, however, on the subject, addressed to the Commissioners, remained unnoticed, and the receipt of my letters was not even acknowledged. Under these circumstances, and feeling assured that the Government would not wish that the representation of the mineral resources of the Dominion should be other than a credit to the country, I assumed the responsibility of carrying on the work, and of defraying the necessary expenditure from the funds appropriated for Geological Survey purposes; and by the 21st of March, one hundred and seven large boxes and barrels, of an aggregate weight of 60,000 lbs., were securely packed and ready for shipment to Philadelphia.

Arrangement of the specimens.

To avoid confusion and delay in placing and arranging the specimens for exhibition, each package was numbered, and the contents carefully entered in a book, while further to facilitate this work, a plan, divided into square feet, was made of the whole of the space allotted for the mineral and geological collections, and on it the spaces to be occupied by the respective specimens were marked off.

While attending to these and other details connected with the Exhibition, and with the general work of the Survey, the Volume of Reports, recently published, relating to the work of the season 1874-75, was being put through the press, and the manuscript for the descriptive catalogue of the mineral and geological exhibits was being prepared. Publication of Report for 1874-75, and Descriptive Catalogue of Geological Exhibits.

The work connected with the Exhibition, in which every member of the Geological Corps was more or less engaged, has necessarily interfered, to some extent, with the ordinary course of the operations of the Survey, and more particularly with the early preparation of the reports now presented. Nevertheless, I trust that the result of the labours of the Survey in this matter will meet with approval, and be the means of making the varied mineral resources of Canada more widely known, and thus promote their legitimate and successful development.

On the 5th of April I went to Philadelphia, to superintend the unpacking and arranging of the specimens for exhibition. Mr. James Richardson, to whose energy, zeal and constant attention much of the success of the work was due, had preceded me, and had already commenced the necessary arrangements. In carrying these on considerable difficulty was experienced at the outset, from the fact that the stands on which we were now required to place the specimens had been made all of an uniform pattern and size, in Montreal, entirely without reference to the space to be occupied, or to the nature of the specimens to be placed on them. After much trouble, opposition and delay, this difficulty was overcome; the requisite stands and shelving were constructed, and, by the day appointed for the opening, Mr. Richardson, Dr. Honeyman and myself had succeeded—by working from early morning till midnight—in placing the mineral section in a fairly presentable condition, though a large amount of work still remained to be done.

During the season of 1875, besides the investigations, of which an account is given in the accompanying detailed reports, Mr. Henry G. Vennor continued his surveys and explorations in Ontario. These involve the determination of some very intricate and important points relating to the structure of the Laurentian rocks, and it has been thought best to defer publishing in detail the conclusions arrived at until they have been further verified by more extended observations. Respecting these, however, Mr. Vennor states as follows:—"My investigations were in continuation of those made the previous season in Lanark and Renfrew Investigations of Mr. H. G. Vennor.

counties, and were chiefly in the townships of Levant, Darling, Bagot, McNab, Horton and Ross, and thence up the valley of the Bonnechere towards Golden and Round Lakes.

"The geological structure of this section of the country is exceedingly intricate, but, when worked out, will be both important and instructive. It is now apparent that the rock groups, referred to in my last report as I. II. III. and IV., constitute together the lower members of one great crystalline series, while V. and VI., of the same report, constitute its upper members. These groups include the so-called Hastings series of earlier reports, and Eozoon has now been found from the lowest to the highest group, to which latter belong the great deposits of apatite and plumbago.

Position of Eozoon Canadense.

"Throughout this region the lowest rock is a massive red, orthoclase gneiss, in which, as a rule, no bedding planes can be recognized, and the groups above enumerated overlie it in, probably, unconformable sequence. In many places, in connection with the Bonnechere limestone trough, labradorite rocks were observed, but these appear to be quite conformable with the rest of the series."

Magnetite, apatite and plumbago.

The facts thus briefly stated show that there is, in western Quebec and in eastern Ontario, a great and varied series of crystalline deposits, characterized by Eozoon and by great beds of magnetite, apatite, and plumbago, and that these rest, probably, unconformably and very irregularly, on what may be called a massive fundamental gneiss, chiefly red orthoclase and quartz, without visible stratification. In Renfrew and Pontiac counties the labradorites are interbedded with the lowest limestone bands. In the present state of our knowledge, therefore, and admitting that elsewhere the labradorite series lies, as hitherto supposed, unconformably above the crystalline limestone group, we may regard the crystalline limestone series as Middle Laurentian and the red gneiss as Lower Laurentian, while the labradorite series remains as Upper Laurentian; but we have yet to ascertain what are the relations of this Middle Laurentian to the wide-spread gneisses and associated so-called Huronian rocks of Western Ontario—a question not only of scientific interest, but also of the very greatest practical importance in connection with the possible discovery among the gneisses of the latter region of valuable mineral deposits similar to those of Eastern Ontario and Quebec.

Explorations of Mr. Richardson.

Early in April, 1875, Mr. Richardson proceeded to British Columbia, returning to Montreal on the 27th of August. The greater part of his time while in British Columbia was devoted to collecting specimens for the Exhibition, but he also visited such portions of the Nanaimo and Comox coal areas as had not been previously examined, including nearly all the islands in the Strait of Georgia, from the north-west end of Texada, opposite Comox, south-east to Sucia Island, a distance of about 140 miles. Valuable and important collections of fossils were made, and the information secured will enable Mr. Richardson to furnish a complete map and a final report on the structure of the Nanaimo and Comox coal areas.

Palæontological work.

In my last summary report, dated May, 1875, it was stated that Mr. Billings was engaged on Part II. of the second volume of the Palæozoic Fossils of Canada, and hoped to have it completed and ready for publication during the coming year. This, I regret to say, owing to failing health, he has not been able to accomplish.

The figures and descriptions of the Mesozoic Fossils from Queen Charlotte Islands, by Mr. J. F. Whiteaves, are now being printed, and will be ready for publication before the close of the year. This volume will contain about 126 pages of descriptive matter, with ten plates and several wood cuts.

Chemical investigations.

During my seven months absence on field duty in British Columbia, much of Dr. Harrington's time and attention was occupied with the general correspondence and other matters connected with the Exhibition and the Survey, and also in attending to the publication of the Annual Report, while, later, the preparation of the descriptive catalogue of the minerals sent to Philadelphia engaged his attention, leaving but little time during the year for chemical investigations. The work in the laboratory was, therefore, carried on chiefly by Mr. C. Hoffmann. Five samples were assayed for gold, and ten for silver. Among the latter was one of ore, brought by Mr. Richardson from the Eureka Mine, Fort Hope, B. C., for exhibition at Philadelphia. It was found to contain 221.66 oz. of silver to the ton of 2,000 lbs., and, in appearance, closely resembled a specimen from the same locality, examined in 1874, and which contained 271.48 oz. of silver to the ton. (Report of Progress, 1873-74, page 7.)

Six copper ores have been assayed, among them one from a vein which crosses the North Thompson River, B. C., a little above Spences Bridge. This contained 5·84 per cent. of copper. Partial analyses were made of two samples of iron ore from St. Julienne, Rawdon township; and a sample of coal from a thin seam at the Cañon of the Mountain of Rocks, Peace River, was examined, with the following result:—

	FAST COKING.	SLOW COKING.
Hygroscopic water	2·10	2·10
Volatile combustible matter..........	25·09	21·54
Fixed carbon......................	68·08	71·63
Ash	4·73	4·73
	100·00	100·00

By rapid heating it gave a good firm coke. The proportion of fixed carbon is worthy of note, though not as high as was found by Dr. Hunt in a specimen of coal from Nicola River, B. C.—74·58 per cent.

Eleven complete and fifteen partial analyses have been made of various rocks and minerals of scientific interest. Among the minerals are two feldspars from the diorites of Dalhousie and Tudor, in Ontario. That from the former township is labradorite, while that from Tudor approaches anorthite, and it will be remembered that a third variety, closely resembling oligoclase, was described in the Report for 1873-74, page 198, from South Sherbrooke. This variation of the feldspars in the Laurentian diorites of Ontario is interesting, and corresponds with what has been observed in the United States and in Europe.

Museum.

The scientific collection of Canadian minerals has been re-arranged, and some additions have been made to it, but it is still imperfect, and several important minerals are at present unrepresented, while many of the species should be replaced by better specimens. This will be done so soon as the specimens which are required can be secured. It is very desirable that the Museum should contain a complete stratigraphical collection of Canadian rocks ; nearly the whole of the material for this is already on hand, but the want of the requisite show-cases at present prevents the making this interesting and valuable addition to the specimens already exhibited.

Number of visitors.

The number of visitors, and the interest taken in the collections, seems to be steadily, though slowly, increasing. From the 1st of May, 1875, to the 30th of April, 1876, 1,728 persons visited the Museum, showing an increase of 590 on the corresponding period in 1874-75.

From the 1st of April, 1875, to the 30th of April, 1876, 900 copies of the publications of the Survey have been distributed. Appended is a list of publications which have, during the same period, been added to the library of the Survey by presentation and by purchase.

Changes in the staff of the Survey.

In the staff of the Survey several changes have occurred during the year. On the 30th November, Mr. Walter McOuat died at River Philip, in Nova Scotia, at the early age of 33 years. His connection with the Survey dated from 1869, and, but for this sudden and unlooked for termination of his career, the industry, ability and aptitude which he displayed in geological investigation must soon have placed him in the front rank of his profession. Up to the time of his death, and for two previous seasons, he was engaged in working out the structure of the eastern portion of the Cumberland County coal field, toward the elucidation of which he had already accumulated important facts and material, much of which will now be lost.

Mr. Charles Robb and Mr. H. Y. L. Brown, of the field staff, resigned, and Mr. G. M. Dawson, late Geologist and Naturalist on the International Boundary Survey of the 49th parallel, was appointed, and has since been actively engaged in explorations in British Columbia.

Death of Sir William E. Logan.

The year 1875 is further made memorable in the annals of the Canadian Geological Survey by an event which may be said to mark an epoch in the history of geological investigation in Canada. I refer to the lamented death of the founder and constant benefactor of the Survey, Sir William Edmond Logan. And it will, I think, be regarded as only a fitting and proper tribute of respect to his memory to reproduce, as a part of the permanent records of the Survey which he so long, so ably and so faithfully directed, the excellent obituary notice from the pen of my friend and colleague, Dr. Bernard J. Harrington, which has already appeared in the *Canadian Naturalist* and in the *American Journal of Science.* This notice is accordingly appended to the present Report.

It may be further mentioned in this connection that, not long before his death, Sir William stated that he intended the whole of his library and surveying instruments, purchased at a total cost of $8,532, to remain for the use of the Survey, so long as its head-quarters were in Montreal, and this intention has been carried out by his executors.

Besides the cost of the library and instruments, he expended $8,434.38 in various items on account of the Survey; and the commodious offices, on St. James Street, built at a cost of upwards of $30,000, and now occupied by the Survey, are likewise due to his liberality.

I have the honor to be, Sir,

Your obedient servant,

ALFRED R. C. SELWYN.

Geological Survey Office,

Montreal, *May*, 1876.

SIR WILLIAM EDMOND LOGAN.

On the 22nd of June, at Castle Malgwyn, Llechryd, South Wales, Canada's veteran geologist passed from his labours. For several years his health had been failing, and he felt more and more the need of rest and change of climate. Accordingly, in August, 1874, he crossed to the mother country, intending to pass the winter there, and then to return to his work in the spring. But rest and a more genial clime were unavailing, and now—kindest of friends, most indefatigable of workers for science and for his country—he is no more!

William Edmond Logan was born at Montreal in 1798. He was of Scottish parentage, and his father, after a residence of many years in Canada, returned to Scotland, and purchased an estate near Stirling, known as Clarkstone. His education was begun at Mr. Skakel's school, in this city, and completed at the High School and University of Edinburgh.

On leaving college he betook himself to mercantile pursuits, and we find that in 1818 he entered the counting house of his uncle, Mr. Hart Logan, of London. Here he remained for about ten years, and here, it is said, he first became fond of geology, making geological excursions into the country whenever opportunity offered.

In 1829 he paid a visit to Canada; but, returning the same year, took up his residence at Swansea, in South Wales, where he was appointed manager of a copper-smelting establishment, and of coal mines, in which an uncle of his was interested. In 1834 he made a tour through France and Spain, visiting many of the mines in the latter country, and making many observations on the geology of the regions through which he passed. In 1838, his uncle dying, Mr. Logan resigned his position at Swansea. But the nine years he spent here were well-spent years; for not only had he gained a practical knowledge of mining and metallurgy, which afterwards proved of the greatest value to him, but had done a large amount of very excellent geological work—work which caused Dr. Buckland, of Oxford, to say of him, "He is the most skilful geological surveyor of a coal-field I have ever known." During his stay at

Swansea, he was an active worker for the interests of the Royal Institution of South Wales. He was Honorary Secretary and Curator of the geological department, and the Institution is indebted to him for valuable collections of minerals and metallurgical products, besides books, drawings and laboratory apparatus. The whole of his geological work in South Wales he placed gratuitously at the disposal of the Ordnance Geological Survey of Great Britain, and it was not only gladly accepted, but published "without alteration," and made the basis of future work in that region. Concerning it, Sir H. T. De la Beche afterwards wrote as follows :—

"Prior to the appearance of the Geological Survey in that part of the country, Mr. W. E. Logan had carefully investigated it, and at the meeting of the British Association for the Advancement of Science, held at Liverpool in 1837, he exhibited a beautifully executed map of it.

"The work on this District being of an order so greatly superior to that usual with geologists, and corresponding, in the minuteness and accuracy of its detail, with the maps and sections executed by the Ordnance Geological Survey, we felt desirous of availing ourselves of it, when Mr. Logan most handsomely placed it at our disposal. Having verified this work with great care, we find it so excellent that we shall adopt it for that part of the country to which it relates, considering it but fair and proper that Mr. Logan should obtain that credit to which his labours so justly entitle him.

"His sections are all levelled and measured carefully with proper instruments, and his maps are executed with a precision only as yet employed, except in his case, on the Ordnance Geological Survey; it being considered essential on that survey, for the right progress of geology, and the applications to the useful purposes of life, that this accuracy and precision should be attained."

In 1840, Logan read a paper before the Geological Society of London, in which he explained, for the first time, the true relation of the *Stigmaria* underclays to the overlying beds of coal, showing that the underclay was the soil in which the plants grew which were afterwards converted into coal. Of the 100 thick and thin coal-seams in the South Wales coal-field, he found that not a single one was without an underclay, and the inference appeared to be that there was some essential connection between the production of the one and the existence of the other. "To account," said he, "for the unfailing combination by drift, seems an unsatisfactory hypothesis; but whatever may be the mutual dependence of the phenomena, they give us reasonable grounds to suppose that in the *Stigmaria ficoides* we have the plant to which the earth is mainly indebted for those vast stores of fossil fuel which are now so indispensable to the comfort and prosperity of its inhabitants."

So much did he become interested in this subject that in the following year (1841) he crossed to America, and visited the coal-fields of Pennsylvania and Nova Scotia, in order to ascertain whether the same conditions existed there. Such he found to be the case; and in the following spring he read an interesting paper before the Geological Society, the object of which, to use his own words, "was to state the occurrence immediately below the coal-seams of America of the same *Stigmaria* beds as had been observed below those of South Wales, and to show the importance of this prevailing fact." Shortly after his return from America, he also visited coal-seams in the neighbourhood of Falkirk, Scotland, there, too, finding the *Stigmaria* clays beneath the coal.

It was during his visit to Nova Scotia, in 1841, that he discovered in the Lower Coal-measures of Horton Bluff the footprints of a reptilian animal—a discovery which, perhaps, failed to attract as much attention as it deserved, although it was the first instance in which any trace of reptiles had been detected as low down in the geological scale as the Carboniferous. The winter of 1841–42 was also spent in Canada, and the facts were obtained for a paper on the packing of ice in the St. Lawrence, which was subsequently read before the Geological Society of London.

Such, briefly, was the career of Logan previous to his appointment as Director of the Geological Survey of Canada. Already he had acquired a reputation in Britain as a geologist, and had given himself the best of trainings for the work upon which he was about to enter on this side of the Atlantic. But what was meantime passing in Canada? * * *

"In July, 1841, in the first United Parliament, a petition from the Natural History Society of Montreal, praying for aid to carry out a systematic geological survey of the Province, was presented by Mr. B. Holmes. It was referred to a Select Committee consisting of Messrs. Holmes, Neilson, Quesnel, Merrit, and the Hon. Mr. Killaly, but it was not reported on. A similar petition was presented by Mr. Black, from the Literary and Historical Society of Quebec, which was read. The Government took up the matter, and on the motion of the Hon. B.

Harrison, the sum of £1,500 sterling for the purpose of a survey was introduced into the estimates."*

Lord Sydenham dying in 1841, it fell to his successor, Sir Charles Bagot, to appoint a Provincial Geologist. Sir Charles referred the matter to Lord Stanley, Secretary of State for the Colonies, and his Lordship, on recommendation of Murchison, De la Beche, Sedgwick, and Buckland, offered the position to Mr. Logan in the spring of 1842.

Logan was now thoroughly in love with geology, and seeing in Canada the grandest of fields for original research, at once accepted. Still, he well understood the difficulties which lay before him, and shortly afterwards addressed the following words to De la Beche: "You are aware that I have been appointed by the Provincial Government of Canada to make a Geological Survey of that Colony. The extent and nature of the territory will render the task a most laborious one; but I am fully prepared to spare no exertion of which I am capable, to render the work, when it is completed, satisfactory to those who have instituted the examination and creditable to myself. * * No one knows better than yourself how difficult it would be for one person to work with effect in all the branches of so extensive a subject. To carry out the field-work with vigour, to reduce all the sections with the requisite degree of accuracy, and map the geographical distribution of the rocks, to collect minerals and fossils, and to analyze the one, and by laborious and extensive comparisons, to determine the geological age of the other, is quite impossible without a proper division of labour. * * In Canada all the expensive means of palæontological comparison have yet to be brought together. There is no arranged collection of fossils, and no such thing as a geological library to refer to."

Arriving in Canada late in August, 1842, Logan devoted several months to making a preliminary examination of the country, and to collecting information with regard to the topographical work which had been accomplished. This was done entirely at his own expense. In December he returned to England to fulfil engagements there, but came out again in the following spring. During his visit to the old country, he was so fortunate as to secure the services of Mr. Alexander Murray, a gentleman who afterwards proved himself an invaluable assistant and friend, and who has contributed largely to our knowledge of the geology of Canada, and, more recently, to that of Newfoundland.

* From Scobie's Canadian Almanac for 1851.

Reaching Halifax on the 20th of May, Logan spent several weeks in examining portions of the coal-fields of Nova Scotia and New Brunswick, and it was at this time that he made his section of the Coal Measures at the South Joggins, which, as has been truly said, is "a remarkable monument of his industry and powers of observation." It gives details of nearly the whole thickness of the coal formation of Nova Scotia, or 14,570 feet, including seventy-six beds of coal and ninety distinct *Stigmaria* underclays. Shortly after his visit to the Joggins, he wrote to a friend as follows: "I never before saw such a magnificent section as is there displayed. The rocks along the coast are laid bare for thirty miles, and every stratum can be touched and examined in nearly the whole distance. A considerable portion has a high angle of inclination, and the geological thickness thus brought to view is very great. I measured and registered every bed occurring in a horizontal distance of ten miles, taking the angle of dip all the way along." And again, in a letter to De la Beche, written in the spring of 1844, referring to the Joggins section, he says: "Since my return from field-work, I have reduced all the measurements and made out a vertical column. It occupies fifty-four pages of foolscap, closely written, and you will be astonished at the details in it."

Reaching Gaspé early in July, the summer and autumn were spent in making an examination of the coast, while Mr. Murray was at work in the Upper Province, examining the country between Lakes Huron and Erie. The Gaspé peninsula had been selected by Mr. Logan as the field for his first operations, as it was thought that outlying patches of the Carboniferous might be found to exist there, and the Government was especially anxious to ascertain whether there was any truth in the reported occurrence of coal.

The following season the work in Gaspé was continued, the Director being this time accompanied by Mr. Murray, who, in 1845, again carried on the work, while Mr. Logan was engaged in explorations on the Upper Ottawa and Mattawan. Altogether, during the three seasons, 800 miles of the Gaspé coast were examined, and several sections made across the peninsula, from the St. Lawrence to Baie de Chaleur. No coal was found, but many geological facts of importance were accumulated, and a large amount of topographical work accomplished in what was previously almost a *terra incognita*.

"Living the live of a savage, sleeping on the beach in a blanket sack with my feet to the fire, seldom taking my clothes off, eating salt pork and ship's biscuit, occasionally tormented by mosquitoes,"—such is the record which Logan has left us of his Gaspé life, the foretaste of what was to be endured for many years. From early dawn till dusk he paced or paddled, and yet his work was not finished, for while his Indians—often his sole companions—smoked their pipes round the evening fire, he wrote his notes and plotted the day's measurements.

To give details of his work during the many remaining years of his life would be to write a book; and all that we can do here is to trace briefly what his movements were, at the same time calling special attention to those of his labours which have given him a world-wide fame.

The summer of 1846 found him studying the copper-bearing rocks of Lake Superior. These he showed to consist of two groups of strata, the "upper" and the "lower," the latter of which was seen at Thunder Bay to rest unconformably upon chloritic slates belonging to an older series, to which the name of Huronian was subsequently given. This older set of rocks, which he had already observed in 1845 on Lake Temiscamang, he had ample opportunity of studying in 1848, when he devoted several months to an examination of the Canadian coast and islands of Lake Huron, where the formation attains—as shown by Murray—a thickness of 18,000 feet.

The seasons of 1847 and 1849, and a portion of that of 1848, were employed in studying the rocks of the Eastern Townships. Part of these were shown to be a prolongation of the Green Mountains of Vermont, and to consist of altered Silurian strata instead of "Primary strata," as was previously supposed by American geologists. In 1849, also, a short time was spent in an examination of the rocks about Baie St. Paul and Murray Bay, where coal had been reported to exist. The member for Saguenay County had previously made application to the Legislature for means to carry on boring operations in the vicinity of Baie St. Paul, but before his request was granted it was deemed advisable to obtain the opinion of the Provincial Geologist. By this means the Government was saved a large and useless expenditure of money.

In 1850 an examination was made of the gold-bearing drift of the Chaudière, and the auriferous district found to extend over an area of between 3,000 and 4,000 square miles. Most of the year, however, was devoted to the collection of specimens for the London Exhibition of 1851, at which Mr. Logan acted as Juror. His visit to England at this time must have been for him an agreeable change. After a lapse of eight years to meet again with men like De la Beche, Murchison and Lyell, to hear from their own lips of the strides which science had been making, and in turn to tell of all that he had himself seen and done—surely this was a treat that none but the scientific man can understand who has long been well-nigh deprived of the society of brother scientists. For him, however, there was little relaxation from labour, for he toiled early and late in order that the Canadian minerals might be displayed to the best advantage. And everyone knows the result—the collection elicited universal admiration, and Mr. Logan received a highly complimentary letter of thanks from the Prince Consort, and was elected a Fellow of the Royal Society, his name having been proposed by Sir Roderick Murchison.

Returning to Canada in August, before the close of the Exhibition, his explorations were renewed with undiminished vigour, and the remainder of the season devoted to an examination of the rocks in the county of Beauharnois, where the Potsdam sandstones had afforded those curious tracks of crustaceans to which Owen gave the name of Protichnites, and to a further study of the Chaudière gold region. During the winter he again visited England to attend to the distribution of a portion of the Exhibition collection which was to be left there, and to see to the return of the remainder.

In 1852 an examination was made of a strip of country on the north side of the St. Lawrence, extending from Montreal to Cape Tourmente, below Quebec. The distribution of the fossiliferous rocks was accurately determined, and several excursions were made into the hilly, "metamorphic country" to the north. In his report on this season's operations, published in 1854, Logan for the first time designated the rocks comprising these hills as the "Laurentian series," substituting this for "metamorphic series," the name which he had previously employed, but which, as he says, is applicable to any series of rocks in an altered condition.

The following season was spent among the Laurentian hills of Grenville and the adjoining townships, a field which proved so attractive that he afterward returned to it in 1856 and 1858. Nearly the whole of 1854 was occupied in making preparations for the Exhibition which was to take place at Paris in the following year, and to which Mr. Logan was to go as one of the Canadian Commissioners. It was in the autumn of 1854, also, that a Select Committee was appointed by the Canadian Government to inquire into the best method of making the information acquired by the Geological Survey more readily accessible to the public. A lengthy report on the subject—indeed on the entire working of the Survey—was published, and the evidence which it contains is of a most flattering character, both as regards the Director and those associated with him.

Then came the Paris Exhibition of 1855, at which the representation of the economic minerals of Canada was so complete and the arrangement so admirable that the collection attracted universal attention. This in itself Logan would have regarded as amply repaying him for his trouble ; but greater honour was in store for him. The Imperial Commission presented him with the Grand Gold Medal of Honour, and the Emperor of the French made him a Chevalier of the Legion of Honour. Early in the following year (1856) he was knighted by Queen Victoria, and received from the Geological Society of London the Wollaston Palladium Medal in recognition of his distinguished labours in geology. Long previous he had won the confidence and esteem of his fellow-countrymen in Canada, but this seemed to be a fitting time to testify to him their appreciation of his worth. Accordingly, on his return to Montreal, the citizens presented him with a testimonial, on which were engraved the words :

"In commemoration of his long and useful services as Provincial Geologist in Canada, and especially his valuable services in connection with the Exhibition of all Nations in London in 1851, and in Paris in 1855, by which he not only obtained for himself higher honour and more extended reputation, but largely contributed in making known the natural resources of his native country."

The Natural History Society of Montreal presented him with an address, and made him an honorary member, while the members of the Canadian Institute of Toronto, of which Sir William was the first President, had his portrait painted and hung up in their hall. They also presented him with an address expressive of their affectionate esteem and respect. Sir William's reply to this was so full of feeling, and so highly characteristic, that we give a portion of it: "Whatever distinctions," said he, "may be bestowed on us at a distance, it is upon the respect, esteem, and confidence shown us at home, that our happiness and satisfaction must chiefly depend. I can assure you with sincerity that the honour conferred upon me, when you elected me the first President of the Institute, was one highly prized, although the circumstances of a distant domicile, and the intent pursuit of the investigations with which I am charged, rendered it extremely difficult for me to be of much use in your proceedings. * * * It is a fortunate circumstance for me that my name should be connected with an act of grace on the part of Her Majesty, which serves to confirm your feeling in regard to the fact that as Canadians we enjoy a full share in the honours and privileges of British subjects. And I am proud to think that it was, perhaps, more because I was a Canadian, in whom the inhabitants of the Province had reposed some trust, that the honour which has been conferred upon me by Her Majesty was so easily obtained. That I am proud of the honours which have been bestowed upon me by the Emperor of France, in respect to my geological labours, and also by my brother geologists in England, there can be no doubt; but I have striven for these honours because I have considered they would tend to promote the confidence which the inhabitants of the Province have reposed in me, in my endeavors to develop the truth in regard to the mineral resources of the Province; and in this work none could have been more interested in my success than the members of this Institute." *

In August, 1857, the American Association for the Advancement of Science held its annual meeting in Montreal, and for several months previous Sir William was hard at work getting his museum in readiness to receive his brother geologists. Owing largely to his untiring exertions, the meeting was a most successful one. He himself read two interesting papers, one on the "Huronian and Laurentian Series of Canada," and another on the "Sub-division of the Laurentian Rocks of Canada." After the business of the Association was concluded, accompanied by Professor Ramsay, who had come over to represent the Geological Society of London, and Professor Hall, he made a geological tour through New York State. Returning from this trip he spent the autumn months among the Laurentian rocks of Grenville. Here, too, as already mentioned, he continued to work during the season of 1858.

For several years after this his time was much taken up with the preparation and publication of the *Geology of Canada* and its accompanying Atlas, the former of which appeared in 1863, and the latter in 1865. Before these could be completed, however, many facts had to be added to the stock already obtained, and besides a large amount of geological work among the Laurentian rocks of Grenville and the rocks of the Eastern Townships, a personal examination of many parts of the country, as well as of portions of the New England States, was rendered necessary.

In 1862, Sir William was again present in the capacity of Juror, at the London International Exhibition, and again displayed a large and interesting collection of economic minerals. Another opportunity of seeing his scientific friends in Britain was also afforded him in 1864, when he went to London to superintend the engraving of the Atlas already mentioned. In 1866, a geological collection was again prepared

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* "Can. Journal." New Series. Vol. I., p. 404.

for the Paris Exhibition of 1867, and Sir William worked so closely in getting up a geological map to accompany it, that he is said to have nearly ruined his eyesight. 1868 found him once more on this side of the Atlantic, hard at work in the Pictou coal-field, and the results of this season's work constitute the last of his reports. In 1869 he resigned his appointment to Mr. Selwyn, the present Director of the Survey.

The few remaining years of his life were occupied chiefly with a study of the rocks of the Eastern Townships and portions of New England; but, unfortunately, the conclusions at which he arrived concerning them were not published.

No man has done as much as Sir William Logan to bring Canada before the notice of the outside world, and no man is more deserving of being held in remembrance by the people. Just as statesmen or generals have risen up at the moment of greatest need to frame laws or fight battles for their country, so Sir William appeared to reveal to us the hidden treasures of Nature, just at a time when Canada needed to know her wealth in order to appreciate her greatness,—for rising nations require to know what their resources are. He possessed rare qualities—qualities, which, combined, eminently fitted him for his work. He was strong in body, of active mind, industrious and doggedly persevering, painstaking, a lover of truth, generous, possessed of the keenest knowledge of human nature, sound in judgment, but always cautious in expressing an opinion.

He belonged to that school of geologists—unfortunately not so numerously represented as it ought to be—whose motto is, "Facts, then theories," and was wholly above rasping down facts to make them fit theories. As a consequence, he rarely had to un-say what was once said: and this is why he so thoroughly gained the public confidence. So long as he felt that he was in the right, he held to his own views as tenaciously as did ever any true Scot; but if shown to be in the wrong, he knew how to surrender gracefully.

Those who have clambered with him over our log-strewn Laurentian hills know well what were his powers of endurance. He never seemed to tire, never found the days long enough. His field-books are models of carefulness, replete with details, and serve as an example of the painstaking way in which he did all his work. They were written in pencil, but regularly inked in at night, when the camp fire was often his only light. In addition to his field-book proper, he frequently kept a diary, and delighted to jot down little every-day occurrences, or sketch objects of interest—for the hand that could so well wield a hammer could also guide a pencil and produce drawings of no mean artistic skill. His descriptions of his backwoods experiences are often very amusing, and we cannot resist giving a specimen. He had been travelling through the forest for two months and had suddenly come upon the house of a settler called Barton, whose good wife was justly alarmed when Sir William and party entered her dwelling. Sir William describes his appearance on this occasion as follows :—"We are all pretty-looking figures. I fancy I cut the nearest resemblance to a scare-crow. What with hair matted with spruce gum, a beard three months old, red, with two patches of white on one side, a pair of cracked spectacles, a red flannel shirt, a waistcoat with patches on the left pocket,—where some sulphuric acid, which I carry in a small vial to try for the presence of lime in the rocks, had leaked through,—a jacket of moleskin shining with grease, and trowsers patched on one knee in four places, and with a burnt hole in the other; with beef boots—Canada boots, as they are called—torn and roughened all over with scraping on the stumps and branches of trees, and patched on the legs with sundry pieces of leather of divers colours; a broad-brimmed and round-topped hat, once white, but now no colour and battered into all shapes. With all these adornments, I am not surprised that Mrs. Barton, speaking of her children, and saying that here was "a little fellow frightened of nothing on earth," should qualify the expression by saying, "but I think he's a little scared at *you*, sir."

It was not alone in the field that Sir William was busy. His office work was often most arduous, and during the earlier years of his directorship, in addition to preparing his annual report, he even kept the accounts, entering every item of expenditure, so that he could at any time show exactly how every penny of the public money placed at his disposal had been spent. He also tells us that, with his own hands, he made at that time four manuscript copies of the Annual Report of Progress, often reaching more than one hundred printed pages—one copy for the Government, one for the House of Assembly, one for the Legislative Council, and one for the printer.

His manner of living was simple as it was solitary. Like his four brothers, he never married, nor does he seem to have formed many intimate friendships. Still every one who knew him loved him and respected him, and if you go the length and breadth of all the land you will everywhere hear his praises, alike from rich and poor.

He peculiarly possessed the power of inspiring others with his own enthusiasm; not only those in his employ, but even uneducated farmers and backwoodsmen—men who, as a rule, are rather sceptical about the advantages to be derived from geology.

Though possessed of private means, he spent little upon himself; not that he was parsimonious, but he cared not for fashion or luxury. But with him Science never pleaded her needs in vain. The first grant of the Legislature, to make a geological survey of the Canadas, was £1,500—an amount which, Sir William quaintly remarked, was but a drop of what would be required to float him over twenty-five degrees of longitude and ten of latitude. This was, of course, very soon spent, and not only this, but at the end of the second year the Survey was £800 in his debt, and he had no guarantee whatever that his money would be returned to him. Since then the Survey has been constantly indebted to him for books, instruments, and other aids, and the building on St. James street, now used for office purposes, was built by him, two years ago, and rented to the Government for about half the amount which he could have obtained from other tenants. To Logan also, McGill University owes much; for, in 1864, he founded and endowed the "Logan Gold Medal" for an honour course in geology and natural science, and, in 1871, gave $19,000, which, together with $1,000 given by his brother, the late Mr. Hart Logan, forms the endowment of the "Logan Chair of Geology."

Since resigning his position as Director of the Geological Survey he has carried on explorations at his own expense, and, at the time of his death, arrangements had been nearly completed for putting down a bore-hole in the Eastern Townships, at a cost of $8,000; as he thought that this would enable him to prove the truth of his views with regard to the age of the metamorphic rocks there. * * * *

Sir William was the first to give us any definite information about those wondrous old Laurentian rocks which form the backbone of our Continent. He showed us that they were older than the Huronian, and that they consisted of a great series of metamorphosed sedimentary rocks, which are divisible into two unconformable groups, with a combined thickness of not less than 30,000 feet. The great beds of limestone which he found in the lower series, the plumbago, the iron ores, the metallic sulphurets, all seem to point to the existence of life in the Laurentian days; but the discovery of *Eozoon Canadense* made conjecture give place to certainty. Now we *know* that the world of that far-off time was not a lifeless world. Life, whatever that may be, had been joined to matter.

The first specimens of *Eozoon* were found by Dr. James Wilson, of Perth; but at the time of their discovery were regarded merely as minerals. In 1858, however, Mr. J. McMullen, of the Geological Survey, discovered other specimens, the organic origin of which so struck Sir William that in the following year—four years before their true structure and affinities were determined by Dawson and Carpenter—he even exhibited them as fossils at the meeting of the American Association.

In widely extending our knowledge of the early geological history of the earth, Sir William has done a great work; indeed, this may be regarded as his greatest work. Its importance has everywhere been recognized, and the name Laurentian, which he chose for the rocks at the bottom of the geological scale in America, has crossed the Atlantic, and is now applied to the homotaxial rocks of Europe. Sir Roderick Murchison, who dedicated the Fourth Edition of "Siluria" to Sir William Logan, even substituted Laurentian for "Fundamental Gneiss," the name which he had given to the rocks of the West Highlands of Scotland. "I at first," says Murchison, "termed them 'Fundamental Gneiss,' and soon after, following my distinguished friend, Sir William Logan, I applied to them his term 'Laurentian,' and thus clearly distinguished them from the younger gneissic and micaceous crystalline rocks of the Central and Eastern Highlands, which were classed as metamorphosed Lower Silurian."

Logan was not a voluminous writer, and during the later years of his life writing was a great effort to him. Occasional papers from his pen have appeared in the *Transactions of the Geological Society* of London, in the *Canadian Naturalist* and the *Canadian Journal*, and some of these have already been referred to; but most of what he has written is to be found in the *Reports of Progress* annually submitted to the Government, and in that invaluable book, the *Geology of Canada*, which is, to a large extent, a digest of what is contained in the reports published previous to 1863. He sometimes expressed himself quaintly, but everything he wrote is clear and exceedingly concise.

In addition to being a Fellow of the Royal Society and of the Geological Societies of London and Paris, he was a member of numerous other learned societies both in Europe and America. At the time of his death, and for many years previous, he was one of the Vice-presidents of the Montreal Natural History Society; but though frequently solicited to accept the office of President, he always declined,—not on account of any lack of interest in the Society, but he felt his time was too fully occupied to permit of his successfully discharging the Presidential duties. We have already alluded to some of the medals which were awarded to him; but it may be mentioned that altogether he was the recipient of more than twenty, including two from the Royal Society.

And now, in concluding, let me say to you, my friends, if you would do honour to the memory of that noble old man, who fought so long, so bravely, for his country, for science, for you, then honour the cause for which he fought: strive with all your might to advance the interests of that cause, and to raise up a superstructure befitting the solid foundation which Logan has laid. He himself even hoped to build the superstructure; but his anticipations were not realized, for life was not long enough, and we must take up the mantle which he has dropped.

B. J. HARRINGTON.

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REPORT

ON

EXPLORATION IN BRITISH COLUMBIA,

BY

ALFRED R. C. SELWYN,

IN

1875,

ADDRESSED TO

THE HONORABLE DAVID LAIRD, M.P.,

MINISTER OF THE INTERIOR.

SIR,—I have the honour to submit the following report of my Exploration during the past summer of a part of Northern British Columbia, and of the Peace River and Pine River passes of the Rocky Mountains.

Acknowledgment of assistance.

Mr. Sandford Fleming, Engineer-in-Chief of the Canada Pacific Railway, had kindly given instructions to his officers in British Columbia to afford the Geological Survey party every possible assistance, which the resources at their command enabled them to do; and my best thanks are due to Mr. Marcus Smith, C.E., in charge, and to the officers of the commissariat and transport departments of the Railway Survey for the very cordial and effective manner in which they carried out these instructions, saving me much time and trouble, and greatly facilitating my operations. I would also beg to acknowledge the assistance and kind hospitality which our party received from the officers at the several Hudson Bay Company's posts on our route; and I may particularly mention Mr. Gavin Hamilton, Stewart's Lake; Mr. MacKenzie, McLeod's Lake; Mr. King, Fort St. John; Mr. Barrasois, at Dunvegan; and Postmaster Charles Dumas, at Hudson's Hope, from all of whom we received most valuable assistance and information.

Party.

I was accompanied from Canada by Professor John Macoun of Belleville, and by Mr. Arthur Webster of the Geological Corps. In Victoria three men were engaged as general assistants, and the party was occasionally augmented by Indians or others when temporary assistance was required. Professor Macoun explored the botanical features of the region traversed, and made very large collections of the flora, and the result of his labours is given in the accompanying valuable and instructive report by himself.

Mr. Webster, besides assisting in the general work of the exploration, took daily observations—weather permitting—for latitude and variation, as well as those required for laying down the bearings and distances of the route. Between Quesnel and McLeod's Lake the measurements were made by pacing, and the bearings taken by prismatic compass. On the water route from McLeod's Lake to Dunvegan, and on Pine River and Smoky River, the distances were estimated both by Mr. Webster and myself, generally travelling in separate boats, and the course of the river, with adjacent topographical features, was sketched to scale at the time, in our note-books, along a carefully protracted bearing of each reach and bend. When ascending the river on the return journey much of it was sketched a second time, and the distances were corrected by walking along the banks while the boats were being laboriously tracked or poled against the current. A similar sketch survey was made of the route from Fort McLeod, *via* the Giscome Portage, to Fort George and Quesnel. I arrived in Victoria on the 13th of May, and left, with our party, for the mainland on the 18th. On the 27th we reached Soda Creek and Quesnel by stage and steamboat, 368 miles from Yale. Our pack-train, however, which was coming up from Kamloops, did not arrive till the 3rd of June, and on the 5th we started for McLeod's Lake. The interval from the 27th of May had been occupied in a hasty visit to the Cariboo gold fields, and in explorations in the immediate vicinity of Quesnel. On the 20th of October we again reached Quesnel, having completed a journey, mostly by water, of about 1,700 miles, extending through three and a-half degrees of latitude and seven degrees of longitude.

Observations and measurements.

Journey.

So far as I am aware the only accounts relating to part of the region we traversed between Quesnel and Smoky River are to be found in Sir Alexander Mackenzie's "Voyages through the Continent of North America," published in 1801; in Mr. Malcom McLeod's "Peace River," published in 1872; in Captain Butler's "Wild North Land," published in 1874; and in the Reports of Messrs. Horetzky and Macoun,* which

Account of previous explorers.

* Report of Sandford Fleming, Esq., Engineer-in-Chief on Explorations and Surveys for the Canadian Pacific Railway, 1874.

also appeared in 1874, together with a small volume by the former, entitled "Canada on the Pacific."

Mr. D. W. Harmon.

Mr. D. W. Harmon, a partner in the North-West Company, resided several years on Stuart's Lake, and in 1820 published a work entitled "Harmon's Travels in North America," in which, doubtless, further valuable information relating to that portion of the region would be found.

Sir Alexander Mackenzie.

In the autumn of 1792 Sir Alexander (then Mr.) Mackenzie established a fur-trading post at the mouth of Smoky River—"The Fork,"—where he passed the winter. In the following spring, May, 1793, he ascended Peace River and the Parsnip to a point whence, by a short portage and a small rapid river—"Bad River"—he reached the Fraser River, a considerable distance above Fort George. Thence he descended the Fraser, which he mistook for the Columbia, and passing up the valley of the Westroad or Black River, his journey was continued westward to the Pacific, which he reached on the 20th July. Returning by the same route he arrived at Smoky River on the 24th of August; making easily, in twenty-nine days, the distance which had occupied him seventy-two days on the upward journey.

Mr. McLeod.

Mr. McLeod's book is an itinerary and journal—with copious explanatory notes by the editor—kept by Chief Factor Archibald McDonald during a trip with Sir George Simpson through this region in 1828.

Captain Butler and Messrs. Horetzky and Macoun.

In the spring of 1872 Captain Butler ascended Peace River and the Finlay and Omineca branches to Germansen Creek, whence he travelled by the pack-trail to Stewart's Lake and Quesnel. In August of the same year Messrs. Horetzky and Macoun were despatched by Mr. Sandford Fleming from Edmonton, *via* the Lesser Slave Lake, to the valley of Peace River, which they ascended from The Fork to McLeod's Lake. Thence, passing by way of Stewart's Lake, Mr. Horetzky reached the sea by Babine Lake and the Skeena and Naase Rivers, and his companion, Mr. Macoun, by Quesnel mouth and the valley of the Fraser.

Trutch's map of British Columbia.

The only available map of all this region is Trutch's map of British Columbia, issued in 1871. This has been copied and used by all explorers since then. Between Quesnel and the point where the trail to Stewart's Lake leaves the old telegraph route, in the vicinity of Sinkut Lake, the map is generally correct. Between this point, however, and Stewart's Lake there must be a very great error: the actual distance is certainly not less than forty-five miles, whereas the map makes it only about sixteen. The course of Peace River is apparently taken from Sir Alexander Mackenzie's map, published with his narrative in 1801, and in many respects differs very considerably from our survey of it. Another very important error is in the course assigned to Pack River—called Parsnip on the map—which, instead of running to the north-east, as represented, has a decided north-westerly course; by which the relative positions assigned to McLeod's Lake and the Parsnip River are entirely changed

The map accompanying the present report has been constructed by Mr. Robert Barlow from our notes and observations. Between Blackwater and McLeod's Lake, a mistake has been made in the magnetic variation of 4° 46′. This makes the longitudes, as shown by the map, 0° 27′ 5″ too much to the west. Appended is a table of the approximate distances between the principal points of our route, and also those given between the same points by other observers. Map of the route.

The illustrations are photolithographs by Messrs. Burland & Co., from photographs taken during the expedition. For these, dry plates were used, but no attempt was made to develope the pictures till I returned to Montreal. Many of the negatives were then found to be a good deal injured by the damp to which they had been unavoidably exposed during the journey; probably while shifting the plates to and from the backs at night in the tent. I had no dark tent, and therefore could change the plates only after nightfall, often involving in those northern latitudes sitting up till after midnight. Illustrations.

Our observations were necessarily very closely confined to the line along which we travelled; and, as regards the general outline and features of the country, I am not able to add much to the information which has already been given respecting these in the published accounts by the previous explorers, whose names have been mentioned.

Journal of Expedition and General Character of the Country.

Leaving Quesnel, as has been already stated, on the 5th of June, our party consisted of the following members:— Party from Quesnel.

Alfred Selwyn, English	Leader and Geologist.
John Macoun, Irish	Botanist.
Arthur Webster, Lower Canadian	Surveyor.
John McClennan, Scotch	Foreman.
James Anderson, do.	General Assistant.
Thomas Hillier, English Half-breed, B.C.	Cook.
Prefecto Manneo, Mexican	Packer.
Basileo Mergao, do.	Assistant.
Donald Walker, Scotch	"
Robt. Todd, Half-breed Scotch	"
John, Chinaman	Cook.

Pack-train.

Our pack-train numbered twenty-six horses: six were used for riding and twenty were loaded with our equipment, including provisions for four months. Prefecto had travelled with me in 1871, when exploring the North Thomson River, and I always found him civil, obliging and trustworthy, and—most important of all—very careful of his animals and their "*rigging*," packsaddles, &c., which, to prevent sore backs, require constant attention.

Besides the special duties assigned to each member of the party, one and all, when travelling, cheerfully and constantly assisted, as circumstances required, with either axe, paddle, pole or tracking-line, in surmounting the many obstacles which impeded our progress, and in consequence we often came to camp at night with stiff limbs and aching shoulders, but excellent appetites, notwithstanding, for the beans and bacon, or the dried moose-meat, which formed the staple of our daily food.

Character of country between Quesnel and Stewart's Lake.

From Quesnel to the Westroad River (Blackwater) and thence to Sinkut Lake our route followed the old Overland Telegraph line. The country is generally level, or only slightly undulating. There are numbers of small lakes abounding with fish, and though the soil is almost always light, and sometimes on the ridges too sandy or gravelly to be fit for cultivation, there are, nevertheless, considerable tracts of good agricultural land on open or lightly-timbered flats and slopes along the borders of the lakes and along the streams and rivers: among which may be mentioned Westroad River, Chilaccoh River, Nechacco River and Stewart River; also, Naltesby Enlatatzela and Sinkut Lakes. At the crossing place on the Nechacco, and between it and Stony Creek, there are extensive areas of the richest land, covered with luxuriant herbage; and similar fine land occurs at intervals along the valley to Fraser's Lake, where most of the horses and cattle belonging to the Hudson Bay Company are sent from other posts to winter, on account of the abundance of fine grass and the lighter snow-fall, as compared with that at Fort George, or even at Stewart's Lake.

Rich land.

The average elevation of the country between the Westroad River and the Nechacco is probably not less than 2,400 feet, and the valleys of the principal streams, being everywhere from 250 to 500 feet lower, are generally reached by a succession of terraced steps cut in the sand and gravel deposits, which are so widely distributed over the whole of the great central plateau of British Columbia, and up to elevations of more than 3,000 feet. The relation of these deposits to the underlying tertiary lignite formation is fully described in Mr. G. M. Dawson's report,

Drift and tertiary lignite formation.

and the terraces are well shown in his sketch of Blackwater Valley, as well as in the photographs which I took of the same valley from above the lower crossing place. Similar terraces are more or less a characteristic of almost every river valley which we crossed, both east and west of the Rocky Mountains.

Rivers and streams between Quesnel and McLeod's Lake.

Between Quesnel and McLeod's Lake the trail crosses twelve considerable streams and one narrow arm of a lake, besides a number of brooks from five to twenty feet wide; these occur in the following order:—

1. West River flows to right, valley 100 feet deep, descent over sand and gravel terraces. Stream twenty-five feet wide; rapid current.
2. River discharging Pantage Lake runs through wide swampy flats, and joins Westroad River below the lower cañon, twenty to thirty feet wide.
3. Westroad River or Blackwater. 120 feet wide at the ford, wide valley, 360 to 400 feet deep; ascent on the south side by five broad terraces of sand and gravel. A good bridge two miles below the ford.
4. Chilacco River, about forty yards wide, swift current. At the crossing place fine grassy flats, rich soil; valley about 250 to 300 feet deep.
5. Sinkut Lake River. Fine grassy flats, rich soil, thirty to thirty-five yards wide: a good bridge. Valley 250 feet deep.
6. Stony Creek, twenty-five to thirty feet wide, deep at both banks; descent over several terraces 400 to 420 feet. This creek joins the Nechacco, and for a considerable distance up runs in the same valley as the latter; wide flats, with rich soil and luxuriant grass intervening. It discharges T. Chaka Lake, which, according to the C. P. R. survey, is 2,349 feet above the sea.
7. Nechacco River, south branch, 150 yards wide, strong current of deep water. No bridge or ferry.
8. Nechacco, north branch, or Stewart's River, 200 yards wide. Ferry. Highest part of the trail between the two branches, 600 feet. From this point there is a fine view to the westward, of the Cascade Mountains. Flats along river thickly timbered.
9. Nine-Mile Creek, twenty-five to thirty feet wide. Bridged. Some good land along the banks.

10. Salmon River, west branch, fifty to sixty feet wide; valley narrow, about 150 feet deep. Bridge broken; horses have to swim.
11. Swamp Creek, or east branch of Salmon River, thirty to forty feet wide; flats flooded by beaver dams. The feed is in patches, poor and thin. White Mud Creek, discharging into the west branch above the crossing, is about fifteen feet wide; the trail crosses it three times. The country between the branches is all sandy and gravelly, in ridges, with boggy creeks, and small lakes or swampy lagoons.
12. Crossing of Carp Lake, ninety yards wide. Horses swim for about twenty yards; the bottom on both sides is fine gravel.
13. Long Lake River, upper crossing fifty to sixty yards wide, rapid current, about four feet deep. Splendid trout-fishing. A mile and a half below the crossing the river falls about 120 feet over ledges of dioritic rock. From near the falls the trail leaves the river and passes through a country of steep mounds, or hills and hollows, and long narrow ridges of gravel, which look as if piled up by ice action. The pebbles and boulders are well rounded—diorite, granite, garnet-gneiss, quartzite and sandstone.
14. Long Lake River, lower crossing at outlet in McLeod's Lake.

Character of the country.

The country between these streams is all more or less undulating, and the soil light, sandy and gravelly. Some of the ridges and mounds are composed almost entirely of rounded gravel, with deep intervening depressions. Immediately south of the Chilacco River bridge these ridges and hollows are very remarkable. Many of the latter are cup-shaped, the sides rising at an angle of thirty-five or forty degrees to fifty or 100 feet. Some of them are dry, while others enclose small lakes or pools without visible outlets. According to the barometer readings taken each day, the highest elevations on the trail between the several streams vary from 300 to 600 feet. And the lowest points between Quesnel and McLeod's Lake are the crossings of the two branches of the Nechacco River. The highest point is crossed near Pantage Lake, a few miles south of Blackwater. Between Swamp River and Carp Lake the country is generally flat, with a poor sandy and gravelly soil, mostly covered with thick forest of pine and spruce, with some balsam fir; very little grass. This country forms the divide between the waters of the Arctic and Pacific Oceans, and is about 2,500 feet above sea level. From

The divide between Arctic and Pacific waters.

here the axis of the divide runs south-easterly to the Giscome Portage road, and thence describes nearly the half circumference of a circle, having a radius of about 100 miles to the Leather or Yellow-head Pass, 3,746 feet above the sea, in the main chain of the Rocky Mountains.

We reached the Carp Lake Crossing at 11 a.m., and tried to make a raft, but were not successful, as there were no trees near by of sufficient size. When our pack train arrived, which was not till 3 p.m., we put the "Nechaçço" together, and by 6 p.m. had landed everything on the opposite bank. The "Nechacco" was a light-framed boat covered with canvas, about five feet wide and eighteen feet long, flat-bottomed and square at both ends. It was sent to British Columbia for this expedition. We put her together first at the Nechacco crossing, hence the name. The operation did not occupy more than forty minutes. When travelling the whole folded together, and was easily packed on one horse. For crossing lakes and rivers, and for down-stream work, it was found to answer admirably, and often saved the delay which would have occurred in making rafts or canoes. Every exploring party travelling in such a country as British Columbia should have one of these boats. Very great improvements, however, might be made in their portability, and if shaped, as they might be, so as to be suitable for ascending against a current, they would be of much greater value for exploring purposes.

Carp Lake crossing.

Canvas boat.

As there was no feed here, the horses had to be sent to a swampy flat some distance off. The trail along Carp Lake, and thence to the crossing, was reported as very bad, and running for a long distance in the water. I therefore decided to lighten the horses by taking a load in the boat, especially such things as might be seriously damaged by being wetted. It was a very wet morning, and I was, therefore, unable to make an accurate sketch of this water traverse. The distance is, however, approximately eleven miles and-a-half—namely, Carp Lake, five and-a-half miles; river, four miles; Long Lake, two miles. The river is about sixty to eighty feet wide, three to five feet deep, with a sandy and gravelly bed. It winds a good deal, and is obstructed by timber jams: we had to make a portage over one of these, and to cut a passage through three others. Both above and below Long Lake a very short time suffices to catch a dish of fine trout, from a pound to a pound and-a-half weight. There appear to be two kinds, one quite like the common brook trout; the other has a broad red band along the centre of the body from head to tail, and the flesh is as red as that of salmon.

Long Lake river.

Fine trout.

We reached Fort McLeod on the 28th of June, twenty-four days from

Quesnel, including one day at Blackwater, one day at the Nechacco crossing, and two days at Fort St. James. On the 5th, 6th, 9th, 13th and 27th we either started late or camped soon after mid-day. Thus it may be said that we travelled eighteen days, and assuming the distance to be 221 miles, to have averaged about 12·2 miles per day. Between Stewart's Lake and Fort McLeod much of the forest had been burnt, and the trail was constantly obstructed by large fallen trees, often forming a perfect network of logs, all of which had to be cut through and removed before the train could pass; in consequence, though we started early and camped late, the distance travelled each day was comparatively small.

Rate of travelling with pack train.

Preparations at Fort McLeod.

As there is no trail beyond McLeod's Lake, our pack-train left us there and returned to the depot at Blackwater. Henceforth our journey was to be by water, and from the 28th of June to the 3rd of July was occupied at Fort McLeod in making the necessary preparations.

We had brought two Indians, Baptiste and Ahquon, with us from Stewart's Lake. They were engaged there by Mr. Hamilton to accompany us as far as the Rocky Mountain Portage, and he spoke highly of them as good canoemen and guides on the river. They neither of them, however, deserved the character given them. Baptiste deserted us at McLeod, and Ahquon, whom we persuaded with difficulty to go further, proved to be of very little use, either as hunter, canoeman, or guide. It is, however, true that he devoted a great deal of time and energy to the occupation first named, but whenever the field extended beyond his own person, which was rarely the case, his efforts were wholly unsuccessful. A large number of Indians were assembled at Fort McLeod, but Mr. McKenzie could not induce any of them to accompany us, the reason, as I afterwards discovered, being that Baptiste had been telling them that if they did so they would be starved and otherwise ill-treated. When at Stewart's Lake I had arranged with Mr. McKenzie to let us have a light pine boat, which he had just built there for his own use, and which he was then about to take round to McLeod's Lake by Fort George and the Giscome Portage, expecting to arrive there about the same time as ourselves. This was a fortunate circumstance, as we had great difficulty in getting one very poor canoe at Fort McLeod, and if we had not had the "Nechacco" and the "McLeod," Mr. McKenzie's boat—we should not have been able to continue our journey.

Indians.

Difficulty in getting canoes.

I shall now give regular extracts from my diary, beginning on the 3rd of July, the day we left Fort McLeod, and embarked on the waters of the great Unjigah.

After several hours spent in getting the Indians to make up their minds about going on with us, it was at length decided that Baptiste would leave, and that we should take in his place a French Half-breed lad, Morice Deschamps. This settled, we loaded our boats, and at 2.30 p.m. were under weigh and floating down stream in the following order, the boats being all freighted to their utmost capacity:— Leave Fort McLeod.

In the "McLeod"............Self, Ahquon and Deschamps.
In the "Nechacco"...........Mr. Webster, Professor Macoun and John McClennan.
In the Canoe................James Anderson and Thomas Hillier.

We hoped to be able to make a micrometer survey of the river, and commenced to do so, but after having gone about two miles I saw that Anderson and Hillier were quite incapable of managing the canoe, and were incurring very considerable danger. I had, therefore, just requested Mr. Webster to give up the survey, when I saw the canoe, in trying to gain the bank to stop for the next sight, whirled helplessly into the branches of a fallen tree and turn over in a swift current. Neither of the men could swim, and they had a somewhat narrow escape. Anderson managed to reach the shore, but Hillier was swept away down the stream holding on to the canoe. We, however, succeeded in overtaking it, and towed it safely to the opposite shore. Both the men were considerably frightened, but fortunately not otherwise injured. Except one bag of bacon and a small valise, everything in the canoe had gone to the bottom, making rather a serious reduction in our stock of provisions. Game and fish will have to supply its place. Thus ended our first days journey on the river, and the rest of the afternoon was occupied in drying clothes, catching fish and re-arranging our cargoes. At the foot of the island on which we are camped, an immense timber-jam completely blocks the river; there is, however, now sufficient water to float our boats in the small channel at the back of the island. At low-water a portage of both boats and cargoe has to be made here. Survey of the river. Upsetting of the canoe.

July 4th.—Started at 7.30 a.m., and after getting our fleet through the narrow channel, we proceeded on our course down the river. In about four miles we entered Trout Lake, a picturesque sheet of water about two miles long and one to one and-a-half miles wide. It is pretty closely surrounded by low wooded hills, but on the north side, about a mile above the outlet, there seems to be a narrow valley extending back towards the Parsnip, and an easy route would probably be found through it to that river. Except where burnt patches occur, the country around is every- Trout Lake.

where thickly wooded with spruce, cottonwood, poplar, birch and aspen. Immediately below the outlet we halted for lunch, and while the kettle was boiling several fine trout were caught, and also the first specimen we had seen of the beautiful "Arctic Trout." This fish is only known in the waters which flow to the Arctic Ocean, and is probably the same species figured and described by Richardson in his "Fauna Boreali Americana" as *Thymallus signifer*, Backs Grayling, Poison Bleu, of the French *Voyageurs*, and Hewlook Powak, of the Esquimaux, denoting wing-like fin. Richardson does not mention it, however, as occurring south of the 62nd parallel of north latitude. Where we first caught it, was about latitude 55° north.

Arctic Trout.

After lunch we proceeded down the river; two strong rapids over large boulders occur in the first two miles, then about eight miles more of a winding course, generally between high wooded banks, brought us to the Parsnip. Both rivers are now at their highest summer level; the water of the Parsnip is white and turbid, while that of Pack River is clear and dark. For a considerable distance the two flow side by side without mingling. The Parsnip is about 100 yards wide, with an even swift current, and Pack River has a width of about seventy or eighty feet. We camped at 5.30 p.m., at about two miles below the junction, on a low flat island, timbered with spruce and large cotton-wood, around which the river flows in two now apparently nearly equal sized streams. At low water in the fall, however, the northern channel is nearly dry. It was, perhaps, up this northern channel that Mackenzie passed at high water in 1793, and thus missed the junction of Pack, or McLeod's Lake River, of which he makes no mention either on his upward journey in June, or on his return in August.

Reach the Parsnip River.

We had learnt from the Indians at McLeod that the trail for the Pine River pass left the Parsnip at the junction of the first large stream, on the left above Pack River, and I determined, before going further, to make an attempt to explore this pass. Accordingly on the following morning, 5th July, I started at 7 a.m. in the McLeod, with Mr. Webster and our two Indian boys, Morice and Ahquon, leaving the rest of our party encamped on the island till our return. We took nothing with us but our blankets and enough provisions to last four or five days. Our progress, poling against the rapid current, was exceedingly slow, and it was evident that our Indian boys would not be able to take our boat safely up any heavy rapid. By 5 p.m., however, we had, I judged, made about twelve miles, when we landed on a small island and camped. We were now about eight miles west magnetic from the mouth of Pack River.

Trail to Pine River pass.

PHOTO LITH BY THE BURLAND DESBARATS CO MONTREAL.

From Photo. 9th July, 1875.

LOOKING DOWN PEACE RIVER TO FINLAY RAPIDS, FROM THE FINLAY RIVER JUNCTION.

6th July.—Started at 7 a.m., and continued our upward course. At 9.09 a.m. we reached the mouth of a river, which we supposed to be that leading to Pine Pass. It is from sixty to seventy feet wide, with a strong, rapid current, apparently of snow water, like that of the Parsnip. On trying to ascend it, we found our Indians quite unable to stem the current. Mr. Webster and I then landed on the left bank and went into the woods to look for the Indian trail. In a short distance we struck one, which was well marked through the belts of thick wood, but very indistinct and difficult to follow in the open pine forest. After following it for about two miles we returned to our boats. From the furthest point which we reached, on a plateau or terrace about 200 feet above the river, the view from east round to south was limited by level forest country. To the north-north east some high rounded peaks were visible, probably fifteen or twenty miles distant, while the main valley seemed to trend more easterly and to pass behind the level country in that direction. There is no doubt that this is the route by which the Indians reach Fort St. John in ten days.

At 11.30 a.m. we again turned down stream, and, in forty minutes, arrived where we camped last night. Leaving this again, at 1.30 p.m., we reached our camp on the island at 3.50. The country along the Parsnip is generally level; the immediate banks of the river are, for the most part, low, but, in some places, rise to as much as eighty or one hundred feet, showing steep slopes, composed of sand, clay and gravel. For some ten or fifteen miles, midway between the mouths of Pack River and of Nation River, the channel is much cut up by islands, and "slews," or side channels. Most of these are dry at low water, and large timber jams generally occur where they branch off from the main stream. Where they again join the river they may often be mistaken for tributary streams, or, when coming up stream, for the main channel itself.

Country bordering the Parsnip River.

7th July.—Started at 7 a.m.; heavy dew; very fine and bright. Thermometer 60°. Soon after 11 o'clock we had made about fourteen miles, floating with the current, when we landed for our midday meal. Mr. Webster took observations for latitude, and I exposed two plates for views of the mountains to the north and north-east. At 12.45 p.m. we re-embarked, and, at 4.45, camped on a low gravel bench, directly opposite the mouth of Nation River. At several points on the river, passed this afternoon, rocks crop out; they are all of the same character: thin-bedded, bluish-grey, sandy limestone shales, much traversed by veins of calcspar, and dipping at high angles in various directions, but most frequently to southwest. The country around our

Camp at mouth of Nation River.

camp is low for a considerable distance. It rises from the river valleys by successive terraces or benches to about 350 feet, but the average level of the country is, probably, not more than 150 feet above the river, gradually rising, however, towards the mountains to the north. Much of it has a very desolate aspect, owing to the forest having been burnt, leaving leafless trees and bare white poles. The view facing page 70 was taken from this camp, looking up the valley of Nation River. To the south-east no hills are visible; to the south and south-west twenty to twenty-five miles distant, are the Nation River and Omineca Mountains; to the north and north-east the outlying spurs and foot-hills of the western slopes, as well as some of the higher peaks of the Rocky Mountains are visible. None of the latter are, probably, as much as 7,000 feet above the sea; on some of them the snow still lies in patches, but they are all below the permanent snow line.

View of the Nation River valley.

8*th July.*—Very fine and clear; heavy dew; thermometer, 56° at 6 a.m.; barometer, 28.28. While breakfast was preparing, I ascended one of the gravel terraces, about fifty feet above our camp, and took two photographs, looking up the valley opposite. Started at 7.55 a.m.; halted for an hour at noon; took observations for latitude and photograph of mountains, bearing east, 30° north. At 4.45 p.m. my sketch of the river showed a distance of about thirty-two miles from Nation River. Here we landed, on the left bank, and made our camp alongside a deserted hut, once inhabited by "Nigger Dan." It was a lovely spot; in front, the broad, swift-flowing river, on the opposite shore, fully 300 yards distant, a gently rising, wooded country; and, beyond, a magnificent view of rocky precipices and snowy peaks. "Nigger Dan," who, Butler says, is looked upon by the Indians "as something between a beaver and an American bear," had certainly shown very great taste in his selection of a site whereon to erect his dwelling; but, perhaps, the proximity of a rich "bar" had, in reality, more to do with the selection than the beauties of the surrounding landscape.

"Nigger Dan's" hut on the Parsnip.

Finlay Forks.

9*th July.*—Started at 7 a.m., and at 9.15 reached the Finlay Forks. A very swift, eddying current ran along the right bank of the Parsnip, and, to avoid this and reach the opposite shore, without being carried down the rapids below, we were obliged to go some distance up the right bank of the Finlay; we then crossed over and were swept rapidly down the left shore, when, rounding a sandy point at the angle formed by the two rivers, a few vigorous strokes of the paddle brought us into still water. We landed here, and Mr. Webster observed for latitude, while I took a photograph, looking north, or directly down the river towards the

Finlay Rapids, about a mile below. When we reached these, all hands had to go to work "portaging." At 5.30 p.m. everything was safely landed below the rapid. At the first carrying place we lifted the Nechacco and the canoe over the rocks, and the Indians ran the McLeod, lightened The whole rapid may be run easily, with good canoe-men, without any danger. It is barely half-a-mile in length, and now the river is nearly the same width, with plenty of water over the rocks. At 6.30 p.m. we camped on the left bank, about two miles below the rapids. Here Peace River enters the main chain of the Rocky Mountains, and commences the westerly course which it afterwards maintains through nearly five degrees of longitude, or to the confluence of Smoky River. The relative positions of the latter and the Finlay Rapids, according to our observations, are :—Smoky River Forks: longitude, 119° 6′ 45″ west; latitude, 56° 11′ 20″ north. Finlay Rapids: longitude, 124° west; latitude, 56° north. Sir Alexander Mackenzie's position for The Forks is longitude 117° 35′ 15″ west; latitude, 56° 9′ north.*

Finlay Rapids.

Difference in longitudes.

10th July.—This morning we decided, if possible, to ascend one of the high snowy peaks, which were now close in front of us. At each turn of the river we expected that the remarkable conical mountain, depicted in "The Wild North Land," page 271, would break upon our vision. In this, however, we were destined to be disappointed, and I can now state that no such mountain exists in any part of the Peace River Pass. At about four miles below our last camp, however, a turn in the river brought us quite close beneath one of the highest peaks, apparently rising almost perpendicularly from the river. After a critical survey of it from the opposite or right bank, I thought we could reach the summit; at all events I determined to attempt it, and we accordingly crossed to the left bank and selected our camp. For a considerable distance here, both sides of the river are thickly fringed with alder bushes, and before our tents could be pitched a good deal of clearing was necessary. It was too late for our ascent of the mountain, but in the afternoon, Mr. Macoun and I ascended a rocky spur a short distance in rear of our camp to reconoitre; we reached a height of 950 or 1,000 feet above the river. I took several bearings from this point, and was also able to determine the best route for our ascent the next day. This seemed to be up a leading ridge on the other side of the valley of a small brook, which entered the river about half a mile below our camp. We accordingly made our way across to this ridge, and on reaching the axis of it, I was surprised at finding what

The Rocky Mountains.

* See remarks on map of our route, page 31.

appeared to be a well worn Indian trail. A closer examination, however, showed that it was a path made by the Rocky Mountain Goat (*Aplocerus montana*), and I at once concluded that it would lead us by the easiest path to the highest summit of the mountain, and therefore determined to follow it on the morrow.

Rocky Mountain goat.

This has been the hottest day we have had this summer; at 4 p.m. the thermometer stood at 84° in the shade, and 74° in the tent at 9 p.m. For the first time mosquitoes are numerous and troublesome.

11th July.—After breakfast I called for volunteers to accompany Mr. Macoun and me up the mountain, and at about 8 a.m. we set out, steering through the dense forest in rear of our camp for the rocky spur on which we had found the trail the previous evening, and which ran down with a gradual slope to near the mouth of the small brook already mentioned. There had been considerable discussion in camp upon the probability of our being able to reach the summit; one of our party confidently asserting that it was quite impossible. So far as his own power of climbing was concerned, his opinion proved correct; as when we still had some 1,500 feet to ascend, he gave it up, and lay down to await our return, reiterating his opinion that none of us would ever reach the summit; and doubtless to persons unaccustomed to alpine climbing the undertaking might appear somewhat formidable. At about 2 p.m., however, we arrived there notwithstanding, and though it had cost us five and-a-half hours of continuous toil, we were amply repaid by the magnificent scene around us. We were now 4,590 feet above our camp, and about 6,220 feet above the sea. To the north the river lay directly beneath us, at probably less than three-quarters of a mile of horizontal distance, and beyond it, from north-west to north-east, stretching away for twenty or thirty miles, a perfect sea of alpine peaks and ridges. To the east and south a similar scene met the view, while to the south and west we looked into the valley of the small brook we crossed in the morning, and up to its source in an alpine lake; on the other side, and to the right of which, were the rocky peaks we had passed in full view on our left when descending the Parsnip. None of the summits appeared to differ much in height from that on which we stood. On all of them snow lay in patches, sometimes of several acres in extent, but no glaciers or permanent snow-peaks were to be seen. At similar elevations, two to three degrees further south, many of the highest points are permanently covered with snow, and extensive glaciers occupy the intervening valleys.

Ascent of "Mount Selwyn."

View from the summit.

Absence of glaciers.

emperature.

At 2 p.m., when we reached the summit, the thermometer registered

Photo Lith by the Burland Desbarats Co Montreal

From Photo. 22nd Sept. 1875.

MOUNT SELWYN, FROM OUR CAMP, 22ND OF SEPTEMBER, 1875.

82°, and at 4 p.m., a few hundred feet below, it stood at 84°. Wherever the snow had disappeared, the ground between the rocks was carpeted with a profusion of lovely alpine plants in full bloom, affording a rich harvest to my colleague, Mr. Macoun. The limit of trees was at about 4,000 feet, but a few scattered and dwarfed spruces, three to four feet high, were observed up to about 4,500 feet, above which neither trees nor shrubs of any kind were seen.

Lovely alpine flowers.

We had just returned to camp, when we were surprised to see a large canoe full of men poling up under the opposite bank. They turned out to be old acquaintances of Professor Macoun's, on his previous trip up Peace River; Mr. King, from St. John, and Charles Dumas, or "Charlette," post-master at Hudson's Hope, on their way to Fort McLeod for stores. They had killed a moose the day before, and were well supplied with fresh meat, but had been a long time without flour, and, as we had not tasted fresh meat since we left Quesnel, we were mutually well pleased to effect an exchange.

Unexpected acquaintances.

The outline sketch facing page 44, which was taken from our next camp, looking south, will afford some idea of the character of the peaks to the eastward of the one on which we stood.

12th July.—Mr. King left on his upward journey at 8 a.m., and at 9 we were under weigh. Before parting, Dumas had given us a letter of introduction to his wife, who was left in charge at Hudson's Hope, and in it had requested her to assist us in getting the horses which the Company keep there for the purpose of transporting their goods across the "Portage of the Mountain of Rocks," and which were now kindly placed at our disposal.

At about a mile and a half below our camp we passed the mouth of Barnard River, a large mountain torrent coming in from the north, and, a short distance further on, I landed and exposed a plate, in the hope of securing a view of the mountain we ascended yesterday, but the day was very unfavourable for photography—the thermometer at 80° in the shade, and a yellow haze pervading the atmosphere. We were now passing through the main chain of the Rocky Mountains, and, for the next ten miles, the summits on either side (4,000 feet above the water) are barely a couple of miles apart. Notwithstanding this, I do not think there is any serious impediment in any part of the pass to the construction of either a waggon road or a railway, especially along the right bank. The only really difficult portion is that immediately opposite, and for a short distance below the mouth of Barnard River. The view, page 42, is from a photograph taken on the 21st Sept., on the beach, 150 yards above the

Barnard River.

No difficulty in making road or railway through the pass.

View of Mount Selwyn.

mouth of Barnard River. When we passed down, in July, the steep, stony beach on the left was completely covered, and the water ran along the edge of the woods fifteen or twenty feet above where our boats are seen.

Fossils.

This afternoon we came to a small rapid where we thought it prudent to let the boats down with the line; this was accomplished without accident, and, at 4 p.m., we camped below it, on the left bank, having made about fifteen miles. The first fossils we had seen on the river were found this afternoon at the rapid, in pebbles of hard black shale. They had, apparently, not been moved far, and I wished, if possible, to find them in place. A short distance below our camp, a steep, rocky spur projected into the river. This I afterwards named Fossil Point, from the fact of the limestone which forms it holding a great variety of fossils, but, probably, of quite a different formation from those found at the rapid. Below our present camp the valley appears to open out considerably, a circumstance probably due to the change in the character of the rocks, and to their less disturbed condition, as we recede from the main range of mountains.

View from Fossil Point.

13*th July*.—This being, in every respect, a most interesting locality, I determined not to move camp. We accordingly devoted the day to geological and botanical work. A considerable collection both of fossils and plants was secured, and, as the hazy condition of the atmosphere precluded photography, I made an outline sketch, already mentioned, of the magnificent view of mountain peaks as seen from Fossil Point. The sketch was taken about 150 feet above the water, looking south up the valleys of two large streams, which join the river a short distance above our camp and less than a mile apart. One of these is known as Clear Water River; the name of the other, if it has one, was not ascertained.

Rapide-qui-ne-parle-pas.

14*th July*.—Start at 6.30 a.m.; at 9 we reached the upper end of the Rapide-qui-ne-parle-pas, why so called is not obvious, as the noise of its water can be heard very distinctly and for a long distance. As we had no good canoe-men, or any one in the party who knew the rapid, I thought it best to avoid all risk by letting our boats down along shore with the line. At noon we reached the Na-bes-che, or Big Horn River, about eight miles from Fossil Point, and, as there appeared to be a heavy thunder storm coming on, we landed, and camped on a low flat at its mouth. The afternoon was spent in fishing and in repairing the "Nechacco," the canvas having got a little cut on the rocks when

Otter-tail River.

descending the rapids. The Na-bes-che (Indian for Otter-tail River) is now about seventy or eighty feet wide, with a rapid current of clear water, about eighteen inches or two feet deep. Some fine Arctic trout were caught here. About 3 o'clock it commenced to rain and continued till 8 p.m., accompanied by heavy thunder. This is the first rain we have had since we left McLeod's Lake.

15th July.—This morning the mountains are all shrouded in mist. Embarked at 9.30 and made about eight miles, when we landed for lunch on a rocky point of sandstone. The view, page 75, looking up the river, is from a photograph taken at this point. The mountains were still covered with fog, and are, consequently, not seen in the picture. The valley has now widened out, and broad flats rise in terraces from the margin of the river and extend back to the foot of the hills on either side; to the south these are for the most part thickly wooded with spruce, poplar and birch, while, to the north, they are well grassed and almost bare of trees, the flats are all thickly wooded with small aspen poplar. At 2.40 p.m. we continued our voyage down the river with a very strong current, which carried us along at not much less than five miles an hour. Two considerable streams were passed to-day, coming in nearly opposite each other; and at 5 p.m. we camped on the left bank, opposite a considerable outcrop of rocks, which I proposed to examine next morning. Our run to-day has been about nineteen miles. Flats and terraces.

16th July.—This morning I crossed the river and examined the rocks; they were all massive-bedded, dark grey, very calcareous sandstones, through which fossils were sparingly distributed. The dip was to the east at 30° to 40°. At 7.40 a.m. we proceeded on our journey, and at 12.30 reached the portage. We landed at Cust's House; (see map) here the banks are about forty feet high and very steep, of sand and gravel; about three-quarters of a mile lower down there is a much better landing and camping place; had we known of this, it would have saved us the heavy work, which we had now to do, carrying everything to our camp on the top of the cliff with the thermometer at 84°. Reach the portage.

17th July.—At 5.15 a.m. I started with Morice to walk to the other end of the portage. At 9.50 we reached the edge of the upper terrace, overlooking the "Hope of Hudson," situated on a small flat on the opposite side of the river, and some 600 feet beneath where we stood. On the bank of the river we found a small canoe, in which we crossed to the Post; our arrival created considerable excitement amongst the Indian women, children and dogs, who were the only occupants. Morice, however, explained our business, and we learnt that the men were all away hunting, that there was nothing to eat at the post, and that Mrs. Hudson's Hope.

Dumas, to whom our letter was addressed, was on the other side of the river setting snares for rabbits, on which they had to depend for subistence till the hunters returned. On our way across I shot four partridges, and when Mrs. Dumas returned she set to work to cook these for our dinner. They were not plucked, that being too tedious an operation, but skinned, cut into quarters and fried with moose fat and a few onions. While we were satisfying our hunger on this savory dish, some of the children had gone into the woods and driven in four horses; the "rigging," a curious combination of wood, raw moose leather, buffalo skins and old blanket, together making up the pack-saddles, was hunted up and placed in the canoe; the horses were then led down to the river and with the aid of sticks, stones and yells, made to swim to the opposite shore, we following them in the canoe. A short time was occupied in saddling them, and we then started on our return, reaching our camp at the other side at 6 p.m. During the day the rest of the party had been busily employed. Professor Macoun, accompanied by one of the men, had ascended and explored the Horse-head, Bull-head, or Buffalo's-head mountain;* Mr. Webster had taken observations for latitude and variation, and explored the entrance to the cañon a mile and-a-half below our camp; while the others had taken apart and packed the "Nechacco," hauled up and "cached" the "McLeod" and the canoe, and carried the remainder of our stores to the top of the cliff. It has been very hot and hazy all day, thermometer 72° in the shade; large horse-flies very numerous and troublesome; I had the horses all tethered before dark to prevent them straying into the woods.

Scarcity of food.

Return with the pack-horses.

18*th July*—At 7.30 a.m., McLennan, Hillier, Ahquon and Morice started with the four horses packed, for the other side of the portage. To take all our cargo across two or three more trips will be required. Busy all morning drying plants, ticketing and packing specimens and sorting and packing stores to be left at Hudson's Hope for our return trip. In the afternoon I examined the rocks at the cañon. At 6.30 p.m. the men returned with the pack horses; I had always been under the impression that this cañon was a part, indeed the principal part, of the cut or gap through the Rocky Mountains, whereas I now find it can scarcely be considered to be either physically geologically, or orographically connected with them. The name, moreover, has hitherto been incorrectly given, and hence, perhaps, the erroneous impression respecting it. It should be "The

The Canon of the Mountain of Rocks.

* See "Wild North Land," Capt. Butler, pages 243 and 244.

Cañon of the Mountain of Rocks," * referring to the entirely isolated rocky hill, which I have named Portage Mountain, and the base of which forms the cañon, and in no way to the *Rocky Mountains*, which are some thirty or forty miles to the westward.

19th July, (5 a.m., thermometer 48.°)—It is so hazy this morning that we cannot see the mountains in any direction, not even those two to three miles distant. The horses have strayed during the night; sent the Indians out to look for them. At 8 a.m. they returned with the horses, and at 9.30 started to cross the portage with the second load. In the afternoon I went down to the cañon and took two photographs. Mr. Webster started with Morice to walk round the cañon to Hudson's Hope. There are great numbers of rabbits here, but the grass is so long it is impossible to shoot them; at dusk I shot a porcupine. Men and horses returned at 10.30 p.m. Mountains hidden by haze.

20th July, (9.15 a.m.)—Horses loaded and ready to start. Breakfasted on porcupine. Very hot and hazy all day. At 3 p.m. Mr. King arrived from Fort McLeod with two canoe loads of goods; one canoe he sent adrift down the cañon on the chance of it being carried safely to Hudson's Hope. The men and horses did not get back this evening. Arrival of Mr. King from Fort McLeod.

21st. July.—Pack train in at 6 a.m. At 9.15 we started on our last trip all hands accompanying the train. Mr. King has yet to bring his stores over. The trail, as laid down on my map, is from the paced measurements which I made of it to-day, showing it to be 11.81 miles from the top of the first terrace, about a quarter of a mile from Cust's house to the stock-yard on the hill opposite the post. At 5 p.m. we had everything across the river and our tents pitched between the houses at Hudson's Hope; Mr. Webster and Morice had arrived at 6 a.m., having passed two rather uncomfortable nights in the woods. The distance round the cañon Mr. Webster estimates at about twenty-five miles. My barometer readings make the highest point of the portage trail 901.9 feet above Hudson's Hope, and 631 feet above the river at Cust's House, giving a fall of 270 feet from the upper to the lower end of the cañon. The average readings in July at Cust's House, give 1,534 feet above sea; the average readings at Hudson's Hope give 1,262 feet above sea, which would show a fall in the cañon of 272 feet, or two feet more than by the previous calculation. Length of the canon. Elevations.

The average of eight readings in July—17th to 24th - at Hudson's Hope, gave 28.79, and the average of twelve readings there between the 9th and 15th of September, gave 28.78.

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* Sir Alexander Mackenzie, page 392 of his Voyages, speaking of this portage, says: "We soon after came to the carrying place called the Portage de la Montagne de Roches, latitude 56. 35 51 north."

Arrangements for continuing our journey.

22nd. July.—Arrangements had now to be made for our further progress down the river, and for our contemplated exploration of Pine River Pass. There were no canoes or boats available at Hudson's Hope, and we only had the "Nechacco." After consultation with Mr. King, it was decided to construct a large raft, which, with the "Nechacco," would carry every thing, both Mr. King's stores and ours, as far as Fort St. John, where we should have to build a good canoe for our trip up Pine River, and down to Smoky River. I was occupied to-day plotting my traverse of the portage, and examining the sections of the rocks in the creek above the Post and up the river towards the foot of the rapids, McClennan and Anderson putting the "Nechacco" together.

23rd. July.—Charles Dumas (Charlette) went over the portage yesterday and brought a load of goods back, arriving about midnight. He had no pack-saddle, and he had been searching for the horses and without food since the morning; Anderson, with Morice and Ahquon, making poling-sticks, finishing the "Nechacco" and repairing tents; McClennan with Baptiste Lafleur, at work at the raft on an island half-a-mile down the river. To-day a heavy rain storm passed to the southward, only a few drops fell here. Charlette cultivates a small garden, and vegetables of all kinds grow splendidly. He has potatoes, carrots, parsnips, onions, turnips, french-beans, beets and barley. These were all planted or sown between the 15th and 24th of May. The potatoes, turnips and onions are already a fair size and fit for use. Wheat has not yet reached this part of Peace River, but would doubtless give an excellent crop.

Fine vegetables.

24th July.—After breakfast I started in a small canoe with Ahquon and Morice, to examine the rocks up the river. In trying to pole up the first rapid, which occurs at the mouth of the small creek, immediately above the post, they upset the canoe in quite shallow water. I was rolled out but held on to the canoe. They let go and scrambled to the shore, yelling and vociferating, but doing nothing more effective to prevent myself and the canoe being carried down the stream, which we accordingly were; after rolling over once or twice in the current, still holding on to the canoe, which was now bottom up, I managed to get astride of it, and then had time to contemplate the situation, which was not altogether an agreable one. A due regard for note-book, watch, barometer and compass, which were in my pockets, prevented my attempting to swim ashore. Where I was I could just manage to keep them from further wetting, provided the canoe, a round-bottomed dug-out, did not take another roll, and to prevent this, the most careful balancing on my part was needed. There was now great excitement on shore, in which women,

Capsized in the rapid.

children and dogs participated, and they seemed to vie with each other in making as much noise as possible, but no one knew what to do. The canoe had now reached an eddy where it was quietly turning round without being carried down, when some Indian lads who had a small canoe on the opposite side of the river, paddled off to my assistance and towed me to the bank. I had been nearly a quarter of an hour in the water, and felt rather numbed, but otherwise had suffered no inconvenience or alarm, except on account of my note-book and instruments, which, however, after carefully drying them, I was very pleased to find had not been seriously injured. A good geological hammer was the only loss, and this was, I believe, found by Charlette in the fall, when a dry boulder-covered beach replaced the foaming rapid of the summer. In the afternoon I disharged Ahquon and Morice, as it was quite plain from our experience this morning of their skill in poling up swift water, that they would be no use for the work which we had before us. We were very anxious, however, to secure the services of some experienced canoeman, who was acquainted with Pine River. An Indian named Mastie, who was now at the post, was just the man we required. After a great deal of talk and all the customary Indian excuses having been made and overcome, Mr. King succeeded in persuading him to accompany us, and he also kindly arranged to send with us one of his own men from Fort St. John, an experienced old Half-breed hunter and *voyageur* named Luizon. So far everything appeared satisfactory, and our raft being completed, we prepared to start on the following day. Discharge Ahquon and Morice.

25th July.—This morning Mastie does not want to accompany us to St. John, but to go overland with his family to Pine River, where he says he will meet us. This we all thought was only a fresh excuse, and both Mr. King and Charlette used every argument to induce him to accompany us to-day, but to no purpose. Having loaded the raft and put some light baggage in the "Nechacco," we embarked at 2.30 p.m., Luizon with his wife and small boy in a canoe, Mr. Webster and Hillier in the "Nechacco," and the rest of the party, Mr. King, Professor Macoun and self, with McClennan and Anderson on the raft. Later we lashed the "Nechacco" alongside the raft, and both were carried swiftly along by the current, Hillier and Anderson assisting occasionally with the oars. At 7 p.m. we camped on the left bank, half a mile below the mouth of Middle River, nineteen miles from Hudson's Hope. In 1872, Mr. Horetzky travelled from St. John to Hudson's Hope by the trail on the north side of the river, and calls it twenty-two miles from Middle River to Hudson's Hope. He says Middle River was then (21st of October) sixty yards wide, with an Leave Hudson's Hope for St. John. Middle River.

average depth of five feet. We did not see it either on our downward or upward journey; where it joins the Peace the main channel is near the opposite side, and a rather large wooded island stands right in front of the entrance. I shall here quote Mr. Horetzky's description of the country between Middle River and the portage.

Mr. Horetzky's description of the country.

"Between the Middle River and the portage we crossed several deep ravines, the outlets of small rivers flowing into the main one. The trail, though rough in occasional spots, carried us over a very fine country, where the excellent soil and large tracts of fine land facing the south would offer great facilities for farming. There was, however, a scarcity of wood, but the southern banks and the numerous islands being covered with dense forest, afford unlimited quantities of that material for both fuel and manufacturing purposes."

26th July.—We were under way at half-past five this morning, and at 11 a.m. landed at Fort St. John, nineteen miles from our last night's camp, or thirty-seven miles from the portage. The general character of the valley is very uniform; on the south side the hills are thickly wooded, on the north they present alternating patches of prairie and coppice of aspen, poplar, willow and other shrubs, and they rise either abruptly or in broken slopes and steps to from 600 to 800 feet above the river. These broken slopes commence at about four miles below Hudson's Hope.

Land slides.

They are evidently the result of the successive slides which have taken place in the soft clay shales that here form the banks. The broad terraces of sand and gravel which form such a marked feature at and above the portage are no longer seen, or occur in such a modified form as to be scarcely noticed.

"Nigger Dan."

Shortly after our arrival at St. John we were introduced to the renowned Daniel Williams, commonly known as "Nigger Dan." In the afternoon I took two photographs looking down the river, and taking in the Hudson Bay houses and Dan's hut, and afterwards climbed to a high point in rear of the post, nearly on a level with the table land, the height by barometer being 639 feet above the river.

27th July.—A canoe had now to be built for our trip up Pine River, and this morning, McClennan with Baptiste Lafleur and Luizon, went down to an island about two miles below the post, to seek for a large cottonwood tree for the purpose.

Little Lake.

Mr. King and I rode out to a small lake known as Little Lake (see map), about seven miles to the north-west, on the table land. This lake is one of the sources of Pine River North, which joins the Peace about thirteen miles further down, at the site of the old Fort St. John. After rising 724 feet we came upon a fine level or slightly undulating country, covered with the richest herbage, of astonishing luxuriance; I have seen nothing in the Saskatchewan region that at all equals it—both the soil and the climate here are better; the former a rich loam, resting on gravel and sand, underlaid by the dark shales of the Cretaceous formation. There was no rock at the surface on the south side of the Lake, but numbers of large, angular blocks of hard, dark-coloured, fine-grained sandstone, with others of quartzite lay along the shore, while, at one or two points on the opposite side, there were low bluffs of brown sandstone, with rounded and thickly-wooded hills at the back. Mr. King states that fine fish are sometimes caught here. Suckers of one to two pounds weight, abundant; white-fish of about the same size, and a few pike. Bear and moose abound here. Fine country. Game.

Similar fine country extends for many miles both up and down the river. Professor Macoun and Anderson walked to the nearest point of Pine River North, and passed the whole distance, seven to eight miles, through similar country.

Mr. Webster's observations to-day make the latitude 56° 12′ 24″ north, and the variation, 26° 34′, east.

28th July.—6 a.m.—Barometer, 28.95; thermometer, 58°; cloudy, with showers since 10 p.m. last evening. Examined the cliffs about a mile below the post and found numerous fossils: inoceramus, large ammonites and other Cretaceous forms. McClennan reports the canoe nearly finished. Fossils.

29th July.—This morning, Professor Macoun, with McLennan, Hillier and Anderson went down to help Baptiste and Luizon get the canoe out of the woods and launch her; they then brought her up to the post. It will take another day to finish her. She is 36 ft. 3 in. long, 2 ft. 3½ in. beam amidships, and 1 ft. 5 in. deep. A band of Beaver Indians came into the post to-day. They brought eighteen bear and a few beaver skins, but no fresh meat. Having completed their trade, they started about dusk, all riding, for their hunting ground on Pine River North. A heavy shower of rain fell to-day, lasting about a quarter of an hour. Launch the "St. John."

30th July.—Ascended a high point below the post, took a round of bearings and added to topographical sketch. After lunch, broke up the Hudson Hope raft, the ropes we lashed it with being now required for tracking lines; carried the "Nechacco" up to the store, where she was to be left till our return; took photograph of the cliffs at "Ammonite Bend," and collected more fossils. This evening the last finishing touches were put to the canoe, the poles and paddles made, the tracking-lines fitted, and everything prepared for a start to-morrow. As we could only take one canoe on our Pine River trip, it became necessary to reduce the number of our party to six persons. I therefore arranged that Mr. Webster should accompany me, with McClennan, Hillier and Luizon, and we hoped, but scarcely expected to meet Mastie on Pine River at the place appointed. Luizon was well acquainted with the lower portion of the River, but had never been on the higher part towards the head of the Pass, and for the navigation of this we were dependent on Mastie. Professor Macoun was to accompany Mr. King, who proposed to start in a day or two for Dunvegan and Vermillion, to meet the boats bringing up the "outfit" for the trading posts on Peace River. Mr. Macoun was to return with them and rejoin us, either at Dunvegan or The Fork. Anderson was to remain at St. John till we returned there, look after the stores, &c., and collect fossils.

Party for Pine River.

31*st July*.—At 8.55 a.m. we pushed the "St. John" into the current, and glided down the stream. At 9.55, having made about four miles, entered the mouth of Pine River and encountered a strong current, against which we have to win every mile of our way by unremitting labour with pole and track-line. The average width of the lower part of Pine River is not much less than 100 yards, gradually narrowing, till, at the highest point we reached, the width is not more than fifty or sixty yards. The rate of the current is, probably, from three to five miles an hour. The valley, between the table-land on either side, is from a mile to a mile-and-a-half wide. There are, here and there, patches of open prairie land, but generally both banks are pretty thickly wooded, the prairie occurring, as on Peace River, at the east and west bends on the slopes facing southwards. As the course of the river is laid down on the accompanying map, with numerous descriptive notes of the features presented by the banks, it will not be necessary to enter into further detail respecting them here. At 5.45 p.m. we camped on the left bank. On the other side of the river a small brook descended from between two thickly-wooded hills, the summits of which were capped with thick, horizontal beds of brown sandstone, forming a rocky escarpment above the woods. We had only made about nine miles with six hours continuous exertion.

Character of Pine River.

1*st August*.—To-day we started at 5.30 a.m., halted one hour for lunch, and camped at 7 p.m., the distance made being fourteen and a quarter miles.

2*nd August*.—Eleven hours poling and tracking—5.37 a.m. to 5.15 p.m.—distance about seventeen miles.

3*rd August*.—Started at 5.45 a.m. This morning, about two miles above our camp, we came to the Hudson Hope trail, where Mastie ought to have met us, but there was no sign of him, nor could we find any recent tracks along the banks. About four miles further up we came to a large camp of Indians, but, on enquiry, Mastie was not amongst them. They had nine pine-bark canoes, representing, I imagine, the same number of families, and the usual number of women, children and dogs. A moose had been killed the previous evening, and they were having a great feast. Luizon had a long consultation, which, of course, we could not understand, but the result—so he told us—was that they all said we could not ascend the river any further in our canoes—at least not higher than the Forks, which were about three miles above where we then were. Luizon was getting discontented, and evidently did not like to go any further without Mastie, and none of the other Indians were willing to accompany us. I determined, however, to go up to the Forks, and as much further as circumstances permitted. Mr. Webster's observations here make the latitude 55° 46′ 12″, north. Starting again at 12.45, we reached the Forks at 4 p.m., and camped a short distance above, on the right bank of the west branch. After camping, I ascended to the upper terrace, about 400 feet above the river. From this point the upward course of the valley appears to be about south-west magnetic, through the plateau. No high mountains are visible in any direction. The east branch valley trends south-easterly, but the view up it from this side is limited to some seven or eight miles ; the two branches do not differ much in size. I thought the east branch rather the largest.

Indians.

East branch of Pine River.

4th August.—This morning I had great difficulty in persuading old Luizon to go any further. However, we eventually started, tracking along the bank, and by noon had made about three-and-a-half miles. The river had narrowed considerably, and ahead there seemed to be a long rapid issuing from a rocky cañon, which both Luizon and the men seemed unwilling to encounter. We, therefore, camped here, and after lunch Luizon was to walk up and examine the river to ascertain whether it would be possible to go further. I ascended the terrace at the back of the camp, took a photograph of Table Mountain, and spent the rest of the day exploring a deep rocky gorge, by which a small brook entered the river half-a-mile above our camp. I here found four seams of good bright coal, in about ninety feet of alternating beds of sandstone and shale. These coal seams in descending order are six inches, eight inches, two feet, and six inches thick. A number of fossils were collected in the associated beds, leaf impressions and shells. The former occur

Four seams of coal.

chiefly in the beds below the coal seams, and the latter in the intervening sandy shales, and in the ferruginous and calcareous concretionary nodules which accompany the latter. This evening Luizon shakes his head and says, in a very decided manner:—"Ce n'est pas capable," which means that he has no intention of attempting the further ascent of the river, and I fear we shall have to give up the idea of reaching the watershed to the Parsnip. If we had had a light pine-bark canoe, instead of our heavy cottonwood "*dug-out*," and a couple of experienced *voyageurs*, we might probably have accomplished this without much difficulty; but, under existing circumstances, it was impossible to do so, and the attempt had to be abandoned. I was, however, very anxious to obtain as extensive a view as possible over the country in that direction, and I, therefore, determined to devote the following day to ascending the Table-topped Mountain, which I judged to be distant from our camp from four to five miles. The indicated barometric height of our present camp is 1382.25 feet above sea-level, giving a rise from Fort St. John of 228 feet.

Luizon refuses to proceed.

5th August.—Very heavy dew; thick fog along the river at five a.m.; thermometer, 50°; 6.30, fog cleared off; 7.45, started with Mr. Webster and McClennan to walk to Table Mountain. At one p.m. we reached the top, after climbing the last 200 feet up a steep rocky escarpment formed by the outcropping edges of the massive horizontal beds of sandstone, of which the mountain is composed. The barometer indicated an elevation of 3,400 feet. The view was truly magnificent, embracing an uninterrupted circuit from north-east, round by west, to south and south-east. To the right the peaks at the gorge of Peace River were easily recognized; in front, and far more distant across a wide intervening, low, hilly country, came the snow-clad heights of the Omineca Mountains, which we had seen, far to the westward, when descending the Parsnip; turning still more to the left, the view was up what appeared to be a broad open valley, on the other side and towards the upper end of which the mountains again commenced to rise in snowy peaks, succeeding each other till they were lost to view in the dim distance. The bearing of these latter, according to my notes, places them nearly magnetic south from Table Mountain, and there is no doubt that they are the peaks of the Cascade Mountains near the head-waters of the Homatheo and the Bella Coola Rivers; and thus the Rocky Mountains, in this latitude exist only as a broad undulating and hilly watershed between the Parsnip and Pine Rivers.

Ascent of Table Mountain.

View of the Cascade Mountains.

6th August.—Six a.m., heavy dew, no clouds; thermometer, 44°;

PHOTO LITH. BY THE BURLAND DESBARATS CO MONTREAL.

TABLE MOUNTAIN AND PINE RIVER PASS, LOOKING WEST.

this is the coldest morning we have had. After breakfast I ascended to a high point of the terrace overlooking "Coal Creek," and took two photographs looking up the valley, and one looking down and across it. The view opposite is copied from the former, and affords a fair idea of the general character of the country. At 9.10 a.m. we set out on our return, and reached Peace River at 2.10 p.m. the next day. To accomplish the ascent had occupied thirty-eight and-a-half hours, and the descent was made in thirteen hours and three-quarters, without the slightest exertion. Between the mouth of Pine River and St. John, where we arrived at six p.m., we were drenched to the skin by a heavy thunder storm, only a few drops of which had fallen at the post less than two miles above. Professor Macoun and Mr. King had left for Dunvegan on the fourth. Return to St. John.

8th August.—Making preparations to continue our journey down the river to-morrow. Nigger Dan supplied us with fine young potatoes from his garden; also turnips. He has a small patch of barley, which is now quite ripe, and the grain large and full; raspberries and service-berries ripe and abundant.

9th August.—This morning we again launched the "Nechacco;" Hillier and Anderson embarked in her, and the "St. John" carried me, with Mr. Webster and McClennan. At five p.m. on the 11th we reached Dunvegan, having been actually under way about twenty-three hours; the distance, according to our estimate, is seventy miles, and the average fall 1.13 feet per mile. With the exception of having generally greater width, and there being more country of an open prairie character on the north or left bank, this section of the valley does not materially differ from that above St. John. The trail, by which Messrs. Macoun and Horetzky travelled in 1872, runs on the south side. They travelled three days through a beautiful country, and crossed four considerable streams besides Pine River, the valleys of which, at the crossings, were from 220 to 280 feet below the plain. Mr. Horetzky says:—"Some of the country along the route was really very fine, partly prairie and partly dense timber; the timbered portion was, generally speaking, rough. The soil in every instance was excellent, and vegetation vigorous. Fine poplar, spruce and birch in profusion. All this country is fit for settlement." I must, however, differ from Mr. Horetzky as regards the character of the country between Pine River and the portage, of which he says:—"From this point up to the portage the right bank of the Peace is very high, rough and densely wooded. This piece of country would present very serious engineering difficulties to any road approaching the Start for Dunvegan. Character of the country below St. John.

Peace River Valley Pass from the east." Looking over this country from the hills behind St. John, and again from the summit of Table Mountain, and from the ridge above Moberly's Lake, it does not appear to exceed the average level of the plain, and I think it is by no means improbable that by following the valley of Moberly's Lake River, a comparatively easy line might be found in an almost direct course to the Parsnip, coming out near the mouth of Pack River. I quite concur with Mr. Horetzky in supposing that the "Rocky Mountains" can probably be crossed on this route, at an elevation not exceeding 2,500 feet; and the geological structure of the country would make it likely that the roughest portion of the route would be on the western flank descending to the valley of the Parsnip.

Route to the Parsnip by Moberly's Lake.

At Dunvegan we learnt that Mr. Ross, the officer in charge, had gone down the river to meet the boats coming up with the "out-fit." Mr. King and Professor Macoun had also gone on, down the river; when they would be able to get back was quite uncertain. The boats were not expected before the end of August, and might be much later. The next four days were passed at Dunvegan, examining the cliffs and sections up and down the river, and collecting fossils, and inking-in field notes. On the fifteenth I decided to start the following morning for the Fork, or the junction of Smoky River, and if I could procure a guide there, make a short exploration up the latter, at least as far as the *bocannes* or smokes, from which the river derives its name, and where I fully anticipated finding large coal seams on fire.

Danvegan to "The Fork."

16th August.—Started at 8 a.m, Mr. Barasois steering the canoe. The rocks exposed along the banks below Dunvegan are nearly all brown and grey thick-bedded freestones and sandy shales; numerous ammonites and other fossils were found loose; they are probably derived from the rocks which crop in the adjacent banks. We camped at 5.15 p.m., having had some trouble in finding a good place, owing to the height and steepness of the banks, which, for long distances here, are composed of coarse gravel drift with sand layers, while, in some places, the underlying dark grey shales, with ironstone bands, crop out and form some five or six feet of the lower part. The gravel banks are sections of the terrace deposits which form so conspicuous a feature of the valleys throughout the region, and on both sides of the axis of the Rocky Mountains. About one mile above our camp we passed a large number of Indian lodges; they belonged to a party of Crees and Half-breeds who had come here, from Edmonton and Jasper House, to hunt and pick berries. This, we learnt, they are in the habit of doing every summer, and that

Indians from Jasper House.

there is a good horse trail all the way to Jasper House, by which they can reach the latter in about ten days. Except at the crossings of the rivers, the country is stated to be level throughout and lightly timbered. Trail from Peace River to Jasper House.

17*th August*.—Started at 6.03 a.m., and, at 9.50 a.m., landed at the Hudson Bay house, situated on the left bank, about two miles above the mouth of Smoky River. The whole establishment consists of one small house and an Indian lodge. The bank of the river, about thirty-five to forty feet high, is composed of coarse rounded gravel and sand, and slopes to the waters edge at an angle of forty-five or fifty degrees. From the top of the bank an almost level and well-grassed plain extends back about 250 yards to the base of a series of rounded, grassy hills, which at first rise steeply to 500 or 600 feet above the river, and then stretch away in a vast, rolling prairie, dotted with groves of spruce and poplar, and thickets of willow, service-berry, wild cherry and other shrubs. These often surround swampy pools and lakelets, which occur in almost all the larger valleys and depressions, and teem with a variety of wild fowl, while, on the open hills and flats, prairie chicken are abundant. Looking across the river to the south and south-east, the general outline and elevation of the country does not differ from that on the north side, but in place of open, grassy hills and lightly-wooded dells, an uniformly and apparently pretty thickly-wooded country extends on all sides as far as the eye can reach. The main channel of the river at The Fork is from 400 to 500 yards wide ; towards the right bank there are a number of sand banks and several considerable islands. The current is strong, and runs at not less than three-and-a-half or four miles an hour. Ducks and prairie chicken abundant.

Yesterday and to-day have been the hottest days we have experienced, the thermometer having reached 92° and 94° in the shade. For a considerable time we have not seen any mosquitoes, and even at our last night's camp, fifteen miles up the river, there were none, while here they are in myriads and very troublesome, giving us no peace by day or by night. High temperature.

18*th August*.—5.30 a.m.—Thermometer, 61°. After breakfast I rode to a high, grassy hill, about six miles from camp and two miles below the junction of Smoky River. A fine view was obtained here, the elevation being 555 feet above the Hudson Bay house ; the thermometer marked 73° at 9 a.m., on the summit. This afternoon, as we were very short of provisions and could get no meat at the post,—where the people were subsisting on a mixture of dried berries and bears grease—I went out shooting, and, in an hour or two, returned with ten ducks and one Scarcity of provisions.

prairie chicken, a welcome addition to our larder. This afternoon I arranged to make a trip up Smoky River, having secured the services of Joe Grey, an experienced old Half-breed *voyageur*, and borrowed a light canoe from Mr. McKay, in charge of the Hudson Bay house.

Smoky River.

19*th August.*—Started at 6.45 a.m. with Mr. Webster and Grey; we had not gone far when we found that our canoe was very leaky, and at mid-day some time was spent in seeking and applying gum to the cracks. At 5.30 p.m. we had ascended about fourteen miles, the general course, very nearly magnetic south. Our camp was on the left bank, about one mile above one of the *bocannes* or smokes already referred to; several extinct ones had been passed lower down. I always supposed, and it has, I believe, been generally stated, that these smokes are due to beds of lignite or coal on fire; such, however, does not appear to be the case, as neither coal nor lignite are to be seen. The banks are high and steep and the strata well exposed in the great slides which have taken place in the soft dark-grey or black shales of which they are chiefly composed. Where the fires have burnt out, the cliffs present a variety of shades of red, yellow and white, and where the smoke or vapour is still issuing from the ground there are large patches, which at a distance look like snow and sulphur; dead white and brilliant yellow.

Deposits at the *bocannes*.

Further investigation is required to determine the cause of the spontaneous combustion of these shales; they do not apparently contain much pyrites. Along the margin of the river and in the *battures* are large angular blocks of sandstone; also many of large size of granitic and gneissoid rocks, among which a red orthoclase granite is very prevalent. This, I conceive, indicates that some of the sources of Smoky River are in the main chain of the Rocky Mountains. On Pine River granitic pebbles are rare, and large granite blocks are not seen at all; its sources are in the country occupied by the flat sandstones and shales of the newer formations.

20*th August.*—Started at 6 a.m., barometer 29.12; thermometer 59°, thick fog. By eleven a.m. we had progressed about eight miles, and the river had now narrowed very much, with constant short rapids. We had come about twenty-five miles, and according to the barometer we were ninety-nine feet higher than at "The Fork," showing a rise of 3·9 feet per mile. We camped here, and during the afternoon I ascended to the plateau opposite, whence I could see some fifteen or twenty miles up the river valley, the general course being south 25° east to where the valley appeared to branch, and on all sides there was a perfectly level horizon of forest country. The elevation of the plateau above the river is 600 feet;

the river is not as wide at low water as Pine River, but the rise and fall are probably much greater, twenty to thirty feet. The valley from one plateau to the other is nearly two miles wide, the ascent from the river being over a series of great slides, which have formed a very rugged surface of hills and basins, and trough-shaped hollows enclosing small lakes and pools; the drainage from the plateau finds its way into these, and does not reach the river except by percolation through the slides; the water is hard and has an alkaline taste. The strata are nearly all soft, dark-blue and grey shales, with a few beds of sandstone, the shales are everywhere gypsiferous.

Character of the banks of Smoky River.

21*st August*.—Started at 6.17 a.m. on our return, and at 10.30 we reached The Fork, running down in a little more than four hours the distance that had taken fifteen hours of hard labour to ascend. Joe Grey is a fine specimen of the old Hudson Bay *voyageur*, and a splendid canoe-man; he is, he says, eighty-seven years of age, but does not look more than sixty.

Joe Grey.

22*nd August*.—The Hudson Bay boats, by which we hoped to be able to return up the river, not having arrived, and it being uncertain when they would do so, I thought it best not to wait for them, but to commence our return journey in our own canoe. The "Nechacco" was therefore taken to pieces and packed in three parcels, to come up with the barges, and a note left requesting Professor Macoun to take charge of them. The rest of our baggage was reduced to the smallest possible compass, and everything prepared for a start on the following morning. It has been very hot during the whole of our stay at The Fork, and to-day, at 3.45 p.m., the thermometer showed 92° in the shade, and the mosquitoes are as thick as a swarm of bees. As we had now nothing but very poor dried moose meat, Mr. Webster and I spent a portion of the day on the hills with our guns. I brought in nine ducks and Mr. Webster a similar number of prairie chicken. The people at the Hudson Bay post are living on dried berries and bears' grease, and have neither flour, tea nor sugar.

23*rd August*.—This morning at seven a.m. we started on our upward journey, Mr. Webster and myself walking on the trail inland, and the three men tracking and poling along the shore. At 4.15 p.m. we reached our camp of the sixteenth of August, my pedometer indicating nineteen miles; this, however, includes several deviations from the trail. The country is mostly level, and all fine prairie land, the width from the river bank to the foot of the hills being from one-quarter to three-quarters of a mile. The mosquitoes do not extend more than five or six miles above The Fork, and at this camp we are quite free from them.

Return to Dunvegan.

24th *August*.—A little rain with thunder last night; five a.m., thermometer, 62°. At 5.45 I started walking along the shore, the men followed at six a.m., tracking the canoe. At 4.45 p.m. we camped on the left bank, about two miles below Burnt River. We passed two Indian camps this morning. They complain very much of having nothing to eat. They kill bears occasionally; these and berries form their chief food. They are all Crees and Half-breeds, from Edmonton and Jasper House. The Beaver and Sikinny Indians do not go below Dunvegan. The poire, and a kind of chokecherry, called "grappes" by the Half-breeds, are very abundant and very large on the hills between Dunvegan and Smoky River, but only on the southern aspects. The Indians collect large quantities of these berries; they pound up the cherries, stones and all, and make cakes of them, which are dried in the sun, and either eaten fresh or stored for winter use; the kernels in the cherries give a pleasant taste of bitter almonds. Close below our camp there are large blocks of grey and brown sandstone, fallen from the hills above; they are full of fossils—Inoceramus and two other shells—the latter very abundant. Just below the Burnt River group of islands, (see map) the country immediately on the borders of the river is lower, the sandstones disappear, and thence to The Fork only the dark shales are seen. I collected a good many fossils to-day, among them a large shell, probably an Inoceramus; and from the shales two specimens, showing the remains of a small fish; fish scales are plentiful. Thermometer, 70° at 6.30 p.m.

Indian camps.

Berries abundant.

Fossils.

25*th August*.—Started at six a.m.; thermometer, 55°; walked along the shore to Dunvegan, arriving there at 4.48 p.m. The men arrived with the canoe three hours later. The distance following the shore is probably not less than twenty-one miles. The tracking was unusually heavy, owing to a strong westerly wind blowing all day. At the post Mr. Barrasois regaled us with a good supper of fresh moose steak.

26*th August*.—Remained at Dunvegan, occupied writing notes and packing specimens, to be sent out by the boats, *via* Lake Athabasca and Fort Garry. A heavy shower fell about three p.m. It is now cloudy and much cooler than during the past week; six p.m., thermometer, 60°.

Leave Dunvegan.

27*th August*.—Seven a.m., thermometer, 42°; started at nine a.m. and walked till five p.m., camping about two miles above Isle-aux-Pierres.

28*th August*.—Started at 6.15 a.m., and camped at 5.15 p.m., having walked for ten hours. At nine a.m. we passed our mid-day halting place of the eleventh; the beach is now dry for twenty yards further out, and the water is from twelve to fifteen inches lower.

29*th August*.—To-day we started at 7.30 a.m., and travelled for five-and-a-half hours, camping at the same place as on the tenth. The

Photo Lith. by the Burland Desbarats Co. Montreal.

LOOKING DOWN PEACE RIVER BETWEEN HUDSON'S HOPE AND FORT ST. JOHN.

afternoon was spent washing clothes, repairing boots, baking bread, &c. In respect of boots, the whole party are now in a very dilapidated condition from the alternations of rough rocks, round boulders, soft mud, sand and water, which they have to encounter on our daily tramp along the shores of the great Unjigah.

30*th August.*—5.30 a.m., thermometer, 36°; thin ice in the water bucket this morning; travelled for nine hours and-a-quarter, and camped at 4.35 p.m., one mile below where we lunched on the tenth. Four days more of work, the record of which does not differ from that of those above described, brought us once more to Fort St. John; in the absence of Mr. King, Baptiste Lafleur and old Luizon reigned supreme. No fresh moose meat had been brought in since we left, and they have been living on bears, of which they had killed four. First frost.

4*th September.*—Six a.m., thick fog on the river, and white frost in patches; thermometer, 34°. This is the coldest morning we have yet had. Intend to start on Monday for Hudson's Hope, letting the men rest to-day and to-morrow. We had left some of our baggage and stores here, and as our canoe was already full, I hired Nigger Dan to take a load up to the portage in his canoe. He tells us that the river is now lower than he has ever before seen it at this season.

5*th September.*—It commenced to rain at dusk last night and has rained steadily nearly all day, with a heavy, clouded sky; wind, easterly; barometer rising.

6*th September.*—6 a.m.—Thermometer, 46°. 7 a.m.—Raining, and thick all round. Toward 11 a.m. it had cleared, and, at noon, we started on our upward course. Mr. Webster, myself, Hillier and Anderson formed the crew of the "St. John," and Dan, with McClennan, "*poled* his own canoe." And now followed three days more of tracking, tramping, poling and paddling, from "early morn till dewy eve," bringing us, at 1 p.m., on the 9th of September, to Hudson's Hope. Arrive at Hudson's Hope.

10*th September.*—7 a.m.—Fog on the river; heavy dew; a little white frost; thermometer, 33°. 9 p.m.—Thermometer, 42°. It has been a splendid, bright, warm day—plotting survey, writing notes, &c. To-morrow I propose to go out to Moberly's Lake, which, Charlette tells me, is about fifteen miles distant, and that there is a good Indian trail all the way.

11*th September.*—A little white frost; thermometer: 32° at 6 a.m. Charlette lent us two horses, and, at 7.30 a.m., Mr. Webster and I started for Moberly's Lake. The trail runs two or three miles up the river, and then turns to the left and ascends, by several steps or benches, to the Trip to Moberly's Lake.

plateau; an undulating country of alternating low, sandy or gravelly ridges, covered with forest of small pine, and swampy depressions, with spruce and tamarac and well-grassed flats, thinly-wooded with aspen, alder and willow. In places the woods were all burnt, and in these *brulés* we lost a good deal of time searching for the trail. At 6 p.m., however, we reached the top of a hill, from which a small piece of the Lake was visible, about three miles distant down a narrow valley. We camped here, an operation which consisted in lighting a fire, putting up a few boughs for a break-wind, and eating our supper of bread and dried moose meat. Starting at 7 a.m. on the following morning we reached a rocky hill, immediately above the south-west end of the lake, at 9.30. The trail wound round the flank of it and descended towards the lake shore. As there was nothing to be gained by following it further, we dismounted, and, leaving our horses on the trail, climbed to the summit, where an extensive view of the surrounding country was obtained and a series of bearings taken. The barometer reading was 26.59, indicating about 2,000 feet above Hudson's Hope, and only a little less elevated than Table Mountain on Pine River, which I think I recognised, bearing 97°. The strata here are quite similar to those of Table Mountain—horizontal, thick-bedded, reddish-brown and grey sandstones—but no fossils were seen in them. The hills around the lake, especially the lower slopes and the intervening valleys, are richly grassed, Pea-vine, *Astragalus* and various nutritious grasses standing above one's knees on horseback. There are large areas of open prairie land, and more which is only wooded with willow, aspen and alder coppices. On the higher slopes pine prevails, and, in the low grounds, spruce, tamarac and poplar. A purple-red *Epilobium* is very abundant, also service-berry, 'poire' and a species of *Viburnum*—high-bush cranberry. I never saw the berries on the latter so fine or so abundant. On some of the open, sandy ridges, blueberries and cranberries were also plentiful. Charlette tells me that the snow fall is comparatively light, and that horses do well through the winter amongst these hills. I consider it a region far fitter for settlement than much of the Saskatchewan country. We are now in the middle of September, the thermometer has only once reached 32°, and potatoe tops at Hudson Hope are still green. As a contrast to this it will be seen, in my report on the Saskatchewan country in 1873, that in the region about Edmonton and Victoria, two degrees further south, and about the same elevation, the thermometer fell, on the 4th of September, to 28°, on the 6th, to 24°, on the 11th, to 20°, and again to 20° on the night of the 23rd. At 6 p.m. we reached

View from hill above Moberly's Lake.

Fine land.

Mildness of the climate.

Hudson's Hope, having been walking and riding on the roughest of horses and over the worst of roads for eleven consecutive hours.

13*th September.*— Making preparations for crossing the portage, ferrying baggage to the other side, &c. A large party of "Free-traders" are now competing very energetically with the Hudson Bay Company for the fur-trade on Peace River, and this morning we learnt that they were daily expected to arrive at the other side of the portage with three large *batteaux* laden with 35,000 lbs. of goods for the winter trade with the Indians. To transport this across the portage they had sent in a train of fourteen mules; the first horses or mules that had ever travelled along these shores of Peace River. The bell-horse and one mule were drowned on the journey at one of the crossings of the river, forty of which had been made to take advantage of the beaches and avoid the forests and bluffs. This evening Charlette's four horses were sent across the river and put in the yard, to be ready for an early start to-morrow. Our baggage is now a good deal reduced; two trips, however, will be required to take it all to the other side.

Free-traders.

The first pack-train on Peace River.

14*th September.*—The first loads were crossed to-day, the trip occupying from 8 a.m. to 5.30 p.m. This afternoon I made a careful examination of the rocky cliffs above the post. Eighty to ninety feet of rubbly, dark grey, or black shales are exposed, and, on top, about eight or ten feet of gravel and sand. There are no iron-stone bands with the shales, and no fossils were observed. They seem to come up on a low anticlinal and dip up the river, passing under, or, perhaps, more probably resting unconformably against the sandstones of the Portage Mountain, and being overlaid by those exposed in the gorge of the small brook above the post. They are generally nearly flat and much jointed, breaking up into angular fragments like small gravel.

The rocks at Hudson's Hope.

15*th September.*—6 a.m., thick fog, thermometer 36°. At nine a.m. we bid adieu to Hudson's Hope and started for the other side of the portage, with the four horses carrying our baggage. Charlette came with us to take back the horses. At 2 p.m. we reached the lower landing place, mentioned page 45, and camped. In the afternoon I explored the cañon; the rocks are now much better exposed than they were in July, the water being fully fifteen feet lower. The cliffs consist mostly of massive brown-grey and whitish gritty sandstone, which is breciated or conglomeritic in patches and bands; there are also some thin interstratified beds of dark shale, and about seventy or eighty feet up, in a perpendicular cliff, there was one seam of coal which I judged to be about six inches thick. Plant remains—mostly large and small stems and branches—were the

Re-cross the portage.

Coal seam and fossil plants.

only fossils found, the bark was always represented by a thin streak of bright coal, the woody structure being completely replaced by sand. Just as I returned to camp the Free-traders arrived with four large *batteaux*, two canoes and a number of men.

Arrival of the Free-traders.

16*th September*.—6 a.m., thermometer 42°. To-day preparations had to be made for our further progress up the river, and our boats first claimed attention. I had arranged with Charlette to let me have the large canoe, in which Mr. King had gone up the river in July, in place of our "St. John" which we left at Hudson's Hope. This canoe had been cached here with our "McLeod" boat, and they now wanted some repairs after their long rest. Leaving the men to attend to this and to prepare poles, paddles and tracking lines, I started at 8.45 a.m. to make the ascent of the Portage Mountain. Four hours and three-quarters of tough climbing, a great deal of it over rough rocks and through tangled brush and underwood, brought me to the eastern summit, a bare sandstone rock dipping slightly to south-south-west. The whole mass of the mountain consists of coarse gritty sandstones and conglomerate grits, similar to those exposed in the cañon at its base. According to the barometric reading, the summit is about 3,960 feet above sea, and about 2,600 feet above our camp. I descended by the right hand spur and along the brink of the cañon, reaching camp at 7 p.m.

Ascent of the Portage Mountain.

17*th September*.—7 a.m., thermometer 34°. To-day everything was prepared for a start to-morrow. We still have a long and toilsome journey to accomplish, and it was a fortunate circumstance that I was able this morning to secure the services of two youths, Frank and Jim, the one a Spaniard and the other an Indian, who had come down with the traders, but now wished to return to Quesnel. Without this assistance it would have been almost impossible for our small party to have taken the "McLeod" and the canoe up the river, and we should have had to wait at the portage for the arrival of Mr. MacKenzie and the "Leather party" from Fort McLeod.

18*th September*.—6 a.m., fog very thick, heavy dew, thermometer 44°. At 10.45 we moved off, and for thirteen consecutive days (the 25th on which we did not travel, excepted) we worked our way against the waters, reaching Fort McLeod at 3.40 p.m. on the last day of September. On the 23rd we passed the mouth of Finlay River; on the 24th met Mr. MacKenzie on his way down to the portage; 27th, passed Nation River, and on the 29th entered Pack River. At the great timber jam, where our accident occurred on the 3rd of July, we had to make a portage, dragging the boats over the almost dry bed of the small channel at the

Return journey to Fort McLeod.

Photo Lith by the Burland Desbarats Co. Montreal.

MOUNTAINS LOOKING E. 30° N. PARSNIP RIVER, 14 MILES BELOW NATION RIVER.

back of the island. The Parsnip is now very low, and on many of the gravel bars there is barely enough water to float our boats, and it was very difficult to recognize in it the broad, deep, and swift-flowing river we had descended in July. From Nation River upwards, a good many quite large lumps of lignite coal were scattered along the beaches, and I have no doubt that a wide basin of tertiary deposits occurs here similar to those of Quesnel and Blackwater. We found the fort almost deserted, Mr. Bovill, Hudson Bay Clerk, being the sole occupant; he had not even an Indian to keep him company.

Drift lignite.

1*st October*.—7 a.m., thermometer 46°, heavy dew. The grass is still quite green, and there has not yet been enough frost to injure the very fine cauliflowers which there are in the garden.

Climate.

This is a very significant fact in connection with the character of the climate of this great North-western Canada, especially when it is remembered that we are now very little less than 1,900 feet above sea level, and in the latitude of the extreme northern part of James' Bay, or as nearly as possible ten degrees north of Ottawa. Heavy rain and strong north-west wind to-day.

2*nd October*.—Six a.m., thermometer, 34°. Our course now lay up McLeod's Lake and Crooked River to the Giscome Portage, and thence by the Fraser River to Fort George and Quesnel. At nine a.m. we were under weigh; the wind being fair, we were able to sail nearly the whole distance, and at 2.30 entered the mouth of Crooked River. McLeod's Lake is sixteen or seventeen miles in length, with an average width of barely two miles. There are four small islands in it, and the shores are everywhere thickly wooded. On the west side they rise abruptly by steps to the level of the undulating country, crossed by the trail, from McLeod to Stewart's Lake, and on the east the country rises gradually towards hills, which, in places, attain a height of twelve or thirteen hundred feet above the lake, and then slope away on the other side to the valley of the Parsnip River. Further to the south-west, along the valley of Crooked River, the country is less broken, and this character apparently continues to the Giscome Portage, whence, looking to the north and north-west, no mountains are to be seen, but a broad expanse of undulating forest country. In its lower part, Crooked River is little more than a winding ditch, from thirty to fifty feet wide; the banks of fine silt, and the flats thickly covered with willow and alder bushes, and beyond these steep ridges and hills and hollows of boulder drift, gravel or sand. Higher up it runs through wide swampy flats, and expands into small lakes, with numerous bays and arms, making it very difficult

McLeod's Lake and Crooked River.

to determine in which direction to steer for the outlet. In some places the channel was twenty or thirty yards wide, full of large rounded stones, and barely sufficient depth of water to float the boats over them; in others it was still shallower, and for long distances we had either to walk alongside in the water, lifting the boats over the stones, or to make a channel by removing the stones or digging out the gravel. In parts the current is swift, but as there are long stretches of almost still water, besides the lakes, there can be no great rise from Lake McLeod to the Giscome Portage. The average readings of the barometer show a difference of 0.10 inches = 94.6 feet. On the sixth of October, at 11.15 a.m., we reached the camping place on the shore of Summit Lake, at the end of the Giscome Portage road, six miles from Fraser River. Some years ago a good waggon road was made across the portage by the British Columbia Government, with the view of this route becoming the main line of traffic to the Omineca gold-fields; but the difficulties encountered in the navigation of Crooked River have caused it to be abandoned for the more direct and certain over-land route by Stewart's Lake. The Hudson Bay Company, however, continue to use it, sending a waggon and horses up from Fort George, to convey their goods over the six miles of road. We were very fortunate in finding the waggon and horses still there; had we been one day later we should not have done so, and to have "portaged" our canoe and boat without their aid would have been an arduous undertaking. As it was, two trips of the waggon sufficed to take everything to the other side, and in doing this we were kindly assisted by Mr. Seymour, who had come up with two Indians from Fort George to take the waggon and horses down for the winter.

Giscome Portage.

For three miles from Summit Lake the road is very level, mostly through thick forest; it crosses two or three swampy meadows, and some small creeks; the soil is all coarse gravel drift; the timber chiefly spruce and poplar, some of the former of large size. This is the summit of the divide between Arctic and Pacific waters. The rest of the distance, on the slope to Fraser River, the country is more open prairie, with scattered trees and patches of copse-wood. It has apparently all been burnt at no distant date. The soil is a brown clayey or sandy loam, which would be well suited for cultivation.

Arctic and Pacific watershed.

9th October.—Six a.m., thermometer, 46°. Last evening Seymour sent the two Indians with the horses by land to Fort George, and assisted by our party, lashed two canoes together, and made a platform on them for the waggon, the baggage being stowed in the canoes beneath. At 7.20 a.m. we started for Fort George, the canoe-raft, navigated by Mr. Seymour, with Mr. Webster, McClennan and Hillier, leading the way, and the "McLeod" following with Jim, Frank, Anderson and myself. The current carried us swiftly along, and at 3.30 p.m. we landed at Fort George, the distance, according to my sketch of the river, being about twenty-seven miles. Between Giscome Portage and Fort George the cliffs along the river present, at some of the great bends, fine exposures of the clays, sands and gravels of the drift and tertiary formations. The only places where the underlying older rocks appear at the surface is immediately below the mouth of Willow River, and about four miles further down, where some rugged massive-looking conglomerate rocks are exposed on the left bank.

Reach Fort George.

10*th October*.—Six a.m., thermometer, 50°. This morning I received a letter from Mr. Marcus Smith, C.E., in reference to the possibility of my endeavouring to reach the coast by going up the Nechacco to Francois Lake, and thence to Gardner Channel. Had I arrived earlier in the season at Fort George I might have accomplished this, but, under existing circumstances, I did not think it prudent to attempt it without good canoemen, or anyone who was acquainted with the country. From Mr. Smith's information I supposed that Mr. Bell, C.E., division N., C. P. R. Survey, was working down the Chilacco, towards Fort George, and that Mr. G. M. Dawson was with him; I, therefore, determined to go out and meet them. Accordingly, on the following day, having procured two horses, Mr. Webster and I started, following the trail up Stewart River to the Chilacco Valley. We took nothing with us but our overcoats and some provisions. That night we camped a little above the mouth of the Chilacco.

Journey to Blackwater depot and return to Fort George.

12*th October*.—Six a.m.; thermometer, 42°. Soon after we set out this morning it began to rain, and continued heavily till noon, making travelling through the long grass and wet bushes very uncomfortable. We were constantly expecting to see some signs of the party which we supposed must be now close to us, but we travelled on all this day and the next without doing so; and on the following morning, the 14th, at 10.20 a.m., we struck the Telegraph Trail about four miles from the Blackwater depot. Shortly after, we met Mr. Bell's pack-train on its way to Fort George, and then learnt that Mr. Bell was about thirty miles up Black River, and that Mr. Dawson had left the depot on Monday, for Fort George, by the other trail. We remained that night at the depot, and on the 15th set out on our return, by the direct trail, to Fort George, arriving there at 4 p.m. on the 16th. Leaving Fort George

Return to Victoria.

again on the 18th, we reached Quesnel on the 20th. We waited at Quesnel for the steamer till the 24th, and after seven days of stage and steamboat travel, landed in Victoria. Leaving there on the 10th of November, we arrived in Montreal on the 23rd, having been absent five months and twenty-seven days, during which we had travelled:—

Total distance travelled.

By railroad and steamboat	8,454	miles.
By stage	548	"
By pack-train, canoe, and on foot	1,217	"
	10,219	"

Comparisons of Peace River and Leather Pass as railway routes.

As our exploration was undertaken partly with a view to ascertain the character of the country in reference to the best route for the Canadian Pacific Railroad, it will, perhaps, not be out of place that I should distinctly state the conclusions I have arrived at on this question.

I am not, nor do I profess to be conversant with railroad engineering, but from what I have myself seen, and from what I have been able to ascertain from others respecting the route by the Leather Pass, when compared with that—my knowledge of which is also partly from personal examination and partly from the testimony of others—by the Athabasca and Smoky Rivers, and thence by the Pine Pass to Giscome Portage and Fort George, I have no hesitation in saying that the latter route is probably in every respect the best in the interests of the railroad and of the country at large. But whether this is so or not, there can be no doubt that this route deserves to be more carefully examined than it hitherto has been.

Taking Edmonton, on the Saskatchewan, and Fort George, on the Fraser, as the initial points, it will, I believe, be found that by Pine Pass the line could not only be carried almost the whole distance through a magnificent agricultural and pastoral country, but that it would be actually shorter than the Leather Pass route, and that it would probably not present any greater engineering difficulties. The latter is, however, a question which can only be determined when proper surveys have been made and the crossings of the Athabasca River, of Smoky River, of Pine River and of the Parsnip have been examined.

Route by which the country should be examined.

The best line on which to carry this examination would, I think, be from the Giscome Portage on an east-northeast course for thirty-five or forty miles to near the fifty-fifth parallel of latitude; then bearing more easterly, it is probable that in a few miles some of the western tributaries of Smoky River would be reached; these could either be followed down or crossed as seemed best, and thus, probably, the great fertile plains between Smoky River and the Athabasca would be easily reached.

It seems quite evident that in the direction indicated there is a broad, perhaps hilly, but not mountainous region, which forms the divide between the waters of the Fraser north-branch on the one hand, and those of the Parsnip and the southern affluents of Peace River on the other; and this watershed, of which the Giscome Portage is a part, represents one of the low spurs or ridges into which the Rocky Mountains in this region are broken up.

Geological Features.

A single rapid traverse of a region so extensive as that to which the foregoing notes refer, is quite inadequate for the purpose of giving a detailed description of its geological structure. I shall, therefore, restrict my remarks on the present occasion to a brief recapitulation of the leading geological facts which were noticed, and to some very general conclusions which may probably be deduced from them.

The report of Mr. G. M. Dawson, submitted with this, gives a very full and accurate description of the geological features observed by him in that portion of the country which lies to the south and west of Fort George, between the fifty-fourth and fifty-second parallels of latitude. My observations will, therefore, refer chiefly to those portions which are to the north and north-east of Fort George, and beyond the limits of his exploration. These are almost wholly within the arctic watershed, and belong to the basin of Peace River.

Region covered by geological observations.

The designation of the various groups will, so far as they seem applicable, be those which were adopted in my first report on the Geology of British Columbia, published in 1872, and may be summarised as follows:—

Classification of deposits.

I. *Cainozoic.*—Superficial deposits and Lignite-tertiary group, including the upper volcanic series.

II. *Mesozoic.* — Cretaceous coal-bearing rocks, shale and sandstone group of the Eastern Plains.

III. ? —Sandstone, shale and conglomerate group of the foot hills and outer ranges of the Rocky Mountains.

IV. *Palæozoic.*—Rocks of the Upper and Lower Cache Creek groups, including the limestones of Stewart's Lake, McLeod's Lake, and Fossil Point, Peace River.

V. Granite and mica schist.

The relative geographical extent of the several formations, and their physical importance in relation to the general character of the region to be described, correspond with the order in which they are above enumerated, and I shall now refer to them in the same order, beginning with the youngest.*

Division I.—Cainozoic.—Without entering into local details of the exposures, it may be stated that, between Blackwater and Stewart's Lake, and thence to the Finlay rapids, on Peace River, the whole country is—with some exceptions, which will be again referred to—more or less overspread with drift material; much of this has probably been derived from the abrasion of the tertiary formations, through which many of the principal valleys of the country have been cut, exposing alternating beds of clay, lignite, sand and rounded gravel, capped by vast sheets of volcanic products, chiefly porous and compact lavas—columnar and concretionary—and dense dolerite, forming high hills or undulating stony table-lands, such as that which is crossed by the waggon road between Clinton and Bridge Creek at an elevation of 4,000 or 5,000 feet. At present the northern limit of these tertiary volcanic products is somewhat uncertain. From Mr. Horetzky's description of the abrupt character of the country on the Susqua River and in the vicinity of Fort Stager, on the Skeena, I should imagine they are extensively developed in that region. At page 26, "Canada on the Pacific," he says, writing of the Chean-Howan River, "the uniform and even bottom through which the river had found its way from the watershed, now disappeared entirely, giving place to a deep and rocky gully, the rugged walls of which rose perpendicularly for a hundred feet on either side, as we picked our way laboriously over huge fragments of dolerite which strewed the river bed." Again, at page 128, on the Naas River, he says: "A quarter of a mile below this rapid we passed some very extraordinary columnar basaltic rocks, of which the river banks were composed."

Drift deposits.

Rocks of Skeena and Naas Rivers.

North of Blackwater, on our route, no indications whatever were observed denoting the existence of these volcanic rocks, whether owing to their having been completely removed by denudation, or to their never having extended over this region, is a question which must remain for future investigation. The lignite tertiary strata, however, which at present are assumed to have preceded the latest of these volcanic outbursts, occupy undefined, but certainly extensive areas between Fort George and McLeod's Lake; and probably continue thence to the valley

Country underlaid by Tertiary.

* It should, however, be stated that the present classification is only provisional, and that some of the so-called Cache Creek rocks may prove to be younger than palæozoic.

Photo Lith by the Burland Desbarats Co Montreal

From Photo, 8th July, 1875.

JUNCTION OF NATION AND PARSNIP RIVERS.

LOOKING WEST.

of Nation River, with only such interruptions as are the result, partly of the original unevenness of the surface upon which they were laid down, and partly of the subsequent denuding agencies to which they have been subjected, giving rise to outcroppings of the older rocks either as hills or ridges rising above the general level of the country, or appearing as rocky bars or cañons in the deep-cut channels of the rivers.

The general similarity of some of the sands and gravels of the drift period to those of tertiary age, makes it difficult, without close and critical examination of each exposure, to determine to which period they should be referred, and the distribution of the drift upon the tertiary deposits is so irregular as to make it quite impracticable to define their respective limits.

Except in a small exposure on the left bank of the Parsnip, close to the mouth of Pack River, no beds of lignite were seen after leaving Quesnel; but both in the valley of the Blackwater, as mentioned by Mr. Dawson, and as observed by myself, and also from the highest point to which we ascended the Parsnip River down to the mouth of Nation River, ample evidence is afforded, by the frequent occurrence of large sized loose blocks, that a lignite formation, similar to that seen on the Fraser River at Quesnel, underlies a very large area of country, both in the vicinity of Blackwater, and also, probably, at intervals from the Giscome Portage to the valley of Nation River.

Large blocks of lignite.

Some of the blocks found along the shores of the Parsnip were of large size and sufficiently pure and compact to be of value as fuel if found in thick seams. At about three miles below Nation River, a steep cliff rises on the right bank from the water's edge to seventy or eighty feet. At the base, stiff blue clays are seen, and these are overlaid by layers of sand and fine gravel, passing at the top into coarse rounded gravel. This is probably near the northern limit of the Parsnip River lignite-tertiary basin, as a short distance further a rocky ridge crosses the river and crops out in both banks, the country then rising rapidly, on one side to the Rocky Mountains, and on the other to the watershed between the Omineca and the Parsnip Rivers. On the eastern side of the mountains there do not appear to be any deposits which can be referred with certainty to the lignite-tertiary series. At intervals along the river, on both sides, deposits of stratified sand and gravel cut into benches and terraces, extend from the water to elevations of seven or eight hundred feet. Somewhat similar sands and gravels are thinly spread over many parts of the great prairie plateau which stretches eastward from the base of the mountains. A section of these, about thirty feet thick, consisting of brown sand and

Tertiary basin of Parsnip River.

Possible representatives on east side of mountains.

reddish rusty looking gravel in thin bands, is seen capping the steep hill of horizontal Cretaceous shales and sandstones which rises to an elevation of 550 feet above the river immediately in rear of the Hudson Bay post at Dunvegan. In these high gravels the pebbles are small and pretty uniform in size, in which respect they seem to differ from those of the lower benches which are much coarser; the small and large pebbles being irregularly distributed through them. These upper gravels cannot well be distinguished from those which, near Quesnel, occupy a position immediately beneath the basaltic lava flows, and perhaps they belong to the same epoch.

Rocks from Smoky River to Dunvegan.

Division II.—Mesozoic—From "The Fork"—Smoky River—up to Dunvegan, and thence to about five miles below Hudson's Hope, the rocks which are exposed along Peace River must for the present be regarded as all belonging to Division II; they consist of dark earthy shales, in parts characterized by numerous bands and septarian nodules of clay ironstone, many of which enclose large ammonites, and they are also associated with sandy calcareous layers holding other Cretaceous fossils, among which, a species of inoceramus is tolerably abundant, while in the dark argillaceous shales the scales of fishes are frequently observed. Descending Peace River, these dark shales are first seen at about six miles below Hudson's Hope. They are nearly or quite horizontal, and are exposed at intervals between this point and Fort St. John, in cliffs which rise almost perpendicularly from the water to heights of fifty or a hundred feet. Near where they are first seen, the hills at a little distance back rise to 500 or 600 feet, and towards their summits present cliffs in which some thick beds of brown fine-grained sandstone crop out. These make excellent grindstones, samples of which, made by Charlette, were in use both at Hudson's Hope and at St. John. About a mile below St. John, on the left bank, the section exposed is nearly 700 feet in thickness, and shows in descending order—

Section at St. John.

	FEET.
Brown earthy clay	30
Rounded Gravel, rather rusty, chiefly Quartzite and Limestone	15 to 20
Dark argillaceous shivery shales, holding fish-scales, the joints and bedding planes often showing films of selenite. Towards the base, these are interstratified with thin bands of hard, fine-grained calcareous grey sandstone; also bands and layers of concretionary septarian ironstone nodules. The latter when split generally show casts of large ammonites, and the shales and associated beds hold inoceramus and other fossil shells. The banks are continually falling in great slides, the shales are ground up and form mud	

coulees with imbedded blocks from the sandstone ledges. In many places the dark shales are coated on exposed surfaces with a white saline efflorescence. Samples of this were collected, and the analysis of it is given in Mr. Hoffmann's report. It consists of sulphate of soda and sulphate of magnesia.

The upper sandstones are not seen at St. John, in the river banks, but they appear to run inland to the north, and are seen again around the shores of Little Lake. From near the mouth of Pine River North, down to twenty miles below Dunvegan, they come upon the river, probably brought in by a slight increase in the dip to the eastward. A little above Dunvegan there are high bluffs and ledges of soft whitey-brown crumbling sand rock; the beds are massive and from twenty-five to thirty feet thick. They weather into all kinds of curiously shaped monumental forms, and often jut out in overhanging tabular ledges. The banks up to the prairie level—600-700 feet above the river—are everywhere rugged and generally broken into irregular hills, ridges and hollows, by land slides. The shales between the thick and harder beds of sandstone are marked by the more gradual slope of the bank and by long horizontal lines of verdure between others of rocky bluffs. Many of the beds are richly charged with fossils, both animal and vegetable. The ammonites, however, appear to be chiefly confined to the lower dark shales, and the plant bearing beds to the upper arenaceous group. At about five miles below Burnt River, the upper part of the Ammonite shale group appears again at the surface, and is seen at intervals cropping from beneath the drift sand and gravels, which here form the banks down to The Fork, while ledges of the sandstone group are seen cropping out in the hills just beneath the upper prairie level. The same succession of beds is exposed on Smoky River, as high up as our examination extended, the only peculiar feature there being the *bocannes* already referred to, page 58. The centessimal composition of the deposit made by these curious *bocannes* is given in Mr. C. Hoffmann's report, and shows it to consist of free sulphur and chloride of ammonium, with a little sulphate of ammonia.

Sandstones and shales.

Bocannes.

Whatever the cause may be which gives rise to these sulphurous fumes, it is certainly not as has been stated, the burning of beds of lignite. At Quesnel, where this has occurred, and is still in progress, the result on the associated strata is precisely similar, but the deposit from the fumes is totally different.

Ascending Pine River, an excellent section of the whole group is afforded from the lower ironstone-bearing Ammonite shales at the

Sections on Pine River.

mouth, to the highest sandstones of the plant-bearing group in Table Mountain.

Bituminous coal.

In the rocky gorge, close to our last camp up Pine River, represented in the sketch page 54, drawn by Mr. Foord from the photographs taken, are the four thin seams of good bituminous coal which have already been mentioned, page 53. These are not less than 1,700 feet below the sandstone of Table Mountain, and as the beds are horizontal, the geographical elevation must very nearly represent the vertical thickness of the formation.

Geological position of the rocks.

If the Table Mountain sandstones shales and coal beds represent the No. 5, Fox Hill group of Meek and Hayden, then the St. John Ammonite shales would be the Fort Pierre group. The latter, at St. John, is not less than 700 feet thick, and thus, Division II of the present report would have a thickness of 2,700 feet, and may, perhaps, include all the subdivisions of the Cretaceous period enumerated and described by Messrs. Meek and Hayden. No rocks, however, which could be paralleled on lithological grounds with their Dakota, Benton and Niobrara groups were observed in the Peace River section, and apparently the dark laminated Ammonite shales of the supposed No. 4, Fort Pierre group, rest conformably on the calcareous brown sandstone and shale series, in which certain fossils were found which Mr. Whiteaves believes to be probably Jurassic forms. We may, perhaps, here find a passage from the Jurassic into the Cretaceous period. When the fossils which were collected from these strata are examined, more light will, perhaps, be afforded on these points. They have now been twelve months in transit, but have, unfortunately, not yet come to hand.

Division III.—Proceeding up the river to Hudson's Hope, another group of strata is met with which must, I believe, be referred to some unconformable underlying formation, whether of lower mesozoic or of palæozoic age, is uncertain.

Underlying formation with coal

It consists chiefly of either hard, occasionally slightly calcareous sandstones, brown, reddish and whitish, with thick beds of rough, brecciated conglomerate or pudding stone, thin bands of dark slaty shale and true bituminous coal. The only fossils that were observed in these beds are indistinct impressions of the stems of plants often of considerable size, and some of the beds are full of small carbonaceous leaf-like markings. The best exposures of this group are seen in the Portage and Horse-head Mountains, and they likewise form both sides of the Cañon of the Mountain of Rocks.

Precisely similar rocks were also observed on the left bank of Peace

Photo. Lith. by the Burland Desbarats Co. Montreal

From Photo. 15th July, 1875.

LOOKING UP PEACE RIVER FROM EIGHT MILES BELOW OTTER-TAIL RIVER.

River, about eight miles below the mouth of Otter Tail River, where I made the following note: Beds of hard grey sandstone (like "whin" rock) from three to eight or ten inches thick, dip very regular to W. 40° S., < 65° to 70°, broad ripple marks on some of the beds; beneath these are other softer, brown sandstones, in which impressions and casts of tree stems and branches are abundant, with much indistinct carbonaceous marking on the faces of the layers. None of these plant remains are sufficiently well preserved for specific identification. Section near Otter Tail River.

The next exposure examined is where a point of rocks juts out upon the left bank of the river; but these belong to some part of the older series included in Division IV. Little more than a mile further up is another rocky point, which running inland, rises into a precipitous mountain with vertical cliffs facing to the east. Among the debris fallen from these cliffs, consisting of dark grey, almost black arenaceous and calcareous rocks—sometimes an impure carbonaceous limestone—were found great masses, every layer of which was a matted aggregation of casts and impressions of a shell which Mr. Whiteaves considers, without doubt, to be *Monotis subcircularis*, Gabb, the most common and widely distributed fossil in the Triassic rocks of California. From this point, which is nearly abreast of the mouth of Clearwater River, down to the entrance to the cañon, fragments of the same kind of rock holding this *Monotis* in great abundance are found scattered along the shores; whether they are all derived from this outcrop, or from others of similar beds lower down, which were not observed, is uncertain. The dip is to the south-west, at 30° to 40°, and it seems probable that these *Monotis* bearing beds turning over the anticlinal axis, which brings up the Fossil Point limestones of Division IV, dip beneath the sandstones and shales of the Portage Mountain group, and are not again seen to the eastward. To the westward they rest on and against the intensely crumpled and contorted masses of limestone-schist, quartzite, clay-slate, &c., which at a short distance rise into the main peaks of the Rocky Mountains. In a fragment of a precisely similar rock, brought from near Fort Rupert, Vancouver Island and given to me in Victoria, I found impressions of the same shell. *Monotis* bearing beds.

Owing to the numerous sharp foldings which have affected all the strata from the cañon westward, and the consequent constant alternations from almost vertical to horizontal attitudes, a very careful examination is required before the real succession of the several groups can be determined with certainty. To do this a much longer time would be necessary than we could give to the work on this occasion.

Fine section of Peace River Valley.

The direct course, however, of this great valley of Peace River, the depth to which it cleaves the main range from west to east, and the splendid sections which are thus afforded either along the principal valley or in its numerous tributaries on either side, offer, probably, far greater facilities than are to be found in any other part of British America for studying the very interesting phenomena connected with the structure and upheaval of the Rocky Mountains, and the succession and precise relation to each other of the various formations which are represented in the bare rugged peaks of the main range, and in the rounded forest-clad hills on its eastern and western flanks.

Rocks, from Portage to Otter Tail River.

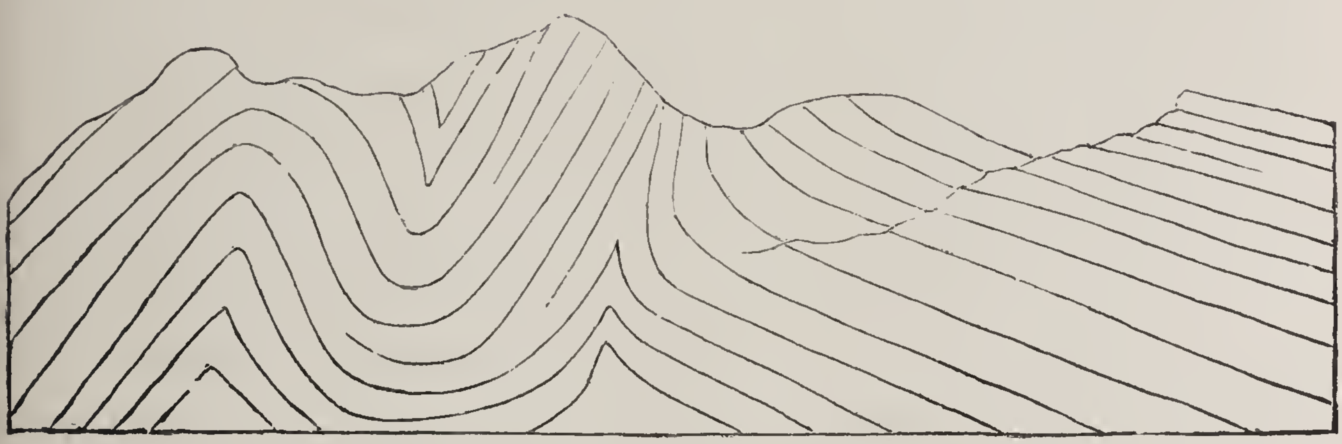
All the hills fronting the river, from the Portage and Horse-head Mountains up to near the mouth of the Otter Tail, are apparently composed of the rocks of this group, and in some of them the curious sharp folding and faulting which have affected the strata are well exhibited. The geographical position, the physical conditions and the general lithological character of this group seem to correspond very closely with the folded and faulted series, described by Mr. G. M. Dawson as occurring in the vicinity of the St. Mary River, and which he assigns to the Lignite Tertiary series, but which he, at the same time, says "do not precisely resemble any part of either the Cretaceous or Tertiary rocks previously examined." The rocks referred to on Peace River can scarcely be Tertiary, and I believe they are even older than Cretaceous. At a point on the River, about fifteen miles above the portage, an exposure occurs on the right bank, and in some rocky islands, of very massive beds of a dark, almost black, fine grained calcareous rock, from which a few fossils were obtained, and amongst them a large *Lingula* was the most abundant. In one part of this exposure the beds have a slight dip to north a little east; a concealed interval then occurs occupied by a sandy beach, and then a second small exposure, in which the beds dip at about 45° in the same direction; this is followed by a third exposure, in which the dip is exactly as in the first.

Lingula beds

Their probable position.

Above the mouth of Otter Tail River is another exposure of exactly similar beds, apparently horizontal, and in which some obscure fragments of fossils were observed. How these fine grained, dark *Lingula* bearing limestones are related to the plant bearing grits, and coarse sandstones of the Portage Mountain, and of the cañon at its base, is a question which cannot at present be determined. But between the two out-crops last described is the one already referred to of sandstones, like those of the Portage Mountain, and the inference would be that the

Lingula bearing beds lie unconformably below the sandstone, and are, perhaps, a portion of the *Monotis* bearing group, which in lithological character they very closely resemble. In the hills on the left bank, a little below this exposure, the strata are folded in the manner shown in the wood-cut.



Sketch of folded strata as seen 500 to 600 feet above the river in the hills on the left bank of Peace River, between Otter Tail and Wicked Rivers.

Division IV.—The rocks which are included in Division IV were observed chiefly to the westward of the main axis of the Rocky Mountains. They were first noticed, after leaving Blackwater, at the highest point of the trail between it and the Chilacco River, the elevation there being about 800 feet above the Blackwater crossing place. The beds exposed at this point are bluish-grey fine-grained or compact and opaline quartzites, precisely similar to those described by Mr. G. M. Dawson, at the upper end of the lower Blackwater cañon. On the trail descending to the Chilacco bridge there are some very limited outcrops showing dark-blue and grey rubbly shales, with beds composed of small angular fragments of cherty rocks: neither dip nor strike could be determined; there is, however, no doubt that these rocks are the north-western extension of those at Blackwater. Exposures on Telegraph Trail.

At about two miles south-east from Naltesby Lake, large angular blocks of dark slate and of white quartz are scattered along the trail, apparently derived from the hill-side on the right; but no unmoved rocks were seen. The hills in rear of the lake appear to be of diorite.

The next exposure met with occurs about three and-a-half miles from Stewart's River, near a small swamp between it and the Nechacco, where a few ledges of blue and grey siliceous shales, and a greenish grey diorite or dioritic sandstone crop out. Lying around, are numerous large boulders of granite and other smaller ones of trap, sandstone and granite. Eight or ten miles east of Fort St. James the trail passes along the base of some high rocky bluffs composed chiefly of massive blue-grey, rather silicious and sub-crystalline limestone. A short distance further, the edge of the descent to the valley of Stewart's Lake is reached, and here we find extensive outcrops of a massive dark coloured rock, which, under the hammer breaks into small rubbly irregular fragments, the faces being all jointage planes coated with a black iron or manganese oxide, and not showing the character of the rock. It is probably an altered shale or a fine grained shaly dioritic rock. Neither in it nor in the limestone was there any indication of the dip to be seen, but they are both traversed in every direction by jointage cracks. Immediately in rear of the post at Stewart's Lake, the limestones are again seen forming rocky hills, and here Mr. Macoun found numerous indistinct fossils. Two miles and-a-half up the north shore of the lake is a rocky point consisting of dark argillaceous and calcareous shales, much broken and disturbed, the dip apparently about south from 50° to vertical. Beyond these the limestone again comes on in great force, and forms the mass of the great mountain ridge which here rises abruptly from the lake shores to an elevation of 2,600 feet above the water.

Limestones of Stewart's Lake.

From the summit, known as "Pope's Cradle," to which we ascended on the 21st of June, this great limestone band can be traced by the eye, forming a broad belt of white rocky ridges, or isolated hills, for a distance of not less than thirty-five or forty miles on a bearing E.S.E. and W.N.W. Looking down upon it from Pope's Cradle, it has the appearance of a hog-backed rugged and broken ridge, winding through the country. Overlying the limestones there are beds of blackish-blue, broken and much jointed calcareous and argillaceous shales. At a rocky point on the lake shore these shales are cut by a massive-bedded dyke of a whitish or light grey feldspathic diorite. The slopes of Back Mountain, on the east of the trail from Stewart's Lake to Omineca, (see plan) seen from a distance, show very red rocks; these, probably, underlie the limestone band, which apparently has a thickness of not much less than 6,000 feet. It would be very desirable to trace out this great limestone belt, and thus ascertain its real position in the series. There is, I think, no reason to doubt that it represents some part of the Cache Creek series, but whether the lower or the upper limestone group is at present uncertain. On Pope's Cradle, notwithstanding that from base to summit there is an almost unbroken exposure of limestone rock, and that a good deal of time was devoted to the search, nothing was found that could, with certainty, be recognized as a fossil.

Great limestone range.

Cache Creek shales.

Between Stewart's Lake and the falls on Long Lake River, only one outcrop of rocks was observed. This occurs a short distance to the south of Salmon River crossing, where there is a small exposure of reddish-weathering flinty shales of the Cache Creek series. At the falls above named, the rocks are apparently exclusively dioritic, but so much broken, jointed and decomposed that it is very difficult to obtain a specimen with a fresh fracture. There are three distinct falls, the upper one, from thirty to thirty-five feet; the middle one, about fifteen feet; and the lower one, fifty feet. The total length being about 100 yards.

Iroquois Creek.

In the valley of Iroquois Creek, below our camp, greenish-grey fine grained sandstones were seen associated with dark-blue slaty shale, dipping S. 10-15° E. $<$ 65-70.–resting on these is a considerable thickness of drift gravel and sand, in which pebbles of various kinds of diorite are the most abundant material. Gold is reported to have been found on this creek. A short distance north of Iroquois Creek, metamorphic grey sandstones and slaty shales were seen, and though not in situ, had not been far removed, the solid rock being evidently close beneath the surface; no further exposures were seen south of McLeod's Lake.

Limestones and schists of McLeod Lake Mountain.

On the 1st July I ascended some rocky hills to the east, and directly opposite Fort McLeod. For the first mile and three-quarters the trail passes through thick forest, and no rocks are seen, thence the range begins to rise more steeply, and the rock which crops out is an olive-coloured and dull grey schist, in which the bedding is not apparent; the cleavage planes strike east and west, and dip north from 85° to vertical; the weathered surfaces are greenish-white, and the rock has a feldspathic aspect. Higher up the hill similar rocks occur, associated with wavy, grey limestone schists which strike E. 20° N., and dip at high angles both north and south. Other outcrops showed thin-bedded, french-grey coloured sandy limestones, strike 10° N. dip south 80°. No traces of fossils could be found. At the highest point which we reached on this ridge the barometer reading was 26.58, and at the lake 27.90, showing an elevation of about 1,300 feet. Here the rocks are all limestone shales and brecciated limestone conglomerate. On the hill-side, up to about 400 or 450 feet above the lake, irregular beds, layers and heaps of large rounded drift pebbles were observed. These may, perhaps, mark old shore lines of the lake when the waters stood at a much higher level than they do now.

Descending Pack River and the Parsnip, wherever outcroppings of the older rocks occur, they are all of similar characters to those just described, and clearly belong to the same series. In the banks opposite the mouth of Finlay River an intensely crumpled black plumbaginous-looking clay slate occurs. At first sight it looks like mica schist, but a closer examination shows that the micaceous-looking surfaces contain no mica, but are probably due to the pressure and motion which this soft carbonaceous shale has been subjected to.

Carbonaceous shale.

The lamination planes, which are also, perhaps, those of bedding, dip south-south-east at low angles; they are folded and contorted, and the bright satiny-looking surfaces which the rock presents are all minutely but irregularly corrugated. Similar micaceous-looking and corrugated rocks occur again at the Finlay Rapids, but here they are strongly calcareous; they are not unlike some of the silvery-looking nacreous slates of the altered Quebec group. Below the Finlay Rapids no exposures were seen upon the river till we entered the gap which cuts through the main range of the mountains, commencing about two miles above the mouth of Barnard's River. Here, as already mentioned, we ascended the peak which Mr. Macoun christened Mount Selwyn. On the lower ridges, up to about 2,000 feet above the river, we passed over massive reddish white-weathering quartzites, and above these the whole mountain was composed of grey calc-schists and limestones, often intensely corrugated, crumpled and wrinkled, and having a general south-westerly dip at high angles. No traces of fossils were found in any of these crumpled strata, and whether they are a highly altered portion of the Cache Creek series or represent some more ancient formation remains uncertain. Similar corrugated calc-schists occur in the precipitous cliffs which rise at a short distance from the water's edge on the opposite side of the river. The ridge we followed in ascending the mountain lay very nearly parallel with the strike of the rocks, and consequently, notwithstanding the height to which we reached, a comparatively small thickness of strata came under observation. At about eight miles lower down, the valley begins again to open out; then turning a sharp bend, we come opposite the mouth of Clearwater River, where we found the black impure carbonaceous limestones and shales holding *Monotis subcircularis*, and less than two miles further, on the same side, is Fossil Point, consisting of thick beds of sub-crystalline grey limestone and limestone shale, in which corals, crinoid stems, brachiopods and other fossils are abundantly distributed, though for the most part so imperfectly preserved as to be not easily recognized. In lithological character and general appearance these Fossil Point limestones do not differ materially from those seen at Stewart's Lake, at Fort McLeod and on the Parsnip. They dip S. 30° W., $<$ 75°, 80°. Eastwards

Quartzite and calc-schists of Mount Selwyn.

Limestones of Fossil Point.

Photo.Lith. by the Burland Desbarats Co. Montreal.

LOOKING SOUTH UP THE VALLEY OF CLEAR WATER CREEK, PEACE RIVER.

from Fossil Point no rocks were seen resembling any part of the Cache Creek series.

Division V.—Throughout the whole of this region there is a marked absence of crystalline, granitic and micaceous rocks, except in the form of boulders, and even these are somewhat rare. The only occurrence of granite rocks which came under our notice was in the ridge which runs along the west side of Carp Lake. As I passed up the lake in the boats I only saw these rocks from the water. Professor Macoun passed over them on the trail, and collected some small specimens which show the ridge to consist of an ordinary grey, garnetiferous gneiss and a coarse granitoid mixture of silvery mica and white orthoclase. The granite and garnet-gneiss pebbles, which were noticed as a prominent feature in the drift on the north side of Iroquois Creek, may have been derived from this outcrop. The only other place where granite boulders were noticed was on Smoky River, already mentioned, page 58. **Garnetiferous gneiss**

From the foregoing remarks it will be seen that our season's exploration has not effected much towards elucidating the geological structure of the region, though it has added considerably to our knowledge of the distribution of the various formations in this hitherto wholly unexplored portion of the Dominion, and the information acquired—topographical, botanical and geological—will, I trust, be found interesting, as well as useful, for the guidance of future explorers in the same region. **General result of exploration.**

Economic Minerals.

Gold has been procured, from time to time, in various places and in paying quantities, both along the Parsnip and the Peace Rivers. It always occurs in very fine, uniform-sized particles, quite similar in character to that found on the Saskatchewan, and it is, I believe, entirely derived, here as there, from the drift deposits and tertiary gravels of Division I, which are cut through, washed and re-distributed by the present river action. **Gold.**

Daniel Williams ("Nigger Dan"), who has been some twelve or fourteen years on the river, and has lived, more or less, by gold washing, showed me the position in which this fine gold was generally found. This was in, or immediately beneath the upper layer of silt left by the spring flood-level of the river along the outer margin of the bushes. He seemed to think that none would be found by digging deeper into the old flood flats of the river, as is done successfully on the Fraser, at Quesnel and elsewhere; but in this opinion he is, probably, mistaken. It may, I **Its position and origin.**

think, be safely stated that there are no gold-bearing rocks on Peace River east of the Finlay branch, and, therefore, the fine gold found on the lower part of the river has, perhaps, originally been derived from rocks on the western slope of the mountains, and that these rocks contain lodes or veins, holding both silver and gold, is sufficiently proved by the occurrence of these metals, often in pieces of considerable size, about the head waters of the Finlay and Omineca Rivers. There are, however, reasons which make it, I think, even more probable that the original source of this fine gold is the same great belt of crystalline rocks which has supplied the Saskatchewan drifts, and which extends from Lake Superior to the Arctic Ocean near the mouth of the Mackenzie. Nodular concretions and bands of clay iron-ore occur in considerable abundance in some of the groups of the Cretaceous rocks, but I scarcely think that these, notwithstanding the general excellent quality of the ore, could ever be profitably mined. Those that appear at the surface would soon be exhausted, and they are not sufficiently abundant or in layers sufficiently thick and persistent to repay the cost of extraction from the associated shales, by costly mining works.

Iron-ore.

Mineral fuel.

Coal and Lignite.—The only coal seams that were seen are those, already mentioned, pages 53 and 63, in the gorge near Table Mountain, and at the head of the Cañon of the Mountain of Rocks. Only one of these can be considered as of any economic value; but it is quite likely that there are others in the region which were not observed by us.

The tertiary lignite beds at Quesnel are of no economic value; but whether there are others of better quality in the Blackwater and Parsnip River basins, as is indicated by the loose blocks which were observed on both these streams, is a question which can only be decided by further investigation.

Sandstones.

Building-stone and Limestone.—Good stone for building purposes could not readily be found on Peace River, west of the mountains, but the sandstones of the several Mesozoic formations afford good material for this purpose, and from some of these, grindstones of excellent quality have been made.

Limestone and tufa.

East of Fossil Point no limestone strata sufficiently pure for lime burning was met with. There are, however, beds on the Parsnip, and in the Stewart Lake and Fort St. James, limestone bands which would probably answer well for this purpose. Opposite Hudson's Hope, and at a few other places on the river, the water issuing from the drifts has deposited great masses of calcareous tufa, and, in parts, this has become so solid and compact as to be a pure crystalline limestone, or mass of calc-spar, from which a good lime could doubtless be burned.

In the appended Notes, furnished by Professor Macoun, relating to the geological features of the country which he traversed after we separated, will be found, besides other interesting facts, some observations on the gypsum, salt and petroleum which apparently abound in this region, and which, at some future time, must rank as the most valuable and most important of its mineral products. Prof. Macoun's notes.

Appendix II. contains Notes by Mr. J. F. Whiteaves, on some of the fossils which were collected by Professor Macoun and by myself. The larger portion of the collection was sent out, as already mentioned, by Fort Garry, and has not yet been received.

Climate and Vegetation.

These subjects are intimately connected, and are dealt with, especially the latter, in Professor Macoun's Report. I shall, therefore, here give only a few observations relating to the former.

On our expedition the thermometer was generally registered three times during the day, and the result is shown in the following table, which may serve to give some idea of the average summer temperature of the region. Temperature observations.

Table showing Observed and Average Temperature of Air.

Temperature.	Four to Six A.M.					Nine A.M. to Ten P.M.				
	June.	July.	August.	September.	October.	June.	July.	August.	September.	October.
Average.....	52°.2	57°.7	55°.5	42°.0	40°.5	61°.7	66°.9	72°.1	55°.9	50°.2
Maximum ...	66°	69°	66°	64°	56°	78°	84°	94°	70°	65°
Minimum ...	36°	46°	36°	31°	18°	46°	50°	54°	42°	26°

There were only two mornings in September when the thermometer indicated frost, viz: the 25th, when the reading was thirty-one degrees, and the 26th, thirty-two degrees. On the 5th of October it fell to eighteen degrees; after which there was no frost till the 13th of October. None of these frosts had been sufficiently severe at Fort George to injure the potatoes, which were still in the ground when we left there on the 18th of October.

Notes on the climate of Peace River.

The following memoranda, extending from 1865 to 1875, were copied from journals at St. John, kept at the Hudson Bay post, and by D. Williams ("Nigger Dan"). They show that the climate on Peace River will compare favourably with that of Montreal, ten degrees further south and nearly one thousand feet lower:—

1865.—Nov. 12.—Ice forming and drifting.
" " 16.—Light fall of snow.
" " 20.—Snow during night; weather mild.
" " 22.—Snow. Ice drifting in the river.
" " 27.—Two inches of snow during the night.
" " 30.—Part of the river set fast.
" Dec. 4.—Weather mild.
" " 5.—Snowed all day.
" " 7.—River set fast up to a little below the fort.
" " 9.—Water rising fast.
" " 10.—River set fast opposite the fort.
1866.—March 30.—Last three days very warm. Snow melting fast.
" April 7.—First goose seen.
" " 8.—Fine warm day.
" " 11.—A flock of ducks passed.
" " 20.—No ice left opposite the fort.
" " 30.—Planting potatoes.
" May 16.—Sowing turnips.
" June 2.—Water falling in the river.
" Sept. 25.—Digging potatoes.
" " 27.—Rained or snowed all day.
1868. " 9.—Rain all day.
" " 30.—Digging potatoes.
" Oct. 19.—Rain and snow during the night.
" Nov. 7.—Ice drifting first time.
" " 17.—River frozen over, but not safe to cross.
1872. " 8.—Ice commenced to run in the river; very cold
" " 28.—River closed.
1873.—April 24.—Ice moved in the river.
" " 26.—Ice broken up and cleared. Planting potatoes.
" Sept. 20.—Digging potatoes.
" Nov. 19.—Weather still mild; ice drifting in small quantity.
" " 26.—Ice still drifting.
" " 2.—First snow (lay in patches).
" " 25.—Deep snow.
" " 30.—River closed up.
1874.—March 14.—Thawing.

1874.—April	15.—Rain. Ice breaking up opposite fort.	
"	"	19.—Ice moving down.
"	"	21.—Geese came.
"	"	22.—Barley and oats being sown.
"	May	1.—Heavy rain. River clear of ice.
"	"	2.—Drift ice passing down.
"	"	3.—River clear.
"	"	5.—Potatoes planted. (1 bushel—crop dug 22nd Sept., 100 bushels.)
"	"	19.—Water rising rapidly.
"	Sept.	22.—Dug potatoes. A little snow fell, but no frost.
1875.—Feb.	18.—Warm rain; wind N.W.	
"	"	21.—Snow.
"	"	22.—Snow all day.
"	"	24.— Do. do.
"	April	14.—Creek flooded the flat.
"	"	15.—Geese came.
"	May	7.—Barley sown.
"	"	8.—Planting potatoes.

No frost on the north side of the river after the 1st of May. All the snow gone on the flats and on the hills by 15th of April.

Average depth of snow, two and a half to three feet. Horses and cattle winter out.

The approximate elevations of the principal points are given on the accompanying map. Those given for the railway crossing of the Fraser, near Willow River, for Fort George, and for Tsin-kut and Ta-chick or T-Chaka Lakes, are the results of the reduced levels taken by the Engineers of the Canada Pacific Railway. Those from Stewart's Lake to Smoky River, and that of Summit Lake, Giscome Portage, are from our aneroid observations, and are only approximate,—probably rather below the actual heights.

The average fall in the river, from McLeod to the cañon, is 2.03 feet per mile; and from Hudson's Hope, to "The Fork"—Smoky River,—1.05 feet per mile. The fall in the cañon, giving it a length of twenty-five miles, is 10.88 feet per mile. Slope of rivers.

The table on the following page shows the distance from Quesnel to "The Fork" by Giscome Portage to be 516½ miles, and by Stewart's Lake 531½ miles. All the distances given in the table are estimated, except those in the first column, between Quesnel and Fort McLeod, which are the result of pacing along the trail. In some cases there is a very considerable difference in our estimate and that of other explorers.

Table of distances.

TABLE OF DISTANCES BETWEEN SMOKY RIVER AND QUESNEL.

	SELWYN.	HORETZKY.	McLEOD.	MACKENZIE.
Smoky River — "The Fork" — to Dunvegan.	44	The Fork to Hudson's Hope. 250	....	
Dunvegan to Fort St. John	70	115	....	From the Fork. 118
Fort St. John to Hudson's Hope	38	50	From Dunvegan. 140	30
Hudson's Hope to head of canon, by the river	20 to 25	30	35	....
Hudson's Hope to head of canon, by the Portage road	11½	14	9½	13
Head of canon to Finlay Junction	75	70	90	72
Finlay Junction to mouth of Pack River	72	75	....	....
Pack River to Fort McLeod	17	14	....	....
Fort McLeod to Giscome Portage	70	....	....	....
Portage road to Fraser River	6	....	....	....
Thence to Fort George	30	....	....	....
Fort George to Quesnel	83	....	....	....
Fort McLeod to Stewart's Lake	70	85	83	....
Stewart's Lake to Quesnel	144	...	....	....

Respecting the opinion expressed (page 54) when describing the snowy-peaks which were seen bearing south, magnetic, from Table Mountain, that "there is no doubt they are the peaks of the Cascade Mountains," it may be said, that while in view of the direction in which they were observed, it is very difficult to understand what else they could be; yet the great distance to the Cascades from the point of observation—not much less, according to the maps, than 200 miles—seems to render the correctness of my supposition somewhat doubtful, and to require further verification.

I have the honour to be,

Sir,

Your obedient Servant,

ALFRED R. C. SELWYN.

MONTREAL, *May*, 1876.

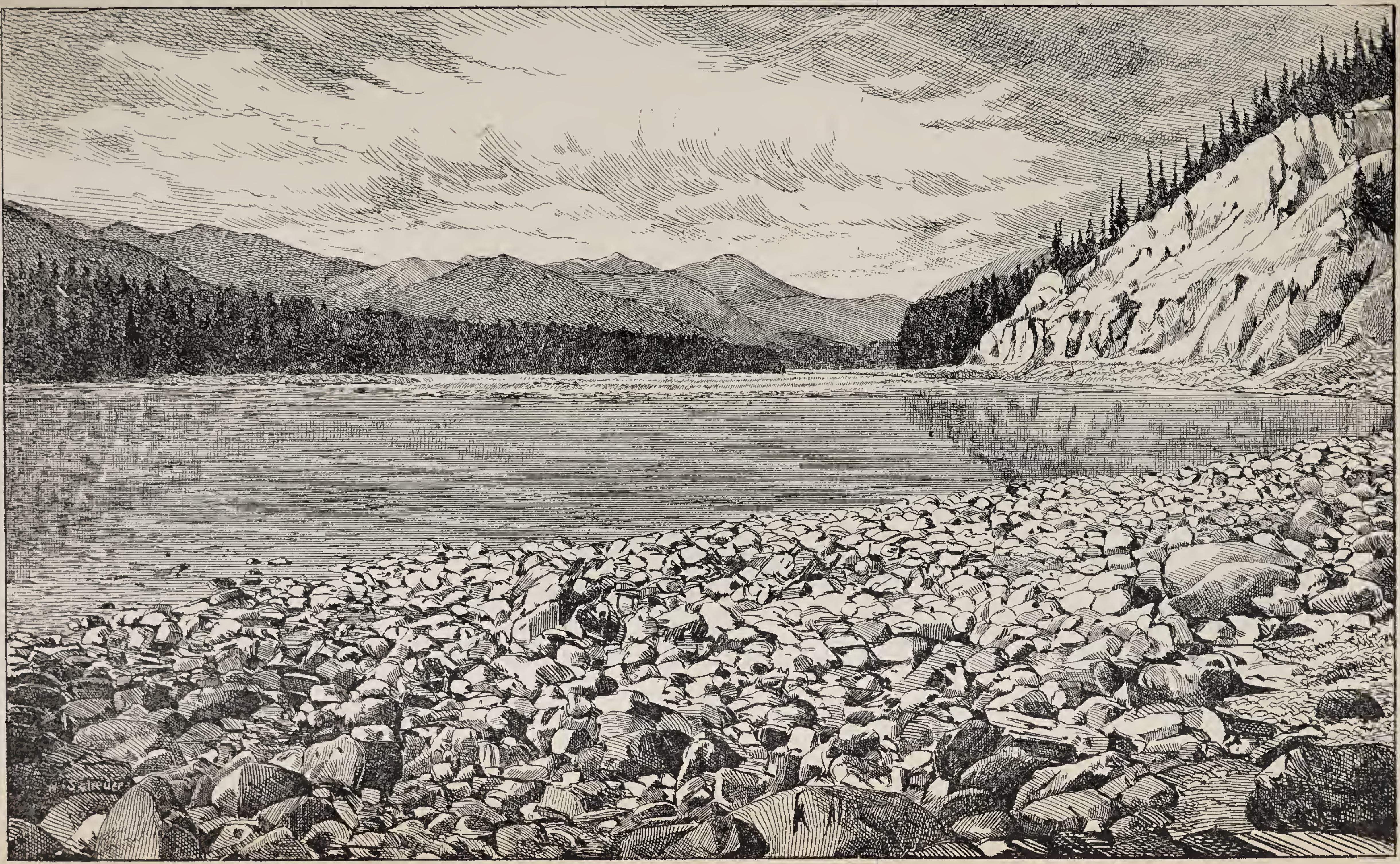


Photo.Lith.by the Burland Desbarats Co Montreal.

PEACE RIVER FROM BELOW PARLE-PAS RAPID.

From Photo. 21st Sept., 1875.

APPENDIX I.

GEOLOGICAL AND TOPOGRAPHICAL NOTES

BY

PROFESSOR MACOUN,

ON THE

LOWER PEACE AND ATHABASCA RIVERS.

Route followed.

Sir,—In accordance with instructions received at Fort St. John, I proceeded down Peace River with Mr. King, intending, as you are aware, to descend the river until we met the H. B. Co.'s boats which were then thought to be coming up, and to return with them to the point of departure. Not meeting them, however, where we expected, we continued our course down the river, and reached Fort Chipewyan on Lake Athabasca the day before the boats left there Acting, then, on the advice of Mr. Macfarlane, Chief Factor in charge of the Athabasca District, I decided to return by the way of Methy Portage, Fort Carlton, and Fort Garry, where I arrived on the 2nd of November. Had I strictly followed your instructions I would have been compelled to winter in the mountains, and to avoid this I chose the eastern route. As you descended Peace River yourself, to the mouth of Smoky River, it is unnecessary for me to say anything about the geology and topography of the country above that point.

Smoky River to Battle River.

From Smoky River to within ten miles of Cadot's River the sandstone formation continues, but very seldom shows any signs of saline matter. The scenery on this part of the river is very beautiful. The sandstone cliffs rise on either hand, and are weathered into the most varied and fantastic forms and outlines. After leaving Smoky River, the country gradually lowers, and as the river winds about, the grassy slopes appear first on one side and then on the other, until they wholly cease, and the country is entirely covered with poplar woods. In this part of the river nodules of immense size are seen at times, cropping out of the clay banks, or lying in oval or spherical masses on the shore. The gravel beaches begin to disappear and at Battle River the last one is passed, and with it all rapid or swift water. The country assumes a more fertile appearance, and everything betokens a change of soil and possibly climate. Below Battle River the Peace becomes much wider, and sandy islands and bars take the place of the gravelly ones of the upper part.

Fossils. Between Wolverine Point and Portage Point many loose fossil shells were found, as well as others which still remained imbedded in angular pieces of limestone rock, some of which was almost wholly composed of them. The banks of the river for many miles were strewed with these fossils, but the limestone rock was not found in *situ*. Fragments of ironstone nodules were abundant, but no fossils of any value could be obtained from them. A few showed the remains of ammonites, and one specimen was obtained which showed the nacreous layer of the shell.

Vast plain. By the time the Vermillion is reached the country is not more than fifty feet above the river, and presents the appearance of a vast plain, extending on the left bank all the way to the Cariboo Mountains, which are said to be forty miles distant.

Ironstone. Below the Vermillion, ironstone nodules become quite common on the left bank; in a few places they form complete strata, and many loose fossils and angular fragments of rock were seen on the beach.

Dolomite. Approaching the *chuttes* we came upon rocks altogether different from any we had yet seen, apparently a thick bedded dolomite, with nearly horizontal stratification, but dipping slightly up the river. The beds present very rough surfaces, full of small holes, which have evidently been worn out by running water.

Expecting to return by the same route I did not pay so much attention to the rocks here as I should otherwise have done. Before reaching the fall, and after passing the dolomite, I crossed, what I believed at the time to be, an oil spring, both from its colour and smell.

Bluish limestone. All the rock at the falls is a bluish limestone, which, when fully exposed to the influence of the weather, breaks up into thin layers. On the right bank, immediately below the falls, it forms cliffs from twenty to thirty feet high. The river at this point is nearly a mile wide, and presents a series of little falls all the way across. The many small rocky islands and isolated rocks that rise out of the river, and on the brink of the fall, all the way to the other side, form a beautiful panorama of rushing and falling water, wooded or rocky islet, succeeded below the falls by placid river and sylvan scene. At present (Aug. 15.) the fall is about fifteen feet, but at high water it cannot be half as much. A couple of fossils were obtained here, which were identical with others collected from a different locality. The islands in the river below the falls are rocky; rocks are also exposed on the right bank for about two miles, and are then concealed. About three miles below the falls Little Red River comes in on the right bank, and, at its outlet, a different rock formation presents itself. The beds are composed almost altogether of corals, of many species. There is a good exposure, and, as we took a day here to rest, I made a large collection. The lower layers are of fine texture, thin-bedded, and without fossils. These are followed by beds almost wholly made up of those branching corals (*Alveolites*) so common in Devonian rocks, intermixed with a species of *Zaphrentis* in great abundance, some of the higher strata being largely made up of these, but occasionally associated with others of a rounded form. Above the latter there are, at least, six feet of rock, holding large corals, in which the fine structure was nearly obliterated by the crystallisation of the mass. Others were observed in concentric layers; and some, when broken, fell apart as if formed in successive laminæ. Fossil corals.

Another outcrop occurs about a quarter of a mile up Red River. No fossils were observed here, but the rock, which is heavy-bedded and in a nearly horizontal position, appears to overlie those just described, and adds a few feet to the total thickness exposed. The rock at this point seems to overlie that at the *chuttes*. Outcrops on Red River.

Approaching "Rapid Bouillé" the banks of the river begin to attain some elevation, but no rocks are exposed until the head of the rapid is passed; then limestone crops out, but so much broken and contorted, that its dip is not apparent. Many fossils were found at this point, both loose and in the rock. A few yards below this, fine white gypsum crops out, and continues as the lowest rock in the section for the next twenty miles. This is overlaid by a light gray granular rock, largely made up of gypsum; perhaps a limestone, but no fossils were observed in it. Rapid Bouillé gypsum.

Descending the rapid the rock rises higher and higher along the shore, and by the time the lower end is reached, it has attained a height of at least fifty feet above the water. At the foot of the rapid the river is divided into two channels by a high rocky island, which stands almost in the centre of the river. In many places the gypsum attains a thickness of from ten to fifteen feet, and is as clear and white as snow. The banks of the river and the islands from here to Peace Point, a distance of fifteen miles, show this rock generally much contorted but seldom broken. At one point on the right bank the beds had been upheaved without being broken, to the height of at least forty feet, and show a very fine example of curved strata.

Contorted strata.

Laurentian rocks.

The next exposure occurs a few miles up Quatre Fourches River where Laurentian rocks crop out. They consist of grayish gneiss-granite, and in a few instances they rise to over 250 feet above the river. These exposures were soon passed, and no more were seen until we entered Lake Athabasca. The lake at its western extremity is full of rocky islands of all shapes and sizes, composed of Laurentian rocks, almost identical with those of North Hastings. Red gneissoid rocks rise in every direction, with the lines of stratification plainly discernible. Similar rocks stretch all around the north and east shores of the lake, and are said to be very precipitous in the neighbourhood of Fond-du-Lac. Beyond that point they stretch away into the Barren Lands, which are the dread of Arctic travellers going eastward from the Mackenzie River. The rock around Fort Chipewyan is all Laurentian, and almost all of a reddish colour.

Boulders and ice-polished rocks.

There are numerous boulders of conglomerate lying about which often contain large round or oval pebbles of quartz. It is just such rock as the sands along the lake would form if converted into stone. All the sand of the lake shore is very pure, and exactly the colour of the rock. It consists almost wholly of small rounded grains, red and white, probably quartz and feldspar. The rocks around the fort are all smoothed and polished by ice action. When the sun shines they glisten like so much glass, and a person walking upon them is in constant danger of falling.

Great salt deposits.

All the salt used on both the Peace and Mackenzie Rivers is obtained at Salt River, a considerable stream emptying into Slave River, about 100 miles below Fort Chipewyan. Some distance up this river a number of brine springs are scattered over a wide plain, and around these large accumulations of excellent salt are deposited. The H. B. Company send a boat there every autumn, and the finest of the salt is shovelled into sacks and brought away. Men who have been there told me that the salt is of unknown depth and extent, and it is supposed that there are vast deposits at an inconsiderable depth below the surface. Another salt region, which takes half a day to cross, is reported at about midway on the portage, between Great Slave and Great Bear Lakes.

The Buffalo Mountains, lying south-east of Vermillion, are said to contain both gold and silver, and both are reported from the neighbourhood of Fond-du-Lac. I saw no specimen of any kind of metallic mineral, except iron pyrites, which was brought from the Buffalo Mountains. Report of gold and silver.

Below Peace Point the land is very low, and the river spreads out like a lake, studded with islands ; the shores are no longer sand, but mud, and the traveller has much difficulty in putting to land, owing to its depth.

Quatre Fourches River discharges part of the waters of Lake Athabasca into the Peace when the latter river is low in the fall, but in the spring the current is reversed, and the waters of the Peace pass by it into the lake. The whole country around the south and west sides of Lake Athabasca is a vast alluvial plain, elevated but a very few feet above the level of the lake, and some years much of it remains permanently flooded. The first night after leaving Fort Chipewyan, we slept in the boats owing to the lowness of the land, which was not more than a foot above the water. The Athabasca has formed a large delta at its mouth, and is every year silting up the lake with the mud it brings down. For miles before we entered it from the lake we passed over mud flats, due to the same cause. The mouth or mouths of the river are a series of willow swamps and islands, scarcely a foot above the present (Sep. 3rd) level of the water. I am at a loss to state the breadth of the main channel of the river, as I believe that we entered by one of its smaller discharges. Extensive marshes south and west of Athabasca.

Where we breakfasted the land was two feet above the level of the water, at dinner four feet, and where we slept, six feet above it. This was twenty-five miles from the lake, and the first spruce was seen, showing that the land here was only subjected to floods in the spring.

One day-and-a-half from the lake we reached the "Embarras River," where the delta commences. At this point the general level is about ten feet above the water. The whole of the country between this and the lake is alluvium, brought down by the river in bygone ages. All this immense delta, including lakes Claire and Mamawa, and their bordering marshes, and all that part of the Peace River Valley below Peace Point, may be called a delta, or, The Delta of the Peace and Athabasca Rivers. There is no doubt but that at one time all this region was lake, which is now either silted up or being silted up by those rivers. The deposits of the Athabasca have encroached so much on the lake, that less than six miles is now the distance from the fort to the line of willows which mark the division between mud and water. Out- Delta land.

side the willows, there are more than two miles of mud shoals, covered with a thick growth of River-weed (*Potamogeton*), and a gradually diminishing depth of water, as one approaches the willows. The waters of the Athabasca are even muddier than those of the Peace, but that which issues from the lake is quite clear. The Delta of the Peace and Athabasca is almost a Manitoba in embryo, being now what the latter once was.

Coarser deposits in ascending the river.

As we ascended the river we gradually passed from mud to sand, but we were fully fifty miles up it before we saw anything like a pebble. The first indications of "tar" were in the form of pebbles composed of sand and tar, formed above and carried down by ice.

About two miles below Echo's Home we came upon the first gravel beach, and at Echo's the true bank showed for the first time on the left, but it was noticed about a mile above Embarras River on the right, and many times afterwards, showing that the river was eroding its right bank, while forming new land on its left. At this point the soil on both sides of the river is good and the banks have the reddish tinge observed at Vermillion. Later in the day Birch Mountains showed blue in the distance, bearing about south-west.

"Tar conglomerate."

Oil shales.

As we ascended, the river banks kept increasing in height, and the country began to assume the appearance of a good agricultural region. No rock was seen, but the "tar conglomerate" became very abundant, often being in beds two feet thick. Early on the afternoon of September 7th we came upon the shale beds which produce the tarry matter. After passing along them for about two miles, we stopped to trade for some dried meat, when I had an opportunity to examine them. I found below, a light grey sandstone, partly saturated with the tar, and overlying this there was at least fifteen feet of it completely saturated, and over this, again, shale largely charged with alkaline matter. This was the sequence all the way, although at times there was much more exposed. Where we landed, the ooze from the bank had flowed down the slope into the water and formed a tarred surface extending along the beach over one hundred yards, and as hard as iron; but in bright sunshine the surface is quite soft, and the men when tracking along shore often sink in it up to their ankles. During the remainder of the afternoon we sailed past other rock exposures, but observed no change in their aspect, or mode of occurence, though very often they were much higher. Next morning we had travelled about two hours when we stopped at a tar spring to procure the tar which you received last winter. The rock here was just the same as that seen yesterday. Instead of get-

Tar spring.

ting the tar on the beach, as I expected, I was led up the hill till we attained the height of forty feet; here we found a small pool of water, and underneath it the pure tar. I noticed a little stream of water flowing into the pool, which was coated with an oily scum, and under the stream an abundance of tar. Along the beach it was seen oozing out in many places, and by gathering and washing the sand saturated with it, we obtained just as pure tar as we brought from the spring on the hill-side.

Bluish concretionary limestone, in appearance like that at Little Red River, crops out on both sides of the river at Point of Rocks, forming cliffs twenty-five feet high. The upper beds are thick and withstand the weather, but about six feet from the top these gave place to rock which crumbles exactly like that containing the large corals at Red River. For more than twenty miles this rock was observed, and it was from it that the fossils were obtained labelled "thirty miles below the forks." After about twenty miles we again came on the tar shale, and passed the place where the Hudson Bay Company get their supply for the boats. All the limestone passed to-day was cream-coloured or light grey, and was heavy bedded on top, but had much the appearance of shale below. The frost disintegrates the latter, and it separates into fragments suitable for road-making. Nearly all the strata show graceful curves, the folds never rising higher than ten feet. The dip is about north and south, the strike crossing the river at nearly right angles. Bluish and grey limestones, and shales.

Within ten miles of the forks a very fine section of the rock is exposed, showing the limestone, and then about ten feet of yellowish clay, followed by at least 100 feet of black shale, which looked like sandstone, and in the distance resembles the shale between Dunvegan and Smoky River. Alkaline springs were observed oozing out of these strata, but no tar. Fine section.

I have no doubt but that the shale, out of which the tar comes, overlies the coral formation observed at Red River. Exactly at the forks the latter rises out of the water, capped by at least 150 feet of black shale, from which the tar oozes, and these are surmounted by a few beds producing an alkaline efflorescence. Mr. Moberly told me that the tar beds extended up the Athabasca to near the mouth of Lac-la-Biche River, and I found that they still continued up the Clearwater, but eventually sank beneath the soil. About ten miles up the Clearwater the men pointed out a tar spring in the stream, from which they very often got tar. Position of oil shales.

Before passing the Pembina River we came upon sandstone which is

Sandstones and limestones.

suitable for making grindstones. This rock was occasionally seen for about two miles, when signs of tar again appeared. These passed away, and limestone was occasionally seen, and towards evening I procured those fine fossils which you so much admired. For nearly a day after this no rock exposures were seen, and the next one seen showed rocks which differed from any I had yet observed. They were cream-coloured, shaly, non-fossiliferous limestones. After passing these we came to the sulphur springs. Four little creeks discharge these springs. They are said to be very bitter, and their margins are lined with sulphur.

Cream-coloured limestones at Five Portages.

We now came to the Five Portages, which I found to be caused by the cream-coloured limestone. The first rapid is about half a mile, and at two points the water falls over ledges about two feet high; opposite the lower one the rocks rise on both sides of the river to the height of twenty-five feet. About a quarter of a mile above the first rapid the second commences, and continues about a mile and-a-half. There are no falls, but the water is very rapid. The third is insignificant, but the fourth, which runs through a real cañon, is a grand sight. It is about half-a-mile long, and is very crooked and full of rocky islands, from an acre to a mere needle of rock in extent. The rocks, both on the mainland and on the islands, rise about sixty feet perpendicularly from the water. Often they overhang the river, and are full of caves of all sizes. The rock is limestone, (I believe) very hard and thick bedded, especially underneath, and in general appearance looks like the Niagara limestone of Owen Sound. I detected a few fossils in it; these are the casts observed in the small pieces of rock in youi possession. After passing up the river about two miles we came to the last rapid, which is the worst of all. It also runs through a cañon, and is altogether impassable for boats or canoes. Here the rocks tower much higher than before, attaining at least 100 feet above the stream, and confining it at one point into a width of less than thirty yards. At the head of the rapid is an island, with a fall on one side of it fifteen feet high, and towering rocks on either hand. Immediately above the fall is a little channel on the right bank, into which the boats are run when coming down stream, and to which they are hauled when going up.

Last rock xposure.

This was the last rock exposure observed; between Portage-la-Loche and the Saskatchewan the whole country is covered with drift. The difference in level between the Clearwater and Methy Lake is not less than 600 feet, so that the traveller coming from the north rises at least 600 feet in less than a mile. The portage is mostly sandy, and the lakes passed on the way are bordered with fine white sand. Many

Drift covered country.

Laurentian boulders are scattered around, and the soil is very poor. Sandy and peaty soils were of constant occurrence until we reached Buffalo Lake, when the land improves in quality. Every part of Buffalo Lake, except in sheltered bays, is fringed by a bank of boulders packed together like a pavement, and extending under the water for an unknown distance. Clearwater Lake has a similar margin, and possibly all the others. I suppose they are formed by the piling and pressing action of the ice in the spring.

Buffalo Lake, Clearwater Lake and Lacrosse Lake are on the same level; they contain multitudes of whitefish of the finest quality. All the lakes throughout the whole region are filled with a confervoid growth, which gives them a green colour and makes the water very unpleasant to drink. I suppose this matter serves the whitefish for food.

About eighty miles from Carleton I observed the first limestone boulders, which are so abundantly distributed in the Saskatchewan valley and over the adjoining plains.

I have the honor to be,

Sir,

Your obedient Servant,

JOHN MACOUN,

Botanist to the Expedition.

BELLEVILLE, ONT.

APPENDIX II.

NOTES

BY

J. F. WHITEAVES, F. G. S.,

PALÆONTOLOGIST TO THE SURVEY.

ON

SOME OF THE FOSSILS COLLECTED DURING THE EXPEDITION.

JURASSIC OR CRETACEOUS.

From Rock Island Gates, below Hudson's Hope, Peace River.

Camptonectes,——— (?)—Shell compressed, lenticular: outline subcircular, height slightly exceeding the length. Ears of the left valve small, subequal, truncated somewhat obliquely at the sides. Hinge line about one-third of the height of the shell. Surface of the test marked by crowded concentric striæ, which are scarcely visible to the naked eye unless examined in a strong light. The species is represented by two left valves and by one right, but the latter specimen is a distorted cast with very little of the shell remaining. The exact shape of the ears is only to be seen in one of the left valves, which must have belonged to a shell which was not full grown. Closely allied in sculpture and shape to *Camptonectes stygius*, White,* with which it may be identical, but its ears are much smaller and its hinge line consequently shorter.

Thracia——— (?)—A single valve of a shell which probably belongs to this genus, but which is not in a sufficiently good state to be determined.

From these rocks there are casts of two other species of lamellibranchiates in very bad condition; one may be an *Aucella* or an

* "U. S. Geological and Geographical Surveys West of the 100th Meridian." Part I., Vol. IV., Palæontology, Page 164, Plate XIII., Fig. 2, *a*, *b*, and *c*.

Inoceramus, the other looks more like one of the Veneridæ or Cyprinidæ, but in neither case can the genus be satisfactorily made out. There is also a compressed fragment of a cast, which may be part of a mould of the chamber of habitation of a Nautilus or Ammonite.

Triassic.

From a few miles above Fossil Point, Peace River.

Monotis subcircularis, Gabb. ("Palæontology of California," Vol. I., page 31, Plate VI., figs. 29, 29 *a*.

This characteristic fossil of the Californian Triassic is abundant in the blackish limestone of the locality above mentioned, where it seems to prevail almost to the exclusion of every other species. Some individuals are more oblique than the original of Mr. Gabb's figures, but the character principally relied upon for distinguishing between this shell and the *Monotis salinaria* of Europe, viz., the rounded upper end of the anterior margin, is remarkably constant in the Peace River specimens.

The only other species collected in these rocks is a spiral shell, which is crushed flat, and so badly preserved that it is difficult to decide whether it belonged to a gasteropod or cephalopod.

Carboniferous or Permian.

From rear of Fort St. James, Stewart's Lake, B.C.

Fusulina Cylindrica, Fischer.—Sections of the limestone at Fort St. James show several specimens of Fusulina quite distinctly under the microscope, and Mr. G. M. Dawson has since obtained others from this locality which are plainly visible without the use of a lens. The whole are referred to *F. cylindrica* in accordance with the conclusion of Dr. A. C. White that all the known *Fusulinæ* belong to one species.

Chætetes (?) species.—A small silicified coral or polyzoon, whose characters do not accord well with those of any known genus. The mass, as a whole, is sub-cylindrical, but dilated at one end into an irregular sub-sphærical head. Its maximum length is less than half an inch. The corallites are exceedingly minute, and diverge towards the larger end; their apertures are irregular in outline, and are not uniformly either round, polygonal or crescentic. No traces of any septa or tabulæ were detected in the tubes.

Devonian or Carboniferous.

From Fossil Point, Peace River.

1. *Zaphrentis*, ———(?)—Several imperfectly preserved examples of a Cyathophylloid coral, which are believed to be referable to this genus. The pointed extremity of nearly all the specimens is broken off, and the structure of the interior is not well shown. No tabulæ or transverse diaphragms are apparent in any of them, and in this respect the species resembles a *Petraia*. The corallum is simple, conical and slightly curved; the epitheca, of which only fragments remain, is thin and marked with very numerous longitudinal striations, also with a few distant encircling lines of growth. Where the epitheca has been weathered off by exposure the longitudinal striation of the surface is much coarser, and the striæ, or rather costæ, bifurcate above. Judging by these external markings the septa appear to have been twisted, but as the calice in each specimen is filled up by the matrix, it is not known whether there is a septal fossette, or if there are any dissepiments between the septa. The largest and best example has part of the base broken off, but when complete its height must have been nearly two inches and-a-half; the width across the top of the cup is one inch and seven lines. A longitudinal section of this individual shows that the calice was moderately deep and that at its base the septa extend to the centre of the visceral chamber. The specimens are not perfect enough for a critical comparison with nearly related forms, and the same thing may be said of most of the fossils from this locality.

2. *Syringopora* (?) species.—A small piece of rock in which the matrix is siliceous and the coral calcareous. In the upper part of the specimen most of the corallites are weathered out, and a number of cylindrical holes about half a line in diameter is the result. The basal portion contains the corallites in place, but on breaking a portion off and immersing it in dilute acid, they were entirely dissolved out. It is scarcely possible to tell if there were any transverse connecting processes between the corallites, and hence the doubt as to what genus the coral should be placed in. Transverse sections of the tubes show no structure at all, and longitudinal slices expose only what appear to be deeply funnel-shaped tabulæ, but these are very indistinctly seen.

3. *Favosites*, ——— (?)—Two large fragments, probably different parts of the same specimen, of what is most likely a massive species of *Favosites*, though the mural pores characteristic of that genus are nowhere visible. The corallites are long, irregularly flexuous (probably

from horizontal compression) and equal in diameter. They are uniformly hexagonal, about a line or a line-and-a-half in their greatest width and longitudinally striated on the outside. Their internal structure is exceedingly complicated. One of the specimens was ground down so as to give a longitudinal section of the entire mass. The interior of the tubes thus exposed is seen to be filled with a coarse network, formed apparently by the coalescence of innumerable lamellæ, which meet at different angles. In a thin, transparent, longitudinal slice through the centre of a small portion, containing part of four contiguous corallites, each side of the tubes appears as a single linear series of loops placed one above the other in an imbricating manner, their convex faces being directed upwards and inwards. The central portion of each corallite as thus viewed seems to be occupied by crowded, irregular, often crooked or flexuous transverse plates, which rarely extend the whole way across it in one unbroken line. Without actually crossing each other they often coalesce towards the centre. Transverse sections show ten radii, which proceed from the outer wall but do not extend quite to the centre; also what looks like an irregular ring in the middle of each corallite, inclosing a large central space, but the radii seem to penetrate within this circle.

According to Dr. Rominger* the Silurian *Favosites* differ from the Devonian species "by invariably having simple diaphragms and by the spinulose character of their radial crests." The rudimentary septation of the present species is of a lamellar rather than spinulose character, and its transverse diaphragms are by no means simple, but incomplete, complicated and irregular. The Peace River *Favosite* is probably of Devonian rather than Silurian type, and belongs to the section for which Milne Edwards proposed the name *Emmonsia*. It is closely allied to *Favosites Emmonsii*, Rominger, but differs from that species in several, though perhaps, unimportant respects, the principal difference being that in the species just described the diameter of the corallites is about twice that of those of *F. Emmonsii.*

4. *Chætetes* (?) species.—Two specimens of a thin, wavy and entire, but apparently not encrusting coral (or polyzoon) of which only one surface is exposed, the rest being almost entirely concealed by the matrix. The apertures are very minute, sub-circular or polygonal in shape, and surrounded by moderately thin walls whose upper margins

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* "Geological Survey of Michigan, Lower Peninsula." Palæontology, Fossil Corals. New York: 1876. Page 19.

are rounded. The microscopical characters of these specimens are almost exactly the same as those of two or three Silurian species of *Stenopora* described by Mr. Billings. The obscure genus *Stenopora* of Lonsdale is now merged partly in *Chætetes* and partly in *Favosites*, and the present fossil is provisionally referred to *Chætetes* from its resemblance to *Stenopora palmata*, Billings, and to such forms as *Chætetes frondosus* and *pavonia*, as figured and described in the "Polypiers fossiles des terrains Palæozoiques" of Edwards and Haime.

5. A few detached joints and portions of stems of a crinoid, genus undetermined.

6. Two or three casts of the non-celluliferous side of a species of *Fenestella* or of an allied genus of Polyzoa. Somewhat similar specimens are in the collection made by Mr. J. W. Spencer from the Devonian limestones of the north-west portion of Lake Winnepegosis ; and nearly related forms occur also in the Corniferous rocks at Woodstock and at Cayuga, Ont.

7. *Rhynchonella*, (N. Sp.) ?—A solitary but silicified and beautifully preserved specimen of a rather small species of *Rhynchonella*. The shape of the shell is transversely elliptical, the width being greater than the length ; the beaks are small, and there is a sub-angular mesial fold. The sculpture consists of acute plications, which are strongly marked at and near the front margin of the valves, but which become obsolete at the sides. The umbonal or visceral region of the shell is quite smooth. On the ventral valve there are three plications on the central sinus and three on each side ; on the dorsal there are four on the mesial fold, as well as two distinct ones and another partially obsolete on each side. The species very closely resembles small specimens of the variety *anisodonta* of *Rhynchonella pugnus*,* an English Devonian species, but the plications of that shell are more rounded at their summits.

Rhynchonella Uta of Marcou, from the Carboniferous rocks of Utah, has very similar sculpture, but it has much larger beaks and a more triangular shape. This little brachiopod is probably undescribed, but it is not thought desirable to give it a new specific name until it is known whether the characters indicated above are constant.

8. *Spirifera* ——— (?) —Compare *S. disjuncta*, Sowerby, especially as illustrated by Davidson in his monograph on the "British Devonian Brachiopoda," Part VI., No. 1., and by Murchison, De Verneuil and De Keyserling in the "Palæontology of Russia."

* "British Devonian Brachiopoda." Pal. Society. Part VI , page 63, plate XII., figs. 12-14.

An obliquely distorted and imperfect ventral valve of a species of *Spirifera* closely allied to, if not identical with the *S. disjuncta* of Sowerby and other authors. The width of the specimen is about one-third greater than the length; its outline is subquadrate, but the front angles are rounded and the centre is a little produced. The beaks are small and the mesial fold is rounded. The whole surface is marked by numerous, apparently simple, rounded, radiating ribs or plications, which are crossed by somewhat distant and irregularly disposed concentric lines of growth. The sculpture is badly preserved, so that the exact number of the ribs cannot be counted, but there must have been at least fifty. I am unable to find any features of importance by which this specimen can be distinguished from *S. disjuncta*, but it is too imperfectly preserved to be satisfactorily identified. The radiating ribs on the mesial fold and sinus of *S. disjuncta* are indeed said to be bifurcating, and its concentric striæ to be "numerous, fine and contiguous;" but the sculpture evidently varies in these respects, for in some of Davidson's and De Vernueil's figures the radiating ribs of the central part of the shell are represented as simple, and the lines of growth as quite as distant as they are in the solitary example from Fossil Point. In the "Palæontology of Russia and the Ural Mountains,"* it is stated that in the Carboniferous species of *Spirifera* the radiating plications on each side of the mesial fold are either divaricating, or else they are comparatively large and few, while in the Devonian species the corresponding plications are said to be simple, much finer and more numerous. This generalization does not seem to be of much value, but judged by it, the present species would appear to be of Devonian rather than of Carboniferous type.

9. *Spirifera*——— (?) Perhaps a variety of the preceding species. Three crushed and more or less imperfect dorsal valves of a broad-winged *Spirifera*. The width of these specimens is fully twice their length, and the outline of the front margin of the wings, near their apices, is concave in some individiduals and convex in others. The finer details of the sculpture have been obliterated, and no concentric striations are apparent, but the radiating ribs or plications appear to have been rather coarser and fewer in these fossils than in the *Spirifera* last described.

10. *Productus* ——— (?) species. A distorted and much broken valve of a brachiopodous shell, which is very doubtfully referred to this genus.

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* Page 158.

The umbonal region is broad and gibbous, but slightly depressed in the middle, and the beak is strongly incurved. The test is partly exfoliated, and the only surface markings now visible are crowded longitudinal striæ, or fine ribs, without any appearance of their being crossed by transverse lines. The specimen, however, is too imperfect to be worth describing in detail.

(A microscopical examination shows that foraminifera, apparently of a simple Rotaline type, are frequent in the limestone at Fossil Point. These organisms have yet to be studied. No *Fusulinæ* were observed, though they were specially looked for.)

From Peace River, between Fossil Point and the Canon of the Mountain of Rocks.—Loose.

Diphyphyllum —— (?) Compare *D. arundinaceum* and *D. stramineum*, Billings. A rather small rounded boulder of argillaceous limestone containing many silicified corallites of a species of Diphyphyllum, more than a hundred of which are exposed at one end of the specimen, and nearly as many at the other. The corallites are about four or five inches in length, and rather closely aggregated, though they seldom touch each other. They are nearly perpendicular, but diverge from below upwards, and are slightly flexuous. The surface of each is worn, and all the markings visible externally are fine longitudinal grooves, which correspond to the septa within. The corallites are nearly circular in section, and average from two to three lines in diameter, though in one isolated instance the width is nearly three-quarters of an inch. There are no horizontal connecting processes apparent between them. Transverse sections of the corallites show that there are about twenty-two primary septa which extend only a short distance from the periphery, and between these an occasional intervening one can be made out. A longitudinal section near the outside exposes a square open network caused by the septa being crossed by the tabulæ. In a thin slice in the same direction, but cutting through the centre of the corallite, the tabulæ or transverse diaphragms only are visible. These are very irregular in their disposition: some are continuous and extend from wall to wall, but do not turn downwards on approaching the margin; others are incomplete and convex, forming sometimes small compound lateral arches resting on the complete diaphragms, and between these extremes there are almost endless varieties of arrangement, though the structure is never cellular. There does not seem to have been any columella, and in this respect the coral differs from *Lithostrotion*.

Geological Horizon unknown.

From Peace River about twelve miles above the canon.

Lingula—— (?) Shell compressed, elongated; outline in some specimens ovately elliptical, in others the margin of the valves is somewhat squared in front, (the antero-lateral angle being abruptly rounded) and narrows convexly towards the beaks at some distance behind the middle. Sides almost straight and parallel, usually two-thirds of the way from the front, the latter part of the shell being squarely truncate in some individuals, and slightly convex in others. In adult shells the length is about twice the width, but younger specimens are wider in proportion. The most perfect specimen is one inch in length by rather more than seven lines in width. Another and presumably full grown example, which has part of the posterior extremity broken off, is estimated to have been one inch and-a-half long; its actual width is nine lines. The surface is marked by fine and delicate concentric striæ or lines of growth. In one specimen there are indications of a few faint radiating lines in the centre of the valves. Nine specimens were collected, most of which are imperfect. At present I have failed to identify this *Lingula* with any named species, and am inclined to regard it as new to science. If the latter conclusion should prove to be well founded, the shell may be named *Lingula Selwyni.*

Associated with the *Lingulæ*, there are two or three broken brachiopodous shells like a smooth globular *Terebratula* (or *Athyris ?*) with a short marginal fold; fragments of a lamellibranchiate bivalve, and a gasteropodous shell with a moderately elongated spire and whorls encircled by a single keel. The fossils so far obtained from this locality do not afford much clue to the age of the rocks from which they were collected. The matrix is very like the black limestones above Fossil Point which hold *Monotis*, but it is equally like those of the Trenton period.

Fossils from the Lower Peace and Athabasca rivers, collected by Prof. J. Macoun.

All the specimens are of Devonian age, probably about the horizon of the Hamilton group of Ontario and the State of New York. The bituminous shales which overly these fossiliferous limestones, and which were once supposed to be synchronous with the Marcellus shales, are now regarded as more probably the equivalents of the Genessee slates.

From Rapid Bouillé on Peace River, above Peace Point.

(Professor Macoun thinks these beds the lowest in the series.)

1. Detached joints of small crinoidal stems.

2. *Strophomena inæquistriata?*—Conrad. A small but well preserved ventral valve. It wants the minute striation between the ribs usually characteristic of this species, but these striæ are not mentioned in the original diagnosis, and the specimen agrees fairly well with Conrad's description and figures. It is also very much like the figure of *Leptæna interstrialis* (Phillips,) in Davidson's Devonian Brachiopoda, with which *S. inæquistriata* may be identical.

3. *Strophomena demissa* (?)—Conrad. Two very badly preserved specimens. The sculpture is almost obliterated, but although the valves are not very convex, the strong transverse striation of the hinge area, and the absence of any foramen, make it probable that these shells may be referable to the above named species.

4. *Strophomena subdemissa*—Hall. A solitary ventral valve, in very good condition. Only a variety of the preceding, as Prof. Hall now admits.

5. *Strophomena ?*—Fragments of a very flat species, at present undetermined.

6. *Spirifera* (Sp. undt.)—A broad-winged Spirifer, with rather coarse radiating plications, which are absent in the mesial fold and sinus. The only specimen collected is the dorsal valve of an apparently immature individual.

From the Athabasca River, between twenty and thirty miles below "The Fork."

1. Detached joints of small crinoidal stems.

2. *Strophomena deltoidea ?* Wahlenberg.—Two or three minute valves, measuring about two lines in width by a little more than one line in length, of a shell which is believed to belong to this well-known and persistent type.

3. *Productus dissimilis,* Hall.—A single specimen, exactly like the figure of the individual figured by Mr. Meek as this species in the "Transactions of the Chicago Academy of Sciences," Vol. I., Part I., Plate XIII., figs. *a*, *b* and *c*. The original of Mr. Meek's figure was collected by Major Kennicott on the banks of the Clearwater.

4. *Rhynchonella* (?) N. Sp. (?)—A small piece of water-worn limestone containing about thirty partially weathered out specimens of a small brachiopod whose generic position is uncertain, as the internal structure is unknown. The shells are moderately convex, their outline is broadly ovate or sub-pentagonal, and their length is about equal to their breadth. The beak of the ventral valve is uncurved and overhangs that of the dorsal in such a way as to conceal the foramen and deltidium, if either exist. The mesial fold and sinus are broad but shallow, and there are a few faint irregular, rounded plications on the front margin, the rest of the shell being smooth. An average example measures three and a half lines in length by about three in width. This little shell appears to belong to the *Rhynchonella* family, but it may be a *Pentamerus* or a *Camarophoria*.

5. *Pleurotomaria* ——— (?)—Probably the same as the fossil figured by Meek in the Trans. Chic. Ac. Sc., Plate XV., fig. 3, without a specific name.

Prof. Macoun says similar specimens were observed at the *chuttes*, on Peace River.

From the Clearwater River.

Orthis Iowensis, Hall.—Large variety. See Meek's description and figures of this form in the Trans. Chic. Ac. Sc., Vol. I., page 90, Plate XII., fig. 2.

Twenty-two fine specimens of a large *Crthis* which are evidently conspecific with the examples collected by Major Kennicott on the Clearwater a few years since and described by Meek in the journal above named. The largest individual obtained by Prof. Macoun is two inches wide, twenty and-a-half lines long, and thirteen lines in its greatest convexity; its hinge area is an inch and rather more than one line in width. The deep and narrow inflection of the front margin, coupled with the comparatively short hinge line will enable this species to be readily distinguished from the *Orthis striatula* of Schlotheim (not Conrad) to which De Verneuil & Davidson have united the *O. resupinata* of Sowerby. The surface markings of the American and European types are exactly similar, for the specimens before me plainly show traces of imbricating tubular spines on the radiating striæ, a circumstance not mentioned in Mr. Meek's descriptions of this form.

The large variety of *Orthis Iowensis* was collected on the banks of the Slave River in 1825 by the officers of Sir John Franklin's expedition;

on the Clearwater, by Sir John Richardson, in 1858, and afterwards at the same place by Major Kennicott. Smaller and more typical examples of the same species were obtained by Prof. Hind, in 1858, from the Devonian limestones of Snake Island, Lake Winnipegosis.

Atrypa reticularis (Linn.)—Abundant and well preserved.

Spirorbis omphalodes ? Goldfuss.—A small species of *Spirorbis* is abundant, attached to shells of the two species of brachiopoda collected at this locality. The shell is dextral; one whorl and a half are visible externally, and there is a small umbilicus. The outer whorl is either evenly rounded, or else a little angular near its outer edge; the surface is perfectly smooth. It is evidently the same species as the *Spirorbis* described and figured by Dr. H. A. Nicholson in his report on the Palæontology of Ontario (page 121) as *S. omphalodes.*

From the Upper Portage of the Clearwater.

Portions of stems of a rather large crinoid.

My determinations have been greatly facilitated by the skilful manner in which the microscopical and other sections which I required were prepared for me by Mr. T. C. Weston.

J. F. W.

APPENDIX III.

LIST OF COLEOPTERA.

BY

PROFESSOR J. LeCONTE.

A large number of Coleoptera were collected during the expedition. These have been submitted for examination to Professor Le Conte, of Philadelphia, and he has kindly returned me a complete set pinned and named. Professor Le Conte says:—"The series is larger than I supposed it would be, containing 153 species, besides some indeterminate ones which I have kept for future study by any person who will monograph the genera to which they belong. The unpinned duplicates have been securely enveloped in paper and placed in the bottle in which they were sent."

This collection has been placed in the Museum of the Natural History Society of Montreal, and the following is the list furnished by Professor Le Conte of the genera and species :—

1. Cicindela longilabris.
2. " 10–notata.
3. " 12–guttata.
4. Elaphrus Clairvillei.
5. " riparius, *race* Californicus.
6. " probably n. sp. unless described from Siberia.
7. Opisthius Richardsonii.
8. Nebria Sahlbergi.
9. " Mannerheimii.
10. Carabus tædatus.
11. " serratus.
12. Calosoma tepidum.
13. Trachypachys inermis.
14. Lebia cyanipennis.
15. Cymindis cribricollis.
16. Metabletus Americanus (*race ?*).
17. Calathus ingratus *race* confusus.
18. " mollis, *race* lenis.
19. Platynus sinuatus.
20. " melanarius.
21. " anchomenoides.
22. " obsoletus, *race* strigicollis.
23. " retractus *Lec.*

24. Pterostichus orinomum.
25. Amara fallax.
26. " erratica.
27. Anisodactylus (Dichirus) piceus.
28. " confusus.
29. Harpalus oblitus.
30. " ruficornis.
31. " cautus.
32. " basillaris.
33. Patrobus aterrimus.
34 Bembidium paludosum.
35. " planatum.
36. " complanulum.
37. " Mannerheimi.
38. " incrematum.
39. " nigripes.
40. " patruele.
41. " quadrulum.
42. " funereum.
43. " lucidum.
44. " versicolor.
45. " connivens.
46. " sulcatum.
47. " axillare.
48. Stenolophus conjunctus.
49. Hydroporus griseostriatus.
50. Agabus (Gaurodytes) lutosus.
51. " " scapularis.
52. " " infuscatus.
53. Colymbetes sculptilis.
54. " binotatus.
55. " tostus.
56. Dytiscus anxius.
57. Gyrinus ventralis.
58. " picipes.
59. Hydrobius fuscipes.
60. Silpha Lapponica, male and female.
61. Catops Spenciana.
62. Hydnobius n. sp.
63. Homalota.
64. Aleochara.
Boletobius.
"
65. Quedius (fulgidus).
66. Creophilus villosus.
67. Philanthus.
68. "
69. "
70. Anthobium pothos.
71. Hister depurator.
72. Saprinus Oregonensis.
73. " estriatus.
74. Omosita discoidea.
75. Hippodamia quinquesignata.
76. Coccinella trifasciata.
77. " transversoguttata.
78. " picta.
79. Psyllobora 20-maculata.
80. Calitys dentata.
81. Peltis ferruginea.
82. Dermestes talpinus.
83. Cytilus trivittatus.
84. Byrrhus Kirbyi.
85. Platycerus depressus.
86. Aphodius pectoralis.
87. Dichelonycha Backii.
88. Diplotaxis brevicollis.
89. Lachnosterna fusca.
90. Dicerca prolongata.
91. " tenebrosa.
92. Melanophila longipes.
93. " Drummondi.
94. Anthaxia inornata.
95. Adelocera rorulenta.
96. " profusa.
97. Cryptohypnus abbreviatus.
98. Sericosomus incongruus.
99. Corymbites æneicollis.
100. " umbricola.
" lobatus.
101. " æripennis.
102. " cruciatus.
103. " Suckleyi.
104. Eros simplicipes.
105. " coccinatus.
106. Podabrus piniphilus.
107. " lævicollis.
108. Telephorus Curtisii.
109. " grandicollis, male ?
110. " grandicollis, female ?

111. Telephorus fraxini.
112. Clerus undulatus.
113. " sphegeus.
114. Corynetes violaceus.
115. Spondylis upiformis.
116. Asemum atrum.
117. Phymaodes dimidiatus.
118. Merium Proteus.
119. Pachyta liturata.
120. Leptura subargentata.
121. Monohammus Oregonensis.
122. Syneta tripla.
123. Orsodachna Childreni.
124. Adoxus vitis.
125. Chrysomela multipunctata, *race* verrucosa.
126. Entomoscelis adonidis.
127. Gonioctena rufipes.
128. Plagiodera Lapponica.
129. " (Phædon) oviformis.
130. Galeruca sagittariæ ? var.
131. Oedionychis lugens.
132. Graptodera bimarginata, Say. (= G. plicipennis, Mann.)
133. Graptodera evicta.
134. Crepidodera mancula.
135. Phellopsis porcata.
136. Coniontis ovata.
137. Eleodes cordata.
138. Upis ceramboides.
139. Crymodes discicollis.
Meloe, not determined.
140. Cantharis cyanipennis.
141. Cephaloon tenuicorne.
142. Mordellistena vitis.
143. Hypophlœus punctatus.
144. Sitones (indeterminate).
145. Evotus naso. *Lec.*
146. Trichalophus alternatus.
147. Lepyrus colon.
148. Pissodes costatus.
149. Lixus caudifer.
150. Dorytomus laticollis.
151. Xyleborus (Dryocœtes) septentrionalis.
152. Dendroctonus obesus.
153. Cucujus puniceus.

REPORT

OF

PROFESSOR MACOUN,

BOTANIST TO THE EXPEDITION,

ADDRESSED TO

ALFRED R. C. SELWYN, Esq., F.R.S., F.G.S.,

DIRECTOR OF THE GEOLOGICAL SURVEY OF CANADA.

Instructions.

Sir,—Early last April I received your instructions to proceed by San Francisco to Vancouver Island, and there employ myself making collections and observations in connection with its flora until your arrival.

In pursuance of these instructions I left Belleville on the 14th April, but owing to detentions in the Rocky Mountains, west of Laramie City, I did not reach San Francisco until the morning of the 27th. At noon the same day I embarked on board the mail steamer "Los Angelos," and reached Victoria on the morning of May 2nd.

Work was commenced at once, but owing to the almost constant rains for the first five days, I could collect nothing but mosses. The weather having cleared up a number of excursions were made in the neighbourhood of Victoria, and among other noted localities, Mount Tolmie and Cedar Hill were visited.

Character of the country and the vegetation around Victoria.

The country examined is more or less rocky, but, as there are no boulders, portions of the valleys are well suited for cultivation, and these in most cases are cleared and occupied. The higher rocky prominences are covered with Douglas fir (*Abies Douglasii*), which may be said to be the characteristic tree of Vancouver. Where the Douglas firs prevail the forest is more or less dense, but where the oak (*Quercus Garryana*) abound it is more open. The oak lands are usually rocky and unsuited for cultivation, but make good pastures, being generally covered between the rocks with a grassy sward. The cultivated lands are generally low and evidently very rich; but I was told that large crops were not raised, owing to bad cultivation and the want of proper drainage. In the woods on the low ground, there are a number of species of deciduous trees. Prominent amongst them are two maples (*Acer macrophyllum* and *circinatum*), a number of large willows, a large alder (*Alnus rubra*) with a stem above a foot in diameter, a crab-apple (*Pyrus mollis*) and two poplars (*Populus tremuloides* and *balsamifera*). Along the coast *Pinus contorta* was occasionally seen, and the beautiful *Arbutus Menziesii*, with its large laurel-like leaves and bright red bark, is a striking object on every point. On Cedar Hill the western cedar (*Thuja gigantea*) is still abundant, while the slopes of Mount Tolmie are covered with gnarled oak. A yew (*Taxus brevifolia*) and a cypress (*Cupressus Nutkatensis*) were occasionally seen. Deciduous trees.

Many beautiful flowering shrubs were seen in the thickets, but owing to the season only a few were in flower. Prominent amongst them were various gooseberries and the red-flowered currant (*Ribes sanguineum*). Several species of raspberries were observed which were new to me, and one (*Rubus Nutkanus*) which extends as far east as Lake Superior, replaced in Ontario by the flowering raspberry (*Rubus odoratus*). Spiræas and roses were in profusion, but were not in flower. These shrubs are a very prominent feature of the West Coast forests, and form such tangled thickets in many places that I found it difficult to penetrate them. A very fine rosaceous shrub *Nuttallia cerasiformis* was frequently met with in company with the closely related species *Prunus emarginata*. Blueberries and winter green were represented by *Vaccinium cæspitosum V. angustifolium* and *Gaultheria Shallon*, both of which were frequently seen. The "Oregon Grape" was very conspicuous on the hill-sides and in the deep hollows, its long racemes of yellow flowers being showy at this time. Two species (*Berberis aquifolium* and *nervosa*) were observed—the former amongst the rocks, the latter by the streams. Another small shrub (*Pachystima myrsinites*) deserves mention on account of its beauty and its adaptability to our climate. I found it in flower in November, 1872, when the thermometer was below zero, as far north as McLeod's Lake, latitude 55°, and again in May, on Vancouver Island. It is an evergreen, and the flowers of the preceding autumn remain on all winter and produce fruit the following summer. A number of other shrubs were noted, the names of which are given in the lists appended.

Many spring flowers were collected, admirable for the brightness of their colours and the beauty of their forms, apart from the interest which attached to them as being the harbingers of the Western spring. No plants in Eastern America can compare with the bright blue of the camass (*Camassia esculenta*) which covered at times many square rods of meadow land intermixed with the lovely *Dodecatheon Meadia* and the superb *Erythronium grandiflorum* or western dog-tooth violet. Fritillarias, trilliums, and many other lilaceous plants, violets, yellow, blue and white, eight or ten species of Claytonia and a host of lesser beauties, with the western skunk cabbage, (*Lysichiton Kamtschatense*), made up the flora of the low grounds; while the crevices of the surf-beaten rocks and the moss that covered them in part abounded with very interesting if not beautiful flowers. The slopes of Cedar Hill and Mount Tolmie had many species which seemed peculiar to them, and which plainly indicated that a part at least of the California flora had worked its way thus far to the north.

Climate of Vancouver.

Two facts regarding the climate of Vancouver Island are indicated by the flora: dry summers, and abundant rainfall; the former shown by the annuals being all in fruit and flower by the first week in May, and the latter by the luxuriant growth of succulent vegetation in the low grounds.

The general character of the flora further proves that the climate is warmer than that of England, and that the rainfall is periodic rather than variable, and corresponds with the increase and decrease of summer heat. It is a remarkable fact that July, the month of least rainfall on the coast, is that of the greatest on the dry region along the Thompson. The difference in the time of blossoming of apple trees on Vancouver Island and at Belleville, Ontario, is about three weeks. In the beginning of May, 1875, vegetation was said to be unusually backward, and yet it was three weeks in advance of Ontario.

Apple trees.

Owing to the wetness of the soil, many apple trees, though young, were beginning to show signs of decay; but draining would remedy this, and if the advice I gave, to plant orchards amongst the rocks, where the oak abounds, is attended to, no more complaints will be heard about apple trees dying young. Although the spring was so far advanced, scarcely any ploughing had been done owing to the water in the soil, and consequently over a month of the best period of growth for cereals was gone. In many places I saw grass a foot high, and expected to find cabbages and other vegetables proportionately advanced, but there were none to be seen. The climate is everything that can be desired, and a larger number of settlers, with more advanced ideas of agriculture, is alone required to make Vancouver what nature intended it to be—the garden of Canada on the Pacific coast.

Appended is a list of the principal herbaceous plants found in flower on the southern part of Vancouver Island in the early part of May, 1875 :— List of herbaceous plants, Vancouver Island.

Delphinium Menziesii, D C.
Myosurus minimus, L.
Barbarea vulgaris, L.
" præcox, L.
Brassica campestris, L.
Dentaria tenella, Pursh.
Lepidum Menziesii, D C.
Thysanocarpus curvipes, Hook.
Viola Nuttallii, Pursh.
Hypericum Scouleri, Hook.
Arenaria tenella.
Sagina Linnæi, Pursh.
Stellaria nitens, Nutt.
Claytonia Chamissonis, Esch.
" exigua, T. & Gr.
" linearis, Dougl.
" parviflora, Dougl.
" perfoliata, Donn.
" Siberica, L.
" spathulata, Dougl.
Sidalcea malvæflora, Gr.
Erodium cicutarium, L'Her.
Cytisus scoparius, L.
Hosackia parviflora, Benth.
Lathyrus venosus, Meek.
Lupinus bicolor, Lindl.
Trifolium cyathifolium, Lindl.
" fimbriatum, Lindl.
" microdon, Hook & Aud.
" microcephalum, Pursh.
" pauciflorum, Nutt.
Alchemilla occidentalis, Nutt.
Fragaria Chilensis, Ehrb.
Prunus rivularis, Doug.
Heuchera glabra, Willd.
Lithophragma parviflora, Nutt.
Saxifraga cæspitosa, L.
" integrifolia, Hook.
Tellima grandiflora, Dougl.
Tolmica Menziesii, T. & Gr.
Daucus pusillus, Michx.
Ferula multifida, Nutt.
Peucedanum leiocarpum, Nutt.
" macrocarpum, Nutt.
Sanicula Menziesii, Hook.
Galium aparine, L.
Plectritis congesta, D C.
Macrorrhynchus heterophyllus, Nutt.
Leontodon hispida, Willd.
Bahia lanata, Nutt.
Balsamorhisa deltoidea, Nutt.
Bellis perennis, L.
Campanula Scouleri, Hook.
Plantago lanceolata, L.
" gnaphaloides.
Dodecatheon Meadia, L.
Trientalis latifolia, Gr.
Castilleia parviflora, Bong.
Collinsia nana, Gray.
Gratiola ebracteata, Benth.
Mimulus alsinoides, Doug.
" luteus, L.
Orthocarpus attenuatus, Nutt.
" bracteosus. Benth.
" pusillus, Benth.
Pedicularis bracteosa, Benth.
Tonella Collinsoides, Nutt.
Veronica Stelleri, Pall.
Micromeria Douglasii, Benth.
Echium Menziesii, Hook.
Eritrichium fulvum, D C.
Collomia gracilis, Nutt.
Lysichiton Kamtschatense, Bong.
Calypso borealis, Salisb.
Sisyrinchium grandiflorum, Dougl.
Camassia esculenta, Lindl.
Erythronium albiflorum, Pursh.
Fritillaria lanceolata, Pursh.
Zygadenus paniculatus, Gray.

Leave Vancouver Island.

In accordance with your instructions I left Victoria on May 14th on the steamer "Enterprise" for New Westminster. While crossing the Gulf of Georgia a heavy rain commenced, which continued all day without intermission. Our approach to the mouth of the Fraser was indicated before we reached the light-ship by the muddy appearance of the water, while extensive mud banks and low marshy grounds gave evidence of the immense quantities of detritus brought down by the river. As we passed up, marsh gave place to meadow, and soon the meadow to a thick jungle of willow and other bushes, which gradually merged into forest that would vie with a tropical one for luxuriance. New Westminster was reached early in the afternoon, and although the rain still fell in torrents, I made an excursion in the vicinity, and detected a number of species not seen on Vancouver Island.

Harrison River

Early on the morning of the 15th we were again under weigh, and reached Harrison River about dark. I found the vegetation further advanced here than at Victoria. The whitethorn (*Cratægus rivularis*) was in flower, and the shoots on the trees had made more growth. A number of Indians came on board with large bundles of shoots of various species of *Rubus*, which were evidently in great demand for food. On asking one old man what it was used for, he took a stem and began to chew it, calling it "Siwash muck-a-muck"—Indian food. After becoming more acquainted with the natives I found that many species of plants were used as food, none, having mucilaginous matter in their stems, leaves or roots, being rejected.

The valley of the lower Fraser, for agricultural purposes, may be said to end at Sumass; but there are numbers of small locations where farming could be done on a limited scale as far up as Fort Hope. Beyond this point the valley becomes confined between the mountains, and these press so upon the river, that, before reaching Yale, the traveller realizes what a cañon is, and the mind is tortured with the thought of what might happen if anything went wrong with the boat or its machinery.

Lower Fraser Valley.

A short description of the Lower Fraser Valley may not be out of place in this connection. This whole region is moist, whether we regard its soil or its climate, and therefore the vegetation is of the most luxuriant type. It is here that the Douglas fir, the giant cedar and Menzie's fir attain their greatest dimensions. The western hemlock (*Abies Mertensiana*) attains a very large size, being often more than thirty feet in circumference and over 150 feet in height. The other above-named trees are all larger than the latter, and often rise to the height of 250 feet. Even the large-leaved maple (*Acer macrophyllum*) grows in the more open woods to a height of 150 feet, with a diameter of over six feet, Along with this tree, as well as in other places, we meet with the *Acer circinatum*, of Pursh—a beautiful tree—and the western dogwood (*Cornus Nuttallii*), which often attains the height of forty feet with white flowers expanding to a breadth of three inches. The red alder (*Alnus rubra*) is another conspicuous tree as you ascend the lower reaches of the river, but gives place to others as the ground becomes dry. A birch (*Betula occidentalis*) is another fine tree on the borders of the forest, often growing to a height of seventy or eighty feet, and having a most lovely appearance. The balsam poplar (*Populus balsamifera*) grows to a very large size on the islands in the river and on the grounds that are flooded in the spring.

In some parts of the forest the undergrowth is so close that it is almost impossible to force a way through the dense tangled thickets, while in others the trees stand so close that no undergrowth exists, and the fallen trunks lie piled one on the other in such numbers as to form an almost impassable barrier. Undergrowth on the Lower Fraser.

The undergrowth consists principally of the following shrubs :—

Berberis aquifolium.	Ribes sanguineum, Pursh.
" nervosa, Pursh.	" lacustre, L'Her.
Acer glabrum, Tor.	" divaricatum, Dougl.
Spiræa Menziesii, Hook.	" bracteosum, Dougl.
" Douglasii, Hook.	Echinopanax horrida, Dec.
" ariæfolia, S.	Lonicera involucrata, Banks.
Rubus Nutkanus.	" occidentalis, Banks.
" spectabilis, Pursh.	Viburnum pauciflorum, ?
Spiræa betulifolia, Pall.	Vaccinium parviflorum, Smith.
Cratægus rivularis.	Gaultheria Shallon, Pursh.
" Douglasii	

And numbers of others less conspicuous. Many beautiful flowers and herbaceous plants were in profusion, the most prominent of which are :—

Anemone nemorosa, L.	Angelica arguta.
Dicentra formosa, D. C.	Amelanchier alnifolia, Wat.
Dentaria tenella.	Claytonia, various species.
Tellima grandiflora.	Valeriana capitata.
Mitella caulescens.	Pyrola rotundifolia.
Tiarella trifoliata.	" picta, Smith.
Osmorhiza nuda, Don.	" occidentalis.
Viola Nuttallii, Pursh.	" elliptica.

Actæa rubra var arguta.	Chimaphila umbellata.
Spiræa aruncus, L.	Monotropa uniflora.
Epilobium angustifolium, L.	" lanuginosa, Nutt.
Impatiens pallida.	Castilleia pallida, Bong.
Orthocarpus hispidus, Benth.	Trillium grandiflorum, Pursh.
Calypso borealis, Salisb.	Cypripedium parviflorum, Salisb.
Corallorhiza Mertensiana, Ben.	Platanthera fœtida, Geyer.
Prosartes Hookerii, Torr.	Mimulus luteus, L.

The following extract is taken from Dr. Lyall's report :—

Extract from Dr. Lyall's report.

"The Lower Fraser valley is bounded on the south by the 49th parallel. The boundary line for the first twenty-five miles from the sea runs at an average distance of about ten miles from the Fraser. About twenty-four miles inland it strikes one of the spurs of the Cascades. Up to this point the ground is nearly level, but little above the sea, and densely timbered with the trees mentioned above.

"The Lower Fraser valley has along its left or south bank a range of low rocky hills, extending from Langley to the mouth of the Sumass River ; and to the southward of these, between them and the spur of the Cascades before mentioned, lies the Sumass prairie. Nearly in the middle of this prairie lies the lake of the same name, about ten miles long and four broad in its widest part. During the season of flood it extends from hill-foot to hill-foot, and even after the subsidence of the waters its mud banks or beaches reach certain points on both sides. The larger half of the prairie is at the south-west end of the lake, and is about four miles square.

"The prairie ground at the north-east end of the lake is bounded by a belt of trees, separating it from the clear or prairie ground on the banks on the Chilukweyuk River. The clear ground on both sides of this river has been apparently formed, partly by the repeated action of fires destroying the trees which at one time grew on the higher banks, and partly by the action of the floods which annually submerge a large portion of it. These prairies have, during the season of flood, very much the appearance of immense lakes, being, with the exception of a higher ridge here and there, almost entirely covered by water. When the water subsides the growth on these low grounds and prairies is most astonishing, reminding one of the luxuriance of the tropics without its peculiar vegetation."

Mild climate on the Pacific coast.

The cause of the mild and moist climate of the Pacific coast is precisely the same as that of Western Europe. A stream of warm water a little south of the island of Formosa on the eastern coast of China, a current analagous to the Gulf Stream, is observed moving to the north-east. It passes east of Japan, and while a part of it enters Behrings Sea, the remainder passes south of the Aleutian Islands and ameliorates the climate of Alaska to such a degree that the annual temperature of Sitka in lat. 57° is higher than that of Ottawa, in lat. 45° 25′. The mean annual temperature of the former being 44.8°, while the latter has only 37.4°. Esquimault, within three miles of Victoria, in lat. 48° 25′, has a mean annual temperature of 47.4°, only three degrees higher than that of Sitka, which is nine degrees further north. With these facts, the temperatures of Sitka and Esquimault before us, it is very easy to forecast the future of the whole region west of the Cascades, between Victoria and the Stikeen river. The Queen Charlotte Islands being more insular than Vancouver, must have a climate even milder, and hence they may be set down as of equal value. An examination of a map of the world will show the close relationship existing between western Europe and western America in the same parallels. A warm current of water flows down the coast of the latter, while the shores of the former are bathed in the tepid waters of the Gulf Stream. Both regions have their shores deeply indented by inlets, "Fiords" in the one case and "Canals" in the other. The oak and pine forests of the British Isles and Norway are simulated by the oak and fir forests of British Columbia. In both the moist climate is caused in the same way. The vapour rising from the warm sea water is blown inland, and becoming condensed by the cooler air over the land, falls in rain or fog upon the slopes and valleys. The old forests of Great Britain and Ireland, including those of Norway, were a product of the Gulf Stream, while the mighty forests of our western province, including Queen Charlotte Islands, are as certainly a product of the "Kuro Siwo." It only remains for me to add that as years roll on, and our possessions become developed, the value of this second Britain will come so vividly before our people that men will ask with astonishment why such ignorance prevailed in the past. To-day there are four hundred miles of coast line in our western possessions clothed with a forest growth superior to anything else in the world at present. Its shore indented with multitudes of harbours, bays and inlets, teeming with myriads of fish. Its rocks and sands containing gold, iron, silver, coal, and various other minerals. And besides all this, a climate superior to England in every respect, both as regards heat and moisture, and yet men ask what is it all worth? I answer, worth more than Quebec and all the Maritime Provinces thrown in, and sceptics may rest assured that the day is not far distant when my words will be accepted as truth.

Climate of Queen Charlotte Islands.

A second Britain—its value.

Yale.

The boat reached Yale at noon, and after resting for a short time, I went out to examine the neighbourhood. Tempted by the close vicinity of the mountains, I climbed the nearest, and found it to be by aneroid 1,000 feet above the river. At the base many plants were in flower, which, as I neared the summit, ceased to show blossoms. On the middle slopes there were quite a number of eastern species, and the species noticed at Victoria were congregated around a little moisture on the top.

I added forty-eight species of flowering plants to my list, many of them both rare and interesting. The more interesting ferns were *Woodsia, Oregana, Cryptogramma crispa, Pellæa densa, Asplenium trichomanes,* and possibly *Aspidium Filix-mas.* On the slopes of the mountain *Ceanothus velutinus, Rhus Toxicodendron, Spiræa, betulifolia* and other shrubs formed thickets interspersed with both species of *Berberis* and many species of violets and other early spring flowers.

Interesting discovery.

During the next day and a half I employed myself clambering amongst the rocks, and collected many interesting forms; amongst other rare things, I had the good fortune to re-discover *Saxifraga ranunculifolia* Hook. This species seems never to have been found since its discovery by the lamented Douglas. I found it under the high cliffs, some distance from where the road turns to go up the Fraser. Dr. Gray tells me there are no specimens in American herbaria, and that my discovery is very interesting.

Saxifragas, Delphiniums, Cruciferæ, Grasses, and Carices, were in profusion, and the rocks and banks yielded a perfect harvest of Cryptogams, the names of which will appear in their proper place. In the vicinity of Yale I obtained the following, the greater number of which I had not found on Vancouver :—

List of plants found near Yale.

Actæa rubra var. arguta.
Delphinium Menziesii.
Berberis nervosa.
" aquifolium.
Corydalis aurea.
" glauca.
Dicentra formosa.
Arabis petræa.
" hirsuta.
Sisymbrium Austriacum.
" canescens.
Draba nemoralis.
Viola sarmentosa.
Viola glabella.
" Nuttallii.
Stellaria borealis.
Cerastium Behringianum.
Ceanothus velutinus.
Rhus toxicodendron.
Acer glabrum.
Trifolium repens.
Lupinus bicolor.
Echinopanax horrida.
Cornus Nuttallii.
" Canadensis.
Valeriana capitata.

Artemisia discolor.
Matricaria discoidea.
Antennaria plantaginifolia.
" margaritacea.
Specularia perfoliata.
Vaccinium parviflorum.
" myrtilloides.
Chimaphila umbellata.
Pyrola secunda.
" rotundifolia.
" picta.
Vicia Americana,
Spiræa ariæfolia.
" aruncus.
" Menziesii.
" betulifolia.
Prunus demissa.
Rubus leucodermis.
Potentilla arguta.
" gracilis.
Pyrus mollis.
Fragaria vesca.
Cratægus rivularis.
" Douglasii.
Ribes lacustre.
" bracteosum.
Saxifraga ranunculifolia.
" Virginiensis.
" bronchialis.
Mitella caulescens.
Epilobium angustifolium.
" coloratum.
Mentzelia albicaulis.
Corylus rostrata, var.
Betula occidentalis.
Alnus viridis.
Pinus monticola.
Abies Mertensiana.
" amabilis.
Thuja gigantea.
Carex laxiflora.
" umbellata.
" Rossii.
" Pennsylvanica.
" Mertensii.
Smilacina uniflora.
" stellata.
Pyrola maculata.
Penstemon confertus.
" Menziesii.
Mentha piperata.
Echinospermum Redowskii.
Phacelia circinata.
Apocynum androsæmifolium.
Asarum caudatum.
Polygonum tenue.
" aviculare.
" convolvulus.
Callitriche verna.
Fritillaria lanceolata.
Luzula melanocarpa.
" spicata.
Stipa occidentalis.
Poa Andina.
Adiantum pedatum.
Lomaria spicant.
Cryptogramma crispa.
Pellæa densa.
Woodsia Oregana.
Asplenium trichomanes.

May 17th.—The view from the mountain ascended yesterday was very fine, especially down the river. From where I sat I could see a large number of snowy peaks, which were at least 5,000 feet high. I was among the rocks all day and had many charming views of the enchanting scenery. Sitting on the hill.side above Yale and looking up the cañon, I saw no less than three streams issuing from the snow on the upper slopes of the mountain, and falling from rock to rock more than 2,000 feet into the river. Many of the higher peaks were enveloped in mist or cloud, which at times fell in showers but oftener passed away Fine view.

without rain, leaving the peaks glistening in the bright sunshine. It was not uncommon to see the same shower falling in snow upon the high mountains and rain on the lower slopes. About 4,000 feet seemed to be the line of frost to-day, as pines on the upper peaks were covered with snow.

While clambering among the rocks, I came across a crevice filled with ice, within less than fifty feet of the river and from which a large supply could be taken.

The flowering dogwood (*Cornus Nuttallii*) and June or service-berry (*Amelanchier alnifolia*), with cherry and thorn bushes were the only shrubs in flower here at the time of my visit.

Yale to Boston Bar.

On the afternoon of the 18th I started on foot, expecting a conveyance to overtake me and carry me to Boston Bar that evening. As I wended my way along the river, now examining a steep cliff or peering down a chasm in search cf cryptogams, the Indians would leave their fishing to look at me, but never addressing a word would gaze for a short time and disappear. On the dripping rocks along the road I obtained fine fruiting specimens of many mosses, prominent amongst which were *Bryum crudum* and *albicans*, and another unknown to me. *Polytrichum strictum* was in fine fruit, and various species of *Grimmia, Racomitrium, Mnium, Orthotrichum, Hypnum* and many others well repaid me for my trouble. The *Alsia abietina* was very abundant at times, and the damp faces of many rocks were covered with beautiful Hepaticæ. The only flowering plants of any note were *Arnica cordifolia* and *Smilacina uniflora*, which were not uncommon. A few miles on the Yale side of Boston Bar we turned the point of the mountain, and almost immediately the plants showed a change in the quantity of moisture, and, on looking back, the eye at once detected the cause, in the mountains acting as a barrier to keep out the superabundant moisture of the Lower Fraser.

May 19th.—We were on our way this morning long before the sun showed above the horizon or even tinged the mountain tops with his earliest rays. There had been a severe frost in the night, and a drive in the cold morning air was anything but pleasant. As we proceeded, the vegetation gave more and more indications of dryness, and at Butchers' Flat, *Pinus ponderosa*, the pine of the interior plateaux, was in some abundance. Under their shade I obtained fine specimens of *Ranunculus glaberrimus* and *Fritillaria pudica*. The evergreen *Ceanothus Oregana* was coming into flower, and *Senecio lugens* with *Comandra pallida* were the precursors of the dry plateaux of the Thompson.

Forty-two mile House.

We breakfasted at the Forty-two mile House, and here a still greater change in the character of the flora was observed. *Ribes cereum*, *Crepis occidentalis*, *Pucedanum triternatum*, and a few other representatives of the Nevada flora were detected, but after passing Jackass Mountain, a few miles further on, a sudden and complete change occurred.

Moisture intercepted by Jackass Mountain.

Jackass Mountain intercepts whatever little moisture comes up the valley from Boston Bar, just as the range below that locality shuts out the moist winds of the coast. After passing the mountain and looking back, the traveller will see that it blocks up the valley, while the river, much compressed, winds round its base. Now all is changed, the sage bush (*Artemisia tridentata*) becomes frequent, and at Lytton a group of Nevada plants is the characteristic flora. While dinner was being cooked, I took a stroll in the vicinity, and collected the following species, which are all natives of Utah.

Artemisia tridentata.
" frigida.
Lynosyrus graveoleus.
Plantago Patagonica.
Crepis occidentalis.
" " var. Nevadense, Watson.
Antennaria alpina.
" dimorpha.
Myosurus aristatus.
Phacelia circinata.
Phacelia Menziesii.
Oxytropus campestris.
Astragalus Beckwithii.
" filifolia.
Lithospermum pilosum.
Chrysopia hispida.
Arnica foliosa.

Lytton.

Lytton is a poor, miserable place, only having three gardens in the whole village. By utilizing the small brook which comes from the mountains behind it, many fine vegetables could be raised, as the soil, where not too much encumbered with stones, is good. Between Jackass Mountain and Spence's Bridge there is very little cultivable land, and this requires to be irrigated before good crops can be raised.

Vegetation was far advanced here, in fact, ahead of Victoria, as roses were seen in flower for the first time a little above Lytton. Proceeding up the Thompson the land gets drier, so that before we reached Spence's Bridge we were prepared for the change that is so marked as one rises on to the terrace beyond the Bridge. All trees have disappeared except those on the mountain tops or in sheltered valleys with a northern aspect. Below the line of trees, beautiful grassy slopes, covered on the lower parts with bunch grass and above with sward, intermixed with a few compositæ and other plants; while the "benches" near the river are altogether bare, except a few bunches of grass and the *Artemisia frigida*, which on all the interior plains throughout the United States and British Columbia replaces "bunch grass" when it has been eaten down.

Grass killed by over-feeding and deficient moisture.

The extreme bareness of the lower benches near the road arises, I believe, from the fact of the grass having been completely killed out by travelling stock.

At Spence's Bridge the bunch grass country of British Columbia is entered by the valley of the Thompson, and from this point it extends east, west and north. The only part of this region seen by me was that part of it between Spence's Bridge and ten miles beyond Cache Creek on the Kamloops road.

The soil of the whole district is of first-class quality, but very little of it is available for cultivation, owing to the want of water. I saw no locations where cereals could be raised without irrigation, and many of the richest flats are now bare, the absence of moisture preventing the rapid renewal of vegetation. Where water can be brought on the "benches," the land gives enormous returns, and were a population in the country requiring farm products, farming would be a paying business, but when the crop of one year will serve for the wants of two, raising grain is not a profitable speculation. Owing to the variation in altitude in the space of a couple of miles a person can pass from the naked and arid benches along the Thompson, by very easy stages, through the whole series of changes from aridity and absolute barrenness to the permanent Douglas fir forest. At Spence's Bridge the forest becomes continuous at about 2,500 feet above the river. A very few feet of difference was observed at Cache Creek mountain, so that the permanent forest line may be taken at about 3,500 feet above the sea level. From the mountain at Spence's Bridge I had an extensive view of the valleys of the Thompson and Nicola Rivers. The valley of each river was identical in structure and almost straight, except for the sinuosties of the stream as it wound through its narrow valley. Looking down from the mountains the "benches" (terraces) along both rivers were seen to be at various heights, but they all conformed to the general contour of the valley, and showed that they had been successively formed as the river had cut its way through the barrier which in former times had stopped its passage below Spence's Bridge. That a barrier existed there in very recent geologic time, is certain, and that a possible barrier may be formed there again is not improbable, as a short distance below the bridge the mountain is constantly sliding towards the river, and even in the short space of time since the road was built it has been rebuilt thrice at a more secure distance from the river. This point is well worthy of a careful examination, as a great landslide might convert the whole country between Spence's Bridge and Kamloops into a lake such

Valleys of the Thompson and Nicola Rivers.

Great landslide.

as it very possibly was in past time. The highest bench seen was no less than 650 feet above the river, and here I found the finest *ranche* I saw in British Columbia. Immense quantities of wheat-hay (wheat cut green for feed) is raised on it, besides other cereals. The pasture lands of the Nicola Valley are said to be the finest in British Columbia, but from many conversations with residents in the upper country, I am led to believe that this valley is but one of many where there are first-class grazing lands and many wide terraces upon which, by means of irrigation, large crops could be raised. It may be interesting to state that the whole of British Columbia south of latitude 52° and east of the Cascades, is really a grazing country up to an altitude of 3,500 feet, and a farming country up to 2,500 feet, where water can be conveyed for irrigating purposes. This includes an area of many square miles, and embraces the valleys of the Okanagan, Nicola, and South Thompson Rivers east of the Fraser, while the same character of country extends south-westwardly through the Chilcoten Plains, west of the Frazer, across the Blackwater River, and forms the extensive grassy plains bordering on the upper tributaries of the Nechacco. As we pass to the north and west, the country becomes more moist, and the arid "benches" of the Thompson change on the Chilcoten to fine grassy slopes, well suited for pasture, while on the Nechacco and its tributaries the same species of grass form extensive meadows with an average growth of three feet. Grazing and farming country.

During the week I spent on the Thompson, at Spence's Bridge and Cache Creek, I collected many species of rare and interesting plants which were not observed in the low country. Spence's Bridge and Cache Creek.

One fact showing the similarity of the flora to that of Nevada and Utah was the actual discovery of two species of plants supposed by Mr. Serrano Watson, who has so ably explored there, to be peculiar to those States. The species were *Astragalus Beckwithii*, T. and G., only detected in the neighbourhood of Salt Lake, Utah and in Ruby Valley, Nevada; the other *Crepis occidentalis, Nutt. var. Nevadense Watson*, was supposed to be peculiar to Nevada, but here it was found in company with the type of the species. Besides the correspondence in the flora, you noticed the similarity of the rocks of this region to those of Nevada, and mentioned the fact to me as we journeyed through the country, long before I knew of the similarity between their floras. At Cornwall's a very remarkable little plant was obtained which puzzled me for a long time, and which owing to its wonderful tenacity of life, actually developed itself so much, after I supposed it to be quite dry, that I was enabled to make out its name. It turned out to be the *Lewisia rediviva*, Pursh., a member of the Purslane family, and like most of its relations, very difficult to kill by drying. The root is considered a prime article of food by all the Indians of Nevada and Utah, and is so looked upon by all the Indians on the Thompson. Mr. Cornwall informed me that at certain seasons the Indians dig up large quantities of the roots, and after roasting them, eat them with great avidity. On the upper slopes of the mountains, near the lower limit of trees, the beautiful Atragene (*Clematis verticillaria, D. C.*) was very abundant and in fine flower. Its range extends all through the upper country, on the mountains as far north as latitude 56° in the Peace River Pass. In the thickets along the Thompson *Clematis ligustifolia*, Dougl., was observed in company with one or two species of roses which were just coming into flower. *Woodsia scopulina* and *Oregana* were abundant in the crevices of rocks on the lower slopes, and a few tufts of *Cheilanthes lanuginosa* were procured, at the risk of a broken neck, at "Limestone Point."

Vegetation on the mountains.

It was very interesting, in ascending the mountains, to notice the change from early summer to late spring, and to observe the shrubs, which at the river side were in full bloom, at 3,000 feet above it were only bursting into leaf. A similar change was also noticed, May 26th, when crossing the high plateau between Clinton and Bridge Creek, and showed most conclusively the contrast between the climate of the Thompson and that of the country between Clinton and Lake La Hache. In the one everything showed the growth of early summer, while in the other the buds were only bursting after a long winter. Only a few plants, indicative of a boreal or alpine climate, were observed on any of the mountains I visited, and never at a less elevation than 3,000 feet. Of these the most noticeable were *Arenaria propinque* and *Antennaria Carpathica.*

Clinton.

Many days and weeks could have been well spent in exploring this interesting country, but my time was limited, and on the afternoon of the 25th I left Cache Creek for Clinton, which was reached late in the evening. I made a short excursion in rear of the village over a pine-covered slope, the trees of which were *Pinus ponderosa* and *Abies Douglasii.* Very few species, and no new forms were observed. At this point spring had hardly commenced, and but few of the spring flowers were far enough advanced to collect. During the next day we travelled steadily on, and did not reach our halting place until far into the night, which was very cold and frosty. Nearly the whole of the country passed over is too elevated for farming purposes, but there is much good pasture land around Lake La Hache and Bridge Creek.

From Clinton to Bridge Creek is a distance of fifty-three miles. *Pinus ponderosa* disappears at about twelve miles beyond Clinton, and from that point to Bridge Creek the prevailing tree is *Pinus contorta*, which you called the "Sugar pine," owing to the sweetness of its "cambium layer," which is scraped off and eaten by all the Indians west of the mountains. Late in June we found it drying in large quantities in the lodges of the Indians, who consume immense quantities of it. About ten miles from Bridge Creek the road passes over an open space, and from this point a very extended view is obtained of the whole country in the vicinity and of the distant mountains beyond. We could see the Cariboo, Kootenay, Cascade and Fraser River mountains with their tops buried in snow, while at our feet lay a wide expanse of country extending between us and Soda Creek. No attempt is made to raise any cereals at Bridge Creek, owing to its height above the sea and the occurrence of summer frosts. Clinton to Lake La Hache.

After leaving the Creek we crossed a long hill, and then descended to Lake La Hache, 2,682 feet above the sea, a beautiful sheet of water ten miles in length. Along this lake and its discharge, San Jose River, we travelled for thirty-six miles, and passed a number of *ranche's* on the way; but very few of them are fit for wheat, the chief cause being insufficient moisture. This statement is made on the authority of the settlers, but my own opinion is that there is no part of the region in question too dry for successful wheat culture. In passing along the lake and valley there is very little timber to be seen near the road, owing to the southern aspect, and the soil in many places seemed to be thin and mixed with gravel. *Pinus contorta* and aspens are the chief timber trees—the former indicating a barren, sandy soil, while the latter, here as elsewhere, shows that the land is fit for cultivation. Late in the night we reached Bates', having travelled, since leaving Clinton, 103 miles. Here we found a fine farm, and were informed that there were others in the neighbourhood just as good, and that wheat of the very best quality could be raised in abundance. Mr. Bates is very enterprising, and has erected a steam saw and grist-mill, with all the modern appliances, and does first-class work for the settlers in the neighbourhood. The lumber is sawn from the Douglas fir, which grows to a good size on the adjoining mountain slopes, and makes very good boards and scantling. From 100 lbs. of wheat I was told that 80 lbs. of first-class flour could be made; and certainly the bread made from this flour was of the finest quality. Bates' farm.

Next day we were up and off before sunrise, as we had to reach Soda Creek, still twenty-eight miles distant, by 8 a.m.. Snatching a few hasty mouthsful, we were soon on the way, and a breezy ride of six miles up the slope of a fir covered mountain, and eight miles down the other side, brought us to Deep Creek. At the point where the road crosses there is a farm, but owing to the uneven nature of the ground very little land is fit for cultivation, although the soil seems to be good. A quick drive of fourteen miles down the valley of the creek brought us in sight of Soda Creek, and the few houses and little steamer were hailed with delight, as they told of ease and comfort after our ride of 131 miles, in little over twenty-four hours. As we drove down Deep Creek the vegetation showed unmistakably that we were passing into a warmer region, and that the valley of the Fraser was enjoying a far milder climate than the country more to the east. Between Deep Creek crossing and Soda Creek the scenery is very picturesque, and the roaring brook on the left was a fitting partner for the fir covered mountain on the right. Very little change in the nature of the vegetation was noticed, and but one new variety was detected. A low cherry was observed in fine flower, which I took to be the Bird Cherry (*Prunus Pennsylvanica*) of the east, but which, on more critical examination, turned out to be *Prunus Depressa*, a western congener of that species.

Soda Creek and Deep Creek.

I now had the pleasure of meeting yourself and the rest of the party, all of whom had passed up while I was botanizing at Cache Creek. We were all in good health and anxious to enter upon the more arduous duties of the expedition. It was but a short time till we steamed out on the bosom of the muddy Fraser, against which we battled all day, not reaching Quesnel till long after dark. The view from the deck of the steamer is limited by the sides of the deep valley in which the river flows, and at times these showed terrace over terrace, rising one behind the other, like gigantic seats in a theatre, while at others, the perpendicular cliffs stood out boldly from the water, or the clay banks were worn by wind and frost into pinnacles and buttresses of most varied and fantastic forms. The distance between Soda Creek and Quesnel is said to be sixty miles by water. It is the only part of the Fraser, above Yale, on which there is a steamboat. Between Soda Creek and Quesnel, the waggon road passes along the benches of the Fraser at various heights, for a distance of at least thirty-six miles. On the right of the road the hills rise to a height of about 600 feet, and the irrigation on the benches is done by means of water brought from these hills. The soil is light and sandy, but produces good crops when properly watered. The hills

Steam up the Fraser to Quesnel.

Irrigation.

are covered with a thin growth of Douglas fir, interspersed at intervals with a little aspen and a sprinkling of white birch, (*Betula papyracea*): bunch grass, a species of *Triticum* (*Triticum repens*, var.) and the pasture sage brush (*Artemisia frigida*), were the leading plants. The latter is the great food plant of the cattle in winter, throughout upper British Columbia, Nevada, Utah, Wyoming, and in fact all the dry North-west. It is said by all the stock-men to be preferable to any kind of grass or hay, and to have a wonderful effect on stock, keeping them fat and sleek in the depth of winter.

Value of sage-brush for stock feeding.

Buchanan's *ranche*, about twenty-two miles from Quesnel, is the largest farm on the Upper Fraser. It consists of over 400 acres under cultivation; originally it was partly prairie and partly aspen copse; oats, barley and wheat are raised in large quantities. The greater part of the farm is about 300 feet above the Fraser; and this part is considerd safe from summer frosts, while potatoes near the river are occasionally injured. Douglas fir and *Pinus cortorta* are the principal forest trees, giving indications of a gravelly soil. Low mountains covered with Douglas firs, at one or two miles distance, skirt the road all along as you proceed in the direction of Quesnel. For a number of miles the road is quite level, and the soil suited for cultivation. Approaching Quesnel, the indications of a change of climate become more apparent, and the absence of many of the characteristic plants of the dry country shows that irrigation in the neighbourhood of Quesnel is no more a necessity than in any part of Ontario.

Observations around Quesnel.

The greater part of a week was spent in the neighbourhood of Quesnel, and many observations made on its flora and climate. It is in lat. 53° north, and about 1,500 feet above the sea. The spring of 1875 was said to be late, but I found, that notwithstanding, the season was not more than eight days later than at Belleville, Ontario. I commenced my examination on the morning of the 28th May, and found the various currants and gooseberries in flower. The bell flower, (*Prosartes Hookerii*) the high bush cranberry, (*Viburnum pauciflorum*) and many of the common eastern species were found in full flower and nearly as far advanced as at Belleville on the 24th May, 1876. Nearly all the species observed were eastern ones, or western plants that reach the wooded country west of Lake Superior. No species indicating a cold or wet climate was seen, except *Viburnum pauciflorum*. This plant seems to take the place of *Viburnum opulus* in a great degree throughout the North-West, and therefore is not necessarily indicative of a cold climate. Some farming is done in the neighbourhood, and all kinds of farm produce comes to perfection. The land on both sides of the river is much broken, but in the hands of a thrifty population much of it might be made to yield large returns. At present only some of the lower "benches" along the river are worked. The indigenous plants observed indicate a cool, moist climate, more like Quebec than Ontario, or resembling that part of Ontario thirty miles north of the lake. The soil is a sandy loam, inclining to sand, and could be very easily worked. The country around Quesnel, on both sides of the river, has been burned over, and the original forest, which was Douglas fir, destroyed. In its stead, poplar, birch and willows have grown up, but not a single Douglas fir. Occasionally a white spruce is seen, but they are very scarce and of little account in the forest. About twenty miles up the Quesnel River there are large groves of white cedar, which very possibly is the *Thuja gigantea* of the coast. The under shrubs are a *Lonicera* (*Lonicera involucrata,*) a rose (*Rosa blanda,*) the service berry (*Amelanchier alnifolia,*) two hazels (*Corylus Americana* and *rostrata,*) a *Mahonia* (*Berberis aquifolium,*) *Shepherdia Canadensis*, a cherry (*Prunus depressa,*) a species of *Cornel* (*Cornus sericea* ?) two raspberries (*Rubus strigosus* and *triflorus,*) *Spiræa betulifolia*, and various species of *Ribes*.

Character of the climate.

June 5th.—Yesterday we crossed the Fraser, and may be said to have launched into the wilderness. This morning broke bright and fair and gave promise of a fine day, which was more than realized. The hot sunshine brought out many insects, and while not engaged collecting plants, I obtained many fine specimens of these. A species of *Haltica* was found in immense numbers on alder bushes (*Alnus viridis,*) growing along the Fraser, and had eaten many of the leaves to the midrib. A carnivorous species, one of the *Carabiadæ,* lived in holes under stones in the sand, and was always found with its mandible open as if to catch its prey. Beetles have been very scarce up to the present, but to-day they were flying about in numbers. The yellow swallow-tailed butterfly was in some abundance and a small blue one was very plentiful. One small brown one, and one or two others which are common in Ontario, were seen. The only remarkable birds around Quesnel are the humming birds and a songster with a red head and yellow wings. I noticed one or two others which were of the linnet family, about as large as the snow bunting and marked very much like it.

Insects.

Birds.

On the logs along the Fraser, and on old rotten ones in the bushes, I obtained the following mosses and hepaticæ. These were all found west of the river, and I had not observed them before in this vicinity:—

Dichlyma uncinatum.	Scapania Beckii.
Desmatodon cermum.	Lophocolea crocata.
Orthotrichum leiocarpum.	Jungermannia.
Bryum pulchellum.	" Helleii.
Mnium orthorhynchum.	" pulchella.

The burnt lands extend five miles from Quesnel, after which the telegraph trail enters the "green timber," which consists of Douglas fir, white spruce, balsam and aspen poplar and whitebirch. A few of the common forest mosses were found under the trees. Burnt country.

Dicranum undulatum.	Hypnum compactum.
" fulvium.	" nitens.
Bryum albicans.	" Blandovii.
Orthotrichum obtusifolium.	" denticulatum.
" strangulatum.	" curvifolium.

After leaving this we passed through a forest of black pine (*Pinus contorta*) from twenty to thirty years old, with here and there, large-sized older trees. Soil light and sandy. At Beaver-dam Creek a few insects were collected, especially one fine *Curculio*, which I found sitting on the roots of grass close to the water. Evidently the spring is very late here, as the aspen leaves are but just coming out. A very few miles has made a great change in the vegetation. We camped this evening on a small creek in a beautiful valley, twelve miles from Quesnel. The soil of the valley is excellent, and would be productive if the climate is not too cold. A few grains of timothy seed had fallen in a number of spots and formed a sward, showing that good hay could be grown. Beaver-dam Creek.

June 7th.—During this day's march the whole country was undulating and very hilly. The dry ground had originally been covered with Douglas fir, but this had given place in the new growth to black pine, aspen and poplar.

June 8th.—The whole distance travelled to-day the country is covered with *Pinus contorta*, except in the hollows and swamps, which are occupied with black spruce (*Abies Nigra*). The greater part of the trail was very boggy and wet, and, as a consequence, I obtained some very fine mosses and lichens. The country becomes colder and wetter as we advance. The Rocky Mountain black currant (*Ribes Hudsonianum*) was first seen to-day. Both yesterday and to-day we passed over some very high ground. At one point where I obtained *Vaccinium Myrtilloides* the aneroid barometer sank to 27°.10. It may be remarked that this *Vaccinium* is always the indicator of altitude and cold on both sides of the Rocky Mountains, yet it is a remarkable fact that it was never found lower than 26°.47 east of the mountains, showing that there the heat of summer is greater than west of them in the same latitude. *Comandra livida* and *Rubus arcticus* were both in abundance, and together with *Vaccinium Vitis-idæa* and *cæspitosum*, and an abundance of the lower cryptogams, gave quite a boreal aspect to the flora.

Boreal flora.

June 9th.—No change in the vegetation until we reached Mud Creek. Between it and the Black-water the soil is dry and sandy, and sparsely covered with *Pinus contorta*. After descending into the valley of Black-water a marked change in species takes place, and on the slopes on the left bank a few of the dry ground or prairie species were obtained, such as *Lithospermum pilosum*, *Triticum repens*, var., *Artemisia frigida*, *Potentilla Pennsylvanica*, *arguta* and *gracilis*. *Festuca ovina*, *Troximon glaucum*, *Heuchera cylindrica*, *Monarda fistulosa* and a number of the common meadow species. I also detected growing on the gravel bars of the river *Dryas Drummondii*. Large patches of it were just coming into flower, and it, together with *Polemonium cœruleum*, *Cerastium arvense*, *Stellaria longipes*, *Androsace septentrionalis* and a few common plants, gave the low grounds near the river the appearance of a flower garden run wild.

Flora of the Black-water valley.

June 10th.—Visited the cañon of Black-water this morning and obtained a large number of fine mosses and lichens on the rocks. The cañon was about three miles below our camp, and on my way down I examined the terraces on the left bank, and found that there were no less than six of them. The higher ones are sparsely covered with *Douglas fir*, but the lower are altogether without trees and covered for the most part with the trailing juniper (*Juniperus Sabina*, var. *procumbens*). A beautiful everlasting (*Antennaria dioica*, var. *rosea*) was in great profusion on the slopes, and from its hardiness and beauty would be well suited for garden culture as a bedding plant. There is some good land in the river valley, and as the railway party under Mr. Jennings was to form a depot here during the summer, its climate could be ascertained.

Black-water canon.

June 11th.—After ascending the hills or benches which border the river the trail led straight ahead through a continuous grove of "black pine," growing on a comparatively level plateau. Across this plateau the C. P. R. R. is to pass on its way from Fort George. The soil is light and sandy, free from boulders, and contains but little clay. This country extends for seven miles, followed by other seven of wet difficult country, after which two miles of undulating ground brought us to the valley of

Cross the line of the Canada Pacific Railroad.

the Chilacco River. No change in the vegetation. The Oregon grape (*Berberis aquifolium*) still continues with us on the dry slopes, and seems to indicate a soil suitable for agriculture.

June 12th.—During this day's tramp very little change was observed in the aspect of the vegetation, except in a small marsh surrounded by a meadow, where I obtained *Taraxicum palustre*, *Ranunculus affinis*, *Rumex acetosa*, *Rubus arcticus* and *Cirsium Drummondii*. A little further on I obtained a *Habenaria* like *H. virescens* and *Lonicera Douglasii*. The country passed over to-day was very uneven, and, being on the northern slope of the valley, was drier than usual. On some of the higher hills and steep slopes many fine Douglas firs were seen, and doubtless much good timber could be procured here. We camped this evening on the shore of Lake Naltesby, and had some fine sport fishing in the lake. Naltesby Lake.

June 13th.—Our morning walk was through a thick forest along the shore of the lake, and through mud and mire of unknown depth, to the head of it, where a small stream enters from the right. There I detected a few new plants, and obtained a number of beautiful trout. Before crossing the brook I picked up *Draba incana*, which I took as a pledge of the mountain flora. Another little plant *Chrysosplenium alternifolium*, which I had observed at Quesnel; was again met with in the brook, and a little further on *Paludella palustris*, a most beautiful moss. Our camp this evening was at the discharge of Lake Eulatazela, in a lovely meadow, where the horses had excellent feed, and we could congratulate ourselves that we had passed the watershed and entered a drier country. Eulatazela Lake. *Bromus ciliatus* and *Triticum dasystachyum*, with a number of peas and a variety of herbaceous plants made a rich carpet of green, where, before the days of the Telegraph Company, there was nothing but forest. The *Triticum* spoken of above seems to be one of the best pasture grasses both east and west of the mountains. In the Peace River and Saskatchewan country it is very abundant, and seems to be preferred at least by horses, to any other grass. I believe it would make an excellent pasture-grass for light dry soils in Ontario, as it throws up a multitude of leaves and seems to grow very fast.

June 14th.—In a muskeg, three miles from camp, I obtained the following plants: *Corallorhiza innata*, *Listera cordata*, *Ranunculus Lapponicus*, *Empetrum nigrum*. A little further on I found a few specimens of the very interesting little plant, *Adoxa moschatellina*. The first part of the road was very muddy, and full of holes, but this changed to sand, and then again to a gravel ridge, along which the trail led for a few miles. Where the road leaves the ridge, I collected a few species in the marsh on the left, amongst them were *Carex irrigua*, *limosa*, *chordorhiza* and *tenella*, *Eriophorum capitatum;* and two rare mosses, *Hypnum trifarium*, and *Meesia tristicha.* The Douglas fir on the "Hog's Back," are the largest yet seen in the upper country. Many of them are at least five feet in diameter. After we descended from this ridge, the land improved, and the whole country had a different aspect. West and north of this ridge there is a much lighter snow-fall, and hence a different flora, and a country better suited for agriculture. When passing over this road in 1872, I noticed that the snow south of the ridge was at least three times as deep as north of it; and this year I noticed that the plants indicate a drier and warmer summer than the country between it and Quesnel.

Character of the country improving.

June 15*th.*—The region passed through to day is all suited for agricultural purposes. Before reaching Tsin-kut Lake the forest ceases, and a continuous prairie extends all along the east side of the lake, and along the foot of Lake Nool-ki, also between this and Lake Ta-chick, and for an unknown distance between the two. A belt of woods separates the prairies around those lakes from the beautiful and rich prairies along the Nechaco River, but the soil of the forest does not differ from that of the prairie, so that the whole is fit for cultivation. On most of the prairie the old grass was still standing, and from its appearance, it must have been both thick and stout. The grass was nearly all of the three genera mentioned before, viz: *Bromus*, *Triticum* and *Poa.* These genera constitute the hay and pasture grasses of this and the Peace River region. A large Indian village stands about half way between Lakes Nool-ki and Ta-chick, on the discharge of the latter lake. These are the Stony Creek Indians, who trade at Fort Fraser, and subsist almost entirely on the fish of the lakes and rivers. While I was there fish were passing in myriads from the latter lake into the former, and could be caught by the hundred without difficulty. The Indians had many thousands drying on poles, and the greater number of them were of the same species as those we caught at the discharge of Lake Eulatazela. The forest between Tsin-kut Lake and Stony Creek, on the new trail, is generally good, and is largely composed of aspen, which is always a sign of first-class soil. The meadows on the right bank of the Nechacco were full of meadow plants, resembling those of Ontario, and there was nothing in the flora to indicate a cold climate, except that it was ten or fifteen days behind that of Ontario this year, (1876.) The familiar plants of our meadows and fields were everywhere, and not a herbaceous plant or shrub reminded one of the fact of being more

Tsin-Kut, Nool-ki and Ta-chick Lakes.

Abundance of fish.

than ten degrees north of Belleville, except the want of our forest trees.

The 16th was occupied in getting our baggage across the Nechacco, a broad and rapid stream, and late in the evening our camp was pitched on the left bank. We had scarcely got into camp when the rain began to fall, and continued with little intermission until about 8 a. m. next morning. Cross the Nechacco River.

June 17th.—Left camp this morning at 5 a.m., and for the first three hours the walking was very bad, owing to the heavy rain which had fallen and the spongy nature of the ground. For nearly seven miles the trail led through a succession of aspen copse and wide prairies, on the latter very tall grass and weeds of the usual species, and in the former the largest aspen leaves I have yet seen. Numbers of the trees were over two feet in diameter. The prairie and forest were quite level, and the soil of the best quality—an alluvium with black loam for a subsoil. On ascending out of the valley the trail passed through a grove of fine aspens, with a great profusion of the *Mahonia* or Oregon grape around their bases.

For the remaining distance to Stewarts River, the trail passes through a succession of black-pine woods, *brulés*, both old and recent; over gravel, sand and stony ridge, by marsh and swamp, till at last it descends into the valley of the river. The only novelties observed to day were *Andromeda polifolia, Ledum palustre, and Eriophorum capitatum.* In a marsh by the path later in the day I detected one tuft, the first one, of *Mitella pentandra,* and amongst a number of the common eastern plants *Lathyrus venosus, Vicas Americana, Carex Vahlii, Collomia linearis, Claytonia linearis* and *Actæa rubra.* One fine moss, *Splachnum sphæricum,* was added to my already large collection. Rough country.

Our march on the 18th was only for a short distance, as owing to the loss of a horse we were unable to get off. After crossing the river the trail led for nearly two miles up the left bank, through aspen copse, then ascended the slope of a terrace for about a mile, then up another terrace and across an almost level *brulé* for three miles, to a creek, which we crossed, and after four miles of bog and swamp, reached our camping ground in a perfect storm of mosquitoes and black flies. A *Luzula*, an *Epilobium* and a willow were the only acquisitions to-day. Stewart's River to Fort St. James.

Early on the 19th I was again on the tramp, and walked nearly all day through the wettest and boggiest road we had seen during our 140-mile journey from Quesnel. The walking, however, was my own choice, for though you had provided me with a horse, I preferred to examine the country on foot. Even to-day, when holding my solitary way, I was more than repaid by discoveries I made. While marching along the creek this morning I detected a few fine grasses, viz.: various *Poas*, a *Danthonia* and a *Melica*. Late in the afternoon, and about six miles from Fort St. James, I came upon a limestone cliff, and immediately the flora changed. The beautiful little one-flowered *Smilacina* (*S. uniflora*) and the grotesque but interesting coral-root (*Corallorhiza Mertensia*) were in abundance, and had not been seen since leaving the valley of the Lower Fraser. *Polemonium cœruleum*, *Potentilla*, *gracilis*, *Woodsia Oregana*, *Saxifraga tricuspidata* on the face of the cliff, and *Mertensia paniculata* and *Aquilegia formosa* amongst the rocks at its base made such a charming picture that I sat down in my loneliness—but not alone—and drank in the surpassing beauty of the scene. Hunger and weariness were forgotten, and I resumed my march with the light joyous step of the morning, feeling that to the lover of nature God's hand was ever open to strew his paths with beauties and fill his heart with praise. While others cursed the road and the flies, I, in my simplicity, saw nothing but nature decked out in the spring loveliness, and instead of grumbling at the difficulties of the way, I rejoiced in the activity of the animal and vegetable kingdoms. For nearly a month we had kept travelling with the spring, but now with one bound we had passed its portals and stood on the verge of summer.

Limestone ocks.

Sunday 20th.—A day of rest. To-morrow we climb Stewart's Lake Mountain. We are told we cannot accomplish it in a day by the wise ones round the fort.

Similarity of the flora to that of Lake Superior.

Looking back over the 146 miles which lie between Fort St. James and Quesnel, I am struck with the resemblance of the flora to that of the forest region west of Lake Superior. There is not a species in the whole distance which in any way indicates either an alpine or a boreal climate, except *Vaccinium myrtilloides* and *Empetrum nigrum*, and these were only observed once. The valley of the Nechacco has an exceedingly rich soil on both sides where the trail crosses, and possibly this extends for many miles both above and below. The valley of Stewart's River is not wide where we crossed it, but it is very rich, and there is no doubt whatever, in my mind, but that after the two rivers unite, the valley all the way to Fort George is rich and fertile and well suited for settlement. From the crossing of Stewart's River to Fort St. James the country was almost impassable, owing to the constant rains, but the soil is rich, and grass and weeds were very luxuriant. The country

Rich soil.

around Lakes Tsin-kut, Ta-chick and Nool-ki is very fertile, and from the occurrence of so much prairie, together with the similarity of the flora to that around Edmonton, I consider the climate of the two regions to be much alike. The former, though further north, is less elevated,* and this, together with the well-known northern trend of the isothermal lines in N. W. America, more than compensate for the difference in latitude. The climate compared with that of Edmonton.

The dry summer climate, which is indicated by the flora, proves the rainfall to be inconsiderable, and therefore the prospects are good for the successful cultivation of grain.

Much of the forest country is undoubtedly wet, but it is swamp, and when the timber is removed, by whatever means, and the swampy lands drained, the soil will become warmer and drier, and the country be less subject to summer frosts. For many years barley has been raised at Fort St. James, and certainly the soil in that neighbourhood is not to be compared with that in the valley of the Nechacco.

When a geological examination of the country has been made, a better opinion can be formed of the amount of arable land, as it may be set down as an invariable rule that wherever limestone is the prevailing rock, there the soil will be suited for agriculture, if the altitude is not too great. Amount of arable lands

Much of the plateau extending from Fort St. James southwards across the Nechacco, by the head waters of Black-water or West Road River to the Chilcoten Plains, seems to lie in the direction of the dry southerly winds that come from the country of the Thompson and Columbia Rivers, and if this surmise be correct, (since partly confirmed by a package of plants received from Mr. George Dawson, who collected them in the Chilcoten region last year,) a large part of this area will yet be cultivated.

The fields cultivated in the vicinity of Fort St. James are of small size, and the crops raised are of little account. The soil seems to be exhausted from constant cropping, and no attempt is made to improve-it. There has once been a large quantity of Douglas fir in this neighbour, hood, and many fine trees are still standing. Crops at Fort St. James

On the morning of the 21st I accompanied you, with two Indians, in a canoe up Stewart's Lake for about eight miles, where we landed for the purpose of climbing Pope's Cradle, or Stewart's Lake Mountain. We commenced to ascend from the Lake shore, and after a

* Recent observations show these lakes to be nearly 2,400 feet above sea. I made Edmonton 2,159 feet. Hector and Palliser give it at 2,088 feet.—A. R. C. S.

fatiguing climb of three hours, in the hot sun, we reached the summit, which we found to be 2,600 feet above the Lake, and about 4,700 feet above the sea. From the summit we had a very extensive view and were well repaid for our arduous climb. As this was my first out-look for alpine plants, I was all excitement, and carefully noted their appearance, but owing to our limited time, I did not collect as many as I desired.

View from Stewart's Lake Mountain, (Pope's Cradle.)

At the landing place a very beautiful Mimulus, (*Mimulus Lewisii*) was growing in great luxuriance around a spring; it was just coming into flower and showed a wealth of pinkish blossoms. Near it was growing a stone crop (*Ledum stenopetalum*.) *Potentilla Pennsylvanica*, var., *Saxifraga tricuspidata* and *Parietaria Pennsylvanica*. Along the lower slopes of the mountains, which were very steep, the vegetation was of the usual character, but after attaining a height of about 500 feet, many fine specimens of *Smilacina racemosa* were obtained, and a *Ceanothus velutinus*, which I had seen on Jackass Mountain, became very abundant. The beautiful *Berberis aquifolium* and a shrub I had seen on Vancouver, (*Pachystima myrsinites,—Oreophila myrtifolia, Nutt*) were in profusion; and under foot were beautiful tufts of *Polemonium cœruleum*, *Antennaria alpina*, *Draba incana* and *Oxytropis campestris*. After ascending another thousand feet I picked up a few specimens of *Antenaria racemosa*, and shortly afterwards, while passing an exposed point, I obtained my first alpine species, *Arenaria propinqua*, Rich.; close to it was growing a solitary specimen of an Alaska plant, *Arabis Gerardi*, var. *borealis*. Passing into a grove of fir I obtained a few beautiful specimens of *Evernia vulpina* in fine fruit, and on the same tree *Alectora jubatæ*, fruiting likewise. Both these lichens are used by the Indians from California to the Mackenzie, the former for a dye stuff, the latter for various purposes. Passing still upwards to a height of 2,000 feet above the lake, I came at once on a group of Drabas, *Dryas octopetala*, *Carex Hepburnii,=nardina*, *Cerastium alpinum*, and a few others. Between this point and the top the following plants were collected:—

Plants collected near the summit of the mountain.

Draba aurea, Vahl var, stylosa.	Dryas octopetala, L.
" muricella. Vahl.	Carex Hepburnii, Boott,
" alpina L.	Arnica angustifolia, Vahl.
" frigida.	Rhododendron alliflorum, Hook.
Stellaria Edwardii, R. Br.	Salix arctica, R. Br.
Cerastium alpinum, L.	Poa alpina var. minor
Arenaria propinqua, Rich.	" laxa, Hænke.

A fire had passed at one time over the summit, and had burnt off the few dwarf spruce that clung to the less exposed parts, but their remnants attested that we were not above the forest line. After we came within 400 feet of the summit, patches of snow were occasionally seen, and with this we slaked our thirst while snatching our mid-day meal. Close to the top the Rhododendron was just putting forth its buds, and a few *Cetrarias* (*Iceland moss*,) made their home in a little hollow close by, while on the highest point of all *Carex Hepburnii*, about one and a half inches high, filled a small crevice in an otherwise naked rock. Very reluctantly I turned my face from the summit, and began to descend. Before doing so, however, I noticed that the north side really supported the growth of alpine plants. After a very rapid descent we reached the lake and started for the camp, propelled by the wind acting on a bear skin which the bowman held up to catch the fitful breeze. It would have been less labour to paddle, but that was *work*. Late in the evening we reached camp, and soon were oblivious to mundane things.

June 22*nd*.—Left camp this morning in a drenching rain, which continued to fall in torrents for the greater part of the forenoon. Travelling was anything but pleasant, owing to the length of the grass and the wetness of the trail. We succeeded, however, in travelling at least sixteen miles; but owing to a mistake about camping, I had the misfortune to travel four miles too far ahead, and had to walk back again, causing me to walk at least twenty-four miles.

Leave Stewart's Lake for McLeod.

For the first twelve miles the road led through prairie and aspen copse, the soil being of the very best quality all the way, and producing a most luxuriant crop of grass and flowers. In the copse-wood the grass and vines grew to an astonishing height, and every indication was seen of a fertile soil, but the vegetation gave unmistakable evidence of a damp, if not a wet climate.

This seems to be the land of the poas, as every locality abounds with them. Whether the soil is dry or wet, mountain or valley, they are the characteristic grasses, and this leads me to conclude that we are now in a meadow and pasture region, and one that in years to come will produce cattle and sheep for the mining populations of the south. Barley may grow and come to perfection, but summer frosts must be prevalent.

Purple avens (*Geum rivale*) and *Geum strictum*, *Heracleum lanatum*, *Epilobium angustifolium*, various grasses and carices were the leading species in the meadows, while in the copse woods *Vicia Americana*, *Lathyrus ochroleucus*, *Sanicula Marilandica*, *Mertensia paniculata*, and a number of other common eastern forms were in abundance. In a swampy meadow I had the good fortune to obtain a fine lot of the beautiful *Botrychium lunaria*. Passing a muskeg I obtained my first specimens of *Rubus Chamæmorus* and *Trientalis arctica*. *Ledum palustre* and *Ranunculus Lapponicus* were collected at this time in fine flower, and I was enabled to identify the latter with a little plant I had obtained near Edmonton in 1872. I picked up a solitary specimen of a *Cynoglossum*, which proves to be *C. grande*, and is quite interesting as coming from this region.

Lake Porteur or Carrier's Lake.

June 23rd.—Early this morning we passed around the east side of Lake Porteur, through groves of very tall and straight timber. After passing the head of the lake, we crossed over a series of sand hills covered with a thin and stunted growth of *Pinus contorta*, and for a length of time through a thick *brulé*, where the trees lay piled in heaps, and through which we had to literally hew our way. Late in the evening we reached Salmon River, and pitched our camp on the further bank. During the day the main features of the vegetation remained the same, but in the meadows along Salmon River a beautiful lupine (*Lupinus polyphyllus*) grew to a height of two feet, with a spike of flowers over a foot in length. *Senecio triangularis*, *Poterium Canadense* and *Delphinium elatum*, var. were in profusion in the open places along the stream, the latter extending through the Rocky Mountains down to the vicinity of Fort Pitt. To-day we passed the last of the Douglas fir which is seen from the trail, but it still appears in the mountains near McLeod's Lake. The woods were full of the lovely *Calypso borealis*, which seems to be at home west of the mountains, as I have not passed through a wood of any size from Vancouver to the present time without seeing it in great profusion. The Indians prize its bulbous root as an article of food, and one of them travelling with me to-day ate a number of them, calling them "Siwash Muck-a-muck." I have seen the Indians dig up the roots of the various species of Fritillaria and split up the stem of the great willow herb (*Epilobium angustifolium*) and run their thumb down the inside and scrape out the pith. Not a stem of the cow parsnip (*Heracleum lanatum*) was allowed to grow as we passed along. Half-breeds and Indians peeled the petioles of the large leaves and ate them ravenously, calling them Indian rhubarb. In fact nothing of a mucilaginous nature escaped them, and the cambium layer of the aspen had to do duty at times, although intensely bitter. As we pass to the north-east, the flora becomes more eastern in its general aspect, but there are certain indications that we are increasing our altitude and that the climate is much moister and colder. Swamp species have left the swamps and venture into the drier grounds, evidently to escape the continued cold

Plants used by the Indians for food.

to which they are subjected, these being replaced by others of a more arctic tendency.

June 24th.—After leaving camp this morning the path led over a number of sand hills, each series adding to our altitude, until after we passed the third crossing of White Mud Creek, we attained the height of land, and could look back on the country we had passed, with Stewart's Lake Mountain in the distance. Pine on the sand hills and spruce in the swamps, with green alder (*Alnus viridis*) everywhere, with occasional clumps of dwarf birch (*Betula nana*). High bush cranberry (*Viburnum pauciflorum,*) has been in all the woods since leaving Quesnel, but to-day was particularly abundant. After attaining the watershed, the country for the next five miles is covered with spruce forest (*Abies nigra.*) In this forest I found a number of rare plants, and had a foretaste of the Rocky Mountain flora. *Veronica alpina, Rubus pedata, Epilobium alpinum Hieracium triste, Mitella pentandra, Ranunculus Lapponicus, Potentilla procumbens, Tiarella trifoliata* and an abundance of sedges and grasses, with multitudes of boreal species, such as *Habenaria rotundifolia, obtusata, dilatata,* and *hyperborea, Listera cordata* and *convallarioides, Triglochin maritima, Ribes lacustre, rubrum* and *Hudsonianum,* while roses, and raspberries are seldom seen. At the crossing of Swamp Creek we camped for the night, and here I obtained a very large and beautiful yellow pond-lily (*Nuphar polysephalum*) for the first and last time. The country in which we now are is evidently a plateau, and is the "divide" between the waters of the Pacific and Arctic Oceans. Swamp Creek meanders through a shallow depression bordered by black spruce swamps, and receives the drainage of this section, while further on the depressions are deeper and take the form of lakes, which help to drain the country and give a different character to the vegetation.

Height of land between the Arctic and the Pacific waters.

Swamp Creek.

June 25th.—Our stage to-day from Swamp Creek to Carp Lake was of a different character from yesterday. The country was almost level, and with the exception of about two miles of spruce swamp, was a forest of *Pinus contorta,* and quite dry in comparison to what we have passed through, *Veratrum viride* was seen to day for the first time, and a yellow Violet, (*Viola sarmentosa*), which had not been seen since leaving Yale. *Echinospermum deflexum var floribundum* was abundant at Carp Lake. To-day I added two beautiful little mosses to my already large collection, viz: *Tayloria splachnoides* and *Dicranum crispum.*

June 26th.—To day I had a lonely tramp along the shores of Carp and Long Lakes to the discharge of the latter lake. When a few miles on the way a pelting rain came on, and continued without intermission all

Carp Lake.

the forenoon. I trudged cheerfully on, believing that I would meet Indians at the ford and get myself dried and warmed, but what was my chagrin to find the Indians gone and their fire burning on the other side of the rapid river. Without hesitation I undressed and plunged in; but the current was strong and the water deep, my courage failed, and I returned to the bank. Shivering and cold, I contemplated the situation, and at last, determined to do or die, waded across. Soon I had a rousing fire, and its genial warmth brought back life and activity to my half frozen limbs. Nothing new observed to day except that *Lupinus polyphyllus* was very abundant in the woods.

The falls of Long Lake River.

June 27th.—This morning visited the falls about a mile below our camp. We were well repaid for our trouble, the river descending at three great leaps about 120 feet. They formed a lovely and never-to-be-forgotten picture; the rushing water flashing in the sunlight, the sombre spruce, mixed with the light and graceful foliage of the aspens—the grey lichen covered rocks and the blue sky and glorious sunlight contributed to make up a picture not often seen in any country, and that once seen can never be erased from the memory. We travelled only four miles to-day through *brulé* and swamp and camped on Iroquois Creek, in the midst of a beautiful meadow covered with the showy flowers of the wild Columbine, (*Aquilegia formosa*,) *Lupinus polyphyllus* and *Echinospermum deflexum*. The country passed through to-day was heavily timbered, but most of the trees were dead and lying on the ground. We may be said to have literally cut our way through from Fort St. James to this point.

Fine forest

June 28th.—We were early astir this morning, and hewed our way through the burnt woods for over six miles. The timber was heavy, and principally spruce; before it was burnt this must have been the finest forest we have seen since leaving Quesnel. *Mitella caulescens* and *Stellaria humifusa* were found to-day. Before reaching McLeod's Lake we descended from the plateau and passed for some miles through pine forest, the ground being covered with the usual lichens, which are invariably to be met with in these woods, viz: *Cladonia rangiferina*, various varieties, *squamosa*, *cornucopioides*, *pyxidata*, *cornuto*, *furcata*, *gracilis*, *derformis*, and *bellidiflora*, *Cetraria Islandica*, *cuculata*, *Sterocaulon*, *denudatum*, and *tomentosum*.

Country around Fort McLeod.

During the next few days I examined the country in the vicinity of the fort, and satisfied myself as to the richness of the soil, and also of its being subject during summer to frequent frosts. A little distance from the fort along the discharge of the lake, there is a flat called the prairie, but which is merely a wide extent of level alluvial land with the trees burnt off. On this flat is excellent grass and great quantites of weeds. The leading forms are *Heracleum lanatum*, *Astragalus alpinus*, *Thalictrum sparsiflorum*, and *dioicum*, *Geum strictum*, *Mertensia paniculata*, *Epilobium angustifolium*, *Poterinus Canadense*, *Stellaria longipes*, *Urtica gracilis* and many other grasses were numerous and very tall. *Bromus ciliatus* and *Kalmii*, *Triticum dasystachum* and *repens*, var, and various Poas, were the leading types : and I might say that these, with a few Stipas, and an occasional Festuca, with the never failing *Calamagrostis Canapensis* and *stricta* make up the greater part of the pasture. Carices are not very abundant in any part of the country, and are principally of the sections *Acutæ* and *Ovales*.

Mr. Mackenzie, the gentleman in charge of the post, had a very fine garden. Amongst other garden vegetables, he had cabbage, cauliflower, turnips, peas and potatoes, the latter six inches high, growing luxuriantly and not at all injured by frost, although it had been very severe one night shortly before our arrival. The frost followed the heavy rain of the 26th just as surely as it would in Ontario, and injured the native plants in sheltered situations, but had no effect on Mr. Mackenzie's garden, because it was exposed to the free circulation of the air. Vegetables at Fort McLeod.

During the forenoon of the 30th I accompanied you and a guide to the McLeod's Lake Mountain, and from its summit had a very extended view of the surrounding country. No arctic or alpine plants were seen except *Arenaria propinqua* and *Arabis incana*, which were first met with at an altitude of 26.58, by aneroid; the mountains were much higher, but no other boreal species were seen. *Ledum stenopetalum* and *Polemonium cæruleum* were very abundant, and in the woods on the flank of the mountain *Spiræa aruncus* was met with, but not in flower.

Although there is much good land between Fort St. James and McLeod's Lake, I do not think that any grain, except barley, will come to maturity. From the vegetation and the habitats of the various species I am led to believe that coldness, caused by a superabundance of moisture, is the prevailing characteristic of the whole region; more especially, however, that part between Salmon River and McLeod's Lake. A greater snow-fall takes place on this part in winter, as was observed by me in 1872, and it was abundantly evident on our passing through the district this year that the spring was very late, and this, we were told, was owing to the late melting of the snow. Country not suitable for grain.

With the exception of the tract on the Nechacco and the limestone land near Fort St. James, none of the country passed over seemed to have reached the period of late spring or early summer. Hawthorn

(*Cratægus rivularis,*) was in flower at Harrison River on the 14th of May, the 16th at Yale, the 27th at Soda Creek, the 5th of June at Quesnel, west side of Fraser, and the 29th of June at McLeod's Lake. From this I am led to infer that, although spring may set in early enough on grounds exposed to the sun, in the deep forest very little growth takes place before June.

Standing on either Stewarts Lake Mountain or McLeod's Lake Mountain the observer looks down on a land of rivers, lakes, marshes and swamps, with occasional tracts of dry arable land, indicated by the light green of the aspen. These tracts are generally by the river margins, and hence are composed of alluvial soil and quite rich. Black spruce, (*Abies nigra,*) in the wet peaty swamps, is replaced on the drier grounds by white spruce (*Abies alba,*) while an intermixture of the latter and aspen always indicates a moderately dry soil. Sandy or gravelly soils are always known by the thick growth of black pine, *Pinus contorta,* called in my former report Banksian pine. These tracts are generally level, and although boggy on the surface, are never marshy. Douglas fir is always at home on the hill-side, and although it does not like to have the ground saturated about its roots it seems to delight in a humid atmosphere. In tracing it all the way from the coast, I found that it cared little for cold, but shrank away from a dry atmosphere.

The forest trees.

These five species of trees may be said to constitute the bulk of the forest for the whole distance of 270 miles by our trail from Quesnel to McLeod's Lake. There can be no doubt but that when the forest is cleared, by whatever cause, the soil will become drier and the climate will be considerably ameliorated. Owing to the latitude, the sun's rays fall obliquely on the forest, and, as a natural result, there is little evaporation. As Germany was to the Roman, so is much of our North-west to us—a land of marsh and swamp and rigorous winter. Germany has been cleared of her forest, and is now one of the finest and most progressive of European countries. May not the clearing of our North-western forests produce a similar result in the distant future of British America.

McLeod's Lake to the Parsnip River.

On the 3rd of July, our preparations being all made, we embarked in three frail boats, and commenced our adventurous journey down a rapid and almost unknown river, the discharge of McLeod's Lake. Late on Sunday evening, July 4th, we passed into the Parsnip, so named on account of the cow-parsnip (*Heracleum lanatum,*) being so abundant on its banks. During the next two days, I examined the country in the vicinity, but found nothing new. In the afternoon of the 5th we camped opposite the mouth of the Nation River, and here there were the first indications of a change of flora. The most notable species seen were a rose, (*R. blanda,*) a Spiræa, (*S. betulifolia,*) an Erigeron, (*E. alpinus*) and *Dryas Drummondii* in very fine fruit. Two Solidagos and a solitary specimen of *Polygonium viviparum* were likewise picked up, the latter the best climate indicator seen. Nation River.

A very severe frost must have occurred here on the night of the 28th of June, as all the tender plants have been nipped by it. Nearly all the herbaceous plants will produce no seed this year, owing to the flowers being either completely destroyed or so much injured that their pistils are infertile. The valley is very beautiful, but is subject to summer frosts. Last season, however, was not so bad as this, for the remains of last year's vegetation show that every species perfected its seed. Summer frosts.

The vegetation of the valley of the Parsnip differs very little from that of the region around McLeods Lake The spruce forest seems to be continuous on both sides of the river, but the immediate banks and tracts devastated by fire are often largely covered with aspen. White birch, (*Betula papyracea*) is frequently seen, and large alder bushes fringe the smaller streams. The forest, as a general thing, is quite heavy, many of the spruce being over two feet in diameter. The island vegetation is peculiar in one respect. Balsam poplar, being exclusively confined to islands and low alluvial points subject to innundation, and in no case throughout the whole length of the Peace and Athabasca Rivers was this known to change. The aspen, on the other hand, will not grow on recent land, and it was by means of this tree that we could tell an island from the main-land when in the delta of the Peace and Athabasca Rivers.

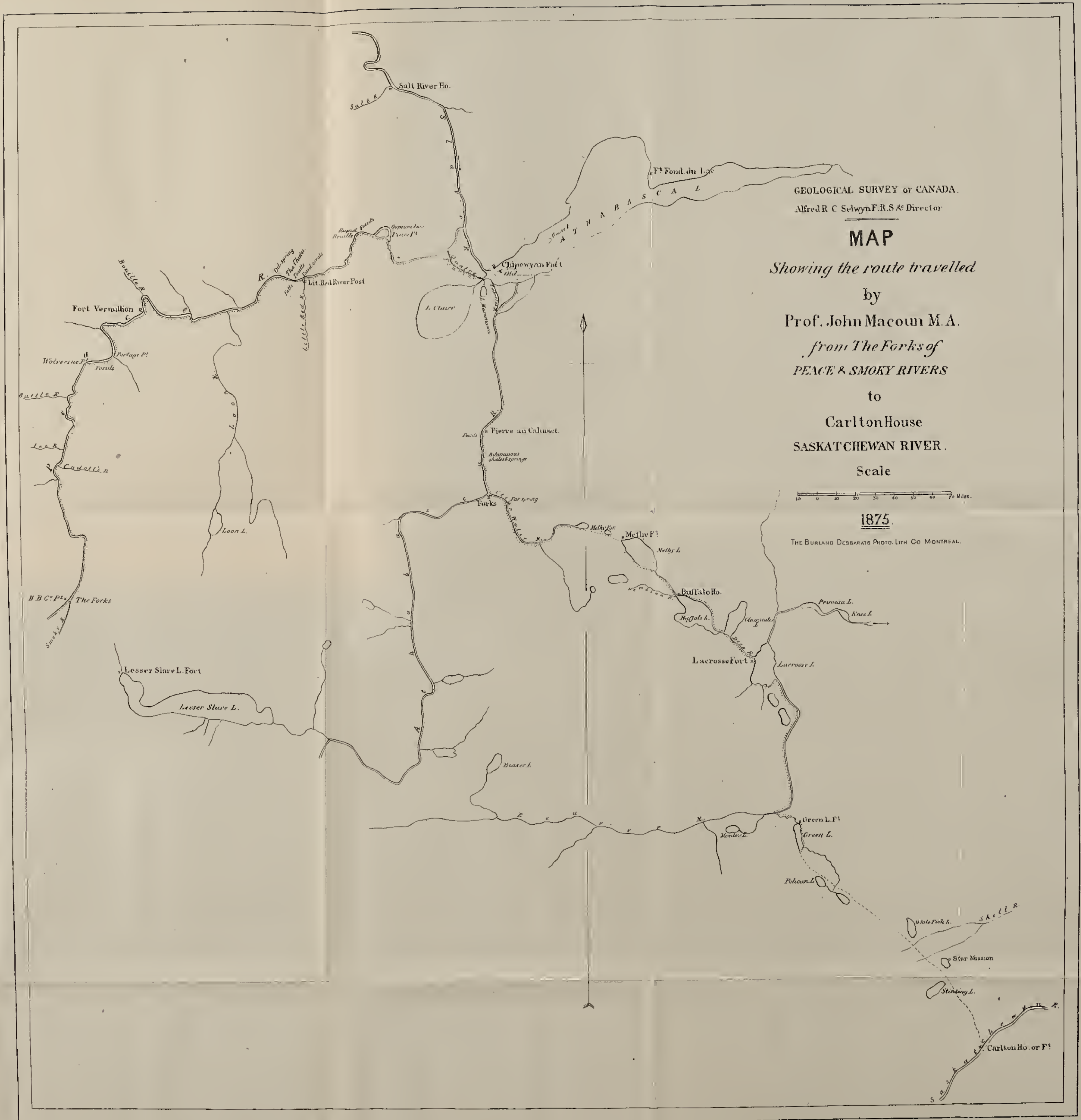
The Parsnip, being a mountain stream, is subject to great floods in spring, and hence is constantly destroying the old land, and forming new. As a rule the upper ends of the islands were being washed away, and the lower ends being added to. The materials and vegetation are arranged in the following order: Gravel as the sub-stratum overlaid with mud; on this mud the seeds of last years willows (*Salix longifolia*) had vegetated. These seedlings of one year are succeeded by those of two, and so on, until the bank is high enough for the balsam poplar, which ranged from the seedling of the present year to the monarch of the forest, towering to the height of over 100 feet, and in many instances over six feet in diameter. As this poplar forest decays, it is replaced by white spruce, which eventually merges into a spruce forest. It was no uncommon thing, on the lower Peace River, to see willows not Floods in the Parsnip River.

thicker than the finger silted up to the height of ten feet and more, and their roots holding the mud in place. The only willow which did this was *Salix longifolia*, and it is characteristic of the river bars of the whole North West.

The junction of the Finlay and Parsnip Rivers.

In the angle formed by the junction of the Finlay and Parsnip Rivers there is a broad alluvial flat, very little elevated above the water, and covered with a thrifty growth of balsam poplar. From the age of these trees I should think that it is not more than fifty years since this land was formed. On the lower part of the river the trees are much larger than those above Nation River, and the herbaceous plants, also, are much less boreal in character.

On the 9th we passed the mouth of the Finlay, and just below it I detected *Oxytropis splendens* for the first time. This is its furthest western limit, and I believe the only notice of its having passed the mountains. In company with it were *Artemisia Canadensis* and wild liquorice (*Glycyrrhiza lepidota*.) We camped about three miles below the forks, and in making a careful survey of the flora I noticed no change, except that *Smilacina uniflora* had been left behind, and more of the common eastern species were beginning to appear. A Betula was observed near our camp, which seems to be closely related to the Betula of Quebec (*Betula alba*, var. *populifolia*). I detected what I take to be the same species in the Saskatchewan country, but it still remains in doubt. Spruce, poplar, a little canoe birch, willows, (*Salix longifolia*,) and alders (*Alnus incana*) make up the arborescent vegetation. The leading forms of undergrowth were roses, having an exquisite perfume, dog wood, (*Cornus stolonifera*), high bush cranberry (*Viburnum pauciflorum*) and the beautiful silver berry (*Elæagnus argentea*,) which at this time was in full bloom, and filled the whole atmosphere with its sweet perfume. It grows to the height of six feet or more; its oval silvery leaves, sweet smelling flowers, graceful habit, and silver-coloured fruit, together with its hardiness, make it a very desirable ornament for our gardens. It is one of the commonest shrubs on the prairie—living on the driest soil—and extends from Point du Chene to Peace River, and by it through the Rocky Mountains to this point. Its fruit constitutes the largest part of the prairie chickens' food in the fall, and according to "Gray's Manual," its mealy fruit is not injurious to man. I believe it should be largely cultivated and introduced into all our shrubberies. Summer may be said to have commenced on the 3rd, as before that we had much cold weather, but since then the days and nights have been warm, and the vegetation very rapid.


GEOLOGICAL SURVEY of CANADA.
Alfred R C Selwyn F.R.S &c Director
MAP
Showing the route travelled
by
Prof. John Macoun M.A.
from The Forks of
PEACE & SMOKY RIVERS
to
Carlton House
SASKATCHEWAN RIVER.
Scale
1875.
THE BURLAND DESBARATS PHOTO. LITH CO MONTREAL.
Salt River Ho.
Ft Fond du Lac
Chipewyan Fort
Lit. Red River Post
Fort Vermilhon
Wolverine Pt
The Forks
Smoky R.
Lesser Slave L. Fort
Lesser Slave L.
Loon L.
Pierre au Calumet.
Forks
Methy Ft
Methy L.
Buffalo Ho.
Buffalo L.
Lacrosse Fort
Lacrosse L.
Primeau L.
Knee L.
Beaver L.
Green L. Ft
Green L.
Pelican L.
White Fish L.
Star Mission
Stinking L.
Carlton Ho. or Ft
L. Claire
Battle R.
Cadotte's R.

The junction of the Finlay and Parsnip Rivers.

vegetation very rapid.

On the morning of the 10th we dropped down the river only about seven miles, and camped in a little grove of poplars at the entrance to "Peace River Pass." Your purpose was to climb, the next day, a mountain—the highest in the chain—which rose in massive proportions a couple of miles in rear of our camp. Right opposite us was the spot where Captain Butler shot the moose and where Calder, myself and Horetzky camped in the fall of 1872, and the mountain in the rear was the very one figured on page 270 of Butler's "Wild North Land." Of course the artist drew largely on his imagination, and the real mountain, instead of being an isolated peak, is really the culmination of the chain which closes in the "Pass" on the south. This mountain I named Mount Selwyn, in your honour, you, as our leader, having been the first to reach its summit next day. It is the same mountain whose base extends at least six miles along the river, and is mentioned in my report of 1872 as the sole obstruction in the "Peace River Pass." Peace River Pass.

During the afternoon I accompanied you on an excursion to reconnoitre the ground for next day. We had great difficulty in forcing our way through the rank vegetation which covered the level ground between the river and the base of the mountain. This growth consisted chiefly of the Devil's Club (*Echinopanax horrida*), the white-flowered raspberry (*Rubus Nutkanus*), the great willow herb (*Epilobium angustifolium*) and lungwort (*Mertensia paniculata*). Clumps of shield fern (*Aspidium spinulosum*, var., *dilatatum*) grew more than three feet high, and great patches of *Polypodium dryopteris* were seen fully half that height. Underneath the trees were the various pyrolas, with the sweet-scented *Moneses uniflora*. After we reached the mountain and began to ascend we entered a *brulé* in which there were numbers of fallen trees, and amongst them many of the plants common to burnt woods in Ontario. *Geranium Carolinianum, Dracocephalum parviflorum, Equisetum scirpoides* and *pratense, Delphinium elatum*, var., *Corydalis glauca* and *aurea*; *Epilobium angustifolium, Mertensia paniculata* and *Streptopus amplexifolius* were particularly abundant, and growing much taller than they do in Ontario.

A few hundred feet up the slope *Pelæa gracilis* and *Woodsia Oregana* were seen in the crevices of the rocks. *Circæa alpina, Carex Buxbaumii, Hedysarum boreale* and *Mackenzii, Acer glabrum, Aconitum Napellus, Oxytropis campestris* and *splendens*, var., attracted attention by their profusion and luxuriance. Proceeding still higher our first alpine plant was the ubiquitous *Arenaria propinqua*, and shortly after a couple of *Saxifragas, Senecio triangularis, Dryas integrifolia*, a *Taraxacum* and one or two grasses. We had a very difficult climb, but were well repaid for our trouble by the view we obtained of the surrounding country. Our descent was little less difficult than the ascent, and our passage through the thickets of "Devil's Club" was anything but pleasant. The whole stem, together with the underside and ribs of the broad leaves—some of the leaves measured fourteen inches in diameter—was closely beset with spines, which penetrated the clothing and entered the flesh, causing much pain and inconvenience. From the coast to the east side of Peace River Pass this plant is an inhabitant of all the thick forest where not too wet, and is the terror of both Indians and white men. I had seen it in the Cascades and occasionally on the way up, but this was my first experience of its powers.

Devil's Club.

Ascent of Mount Selwyn.

On the morning of the 11th, we started, in high spirits, to ascend "Mount Selwyn." As a description of it appears in another report, I shall confine myself exclusively to an account of its flora. In company with Mr. Webster and McLennan I started, carrying my botanical box, and in the latter my portfolio containing a large quantity of paper. We headed for a mountain stream which lay between us and the mountain we intended to climb, and to the mouth of which you and the others of the party had gone in the canoe. When we reached the stream I asked, as a favour, that a halt of a few minutes should be made while I examined the banks, which I did with astonishing success. In less than ten minutes I had obtained *Saxifraga oppositifolia, rivularis* and *Aizoon, Artemisia arctica, Parnassia fimbriata, Phleum alpinum, Potentilla fruticosa, Epilobium latifolium, Carex scirpoidea, Anemone parviflora* and a few others. The greater part of the above species had been brought from the mountains by the torrent, as in some cases their proper horizon was at least 2,000 feet higher up. A mile further on we overtook you and the remainder of the party, and under your direction started for the summit. From the very base we followed a path formed by the mountain goat. On the lower slopes there was no change in the vegetation, but gradually there came a change, at first scarcely noticeable: a few mountain forms intermixed with the forest flora of the valley. Gradually the valley species ceased to appear, the alpine ones became more common, until at last none but the latter remained. We had some steep climbing on the first part of the route, and our progress was both wearisome and slow. After we got above the level of last evenings expedition I began to collect new things, of which the first was the little mountain sorell, *Oxyria digynia*, then came *Erigeron alpinum, Anemone Richardsonii*, closely followed by many others. About 1,500 feet from the summit we reached the limit of

Limit of trees.

trees, and here also we came upon the first snow. From this point to the summit all the plants were alpine, and nearly all herbaceous. As we proceeded the vegetation became more stunted, until at last it was not more than two inches high. With one exception, nothing new was seen on the last 1,000 feet of the ascent, and that exception was a little *Selaginella*, possibly *S. rupestris*. Our trip was very hurried, but I noticed that on the moist places where the snow lay longest there were the greatest number of species; and many were observed that did not appear in drier spots. Where the heaviest drifts of snow had lain, and where much of it still remained, one or two anemones and *Ranunculus hyperboreus* were abundant, and in fine condition to show the progress of spring. Four yards from the snow the petals had fallen, and between that and the snow the plant, was in all stages of growth, from those springing out of the soil to the fading flower. In a little mossy spot not more than two rods in extent I collected quite a number of interesting plants The following are a few of them : *Andromeda tetragona, Arctostaphylos alpina, Campanula uniflora, Salix reticulata, herbacea* and two other species, *Gentiana* Sp.—— ? *Pedicularis* sp.—— ? On the upper slopes *Saxifraga oppositifolia, Silene acaulis, Pedicularis Langsdorffii.*—— ? A number of Drabas and Arenarias actually obscured the ground, with multitudes of flowers. Five hundred feet below the summit, Mount Selwyn stands, first, in my imagination, as the highest type of natures' flower garden. None of the plants, except the pedicularias, rose above the general level, which was about two inches or possibly less, and all was a complete surface of expanded purple, yellow, white and pinkish flowers. The pedicularias were about four inches high, and stood singly amongst the others, and each nearly two inches broad with expanded blossoms.

The summit was quite level, with a little parapet in front upon which we stood overlooking the river, as we gazed upon a wondrous scene. Leaving others to take in the picture in detail, after a few minutes of close scrutiny I turned away from the entrancing sight and busied myself with what more concerned me : the flora of the peak. With sad and reluctant steps I turned from the summit and commenced to descend, intending to examine the different points more fully than I did in the ascent. About 1,000 feet from the summit I was overtaken by the others, and after a slight halt at the last patch of snow, we hurried on, reaching camp in a more or less exhausted state at about 7 p.m., after nearly thirteen hours incessant and continuous labour. My acquisitions were very valuable, as I had obtained a section of the Rocky Mountain flora in Lat., 56°, and that in a vertical range of 5,500 feet. The following is

Smmit of Mount Selwyn.

a preliminary list of the species obtained, the specimens themselves not having reached me yet:—

Panax horridum.
Oxytropis campestris.
" splendens.
Cerastium alpinum.
Aconitum Napellus.
Corydalis glauca.
Delphinium elatum, var.
Hedysarum Mackenzii.
" boreale.
Arenaria Rossii?
Dryas integrifolia.
Rubus Nutkanus.
Epilobium angustifolium.
Acer glabrum.
Epilobium latifolium.
Saxifraga oppositifolia.
" aizoides.
" rivularis.
" cernua.
" exarata.
" nivalis.
" æstivalis?
" Dahurica.
" ——— ?
Potentilla nivea.
" fruticosa
" ——— ?
Parnassia fimbriata.
" parviflora.
" ——— ?
Arenaria cæspitosa?
Draba alpina.
" frigida.
" ——— ?
Silene acaulis.
Lychnis apetala.
Anemone parviflora.
" ——— ?
Ranunculus hyperborea.
" pygmæus.
Triticum ——— ?
Pyrola chlorantha.
" secunda.
Gentiana ——— ?
Gentiana ——— ?
Senecio lugens.
Taraxacum ——— ?
Streptopus amplexifolius.
Artemisia arctica.
Artemisia ——— ?
Solidago ——— ?
Myosotis alpestris.
Pedicularis Langsdorffii.
" surrecta.
" bracteosa?
Erigeron uniflorum.
Campanula uniflora.
Arnica mollis?
Andromeda tetragona.
Arctostaphylos alpina.
Oxyria digynia.
Pellæa gracilis.
Carex festiva.
" nardina.
" scirpoidea.
" atrata.
" concinna.
" ——— ?
" filifolia.
Festuca ——— ?
" ovina, var.
Phleum alpinum.
Luzula spicata.
Drisetum ——— ?
Lycopodium Selago.
Selaginella rupestris.
Salix reticulata.
" ——— ?
" ——— ?
" ——— ?
Zygadenus glaucus.
Betula nana.
Hieracium ——— ?
Polygonum viviparum.
Poa alpina.
Senecio triangularis.

Pyrus sambucifolia.
Spiræa Aruncus.
Aspidium spinulosum, var.

Temperature on the mountain.

When we left the river in the morning the thermometer stood at 84°, and on the top of the mountain, in latitude 56° north, 7,500 feet above the sea, it stood at 82°. I had supposed that we would find it cold on the mountain top, but the very opposite was the case. I had actually to take off my coat and hat and bathe my head and face in the snow to cool myself. Looking east from where we stood, a blue sultry haze hung over the mountains and the river, while to the west the atmosphere seemed clearer and colder. The mountain on which we were seemed to close in on the river valley, and shut out the vapour of the western plateau in exactly the same way as the Cascade range, below Boston Bar, does that of the Pacific. We had this amply verified the next day, for we had scarcely gone six miles—the distance along the base of the mountain—before we all noticed the change to a drier and warmer climate. Mount Selwyn thus closes the Peace River Pass, and stands as a portal barring the way against the Pacific breezes and their moisture, which are the supposed cause of the mild climate and luxuriant vegetation of the Peace River valley. In another part of this report I shall attempt to show the true cause of the mild climate along the eastern base of the Rocky Mountains.

Sudden change of climate.

Where we stopped for dinner on the 12th, although less than twenty miles from our camp of the 11th, the service-berry (*Amelanchier alnifolia*) was more than half ripe, and a few were even fully ripe ; and we had been informed the evening before, while still in camp, that both service-berries and strawberries were ripe at Hudson's Hope as early as the 6th, and yet, west of the Pass, they were only in flower at this date. West of the Pass we find a cold, wet climate, and in one day, without going south or making any appreciable descent, we pass into a dry and warm one, and a region in which vegetation is at least four weeks in advance. If the Pacific breezes ameliorate the climate here, why do they not act in the same manner, or more effectually, on the country west of the mountain barrier?

Limestone Mountain, left bank, near Fossil Point.

On the 13th we remained in camp, and Anderson and I climbed a limestone mountain. We found the ascent both toilsome and dangerous, and got little to repay us for our trouble. On the top, which was 3,000 feet above the river, we found roses and a species of *Rhododendron* (*R. altiflorum*) in flower. We did not see the slightest sign of an alpine plant, and I confess it was with a feeling of disappointment I looked about me and found them not. We ate our lunch on the very verge of a cliff from which we could look down on a little mountain tarn at its base, more than 1,000 feet below, and our hearts yearned for water, but there was none to be had. We knew it was scarcely possible to descend by the way we came, so we decided to return by the head of a little stream we crossed on our way from camp in the morning. We commenced to descend close to a precipice that went down sheer into the valley, and got along without danger. On our way I picked up *Asplenium viride* and *trichomanes*, *Aspidium Lonchitis* and *Cystopteris fragilis*, *Botrichium lunarioides*, a *Pedicularis* and *Carex filifolia*. A few others were met with, and the first appearance of *Campanula rotundifolia* was noted. We reached camp by 6 p.m. thoroughly exhausted, but well pleased with our trip. I had settled one point, that in this region arctic vegetation is not to be found on a limestone mountain in Lat. 56° at a height of 5,000 feet above the sea!

Otter-tail River.

On the 14th we passed the second rapid, and camped at Otter-tail River. A very beautiful *Silene* was observed in flower as we floated along, but I was unable to obtain a specimen. No change was noticed to-day, except that it was still more apparent that the climate east of the mountains is altogether different from that on the west. A number of *Astragali* were seen for the first time to-day—*Oxytropis Lamberti* and *deflexa*, *Agrostis scabia*, *Carex eburnea*, *Prunus serotina* and other eastern species. *Crepis elegans* was noticed at the rapid, and another undetermined composite flower.

During the 15th we floated down the river in the midst of the most beautiful and picturesque scenery. The main chain of the mountains was passed at our last camp, and to-day the rugged scenes of yesterday have given place to those of a fine pastoral country. The river is wider and the country more open, the slopes of the hills are covered with grass and the mountains are bare from base to summit. All this shows a change of climate ; and had I had an opportunity to examine the flora a corresponding change of species would doubtless have been observed.

Reach the canon

At noon on the 16th we reached the cañon, and from sheer exhaustion I was scarcely able to ascend the bank. Our tents were pitched, and I commenced to change my plants and dry my papers. This had been part of my daily work for nearly three months, so that a halt always found me busy.

On the afternoon of the 17th McClennan and I ascended the Buffalo's Head, the view from which is so graphically described in Butler's "Wild North Land." We too found the base of the mountain lying "thick with *brulé* and tangled forest," but worse than this was the tangled mass of pea vine, vetch and various weeds and grasses which covered the logs and made our progress both slow and laborious. Before Butler "there rose abruptly a mass of yellow grass and blue anemones," and before us the same steep; but the grass waved green on the hill-side, and the herald of spring (*Anemone patens* var. *Nuttalliana*) had already perfected its seeds and disappeared under the wealth of grass that covered its grave. We also stood on that hill-top and looked on the wondrous panorama that lay stretched out before us. But our occupations were more prosaic; we were there to see and faithfully report what we observed regarding the soil and productions of the country. Sitting possibly on the same rock on which Butler sat, I mentally attempted to contrast the region we had left west of the mountains with that in which we now were, and I could find no points of agreement. West of the mountains the climate was cold and moist and the land generally covered with a coniferous forest, but here we found prairie and aspen forest and a climate dry and warm, 3,000 feet above the sea the mountains are actually without forest and covered with grass and vetches over two feet high. *Botrychium lunarioides*, a *Lychnis* and *Arenaria propinqua* we found on the highest point. There were many signs of the grizzly bear being in the vicinity, as there was scarcely a log which had not been turned over or torn to pieces in their search for ants and their larvæ. *Aquilegia cærulea* and *Parnassia palustris* were obtained on our way to camp, and a considerable number of eastern species which were not observed west of the mountains.

Buffalo's Head Mountain.

During the four following days we remained in camp close to the cañon, and I employed my time in making excursions in the vicinity, drying, packing and labelling plants. We had now passed the mountains, and I closed my western observations and commenced a new series.

A very careful examination of the rocks at the entrance of the cañon was made, and I obtained many fine mosses and liverworts; but few of them had not been seen before. An *Anemone*, possibly *A. Richardsonia*, was in fine flower. *Tofieldia glutinosa*, *Selaginella selaginoides* and an *Arnica*, without flowers, were obtained. I also procured specimens of *Aspidium fragrans*, *Pellæa atropurpurea*, *Woodsia scopulina ? Cystopteris, fragilis*, and various forms of *Botrychium lunarioides*. In a swamp near the camp I saw the first tamarack (*Larix Americana ?*) seen since leaving the coast, and obtained a number of fruiting specimens of *Meesia longiseta*, *Cotoscopium nigritium*, *Bryum pseudo-triquetrum*, *Gymnostomum curvirostrum*, *Hypnum sprucei*, *commutatum* and *lutescens*, and a new *Splachnum*.

Plants found at the canon.

Cross the portage to Hudson's Hope.

On the morning of the 21st we started to cross the portage to Hudson's Hope. The morning was very warm, and walking over the sand hills was not very pleasant. Since Sunday-week (July 11th) the temperature has been very high, averaging about 80° Fah. each day. A haze has hung around the mountains ever since, and McLennan says this will continue all summer. It is not smoke, but a vapor which seems to take the place of cloud, and evidently causes an accumulation of heat on the earth's surface. Strawberries (*Fragaria Virginiana*) were in some abundance at the cañon, and on our approach to Hudson's Hope we got them in quantity. Service-berries, "Poires" or "Sas-ka-tum berries" (*Amelanchier alnifolia*) were in prime condition, and at Hudson's Hope raspberries (*Rubus strigosus*) were quite common, but only (July 21st) beginning to ripen.

While crossing the portage I found quite a number of eastern species, and amongst others, *Linum perenne*. This species, with *Anemone patens*, var. *Nuttalliana* and *Geum triflorum*, may be said to reach their western limit at this point.

On reaching the post we ate a hearty dinner of dried moose meat, early-rose potatoes, turnips and onions, and rejoiced in the thought that we had accomplished so much of our journey in safety.

Luxuriant vegetation.

While you were getting ready to proceed down the river, I employed myself, as usual, making a thorough examination of the flora in the vicinity for the purpose of comparing it with that further down the stream. The following extract from my journal, written on the spot, will give a truthful picture of Hudson's Hope as I found it on the 22nd of July, 1875:—I have been extremely surprised at the rankness of the vegetation around here, although there is very little rain at this season and has been little all spring. Wild peas and vetches grow to an amazing height in the poplar woods, and form almost impenetrable thickets in many places. Vetches, roses, willow-herb and grasses of the genera *Poa, Triticum* and *Bromus* fill the woods and cover the burnt ground, and surprise Canadians by their rankness and almost tropical luxuriance. Charlette, who is in charge of this post, has two small gardens, in which he has growing, potatoes, onions, turnips, beets carrots, cabbage and various other vegetables. Yesterday we had new potatoes for dinner, of a very fair size, which were planted on April 28th. Numbers of the onions were one and a half inches across, raised from seed imported from England and sown about the first of May. Growth is extremely rapid, owing partly to the length of day and cloudless skies supplemented by heavy dews, and possibly also in part

Vegetables at Hudson's Hope.

to the great range of temperature during the twenty-four hours, from about 45° at sunrise to 80° Fahr. at noon. Sometimes the range is even more, but the above may be taken as the average. The rankness of the vegetation on the west shore of Lake Superior has frequently been alluded to, and may be caused by the somewhat similar great range in the temperature there. Can it be that all the rank vegetation observed around Lake Superior, in the Rocky Mountains and here, is connected with the sinking of the temperature during the night, and increased activity given to the vegetation during the day on this account? We have warm sultry days, and cool pleasant nights, with constant regularity, and we are told that this is the usual summer weather. The left bank of the river is much drier than the right, and, as a consequence of this, growth on it is much further advanced. The frost of the 28th of June, however, was more severe on the left bank than on the right. Charlette informs me that in 1874 there was no frost from the first of May until the fifteenth of September. In 1875 sowing commenced the last week in April, and the first frost came on the eighth of September.

Cause of the rank vegetation.

Summer frosts.

Peace River, at Hudson's Hope, runs in the bottom of a deep valley about 700 hundred feet below the plateau, and has a general easterly course for more than 200 miles. Throughout this distance the right bank, on the slopes near the water, is clothed with a thick forest of tall spruce, but as you ascend, this gives place to an aspen forest, which either covers the country or passes insensibly into prairie. The left bank, on the contrary, is mostly destitute of trees, except in the hollows, and these are always aspens. It is on this bank, and on the prairie on both sides, that the Indians collect such immense quantities of service berries. In many places the slopes are very steep, and so arid that a species of cactus appears to be just as much at home as it is ten degrees further south. These dry slopes were always observed on the left when the river ran eastward, but along north and south bends both sides were clothed with wood. The general altitude of the country decreases as you leave the mountains, and by the time Battle River is reached, the valley is less than 200 feet deep.

Difference in the vegetation on the north and south banks.

Around the springs which gush out with such force on the left bank, opposite Hudson's Hope, I detected a large number of very fine mosses, and the beautiful *Mimulus Lewisii*, which I found in a similar position on Stewart's Lake. It was growing very luxuriantly and covered with a profusion of fine large flowers. On my former trip I had obtained a few specimens of a new moss, *Amblyodon Macounii*, and I now collected a number of others. Only a few novelties were detected here. Near a spring I found a few fine specimens of *Angelica genuflexa*, and up a small stream a *Juncus* and a *Glyceria*, together with a *Stellaria* and a composite plant. *Prosartes Hookeri, Matricaria discoidea, Dryas D rummondii, Epilobium latifolium, Cratægus Douglasii, Mimulus Lewisii, Pinus contorta, Spiræa betulifolia*, and a few other western species were not seen east of this point, and many new eastern ones were observed.

Hudson's Hope to Fort St. John.

During the afternoon of the 25th and forenoon of the 26th July we floated down the river on a raft, and although we had ample time to admire the magnificent scenery, there was no opportuninty to botanize. At St. Johns, a few minutes observation tended to show that this point was much warmer than Hudson's Hope, that the soil was richer, and that the vegetation was in a far more advanced state. Raspberries and service-berries were fully ripe, and in great abundance. Potatoes, oats, barley, and many varieties of vegetables were in a very flourishing state in "Nigger Dan's" garden. The oats stood fully five feet high, and the barley had made nearly equal growth. After the tents were pitched Anderson cut a quantity of wild grass for our beds, which was over three feet in length: it consisted principally of species of *Triticum* and *Poa*. On your decision to build a canoe for the ascent of Pine River, I found I would have several days at my disposal, and on the morning of the 27th, accompanied by Anderson, I started up the hill in rear of the fort, for the purpose of examining the region north of the river, We found the level of the country above the river valley to be about 700 feet. On the plateau the surface is either a dead level or slopes away from the river. For nine miles, the distance travelled, the whole country was covered with the most luxuriant vegetation. Clumps of willows and poplars of various ages were interspersed with the most astonishing growth of herbaceous plants I ever witnessed. Willow herb, cow-parsnip, *Geum strictum, Triticum, Bromus, Poa*, and a number of other tall-growing species covered the whole region with a thick mass of vegetation that averaged from three to five feet in height. Wild larkspur (*Delphinium elatum*,) was found over seven feet high, and many vetches were even taller. In many places the climbing *Leguminosæ* were in such abundance as to completely cover up all other plants, and cause the country to look like a field of mixed peas and vetches. The species were *Vicia Americana, Lathyrus venosus* and *ochroleucus*, the first named being the most abundant.

Wonderful fertility of the soil.

It would be folly to attempt to depict the appearance of the country, as it was so much beyond what I ever saw before that I dare hardly make use of truthful words to portray it. The country passed over your own excursion ten miles to the north-west, you report to bear a vegetation similarly luxuriant, more so than that around Edmonton, or anywhere in the Saskatchewan country. Rainy River and the Little Slave Lake marshes are the only regions known to me that are in any way comparable to it. The latter, however, is swamp, while this is a plateau, nearly level, and in parts over 700 feet above the river.

The soil must be exceedingly rich to support such a growth year after year, and the early summer temperature must be high for the vegetation to be so far advanced at this period. All the cultivation at St. John is on the terrace immediately above the spring flood level on both sides of the river, but there is no reason why cereals should fail on the plateau above, as the soil is, if anything, better. Notwithstanding the difference in altitude, the berries on the plateau ripened only about a week later than those near the river, and Nigger Dan stated that there was about the same difference in the time the snow disappeared in the spring on the plateau and in the valley.

The slopes of the hills on the left bank are very warm, being inclined towards the sun at a considerable angle, and on these the greater part of the prairie flowers are met with. The *Opuntia*, a species of cactus, grows here in company with many prairie species, such as *Anemone patens, Geum triflorum, Linum perenne, Erigeron glabellum, Thaspium trifoliatum, Aster lævis, Danthonia sericia* and numerous others. *Anemone patens* or Pasque Flower, the first spring flower in Manitoba, was seen by Captain Butler in 1873 on these slopes, covering the ground with its pale blue flower as early as the 22nd of April; and the preceding October, as late as the 27th, I saw Erigeron and Aster still in flower.

My observations all tend to show that—ommiting the slopes on the left bank—the flora of this region is almost identical with that of Ontario. I spent over a week in the vicinity, and had ample opportunity of examining the country on all sides. Similarity of the flora to that of Ontario.

At St. John I took extracts—bearing on the commencement of spring and the opening and closing of the river—from journals kept at the Hudson Bay House, and by Daniel Williams ("Nigger Dan"), a native of Napanee, Ontario. Williams has been on the river for many years, but at St. John only four.

This year potatoes were dug at St. John in quantities on the 2nd of August, and were large and dry. Dan supplied seventeen men with potatoes at this time, who were on their way up the rivers and depended on their guns for a supply of meat. The barley and oats were both ripe about the 12th of August.

Metereological extracts from journals at St. John.

The extracts from the journals being given at length in your report, page 84, it will not be necessary to repeat them here. The following dates, showing when the river opened and when the first ice appeared, during the ten years from 1866 to 1875, are from the Hudson Bay Company's journal:—

	Ice breaking.	Ice drifting, first time.
1866........	April 19........................	November 7.
1867........	" 21........................	" 8.
1868........	" 20........................	" 7.
1869........	" 23........................	" 8.
1870........	" 26........................	" No record.
1871........	" 18........................	" 10.
1872........	" 19........................	" 8.
1873........	" 23........................	" 4.
1874........	" 19........................	October 31.
1875........	" 16........................	

A careful examination of the extracts referred to will show, that from the middle of April until the first week in November the ground is fit for the plough ; that winter is actually shorter on Peace River than in Manitoba, and that 1,200 miles north-west of Fort Garry a milder temperature prevails in autumn than at that point.

On the 2nd of November, 1875, I found the Assinaboine frozen solid at Winnipeg so that I could walk across it, while, from the Peace River record, ice has been seen in that river as early as that only once in ten years.

Arrange to proceed down the river.

As Mr. King, the gentleman in charge at St. John, was going down the river to meet the Hudson Bay boats bringing up the *outfit*, you permitted me to accompany him, with the understanding that I should not be away more than forty days, and that I should rejoin our party either at St. John or at Dunvegan. Before you started up Pine River on the 31st of July you accordingly supplied me with forty days' provisions. From the time you left until the morning of the 4th of August I was busily engaged drying and packing plants, and had little time to think of the arduous journey which lay before me.

Early on the morning of the 4th we packed up and proceeded to load our canoe, but found that it was so small that three men and our provisions were too much for its capacity, so the man and a bag of pemmican had to be left behind. With light hearts we pushed off, believing that our trip was going to be a pleasure excursion, and that we should float down about 300 miles, and return leisurely with the boats.

On the evening of the second day we reached Dunvegan, and found the people at the post living on bear meat, so I charitably gave them some of our flour, which Mr. King agreed to replace when we met the boats. We remained only two hours at Dunvegan, camping at dark on Old Woman's Island. The next morning, owing to a fog, we started late, and had proceeded only a short distance when we reached a camp of Indians and Half-breeds engaged picking "Sàs-ka-tum" berries. Their camp was pitched in a beautiful spot, surrounded by meadows and copse wood. The quantity of berries already collected was very great, and these, together with the flesh of the black bear, constituted their sole diet. A dainty dish, composed of berries fried in bear's grease, was served up, but my appetite for such food being very poor, I declined to partake of it. My flour did duty again, but in a few days we would meet the boats. Again we launched our tiny canoe and glided rapidly down stream, reaching McKay's post, at the mouth of Smoky River, early in the evening. On our way to-day we stopped where there were a number of saline springs, and I obtained the following plants:—

Dunvegan.

A dainty dish.

Glyceria airodes.	Corispermum hyssopifolium.
Spartina gracilis.	Glaux maritima.
Brizopyrum spicatum.	Chenopodium glaucum.
Phragmites arundinacæ.	Salicornia herbacea.
Scirpus maritimus.	Grindelia squarrosa.

I had now discovered that my trip meant work from break of day till dark, and that botany must be kept in the back-ground. I had gone too far, however, to recede, and resigned myself to the situation. McKay informed us that it was extremely doubtful if the boats had yet left Athasbasca, and that we might reach Vermillion before we met them. Long before any of the inmates of the post were stirring next morning, we were under weigh, and floated rapidly down, propelled by our paddles and the force of the stream. During the day, we passed "The Ramparts," a series of almost perpendicular sandstone cliffs, after which the country is lower, and as the river winds about, the grassy slopes appear on one side and then on the other, until at last they cease entirely and are succeeded by an almost level country of poplar forest.

"The Ramparts."

Game has been very abundant since leaving Smoky River. Black bears were very numerous along the river margin, feeding on berries; while beaver, lynx and geese were quite common.

We reached Battle River about noon on the 8th, and it being Sunday, we remained with Mr. Macaulay, the gentleman in charge of the post, until next morning. During the afternoon I examined the country in

Battle River.

Mosquitoes. the vicinity, but owing to the multitudes of mosquitoes I found it fearful work. I saw enough, however, to satisfy me that the land was astonishingly rich, fit in fact to produce anything, and yet, six weeks before our visit, the whole family were on the brink of starvation. Throughout the Peace River country the Indians live by hunting, and are, therefore, all flesh eaters. The Hudson Bay Companys' servants have fallen into the same habits, and, therefore, a small garden at each post is about the extent of their efforts in cultivation. A regular hunter is attached to each post, who supplies it with meat. Macaulay's hunter had not been successful, and after eating up all the food they had, Mr. Macaulay himself and his family had to subsist for some time on fried sinew and green hide. We fared sumptuously on cabbage, green peas, radishes, moose meat, bacon and flour, but this could not last, and after breakfast on Monday morning we were again floating down the river.

Scarcity of meat.

Battle River is a small stream in summer, but it has a very wide bed. It flows into the Peace from the south, while the great river itself flows to the south-east. Owing to the windings of the Peace at this point great ice jams occur every spring, and the river rises over thirty feet above its summer level. The banks now decrease in height, the bed of the stream gets wide and the current far less strong: and as we glide along, one is led to believe that there is a sudden change in the general level of the country. After passing Cadots River the Peace sweeps in a series of graceful curves from side to side of what may be called its immediate valley, and at Wolverine point curves round so much that it actually seems to turn on itself. From this point the river may be said to be without current, and at least half a mile wide.

Cadots River.

We slept on a sand bar above Wolverine Point, and at dawn of Tuesday, August 10th, were again at work, paddling with all our might until the afternoon, when the wind coming strong up the river, our frail canoe was in danger of capsizing, and we were compelled to keep close in shore to avoid the waves. After a number of ineffectual attempts to cross the river, we at last accomplished it, and taking a channel behind a large island, we were sheltered from the wind and made good progress. Owing to the muddy water we frequently got aground, but were soon afloat again, as neither of us hesitated to jump into the water to lighten the canoe. Another hour's paddling took us to Portage Point, where we camped, resting our weary frames on a mossy couch. Here the winter road leaves the river to avoid the great bends between the Point and Vermillion.

Portage Point.

We started early this morning and toiled all day with the paddle. Owing to the great breadth of the river, and the many wide sweeps it takes, the current is almost imperceptible, and our progress depended altogether on our own exertions. Early in the forenoon the wind began to blow up the river, causing quite a head sea, which gave us much discouragement and infinite trouble to overcome. At one time we were almost tempted to give up in despair, but perseverence had its reward. Just as the sun began to sink behind the trees, we rounded a point and saw the white buildings of the fort standing out against the sky, about two miles off. Redoubling our efforts we soon reached the haven of rest, and after eating a hearty supper of moose steaks, washed down with good rich milk, retired to rest—not before we had learned, however, that the boats were not expected before the 25th. Reach Vermillion.

Having decided to rest one day at Vermillion, I employed it in making a botanical survey of the neighbourhood. I first examined the field and garden, and found with the utmost astonishment that, although more than two degrees further north than Dunvegan or St. John, the barley and vegetables were much further advanced. Barley was standing in shocks in the field, having been cut on the 6th of August, while scattered ears of wheat, which I found around the fence, were fully ripe, (August 12th.) Wheat is seldom cultivated in the North-West, owing to the fact that barley is more useful, as the former is only used when boiled with meat, while the latter is fed to horses in the winter. The barley was sown on the 8th of May and reaped on the 6th of August, having ben in the ground just ninety days. The heads averaged from four to six inches in length, and were full of large grains of a beautiful colour. In fact, both wheat and barley were the plumpest I ever saw, and must weigh as much as that brought from Fort Chipewyan. They stood very thick in the ground and were uncommonly stout, and must have yielded very heavily. Turnips and early rose potatoes were quite large, and both gave indications of a heavy crop. Fine wheat and barley.

Mr. Shaw, who had been postmaster at Vermillion for fifteen years, told me that he had raised Indian corn both here and at Battle River without difficulty. The whole country around this post is a plain not elevated at its highest point more than 100 feet above the river, but the greater portion of it is less than fifty feet. I made frequent enquiries about its character at a distance from the river, and all agreed in saying that it was exactly like that which I saw. Character of the country.

From the highest point I reached, the view across the river extended to the Cariboo Mountains, distant about forty miles. The intervening country seemed to be perfectly level, or else to slope gradually upwards towards the mountains. As far as the eye can reach, the country was almost everywhere covered on both sides of the river with a continuous aspen forest. Once in a while a group of spruce was seen, indicating a low or marshy spot. Cold nights were common on the upper part, but here, where the banks are low, the days and nights are both warm, and summer frosts are almost unknown. The frost which occurred on the 28th of June, extended from McLeod's Lake to Dunvegan, but was not noted lower down the river. No frosts had occurred at Vermillion since early in May, and none were expected until September. Often a whole season passes without a frost occurring from early in May until late in October, but when winter does come it is continuous.

No summer frosts.

The soil examined is of the very best description, being evidently alluvium, but of what depth I had no means of determining. On the immediate bank of the river the subsoil is a till, composed of gravel and clay, often of a reddish colour. Hence the name, Vermillion. About half a mile from the river the land rises nearly fifty feet, and with this rise the luxuriance of the vegetation increased. Much of the land had been burnt over, and the timber is all destroyed or in various stages of decay. The soil is covered by thickets of raspberry bushes, golden rod, (*Solidago Canadensis*) *Epilobium angustifolium*, asters of various species, and many other plants that appear in Ontario when the forest is cut down or burnt off. In less than a day I detected 151 species, and they showed conclusively that the climate here was much warmer than at either Dunvegan or St. John.

Vermillion to Little Red River.

We started for Little Red River this p.m., (August 15th,) but owing to the head winds and great breadth of the river—over 1,000 yards,—we feared to cross it. As we proceed the river widens, and is filled with islands, and often it is difficult to tell its breadth. On the 14th, we battled all day against a head wind, and ran great risk of being overset; but by great care, and keeping close in shore, we managed to get along. Towards evening a thunder-storm came up, but passed off to one side of us, and immediately the wind fell. We now redoubled our energies, and reached Point-aux Cache before dark. While we were cooking supper a bear walked into the river a few yards off, but soon left us when he saw Mr. King get his gun. Wearied out and exhausted, we spread our blankets on the sand, and soon fell fast asleep. At the first streak of dawn we were up and ready to proceed.

We were now at the point where the *voyageurs* deposit the ropes and tackle with which the boats are hauled up the *chutes*. Cautiously we proceeded down stream; and as we saw the current increase, we drew the canoe ashore and fastened a line to the bow. Mr. King steered and I held the line on shore, and so we advanced. There are two portages at the *chutes*, the first *chute* is only a rapid, but the next is a fall of at least ten feet. By noon we had descended in safety to the very brink of the fall, and were within two miles of Little Red River. We never expected to take the canoe over the fall, but intended to cache our baggage and go on to the fort on foot. After examining the fall, however, we resolved to try our old experiment of a bow and stern line, and after dinner we shoved the canoe off and let her take her chance. Each did his work well, and we had the satisfaction of taking her over the falls in safety. After bailing out the water, we re-embarked, and in less than an hour reached Little Red River. Here we learned, to our chagrin, that the boats were not expected before the 22nd, and that we had better await their coming.

Falls and rapids above Little Red River.

I occupied myself on the 16th collecting fossils, and making a botanical examination. The vegetation indicated that Red River was even warmer than Vermillion, and all garden vegetables were much more advanced. When St. Cyr, who had charge of the fort, knew I was a botanist, he asked me to look at a strange plant he had in his garden. What was my astonishment to find a bed of cucumbers, with a number of ripe ones on the vines, and many green ones also. I asked him if he raised the young plants in a hot-bed, but he knew nothing of such things. He told me he had no plough, and could only cultivate a small patch, but that all kinds of grain would succeed admirably if the ground was cultivated. His beans, (both windsor and pole,) cabbage, turnips, potatoes and cucumbers were first-class. Summer frosts never do any harm here, and the soil is of first-class quality. At Vermillion I noticed that the country was begining to show signs of being parched, and here the grass was beginning to wither. I learned afterwards that the rainfall had been unusually small throughout the whole Peace River country this season.

Fine cucumbers and vegetables

Little Red River is over fifty yards wide. At its month whitefish are caught in nets; and from this I suspect that it is connected with lakes which discharge their waters into the Peace. Whitefish are likewise caught in Loon River, which enters the Peace about fifty miles above Little Red River, and is a favourite fishing ground for the Indians of this region.

August 17th.—Believing that the boats were close at hand, nothing would satisfy Mr. King but that we must go on and meet them. I was disinclined to proceed. However, as I had already come so far, I consented. Our flour was now all gone, and we had only a little mouldy pemmican, a few dried berries and some tea. We still had 200 miles of river between us and Fort Chipewyan, but fully expecting to meet the boats we did not replenish our stock of provisions, and we had no matches. To make matters worse, Mr. King broke his gun, so that this last resource failed us. We worked hard all day, constantly looking out for the boats, and at dark camped at the head of Big Island, in a perfect storm of mosquitoes. We were nearly wild before we got a fire lighted, which we accomplished by means of dried grass and gunpowder. For the next five days all our fires were lighted in this manner, and some evenings an hour was spent groping around in the dark to get it done. We slept little during the night owing to the flies and our anxiety, and were under way long before sunrise. Early in the forenoon we fell in with an Indian family, and from them obtained a supply of fresh (?) moose-meat for the use of the men when we met the boats. During the remainder of the day we worked steadily on, and camped late at night on a sand-bar amongst willows. Here we were so bitten by flies that we could scarcely eat our supper, and sleep we found to be out of the question.

Poor food and no matches.

August 19*th.*—Constantly paddling on we watched for the boats around every turn, but they did not appear. About ten o'clock the wind sprang up dead ahead, and we were under the necessity of putting ashore and waiting until it went down. Here we slept by turns, one watching for the boats while the other slept. About five p.m. the wind fell, and we immediately started, and worked hard until long after dark.

August 20*th.*—About ten miles from our camp we reached the head of "Rapid Bouillé," and after some care and patience succeeded in passing it. In no place is it difficult to pass down, but owing to the shallows extending a great distance from shore, it is a work of great labour to bring boats up. As far as we could judge, a very little labour would be necessary to make a channel fit for steamboats.

Rapid Bouillé.

Between Little Red River and "Rapid Bouillé" the river is very wide, and seldom or ever confined to one channel. Mud or sand-bars covered with willows, and wide mud flats, almost level with the water, are of constant occurrence. These, and islands in every stage of development or decay, are the chief characteristics of the river bed, while the country along the banks seems to be a low alluvial plain, with a soil of surpassing richness. All the islands are covered with immense poplars (*Populus balsamifera*), while the aspen constitutes the greater part of the general forest on the mainland.

Formation of the islands.

After passing the rapid the river is more confined, the islands are less numerous and the banks higher, with gravelly margins. This continues where the rock shows in the banks and on the islands, and ceases about ten miles below Peace Point. Shortly after passing the rapid we decided to camp and wait for the boats, which should have arrived before this. Acting on this decision—caused by a head wind we could not face—we carried our things up the steep bank, made a fire, and dined on a little uncooked mouldy pemmican and tea. The *fresh* meat had all become rotten, and was thrown away; my last meal of it had been taken in the morning at the rapid. It was then so bad that Mr. King could not stay at the fire while I cooked it. The high wind set fire to the dry grass, and before we got all the things together my clothes were more than half burned. Immediately after this the wind fell, and we resolved to proceed. We still had more than seventy miles to make before we could obtain food, and our supplies were all exhausted, except the mouldy pemmican. We worked hard all the evening and camped on the lower end of an island, and built a large fire, so that if the boats came along in the night the men would see the light and at least fire a gun. During the night we had heavy rain and a severe thunderstorm, but after daylight both ceased.

August 21*st*.—Poor food and hard work now began to tell on me. My stomach loathed raw pemmican, and all other food was gone—our gun was useless—and it became painfully evident that from some unaccountable cause the boats had not yet left Fort Chipewyan. Sixty miles lay between us and safety, and we must either hurry on or starve. We had still a few pounds of pemmican, but with all my efforts it would not stay on my stomach, so I reluctantly ceased to eat. We toiled on until after midday, when I became so ill that we had to put ashore. I lay down on the sand utterly exhausted and very sick. A review of the situation brought me to myself, and I rose up, determined to struggle on as long as I could hold the paddle. Without a word we worked on and on, and reached Quatre Fourches River two hours after dark. Tying the canoe to the bushes, we crawled up the bank and were soon asleep. When morning broke we found the current flowing steadily into Peace River, and we knew that twenty-five miles up stream lay between us and food.

Exhausted for want of food.

Reach Quatre Fourches River.

My stomach had now become so weak that tea would not remain on it, so I drank water and eat a few high bush cranberries. We discovered that our united energies would not propel the canoe against the current, so fastening a line to the bow, I went on shore and hauled the canoe for more than sixteen miles, floundering through mud and water, knowing that the goal was drawing nearer every step. The last eight miles I had to take to the canoe, the mud along shore being so soft it would not bear my weight. Every half hour a fainting spell would come over me, but by persistent effort I would overcome it, and at length, wearied and exhausted, we reached the fishery just as it was getting dark. Being unable to stand, I sat on the sand, and was soon the centre of a crowd of Indians. I told them I wanted food and rest, and would soon be all right, and obtaining these, in the morning I felt a new man. None of the people would believe that we had brought our little canoe from St. John—700 miles, as such a thing had never been done before by two men. The next morning I went down in a canoe to Fort Chipewyan, eight miles from the Quatre Fourches, and was well received by Mr. Macfarlane, the gentleman in charge of the Athabasca district. On my arrival I had an interview with a large number of the Hudson Bay Company's officers, who were here from all parts of the north to get their year's supplies. One and all advised me to return eastward, as it was possible I could reach Fort Garry before winter set in, but I could not get out westward until late in the spring. I therefore, much against my inclination, decided to return eastward. Mr. Macfarlane informed me that he purposed sending a boat up the Athabasca to Portage-la-Loche in the course of ten days, which would connect with another going down to Isle-la-Crosse, and by these I could get half way to Carleton. The boats started for Peace River the day after our arrival.

Reach the Fishery and obtain food.

During the ensuing ten days I collected all the information possible regarding the country, its capabilities, resources and future prospects. Coming, as I did, when the men from the northern posts were all in, I obtained more accurate knowledge of the vast interior than had been obtained by any former explorer. Messrs. Ross, Macfarlane, Macdougall, Hardisty, King and Gardner gave me the facts and experience obtained by them during a life of from six to twenty years in the north. Their information was given with the greatest freedom, and the desire of each one was to assist me by every means in his power.

Information from Hudson Bay Company's officers

The tract of country drained by the Peace, Liard and Athabasca Rivers is of immense extent, and contains a vast amount of arable land that in the future will support a very large population. Mr. Hardisty, the gentleman in charge of Mackenzie River district, told me that at Fort Simpson, latitude 62° north, barley always ripened between the 12th and 20th of August. Wheat succeeds four times out of five, and melons, after being started under glass, ripen well. Frost seldom does much injury in

Region drained by the Peace, Liard and Athabasca Rivers.

summer, and there is quite a sufficiency of heat to ripen any kind of grain. At Fort Liard, Lat., 61° north, the climate is said to be warmer than on any part of Peace River, and wheat always succeeds. Even under the arctic circle, at Fort Yucon barley hardly ever fails. Mr. Macdougall, the gentleman from whom I received this information, had been in charge of the Yucon district for more than ten years.

Fort Chipewyan is not well situated for agricultural purposes. With the exception of the small spot of garden ground near the fort, the vicinity shows only glaciated Laurentian rocks, covered with a small growth of Banksian pine rooting in the crevices. The rocks are so smoothed by ice action that they glisten in the sunshine like polished marble. Less than two miles from the fort is the French Mission, where I obtained the samples of wheat and barley which are in your possession. The soil here is a mixture of sand and humus, and in any other locality would be considered valueless, but everything planted or sown around the Mission seemed to flourish. At Quatre Fourches, eight miles from the fort, the land was almost on a level with the water—within a foot—and here potatoes and turnips of a large size are grown. The reason so little land is cultivated, arises from the fact that most of the inhabitants are flesh-eaters, and look with contempt on vegetables and vegetable eaters. Mr. Macfarlane told me that just as much meat was eaten when flour and potatoes were served out to the men as when they got none.

Wheat and barley.

The Quatre Fourches is literally the meeting of four rivers: one being the discharge of Lake Clair, one coming from Lake Athabasca, one emptying into Slave River, and the other either discharging into Peace River, or in spring bringing the waters of that river into Lake Athabasca. The difference in level between Lake Athabasca and Peace River, when I passed up, was less than twenty feet. At the Fourches there is a permanent fishery for the supply of the fort, and every morning during my stay a certain number of fish were brought down for the use of the establishment. Multitudes of fish are taken in Lake Athabasca, the principal of which are whitefish, goldeye, jack, dorey and at least two species of trout. One of these grows to a great size, often from thirty to forty pounds weight. It is taken with hooks in the winter, set under the ice and baited with fish. Geese are killed in prodigious numbers in the latter part of September, it being no uncommon occurrence for one man to kill one hundred in a few hours. The spruce partridge is very abundant in the pine woods, and in the depth of winter the ptarmigan arrive from the "Barren Lands," which seem to stretch along the whole north-east shore of the lake. The meat for the

The Quatre Fourches.

Fish and game.

supply of the fort is procured beyond Fond-du-Lac, at a point where the cariboo pass from the "Barren Lands" to the woods, which they always do in autumn. A report was current when I was at the fort, that the deer had abandoned their usual route, and fears were entertained of starvation. The report has since been confirmed, but happily, the fisheries were sufficient for all purposes.

Fort Chipewyan the Capital of the North.

Fort Chipewyan is situated on a peninsula at the west end of Lake Athabasca. Under the fostering care of Mr. Macfarlane, it has obtained the pre-eminence of being the Capital of the North. All the buildings are of the most substantial character, are all shingled and white-washed, and present from the lake quite an imposing and beautiful appearance. Two large stores with glass windows, each sixty-three by thirty-one feet and seventeen feet high, stand next the landing. In a line with these stand eight houses, occupied by the employés of the Company, all white-washed, while in the rear, and between the two first mentioned stores, is the clerk's house, forty by thirty feet, and seventeen feet high. This building is well plastered, and was so warm last winter, (1874,) from the heat of two stoves, that water did not freeze in it. On the left of the clerk's house, looking lakewards, is the general store, and on the right Mr. Macfarlane's own house, which is both warm and comfortable. Here the wanderer in the north is sure of a hearty welcome, and is apt to forget, while partaking of the hospitality of the *Bourgeoise*, that 1,200 miles intervenes between him and the outskirts of civilization.

The vegetation of Peace River.

The vegetation of Peace River was carefully observed at six different points. Its relation to the flora of Central Ontario is shown in the following table :—

	Total Species.	Central Ontario.
Hudson's Hope..................	211	136
St. John	248	161
Dunvegan	246	160
Vermillion	159	112
Little Red River	128	88
Fort Chipewyan	245	186

Five hundred and ninety-one species of flowering plants and ferns were collected between Hudson's Hope and Fort Chipewyan. Of these 434 are found on the Western Plains, 411 are found in Ontario, and 402 in Quebec.

As will be seen, the flora of the whole region is much like that of the prairie region and of Central Ontario. It may be as well to remark that the character of the winter seems to have no effect on the diffusion of species, and that the temperature of the growing season only can be deduced from the vegetation. After many years of observation, I have come to the conclusion that the geographical distribution of plants in Canada is determined far less by latitude than it is by the amount of aqueous vapour in the atmosphere, and of moisture in the soil. I have found that many species which delight in our warmest soils, extend further north on Peace River than others which require more moisture. The aspen may be said to be the tree that requires least moisture to enable it to thrive. It is the first tree on the plains, as we pass from aridity to a more moist region, and this is alike true in America and in northern Asia. In Ontario, the aspen grows on dry gravelly hill-sides, and on this account the soil where it grows is supposed to be poor, whereas it grows on the soil containing the least moisture.

Geographical distribution of plants in Canada.

On the afternoon of September 2nd, three large boats, in charge of Mr. King, accompanied by myself as passenger, started for Portage-la-Loche (Methy Portage). I left my kind friends with regret, and started on my homeward trip in the anticipation of reaching Fort Garry before the setting in of winter.

As a general description of the Athabasca River is given in my geological notes, I shall now confine myself chiefly, to remarks on the botany. About four miles from the fort the water shows signs of a muddy bottom, and immediately after a number of species of river weed (*Potomageton pectinatus*, *natanis*, *prælongus* and *perfoliatus*) appear.

Athabasca River.

The water gradually shoaled as we approached the willows (*Salix longifolia*), and for some time after we entered them water covered the whole expanse. When the land appeared we stopped, and I made an examination in the vicinity of a log, and obtained *Carex utriculata* and *aquatilis, Salix nigra,* eighteen inches in diameter, and *S. discolor.* Shortly after *Scirpus riparius* and *sylvaticus, Phragmites arundinacea, Typha latifolia* and *Acorus Calamus* were seen.

My slumbers were broken at the first streak of dawn on the 3rd by the cries of innumerable geese, which seemed to be above, around and beneath me. On raising my head I found all our men imitating the cries of a flock of geese, which were rapidly coming towards us and answering

Abundance of geese.

the calls of the men. On they came, and in less than five minutes twenty-seven shots had been fired into the flock, and large numbers of them were either dead or dying in the water. During the next two weeks such scenes were almost of hourly occurrence, and the excitement was pleasing in the extreme. We had started with less than half rations, calculating to get a partial supply of food by hunting as we ascended the river, and the men were not slow to take advantage of every opportunity. Canada geese and white wavys were the species we obtained.

As we passed up the river it was interesting to note the passage from aquatic and marsh plants to those found on a dry soil. After the willows, alder (*Alnus incana*), balsam poplar, and shortly after "Kinnik-kinnik" (*Cornus stolonifera*) made their appearance.

The first appearance of the raspberry and rose betokened drier soil, and they were noticed when the banks were about four feet in height. Twenty-five miles from the mouth of the river the first spruce was seen, and here the banks are six feet above the water. The balsam poplar had already increased in size to over two feet, and appeared in thick groves on the islands.

Embarras River.

At Embarras River, and a few miles north of it, the spruce is of an enormous size, many of them being over three feet in diameter and very tall. Birch was seen two miles north of this point, and the first sand was seen on the last bar we passed. About 200 yards above the delta we came upon the true bank of the river, which was composed of red sand and clothed with a forest of banksian pine and aspen, the former tree being the most conspicuous. About two miles above Embarras River we passed a high bank—at least twelve feet—which was composed of various layers of vegetable earth and the remains of trees. Close to the water's edge stumps were seen with ten feet of soil over them, above these again others, up to the surface, on which there was a heavy growth of spruce. It is quite evident that during certain periods of the year the river silts up its bed, while at others it adds new material to the land along its margin, and thus builds up its banks. This seems to be of constant occurrence on Peace and Athabasca Rivers after you enter the delta. Islands and points are numerous on this part of the river. The former are much larger than those in Peace River, but not so frequent. The greater part of the river flows in one channel, and is from 250 to 300 yards wide. Willow, balsam poplar and spruce make up the forest in the above order, corresponding with the age of the land.

We sailed rapidly up the river, having a fair wind, and at camping time could not have been less than fifty miles from its mouth. Towards night we passed along the old bank of the river for about two miles. It rises about forty feet above the water, and consists principally of yellowish sand. The forest at this point is of banksian pine and aspen. From observations made the next day, (Sunday) I am led to believe that the land on the right or eastern bank of the river is useless for agricultural purposes, as wherever the true bank was seen the forest consists almost wholly of banksian pine, which always indicated sand. All the islands have rich soil, and are well suited for raising garden vegetables and hay. The (true) left bank I had not seen.

Monday, September 6th.—Under weigh at daylight, the wind being fair. At 10 a.m. passed Echo's house, and for the first time saw the left bank. About two miles north of this, saw the first gravel-bar in the river. At Echo's the river runs in one channel, and for the first time, both of the true banks were seen. The soil on both sides was good, with gravel underneath, and the banks had the same reddish tinge as at Vermillion. Later in the day Birch Mountain showed blue in the distance, bearing about south-west. Above Echo's house there are a number of islands in the river; still further up, the river is wasting away the land. The present growth is principally spruce, but about six feet below the surface poplar stumps are laid bare; and about a foot above these spruce. This shows that the river is constantly silting up its bed and changing its level. About fifteen miles above Echo's, is Pointe-aux-Trembles (Poplar Point); here the river again runs between its true banks. A different set of plants come in at this point, indicating a dry limestone soil, and one well suited for agriculture. Pointe-aux-Trembles.

September 7th—River valley narrower; real banks about fifty feet high; country apparently level. Where we breakfasted on the left bank I observed a bed of tar conglomerate about thirty feet above the river. There was sand above and below it, and the ooze along shore both at this point and many places below, looked like the ooze from petroleum springs. Fully one half of the pebbles along shore, in many localities are composed of tar conglomerate: a red ochraceous earth is abundant in many places, and seems identical with that observed on Peace River. Proceeding up the river the valley gets narrower, and the country seems well suited for agriculture. The tar conglomerate was frequently observed, sometimes forming a bed two feet thick. Early in the afternoon we came upon the shale beds which produce the tar, and sailed past them all the afternoon. Tar shales.

The forenoon was cold and chilly, with a light wind from the north; but as the afternoon wore on, a squall came up, accompanied by heavy rain. When the rain ceased the wind continued, and forced us up the river at a great rate. We took our second dinner, (we ate five times a day,) in the boat. A fire was made in the frying-pan, which was placed upon two sticks in the bow of the boat, and the kettle was soon ready. Tea and dried meat of the wood buffalo, with bread and bear's grease to give it a relish, were enjoyed by us as much as a feast of any of the good things of civilized life would have been.

On account of the rain, our camp was formed in the woods, and was both wild and picturesque. Three rousing fires were built, (one for each boat,) and around these in the darkness flitted dusky figures, some cooking, others smoking, and all talking or laughing, without thought of rain or any other matter than present enjoyment. Long after the noises ceased I lay and thought of the not far-distant future, when other sounds than those would wake up the silent forest; when the white man would be busy, with his ready instrument, steam, raising the untold wealth which lies buried beneath the surface, and converting the present desolation into a bustling mart of trade.

Prophetic visions.

Day had scarcely dawned on the 8th, before we were off; the wind being fair we carried on for two hours, and stopped at one of the tar springs for breakfast. On the beach I observed a slab containing corals and shells, and in the bank a layer of tar fully six inches thick almost as hard as pitch. Shortly after leaving this point the rock changes, and limestone, containing corals and shells, occurs on both sides of the river. A short distance above Point of Rocks, we passed Beaver River on the right bank, and immediately after, two anticlinals were seen dipping nearly north and south, the strike of the strata being east and west. Soon after we landed on the left bank, at a rock exposure of at least twenty feet of strata. On examination, I found that the upper beds contained, or were almost wholly composed of corals resembling those obtained at Red River. Underneath these were fossils like those I obtained at the *chutes*, and numbers of those I got at Rapid Bouillé, besides a few which were new. Those labelled, "thirty miles below the fork," were from this exposure. Outcrops of rock were constantly seen all day, but no opportunity to stop was allowed, as we were sailing up the river with a fair wind.

Fossils.

Fine soil.

Both sides are well suited for agriculture, and evidently the soil of the whole country is of excellent quality. It is quite evident that the country for fully fifty miles below the forks, on both sides of the river, is very good, and all the botanical observations confirm this view.

Approaching the fork the scenery is very beautiful and extremely interesting, both on account of location and the rock exposures on the bank. For two miles above the fork we passed under high shale cliffs on the right bank, with coralline limestone cropping out underneath. At the fork, or junction, the Athabasca is about 400 yards wide, and the Clearwater about 100. The former runs with great force against the cliffs, and caused us much trouble to get past them, the wind having fallen. Mr. Moberly, the gentleman in charge of the post, told me that he had examined the channel of the Athabasca all the way to the lake, and found water enough in it, at its lowest stage, to float a steamboat drawing six feet. Cliffs of shale and limestone.

The Hudson Bay Company are now (1876) building a steamboat at the fork, which is intended for the navigation of the Athabasca River and Lake and Peace River, as far as the *chutes*, and Slave River, to the portages. Another boat, built below the portages on Slave River, would give uninterrupted navigation to the Arctic sea, while another on Peace River, above the *chutes*, could run all the way to Hudson's Hope. These boats would command a river and lake navigation of over 2,000 miles, and open up an immense region to trade and settlement. Mr. Moberly had been employed by the Hudson Bay Company to examine the river and report on it, and the above was the result of his examination. He also reports that a road, of possibly not more than 110 miles, can be made from the fork to Cold Lake without difficulty, and from thence to Fort Pitt, on the Saskatchewan, there is nothing but prairie and poplar copse. All the way up the river I had noted every species of plant which came under my observation, and out of 217 species, 186 were representatives of the Ontario flora, showing that although thirteen degrees north of Belleville, there was not a single species to indicate such a northern latitude. Of the remaining thirty-one species, all but one or two belonged to the prairie and forest lands along the Saskatchewan. The familiar eastern species were in their usual locations, and nothing but the everlasting spruce and aspen forest reminded the traveller that he was nearly 800 miles north of Ottawa. Spruce forest means a damp soil with moss as the principal undergrowth, while the aspen represents the dry open forest, and wherever the spruce forest is destroyed the other takes its place. Steamboat. Similarity to the flora of Ontario.

September 9th.—The first frost of the season occurred last night, and killed cucumber vines, pole beans, potatoes, and all the tender vege- First frost.

tables in the gardens. Mr. Moberly told me his wheat and barley were superb, and that the country around the fork was well suited for farming purposes. My own observations agree with this statement, but I had less means of knowing than he had. About a mile above the fork, on the left bank of the Clearwater, is a beautiful prairie, upon which Mr. Moberly had cut a great quantity of hay with a reaper. This prairie only awaits the plough to become a farm of great value. The Hudson Bay Company, if so minded, could raise enough wheat here to supply the demands of the whole north, instead of bringing it all the way from Manitoba. About two miles above the prairie a small river flows in from the same side, and, as it descends from high ground, would probably afford a mill site.

Fine land.

Clearwater River.

Early in the forenoon we made a fresh start, and pushed on up the Clearwater. This river is very crooked, with gently sloping banks which rise to at least 200 feet, and are clothed with aspen on both sides. Once in a while the right bank (north side) shows a slope without wood, but this is not very often the case. Mr. Moberly spoke of a salt spring about fifteen miles south of the fork, and which, he says, has very strong brine. Mr. King also pointed out another about the same distance below the fork, and this also contains much salt. During the afternoon we passed two or three exposures of the Red River coral formation, and at our camp I noticed tar pebbles on the shore.

September 10th—On the way this morning by the first streak of dawn, and shortly after starting passed a fine exposure of sandstone, from which the Hudson Bay Company procure grindstones. The banks of the river and slopes of the hills which we passed to-day were covered with timber of the usual kinds, but towards evening the balsam fir (*Abies balsamea*) became quite common, and more spruce (*Abies nigra?*) showed in the woods. The appearance of the former tree indicated a greater degree of humidity in the atmosphere, as it always affects humid situations. After passing the Pembina, the river narrowed considerably, not averaging more than sixty yards. Alders and willows grow down to the water's edge, so that the men had to row all the time, tracking being out of the question. The river is very tortuous, winding backward and forward through its narrow valley. All the country seen to-day is fit for cultivation. Both species of high bush cranberry (*Viburnum pauciflorum* and *opulus*) are very abundant, the latter more especially on the Clearwater; but the other throughout the whole north-west on both sides of the mountains.

Grindstones.

No change in the general character of the country was noticed on the

11th until towards evening, when the abundance of banksian pine gave indications of the soil being sandy. We camped two miles below the first portage, and although we were almost out of provisions, we remained in camp all Sunday, with the sure prospect of starving till Tuesday, when we expected to reach Portage-la-Loche. The men set traps, and snared rabbits and shot geese, and ate, and smoked, and rested, in anticipation of the hard work they would have on the morrow, passing the Five Portages. The next day we passed up three of the rapids before noon, and dined before making the ascent of the fourth. Here a number of beaver were at work laying in wood for the winter. Many trees were already cut, and others partly so. The statement that they cut the trees so as to make them fall in the required direction is incorrect. In every instance I found they had cut the side farthest from the stream first, and often only on that side. Trees near the water nearly always lean towards it, and therefore they cut the upper side, knowing by experience that the tree will almost certrainly fall the way it leans. The Five Portages.

At the fourth rapid the hills on the right bank are nearly bare of trees, and about 500 feet high. The country rises very rapidly after leaving the Athabasca, and the hills along the river are caused by this rise in the general level. The scenery here is finer than anything I had seen since leaving the Thompson.

The fifth rapid is the worst, and everything, including the boats, had to be taken over the portage. While Mr. King and myself were examining the falls, the men carried the baggage over, and the boats were hauled across in the following manner: A large rope, doubled and tied, was placed under the keel, and the ends fastened on the middle thwart at either side. Another rope was fastened in front, and to this the men attached their hauling or portage straps. Standing two and two, others took hold of the sides, while a few attended to the rollers, and, with hoots and yells, the work was soon accomplished. There was as much delight shown at the launching of each, as school-boys do when launching their tiny boats.

After a long search, I was fortunate enough to detect a few fossils, but they are very scarce. The rock, when exposed to the atmosphere, weathers into hollows and protuberances, so that it is rough and uneven. During the day I obtained a few interesting plants, of which *Thalictrum sparsiflorum* was the most notable, being obtained at the exact locality where Sir John Richardson detected it forty years before. On the rocks at the first portage I found some fine specimens of *Woodsia glabella*, Fossils.

and in the marshy spots, *Stellaria uliginosa.* About forty species besides these were obtained, and everyone of them belonged to the Ontario flora. There is not a species in the whole valley, except the *Thalictrum,* that I have not found in some part of Ontario.

No food.

On the 14th, we were early astir, and pushed up the river on empty stomachs, all our food having been consumed the evening before. The men seemed to think little of it, but I noticed that their hilarity was all gone, and they took their smokes in silence. We reached Portage-la-Loche late in the afternoon; and, as we did not expect anything to eat until provisions could be brought from the other side, Mr. King and the greater part of the men started across at once. We lighted fires and sat listlessly around them. Evening came, and no sign of any food, but just at this time three Indian women walked into camp loaded with rabbits. It seems these women had learned we were starving, and had started at once to their snares with the above results. We had our suppers, and, like beggars, we were contented, caring little about where our breakfast came from.

Formation of *battures.*

The whole of the *battures* on Clearwater River are of fine white sand. Many of them are below, while others are above the surface of the present stage of water. The lower margin in most cases terminates abruptly. Every flood drifts sand down this slope, and although the top of the *batture* is level, its sides are formed of layers lying one over the other, and seemingly on their edges, as is often observed in sand pits. This is the real cause of this appearance in many of our sand pits, and is very easily accounted for when seen in the act of forming. The whole upper part of the river valley is sand of great purity, and the breaking down of the banks causes the formation of bars. The upper part of the river is exceedingly crooked, and the outer sides of the valley very high, being not less than 600 feet.

At dawn on the 15th I was informed that a boat was waiting beyond the Portage to take me to Isle-la-Crosse; so, packing up my few things, and getting them on the men's backs, we started for the other side. After winding up the hill, and attaining the level of the plateau, I paused at the "Crow's Nest," took one last look at the Arctic waters, and hurried on after my men.

Portage-la-Loche.

The portage is less than twelve miles, and has a good cart-road all the way. On the level plateau above the river the vegetation changes, and the surface is either swampy and covered with black spruce, or is dry and sandy and covered with banksian pine. About half way across we came to Lake-la-Loche, bordered by a beach of beautiful sand. We passed a number of marshes containing various species of *Sphagnum*, the most interesting of which were *S. rigidum, cuspidatum, Woffianum* and *Caricinum ; Carices* and *Junci* were abundant, but of the usual species, except *C.Rœana* Boott. and *C. vesicaria. Lycopodium alpinum* was in great profusion and in fine fruit. As we neared the southern side the species became more unmistakably eastern, and a few forms were observed not before seen on the waters of the Mackenzie, gold thread (*Coptis trifolia*), being the most notable.

There must be at least 500 feet between the level of Clearwater River and Methy Lake. As you approach the latter, the country gives indications of being wet and cold. Many boulders are on the surface, and generally the land is unfit for cultivation. Levels of Clearwater River and Methy Lake.

I only remained long enough to eat a few mouthsful at the southern end of the portage, and embarked within an hour for Isle-la-Crosse. The men were anxious to be off, as they had only three days' provisions, and it might take us a week to get to our destination. I got five days' provisions from Mr. King, but as soon as I learned that the men were on short rations I put mine into the common stock. My present companions could all speak English, the greater number having been brought up in Manitoba. I enjoyed the luxury of hearing it spoken very much. We poled down a little river for two miles, and landed on the shore of the lake at its mouth, for dinner. The whole surface is good peat, which seemed to extend for miles. It is not swampy, and is elevated at least four feet above the lake. We had dinner of boiled fish and *rubiboo*, and at once got under way, but the wind being dead ahead we were forced to stop about a mile from the river on the east side of the lake. Here an old Half-breed catches fish and raises potatoes. Having bought some potatoes and fish, we went a short distance further, and camped under the lee of a point. I noticed that the potatoes were grown on land only reclaimed from the forest in spring, and that it had been covered with the Labrador tea plant (*Ledum latifolium*), cow-berry, (*Vacinnium Vitis-Idæa*), and Canada blueberry (*Vaccinium Canadense*) species that delight in a peaty soil. Barley had been grown the preceding year, so that both barley and potatoes will grow and mature around Methy Lake. The frost of the 9th had killed the potatoes, and I learned afterwards that the potatoes were killed in Manitoba on the 21st August, or nineteen days earlier than at Portage-la-Loche, on the height of land between the Mackenzie and Churchill Rivers.

After the 9th we had slight frosts almost every night, but on the night of the 15th it was quite mild. We started early, but, owing to contrary winds, it took us until two o'clock to reach the discharge of Methy Lake. This is a stream of about thirty yards wide and very crooked, winding backwards and forwards through marshes and willow bushes. As we passed along the lake I noticed five Chipewyan houses.

About two miles from the lake the river narrowed to about fifteen yards, and there is a rapid which is very shallow and intricate, causing the boat to touch every few yards. Below the rapid the river is full of weeds, and quite shallow. We seemed to be passing through a wide marshy plain, the stream meandering through it as though lost. Often after running nearly a mile we would come back almost to the same point. Multitudes of ducks were flying around, but having only one gun and but little shot, we killed only a few. We camped on the only dry spot to be seen for miles. Owing to the plunging of the muskrats I slept but little. We were on our way before sunrise, and wound through the marsh as before. The land which borders the river is not elevated more than three feet above the water, and is now quite dry. It is generally peat, covering a subsoil of sand, and was possibly formed when the water stood about three feet higher than at present. A good beaver dam would flood the whole country again. The bog plants were *Rubus Chamæmorus*, *Vaccinium Canadense* and *Vitis-Idæa*, *Ledum latifolium*, *Betula pumula*, *Sparganium eurycarpum* and *simplex*, and various species of willows; and in the river, *Potamogeton pectinatis* and *perfoliatus*, and *Sagittaria variabilis*.

Extensive marshes.

The river was filled with whitefish, which seemed to come up to spawn, as they were often seen on the sand bars. After leaving the marsh the stream is a willow-bordered creek, so narrow that the men could not work the oars on both sides at the same time. I here found *Caltha natans*, and have no doubt that it was here that Sir John Richardson detected it and *Nardosmia sagittata*, and not in Canada *proper*, as is stated in "Hooker's Flora."

After passing two shallow rapids filled with round stones, the last of which is four miles long, and then two miles of crooked river, we came to the mouth of White Fish or Pembina River, flowing from the west and carrying the waters of White Fish Lake. The river was now doubled in volume of water and in size, being more than sixty yards wide, with an increased depth. Passing a few more short rapids and some miles of deep water we came to the head of Buffalo Lake, a sheet of beautiful clear water in its northern part, about forty miles long and more than ten miles wide.

Buffalo Lake.

We had supper at Buffalo House, a deserted Hudson Bay post. After supper, the wind being fair, we embarked, and sailed steadily on till four a.m., when, the wind failing, we put ashore. We had made about thirty miles during the night. After sunrise a head wind sprang up, against which we battled all day, and reached the "Narrows" that connect Buffalo and Clearwater Lakes before dark. The "Narrows" are about a mile long and a few hundred yards wide, and without any apparent current. Clearwater Lake extends north-east for more than thirty miles, and as far as seen contains numerous islands.

Chipewyan House is situated at the eastern end of the "Narrows" and at the head of Clearwater Lake. Here the Chipewyan's have built themselves a number of houses. The evening we arrived one old fellow named Edward Bigbelly was busy making a table, and appeared quite expert with plane and chisel. The Indians here live entirely on fish and potatoes. I examined two large patches of potatoes, which showed the greatest growth of stalks I had seen in the country. They had been badly nipped by frost on the night of the 8th, but were still growing. The Chipewyan Indians.

Our supper to night was somewhat peculiar. I sat at a table and ate fish and potatoes with a knife and fork. The men sat on the floor, and ate them with their fingers. Old Edward Bigbelly and his wife sat in a corner eating pemmican, while all around on the floor were Indians, smoking and staring at the eaters. The Chipewyan women look more like men than their husbands. They are very coarse and masculine looking, while the men are the very opposite. Of course the former do all the work, while the latter only hunt, eat and smoke.

The Chipewyans are the only Indians east of the mountains who build houses and have fixed abodes. They seem to appreciate the comforts of civilization; and probably it would not be difficult to induce them to settle on the land, and support themselves by agriculture.

Sunday, September 19*th*—The head wind last night detained us at the house, and in the morning our prospects were no brighter, the wind being still strong from the same quarter. Early in the forenoon a slight change took place, and we succeeded in making four miles, to the mouth of Deep River, which connects Lacrosse Lake with Clearwater Lake. Here we were compelled to remain all day, owing to the gale, which blew directly up the river. To make matters worse our provisions were exhausted, and we could not set our net, owing to the wind. Forty miles still lay between us and Isle Lacrosse; but plenty of fish were to be had if we could only reach their haunts. Head wind.

The wind fell during the night, but being still ahead, we made little progress. Deep River has a general direction a little east of south.

Deep River.

It averages 350 yards in width, and is twenty miles in length. Like the Narrows, it is without current, and filled with confervoid growth, which makes the water of all these lakes unfit to drink. Its decomposition causes a most unpleasant stench along the shores. In decaying it turns blue, and is said to produce a dye. We were compelled to stop at the entrance of Lake Lacrosse, owing to the head wind, so we ran into a small sheltered bay and set our net. After waiting a few minutes, we examined it and found eight fine fish, which were quickly boiled and eaten.

Lake Lacrosse.

On Tuesday morning, September 21st, we sailed up the lake with a steady breeze; this soon died away under the influence of the rising sun. After rounding a point, a most lovely view burst upon us—one that was worth travelling many miles to see. Looking southward, two points covered with aspen ran out into the lake, on either hand; ahead the lake expanded from these points and was lost in the distance. The placid water, the bright sunshine, the rounded outline of the land, the deciduous leaved forest trees touched with the first tints of autumn, interspersed with the pyramidal spruce, made up a scene seldom seen, except by the wanderer in distant lands. Lacrosse Lake certainly might appropriately be named La Croix, as the land and water assuredly take that shape. Early in the forenoon we reached the fort, where I was heartily welcomed by Mr. Macdonald, the officer in charge of the establishment. I learned from him that the only way I could reach Green Lake would be by taking passage with Edward Bigbelly, who had followed us from Chipewyan House, and who was going to Green Lake to trade. A bargain was soon made, and it was agreed to start early next morning. Edward was accompanied by two boys, a son and nephew, and had a very nice birch bark canoe, which would carry us all in safety.

Character of the country between Portage La-Loche and Clear Lake.

The distance between Portage-la-Loche and Isle Lacrosse, is computed at 130 miles. Between the Portage and Buffalo Lake, the country is little better than a peat bog or marsh, but as the south end of the lake is reached, a decided change takes place, and the forest around Clear Lake becomes nearly all aspen. Ever since the severe frost of the 8th of September the leaves along the margin of the lakes and rivers have been taking their autumn tints, particularly the birch. The aspen is still quite green (September 20th). Deep River and Lacrosse Lake are both surrounded by aspen-forests, which in the north always indicate good soil. The fort is pleasantly situated on an arm of the lake, with a large island exactly opposite, about a mile to the south-east.

On the right, looking from the fort, is the French Mission house. It seems to be well built, and is pleasantly situated on a point less than a mile from the fort. I made a careful examination of the vicinity, and was extremely surprised to see the potatoes still quite green, and even pole beans not touched by frost, (September 22nd.) All kinds of vegetables grow well, and turnips, potatoes, carrots and cabbage were of large size. Wheat, barley and oats succeed well, but the former is not considered a sure crop, although frost never seems to injure anything. What is wanted throughout all the north-west is a supply of early seeds. None of the vegetables grown are from early seeds; and were those sown, the successful raising of vegetables at all points in this northern region would always be a matter of certainty. Wheat and other cereals are raised at the Mission, and a four horse-power grist mill has been erected, to grind the wheat raised in the vicinity. Fall wheat ought to grow here, as the snow lies on the ground until melted by the hot suns of April. The whole establishment of Isle Lacrosse shows that Mr. McMurray, the *Bourgeoise* of the English River District, is determined to make his *Capital* second to none in the North-west. The soil at the fort is poor, compared with that of Peace River. It is principally a loam, mixed with a good deal of white beach sand. Further from the lake the soil improves, being mostly a clay loam. Apparently, there is a much greater rainfall here than on Peace River, and possibly less heat, so that crops may be later coming to maturity.

Fine vegetables

Early seeds

After receiving every attention from the gentlemen at the fort, and a few luxuries, to which I had long been a stranger, from Mrs. McMurray, I embarked with my Chipewyans. The wind being fair, a blanket was hoisted, and our canoe sped like a thing of life across the lake. As we left the land the wind increased, and by the time we entered Beaver river, had risen so much, that had we been in a wooden canoe we must have been swamped. The wind still increasing, we rushed up the river at railroad speed. Instead of being a narrow stream, as I expected, it turned out to be from 600 to 800 yards wide, with marshes filled with a luxuriant growth of *Carex tricocarpa* and *aristata*. Further up, the marshes are divided into long narrow islands, covered with willows and sedges. These islands are from twenty yards in width, and often narrower, to a mile or more in length, and the channels between are often not more than thirty yards wide. Before camping, we passed up one of these for more than two miles. It was bordered by two narrow islands, beyond which, on either side, were 300 yards of river and marsh.

Our camping place was just below the mouth of Water-hen River, nearly half way to Green Lake. We started with four days' provisions, but hope to make the distance in three. My companions know nothing of English, but are kind and attentive. The whole day was bright and warm, and a purplish haze hung over the land and water, reminding one of Indian summer, while the autumnal tints of the foliage added much to the natural beauties of the landscape.

Change in the levels of Lacrosse and Clearwater Lakes.

We were early astir on the morning of the 23rd, and after passing the forks of the river its character began to change, and instead of marshes it became more confined, and narrowed down to about 100 yards in width. There must be some great obstruction at the outlet of Lacrosse Lake, as both it and Clearwater Lake is at least four feet higher than formerly. The same obstruction is changing the river, which is also permanently higher than formerly. Slight indications of a current were observed during the forenoon, but about four p.m. we reached the first rapids, and passed them before sundown. They are continuous rapid water for over three miles—in no place difficult, but the water is much broken by boulders in the bed of the stream. There is no rock exposed in situ anywhere between this and Clearwater River, and almost all the boulders seen are of Laurentian gneiss.

The land along the river gradually rises, but there is no change in the character of the country. Gently sloping banks covered with a young growth of poplar, mixed at times with a few banksian pine, are varied with a grove of spruce, or a steep sand-bank sloping to the water's edge. The appearance of the foliage in the glorious autumn sun was beyond description. All the poplars were in their yellow dress, and the dogwood around their roots was beautifully scarlet.

Country well suited for settlement.

For the first three hours after starting there was swift water, alternating with still pools. After passing the rapids the banks are lower, and the country is sandy and unfit for cultivation. The second forks were reached a little before noon, but no change took place in the width of the river, which still continued about 100 yards wide, though the volume of water was sensibly diminished. We kept the left-hand branch, and at once noticed an improvement in the character of the country. Beautiful aspen and poplar groves bordered the river on both sides, and the whole country seemed covered with the same class of timber. All the country seen this afternoon is well suited for settlement, and multitudes of fish swarm in the river.

We were off by the first streak of dawn on the 25th, and after passing two short rapids, all current ceased, and the river looked like a stagnant pool, gracefully curving backwards and forwards, and the banks clothed to the water's edge with willows, alder, dogwood and poplar. The soil seemed of excellent quality, and covered in the open places with vetches, etc. About two hours after starting, the river forked again, and this time we took the right-hand branch, which was not more than fifty yards wide. The left branch seemed just as large, and apparently passed through a fine country. Scarcely any current was observed in the river, and its channel is very winding. The banks are all alluvium, and only about ten feet high. Land on both sides very rich. Rich land.

We were now evidently on the same level as Green Lake, as the river banks were covered with algæ to the height of four feet or more, showing that this is stagnant water in early summer. About 2 p.m. we came to the discharge of Green Lake—a narrow marsh-bordered stream, the banks of which showed unmistakeable signs of having been torn by ice in the spring. Green Lake was found to be the actual receptacle of the waters of Beaver River in spring, and Mr. Sinclair, the gentleman in charge of the post, told me that the lake was raised more than twenty feet every spring by the influx of Beaver River. It takes the whole summer for this water to discharge itself again, so that Green Lake is a great reservoir to supply Beaver River in autumn. Green Lake.

Green Lake, as seen from the river outlet, or from the post at its northern end, is a most beautiful sheet of water, about eighteen miles long from north to south, with an average width of a little more than a mile. It is very deep, and the water is completely covered with the green scum already mentioned. On either side the land slopes gently from the pebbly shore, and is covered with a thick forest of tall aspen and poplar, giving promise of a good and prolific soil.

The soil in the neighbourhood of Green Lake is of excellent quality, and a number of Half-breeds and traders have houses near the outlet, and raise excellent potatoes. At the post the crop of potatoes this year is over 500 bushels. Barley succeeds well, but wheat is doubtful as yet. The frost of the 8th was very severe here and killed all the potatoes, showing that it is colder than further north.

Many beautiful asters and golden-rods are still in flower, and along the lake shore *Helenium autumnale* is fresh and beautiful. Up to this time the weather has been lovely and quite warm; occasionally a slight frost in the night, but nothing to kill the flowers or check vegetation. This region is fit for settlement throughout, the soil being first-class and quite dry. Myriads of fish—whitefish—are in the lake and river, so that a patch of potatoes is alone required to make this a Chipewyan Paradise.

Mr. Sinclair received me most kindly, and at once took steps to enable me to continue my journey. The only available animals were an old ox and a miserable horse, and with these and a young Cree—who never was over the road—for guide, I started from the southern end of the lake on the forenoon of the 28th for Carlton, a distance of 140 miles. On the afternoon of the 27th Mr. Sinclair took me up the lake in a birch bark canoe, so small that I had to stand in the water and hold it while Mr. Sinclair took his seat in the stern. Long after dark we reached the landing, and I thanked God for His preserving care of me since I started down McLeod's River on that eventful 3rd of July, and for having kept me safely through nearly 1,600 miles of river navigation.

Start for Carlton.

My guide was a poor childish fellow; I got along very well with him, however, although I could not understand a word he said, nor he one word of mine. The first day we passed through a fine tract of country, rather wet in places, but having good soil. It is evidently a water-shed. The second day we crossed a sandy tract covered with banksian pine, which were much infested with a parasite (*Arceuthobium oxycedri*). In all cases it seemed to change the flow of the sap, and cause a thickening of the limb above where it grows. On this account the trees affected by it are easily recognized. Beyond the pine forest we saw a number of beautiful lakes, one of which was fully five miles long and about one wide. Some miles further we came to the discharge of another lake flowing to the eastward. All the lakes passed to-day were on the right, and contained pure crystal water. They are, I think, all lower than Green Lake, and empty into the Saskatchewan.

The watershed to the Saskatchewan.

On the 30th we passed through a thick forest of spruce, birch, aspen, poplar, and occasionally banksian pine of large size,—the soil, a rich sandy loam, which became drier as we proceeded, showing unmistakeably that we had passed the water-shed. We passed many fine timbered tracts, and the country generally is suited for agriculture.

During the next day no change was observed except a gradual one to a drier climate. As we travelled on the aspen woods began to give place to prairie. Where fire had destroyed the timber, prairie flowers were seen, and as we advanced these increased until the flora lost its forest character and became almost identical with that of the plains. At Whitefish Lake, which we kept on our left, the flora was that of the prairies, and such species as *Gaillardia aristata*, *Petalostemon violaceus*, and *candidus*, and numerous other true prairie species showed that the line of permanent prairie was reached. A few miles south of Whitefish Lake we crossed a small stream twelve yards wide and fifteen inches deep, flowing eastward through a wide valley. After crossing this stream the road again wound up into a broken country, and after passing along the borders of a number of swampy lakes we reached the second stream, about half as large as the first, flowing in the same direction.

For the last few days the weather had been rough and squally, with frequent rain storms in the night. This evening was colder than usual, and during the night there was a slight fall of snow. Early in the forenoon we reached the Star Mission, and, it being Sunday, we remained there till the next day. Both myself and Indian were glad of a rest, and a chance to replenish our provisions, which were all but exhausted, owing to the eating powers of the Indian and our slow rate of travel. The rivers passed yesterday unite and form Shell River, which eventually joins the Saskatchewan.

The Star Mission.

Mr. Hines, who has charge of the Mission, is a practical man and a painstaking teacher. Early in the Spring (1875), he had land ploughed for the Indians, and sowed both wheat and barley, and planted potatoes. The wheat was sown on the 10th of May, and reaped on the 10th of September, while the barley, sown five days later, was reaped six days earlier. This shows that it takes nearly a month longer to ripen grain in this region than it does on any part of Peace River, and hence there is greater danger of summer frosts. The prairie soil is sandy loam mixed with gravel; the poplar lands inclined to clay and the bottom lands are black loam. Mr. Hines had a large quantity of land broken up, which he intended to sow and plant next season. He says the soil of the whole region was just as good as that which he was cultivating, and that many of the Indians from the plains intended to come and settle at the Mission.

From the Mission to Carlton is at least fifty miles; nearly all the way the country is quite level and fit for farming purposes. Most of it is prairie, and there is abundance of good water. When within less than twenty miles of the Saskatchewan, we passed three salt marshes but only one of any extent. The land is much better five miles from the Saskatchewan than close to it, and I found it so in all cases. Near the river the land is broken and contains much sand, but this was not noticed away from it.

On the afternoon of the 6th I reached Carlton, having been thirty-three days on the route from Fort Chipewyan. The computed distance is 660 miles, so that, including stoppages, I made twenty miles a day. I experienced no difficulty in passing through the country, as the officers of the Hudson Bay Company, without exception, did everything in their power to assist me. The Indians did all they could to make me comfortable, and never touched an article, or did an improper act, on the whole trip.

After two days' rest at Carlton I was again on the way,—this time in company with a number of Half-breeds, who had brought goods from Fort Garry to Carlton for the Hudson Bay Company. I purchased a light waggon to convey myself and traps across the plains, and one of the Half-breeds furnished the horses. He does everything for me, and agrees to take me to Winnipeg in twenty-one days, weather permitting, for $45.

Start from Carlton for Fort Garry.

We started from Carlton late in the evening of the 9th of October, in the midst of a snow-storm. The next day, however, was beautiful, and the snow nearly all disappeared. We pushed on almost night and day—often making thirty-five miles a day—until the evening of the 23rd, at which time we reached Shoal Lake. The next morning we were off long before daylight; but as the day broke we saw that we were in for a snow-storm. We halted in a little clump of willows, and had a cup of tea.

Heavy snow storm.

We had scarcely started again when the storm broke, and in a few minutes the air was filled with driving snow. For the next sixteen miles there was neither bush nor tree, and for the whole of this distance we battled against the fierce gale and driving storm. Late in the afternoon we reached the timber, and, under the direction of our experienced guide, penetrated to a little marsh surrounded by wood, and there camped. We could hear the roaring of the gale outside, but not a breath stirred where we were. In a short time we had blazing fires, and after the ice was thawed off our clothes we set about making a shelter for the night.

The next morning the snow continued to fall just as heavily as before, and a consultation was held as to what was best to be done. Most of us preferred to remain in camp, but my guide would not hear of it. He said our only hope lay in pushing on as far as possible, before the horses and cattle gave out. We started, and for the next eight days we trudged wearily on, and reached Winnipeg at dark on the evening of the 1st of November. We saved all our horses and cattle, but had to leave some of them at McKimmon's to recruit. Some of our party nearly broke down, but when one was exhausted another took the lead, and broke the way for the cattle. For more than 100 miles we forced our way through from ten to fourteen inches of snow with carts and oxen. We were the only party that escaped without loss—numbers of horses and cattle having perished in this long-continued storm.

I left Winnipeg on the 5th of November, and reached Belleville on the 13th, none the worse for my long and eventful journey.

I have the honor to be,

Sir,

Your obedient servant,

JOHN MACOUN.

BELLEVILLE, *May*, 1876.

APPENDIX TO MR. MACOUN'S REPORT.

CATALOGUE OF PLANTS.

The following is a catalogue of the various plants collected during the summers of 1872 and 1875 in the Saskatchewan country and on Peace River, also on the Rocky Mountains, in British Columbia and in Vancouver Island. Those collected by Mr. Bourgeau in the Saskatchewan country, and by Mr. G. M. Dawson, when attached to the "International Boundary Survey of the Forty-ninth Parallel," are also included in this catalogue.

The geographical distribution of the species is given in the seven parallel columns, as perfectly as the material at hand will allow. I have not used *Hooker's Flora*, as the distribution given in it does not show the northern range of the species. In the present list only those species are given which are known to myself as occurring in the regions cited :—

I. Vancouver Island.

II. British Columbia to the western bases of the Rocky Mountains.

III. The Rocky Mountains.

IV. Peace and Athabasca Rivers east of the Rocky Mountains.

V. The Saskatchewan plains from the Rocky Mountains to the Lake of the Woods and south to the forty-ninth parallel.

IV. Ontario.

VII. Quebec and the Maritime Provinces, including Labrador.

CATALOGUE.

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
	I. RANUNCULACEÆ.							
1.	Clematis verticillaris, D C...........	*	*	*	*	*	*	*
2.	" ligusticifolia, T. & G.........		*	*		*		
3.	Anemone patens, L., var Nuttallania, Gray..................				*	*		
4.	" parviflora, Mx....		*		*		*	*
5.	" multifida, D C............		*		*	*	*	*
6.	" cylindrica, Gray..........					*	*	
7.	" Virginiana, L.............					*	*	*
8.	" Pennsylvanica, L.........				*	*	*	*
9.	" nemorosa, L.............	*	*	*	*	*	*	*

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
10.	Anemone occidentalis, Watson......			*				
11.	" Richardsonii, Hook.......			*				
12.	" deltoidea, Hook..........			*				
13.	Thalictrum dioicum, L.............	*	*	*	*	*	*	*
14.	" Cornuti, L............				*	*	*	*
15.	" sparsiflorum, Turcz.....		*		*			
16.	" purpurascens, L........					*	*	
17.	Trautvetteria occidentale, Gray......	*						
18.	" palmata, Fischer&Meyer, var. occidentale......	*						
19.	Ranunculus aquatilis, L., var. trichophyllus		*	*	*	*	*	*
20.	" aquatilis, L., var. stagnatilis					*	*	
21.	" affinis. R. Br., var. biocarpus		*	*		*		*
22.	" affinis, R. Br., var. cardiophyllus	*	*		*	*		
23.	" acris, L...............	*	*			*	*	*
24.	" abortivus, L...........					*	*	*
25.	" Flammula, L..........	*						
26.	" " L., var. reptans, Gray...........				*	*	*	*
27.	" multifidus, Pursh.......		*	*		*	*	*
28.	" " Pursh, var. repens		*			*	*	
29.	" multifidus, Pursh, var. limosus, Nutt........		*			*		
30.	" Cymbalaria, Pursh......		*		*	*	*	*
31.	" rhomboideus, Goldie....					*	*	*
32.	" glaberrimus, Hook......		*					
33.	" Laponnicus			*	*	*		
34.	" pygmæus, Wahl........		*	*				*
35.	" nivalis, R. Br......		*	*				*
36.	" hyperboreus.....			*				
37.	" orthorhynchus, Hook...	*	*					
38.	" Nelsonii, Gray.........	*						
39.	" heterophyllus, Weber...	*						
40.	" Pennsylvanicus, L......				*	*	*	*
41.	" repens, L.............				*	*	*	*
42.	" hispidus, Mx......				*	*	*	
43.	" nivalis, R. Br., var. Eschscholtzii			*				
44.	" occidentalis, Watson....	*						
45.	" sceleratus, L...........		*	*	*	*	*	
46.	Myosurus minimus, L.............	*				*	*	
47.	" aristatus, Benth..........		*					
48.	Caltha palustris, L..............	*			*	*	*	
49.	" natans, Pall...............				*	*		
50.	" leptosepala, D C			*				
51.	" biflora, D C	*						
52.	Trollius laxus, Salisb.............			*				
53.	Coptis trifolia, Salisb.............				*	*	*	*
54.	" asplenifolia, Salisb..........		*					
55.	Aquilegia Canadensis, var. formosa..	*	*	*				
56.	" flavescens, Watson.......		*	*				
57.	" cœrulea, James...........			*	*			

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
58.	Aquilegia Canadensis, L.					*	*	*
59.	Delphinium elatum, L., var. occidentale		*	*		*		
60.	" Menziesii, D C		*	*				
61.	" decorum, Fischer & Meyer	*						
62.	" azureum, Mx			*		*		
63.	" Napellus, L.			*				
64.	" nasutum, Fischer		*	*				
65.	Actæa spicata, L., var. arguta, Torr.	*	*	*	*			
66.	" spicata, L., var. rubra					*	*	*
67.	" alba, Bigel					*	*	*
68.	Pœonia Brownii, Dougl	*	*					
	II. Berberidaceæ.							
69.	Berberis aquifolium, Pursh	*	*	*				
70.	" nervosa, Pursh	*	*					
71.	Vancouveria hexandra, Decaisne	*	*					
72.	Achyls triphylla, D C	*	*					
	III. Menispermaceæ.							
73.	Menispermum Canadense, L.					*	*	*
	IV. Nymphæaceæ.							
74.	Brasenia peltata, Pursh					*	*	*
75.	Nymphæa odorata, Ait					*	*	*
76.	Nuphar advena, Ait				*	*	*	*
77.	" polysepalum, Eng		*					
78.	" luteum, Smith, var. pumilum					*	*	*
	V. Sarraceniaceæ.							
79.	Sarracenia purpurea, L.				*	*	*	*
	VI. Fumariaceæ.							
80.	Corydalis glauca, Pursh		*	*	*	*	*	*
81.	" aurea, Willd					*	*	*
82.	" aurea, var. curvisiliqua		*	*	*			
83.	" Scouleri, Hook	*	*					
84.	Dicentra formosa, D C	*	*					
	VII. Papaveraceæ.							
85.	Sanguinaria Canadensis, L.					*	*	*
86.	Meconella Oregana	*	*					
87.	Eschscholtzia Californica, Cham	*	*					
	VIII. Cruciferæ.							
88.	Nasturtium officinale, R. Br	*					*	
89.	" palustre, D C	*	*	*	*	*	*	*
90.	" palustre, D C., var. hispidum				*	*		

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
91.	Nasturtium curvisiliqua, Nutt.......	*	*					
92.	Cardamine hirsuta, L...............	*	*	*	*	*	*	*
93.	" hirsuta, L.var. clandestina.	*	*					
94.	" paucisecta, Benth	*	*					
95.	" oligosperma, Nutt........	*						
96.	Arabis lyrata, L....................		*?				*	
97.	" hirsuta, Scop................	*	*		*	*	*	*
98.	" petræa, var. angulata.........	*	*					
99.	" Hopbellii..................	*						
100.	" perfoliata, Lam.............	*	*		*	*	*	*
101.	" " var. macrocarpa...	*						
102.	" Drummondii, Gray..........	*	*		*	*	*	*
103.	" retrofracta, Grah............	*	*				*	
104.	" Gerardi, var borealis........		*					
105.	Barbarea vulgaris, R. Br............	*	*		*	*	*	
106.	" præcox, R. Br.............		*			*		*
107.	Erysimum cheiranthoides, L........		*		*	*	*	*
108.	" asperum, D C.var. Arkansanum................					*		
109.	" asperum var.inconspicuum.					*		
110.	Sisymbrium canescens, Nutt.........				*	*	*	*
111.	" canescens, var. Hartwigianum.............				*	*		
112.	" Austriacum	*						
113.	" junceum, Bieb..........		*					
114.	Brassica campestris, L..............	*						
115.	" Sinipisastrum, Boiss........					*	*	*
116.	Draba incana, L....................		*	*	*			*
117.	" incana, L. var. confusa........		*	*	*			*
118.	" nemorosa, L................	*	*		*	*	*	
119.	" alpina, L...................		*	*				*
120.	" frigida.....................		*	*				
121.	" muricella Wahl.............		*	*				
122.	" aurea, Vahl. var. stylosa......		*	*				
123.	" arabisans, Mx. (Bourg.)					*	*	
124.	" ——— ?.....................			*				
125.	" ——— ?.....................			*				
126.	Vesicaria Ludoviciana, D C.........					*		
127.	" didymocarpa, Hook........					*		
128.	Camelina sativa, Crantz.............				*		*	*
129.	Capsella bursa-pastoris, Mœnch	*	*	*	*	*	*	*
130.	Thlaspi arvensis, L.................					*	*	*
131.	Lepidium Menziesii, D C...........	*						
132.	" Virginicum, L...........	*	*		*	*	*	*
133.	" intermedium, Gray.......		*			*	*	
134.	Thysanocarpus curvipes, Hook.......	*						
135.	Thelypodium laciniatum, Endl......	*						
136.	Hymenolobus erectus, Nutt.........		*					
137.	Smelowskia calycina, Meyer. (Bourg.)				*			
	IX. CAPPARIDACEÆ.							
138.	Cleome integrifolia, T. & G..........					*		
139.	" lutea, Hook.................	*	*					
140.	Polanisia trachysperma, T. & G.....					*		

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
	X. VIOLACEŒ.							
141.	Viola blanda, Willd................	*	*	*	*	*	*	*
142.	" cuculata Ait..................		*		*	*	*	*
143.	" canina var. sylvestris Reg.....				*	*	*	*
144.	" canina var. adunca. Smith.....	*	*					
145.	" Canadensis, L...............					*	*	*
146.	" pedata, L..................					*	*	
147.	" pubescens, Ait..............					*	*	*
148.	" Nuttallii, Pursh.............		*		*	*		
149.	" sarmentosa, Dougl...........	*	*					
150.	" glabella, Nutt...............	*	*					
151.	" palustris, L.................	*	*	*	*		*	
152.	" Nuttalli, var. pramoræa.......	*	*					
153.	" biflora, Gray................		*	*				
154.	" ——— ?....................		*					
	XI. CISTACEÆ.							
155.	Hudsonia tomentosa, Nutt..........				*	*	*	*
156.	Helianthemum Canadense, Mx.......					*	*	
	XII. DROSERACEÆ.							
157.	Drosera rotundifolia, L.............			*	*	*	*	*
158.	" linearis, Goldie............					*	*	
	XIII. HYPERICACEÆ.							
159.	Hypericum Scouleri, Hook..........	*	*	*				
160.	" pyramidatum, Ait.......					*	*	*
	XIV. CARYOPHYLLACEÆ.							
161.	Silene antirrhina, L.................	*	*	*	*	*	*	*
162.	" acualis, L..................			*				*
163.	" Menziesii, Hook.............	*	*	*				
164.	" Douglasii, Hook............	*	*					
165.	Vaccaria vulgaris, Host.............	*				*	*	
166.	Lychnis apetala, L..................			*				*
167.	" Drummondii, Hook........	*	*		*	*		
168.	Arenaria stricta, Mx................				*	*	*	
169.	" lateriflora, L..............	*	*	*	*	*	*	*
170.	" verna, var. hista, Fenzl.....		*	*	*			*
171.	" Rossi, R. Br...............		*	*				
172.	" Fendleri, Gray............		*					
173.	" propinqua, Rich...........		*	*	*			
174.	" macrophylla, Hook........	*	*					
175.	" tenella, Nutt., var. Californica................	*						
176.	" formosa, Fischer..........			*				
177.	" pungens, Nutt............			*				
178.	" ——— ?...............			*				
179.	Stellaria media, Smith.............	*			*	*	*	*
180.	" longifolia, Muhl..........					*	*	*
181.	" uliginosa, Murr...........		*	*	*			*
182.	" borealis, Bigel.............		*	*	*	*	*	*

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
183.	Stellaria borealis var. corallina, Fenzl.	*	*					
184.	" humifusa, Rotbœll.........		*					*
185.	" crispa, Cham..............	*						
186.	" nitens, Nutt.......... .	*						
187.	" longipes, Goldie...........		*	*	*	*	*	*
188.	" " var. Edwardii.....		*	*				
189.	" " " lœta.........		*	*				
190.	" " " palustris.....		*	*				
191.	" " " ———?......		*					
192.	Cerastium vulgatum, L.............	*					*	
193.	" nutans, Raf..............	*	*	*	*		*	*
194.	" arvense, L...............	*	*	*	*	*	*	*
195.	" alpinum, L..............		*	*				*
196.	" Behringianum, Gray......	*						
197.	Sagina occidentalis, Watson.........	*						
198.	" procumbens, L..............	*						*
199.	Spergularia rubra, Presl..............					*		*
200.	Paronychia sessiliflora, Nutt.........					*		
	XV. PORTULACACEÆ.							
201.	Portulaca oleracea, L..............	*					*	*
202.	Claytonia Sibirica, L................	*	*					
203.	" Chamissonis, Eschsch......	*	*					
204.	" linearis, Hook..............	*	*					
205.	" dichotoma, Nutt...........	*						
206.	" parvifolia, Mocino.........	*	*					
207.	" perfoliata, Don............	*	*					
208.	" spathulata, Dougl.........	*						
209.	" exigua, T. & G...........	*						
210.	" Caroliniana, Mx. var. lanceolata..............		*					
211.	Calandrina Menziesii, Hook.........	*						
212.	Lewisia rediviva, Pursh.............		*					
	XVI. MALVACEÆ.							
213.	Malvastrum coccineum, Gray........					*		
214.	Sphæralcea acerifolia, Gray..........					*		
215.	Sidalcea malvæflora, Gray...........	*	*					
	XVII. TILIACEÆ.							
216.	Tilia Americana, L.................					*	*	*
	XVIII. LINACEÆ.							
217.	Linum perenne, L..................		*	*	*	*	*	
118.	" rigidum, Pursh..............					*		
	XIX. GERANIACEÆ.							
219.	Geranium Carolinianum, L..........	*	*	*	*	*	*	*
220.	" Richardsonii, Fischer & Meyer..............		*	*		*		
221.	" Fremontii, Torr...........			*		*		
222.	" Hookerianum, Walph......			*		*		

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
223.	Geranium molle, L	*						
224.	Erodium cicutarium, L'Her	*					*	
225.	Flœrkia uliginosa, Bot. of California.	*						
226.	Impatiens pallida, Nutt				*	*	*	*
227.	" fulva, Nutt				*	*	*	*
228.	Oxalis stricta, L					*	*	*
229.	" Oregana, Nutt	*	*					
	XX Anacardiaceæ.							
230.	Rhus glabra, L					*	*	
231.	" Toxicodendron, L					*	*	*
332.	" aromatica, Ait					*	*	
233.	" diversiloba, T. & G		*					
	XXI. Vitaceæ.							
234.	Vitis cordifolia, Mx					*	*	*
235.	Ampelopsis quinquefolia, Mx					*	*	*
	XXII. Ramnaceæ.							
236.	Rhamnus alnifolius, L'Her			*		*	*	*
237.	Ceanothus Americanus, L					*	*	
238.	" velutinus, Dougl		*	*				
239.	" Oreganus, Nutt		*					
240.	Pachystima Myrsinites, Raf	*	*	*				
	XXIII. Sapindaceæ.							
241.	Acer spicatum, Lam					*	*	*
242.	" rubrum, L					*	*	*
243.	" macrophyllum, Pursh	*	*					
244.	" circinatum, Pursh	*	*					
245.	" glabrum		*	*				
246.	Negundo aceroides, Mœnch					*	*	
	XXIV. Polygalaceæ.							
247.	Polygala polygama, Walt					*	*	
248.	" paucifolia, L					*	*	*
249.	" Senega, L					*	*	
250.	" verticillata					*	*	*
	XV. Leguminosæ.							
251.	Lupinus argenteus, Pursh	*	*					
252.	" bicolor, Lindl	*	*					
253.	" Sabineii, Dougl	*	*					
254.	" leucophyllus, Lindl	*	*					
255.	" laxifolius, Dougl	*	*					
256.	" polyphyllus, Lindl	*	*					
257.	Trifolium parviflorum, L	*						
258.	" pauciflorum, Nutt	*						
259.	" microcephalum, Pursh	*						
260.	" involucratum	*	*					
261.	" fimbriatum, Lindl	*	*					

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
262.	Trifolium fimbriatum var. angustifolium, Lindl........	*						
263.	" amplectans	*						
264.	" pauciflorum, var. subuniflorum	*	*					
265.	" pratense, L.............	*				*	*	*
266.	" repens, L...............	*				*	*	*
267.	" cyathiferum, Lindl.......	*						
268.	Medicago lupulina, L............		*				*	*
269.	Hosackia parviflora...............	*	*					
270.	" Purshiana, Benth.........	*	*					
271.	Psoralea argophylla, Pursh.........					*		
272.	" esculenta, Pursh..........					*		
273.	Petalostemon violaceus, Mx.........					*		
274.	" candidus, Mx.........					*		
275.	Amorpha canescens, Nutt...........					*		
276.	" fruticosa, L					*		
277.	" macrophylla.............					*		
278.	Astragalus caryocarpus, Ker					*		
279.	" Canadensis, L...........		*		*	*	*	*
280.	" alpinus, L..............			*	*	*		*
281.	" hypoglottis, Ker.........			*	*	*		
282.	" pectinatus, Dougl.......					*		
283.	" Collinus, Dougl.........		*					
284.	" sclerocarpus, Gray.......		*					
285.	" speirocarpus, Gray.......		*					
286.	" adsurgens, Pall..........			*	*	*		
287.	" aboriginum, Rich........			*	*	*		
288.	" triphyllus, Pursh........					*		
289.	" pauciflorus, Hook.......			*				
290.	" flexuosus, Dougl.........			*	*	*		
291.	" frigidus, Gray...........			*	*	*		
292.	" microcystis, Gray........		*					
293.	" bisulcatus, Gray.........			*	*	*		
294.	" multifloris, Gray........			*	*	*		
295.	" Drummondii, Dougl.....			*	*	*		
296.	" Purshii, Dougl..........		*					
297.	" oroboides, Hornem......			*	*			
298.	" " var. Americanus, Gray...........			*	*	*		*
299.	" alpinus, var. secundus....					*		*
300.	" Palliseri, Gray..........		*	*				
301.	" Bourgovii, Gray.........		*	*				
302.	" Missouriensis Nutt......				*	*		
303.	" Lyalli, Gray............		*					
304.	" glabriusculus, Gray......			*	*			
305.	" Beckwithii, T. & G......		*					
306.	" miser, Dougl............		*					
307.	Oxytropis campestris, D C.........		*	*	*	*		*
308.	" Lamberti, Pursh.........			*	*	*		
309.	" deflexa, D C............			*	*	*		
310.	" splendens, Hook.........		*	*	*	*		
311.	" podocarpa, Gray.........			*				*
312.	" Uralensis, L. var. pumila, Ledeb			*				*
313.	Glycyrrhiza lepidota, Nutt..........				*	*		
314.	Hedysarum boreale, Nutt...........		*	*	*	*	*	*

Nos.		I.	II.	III.	IV.	V.	VI	VII.
315.	Hedysarum Mackenzieii, Rich.......			•				•
316.	Desmodium Canadense, D C.........					•	•	•
317.	" acuminatum					•	•	•
318.	Vicia sativa, L......					•	•	
319.	" Americana, Muhl............	•	•	•	•	•	•	
320.	" " var linearis......					•		
321.	" Oregana, Nutt..............	•	•					
322.	" gigantea, Hook..............	•						•
323.	Lathyrus maritimus, Bigel..........	•				•	•	•
324.	" venosus, Muhl............	•	•	•	•	•	•	
325.	" " var...............		•					
326.	" ochroleucus, Hook........		•	•	•	•	•	•
327.	" palustris, L..............					•	•	•
328.	" polyphyllus, Nutt	•						
329.	Thermopsis rhombifolia, Nutt......					•		
330.	Cytissus scoparius, D C.............	•						
331	Ulex Europeus, L.................	•						
	XXVI. Rosaceæ.							
332.	Prunus demissa, Nutt..............	•	•					
333	" Virginiana, L..............				•	•	•	•
334.	" Americana, Marsh..........					•	•	•
335.	" Pennsylvanica, L...........					•	•	•
336.	" mollis, Dougl...............	•	•					
337.	" pumila, L..................				•	•	•	•
338.	Nuttallia cerasiformis, T. & G.......	•	•					
339.	Spiræa salicifolia, L...............				•	•	•	•
340.	" Aruncus, L................		•	•				
341.	" Douglasii, Hook............	•	•					
342	" Menziesii, Hook............	•	•					
343.	" ariæfolia, Smith............	•	•					
344.	" betulifolia, Pall............	•	•	•	•			
345.	" opulifolia, L...............					•	•	•
346.	Poterium Canadense, Gray..........		•	•				•
347.	Alchemilla occidentalis............	•						
348.	Agrimonia pilosa, Ledeb...........					•		
349.	" Eupatoria, L............					•	•	•
350	Chamærodos erecta, Rye............					•		
351.	Dryas Drummondii, Rich...........		•	•	•		•	•
352.	" integrifolia, Vahl............			•				•
353.	" octopetala, L................		•	•				•
354.	Geum macrophyllum, Willd					•	•	•
355.	" rivale, L....................		•	•	•	•	•	•
356.	" triflorum, Pursh.............				•	•	•	
357.	" strictum, Ait................		•	•	•	•	•	•
358.	Fragaria Virginiana, Ehrh.........	•	•	•	•	•	•	•
359.	" vesca, L................		•	•	•	•	•	•
360.	" Chilensis, Ehrh...........	•						
361.	Potentilla, Norvegica, L...........		•	•	•	•	•	•
362.	" millegrana, Eng.........					•		
363.	" arguta Pursh...........		•	•	•	•	•	•
364.	" Anserina, L............	•	•	•	•	•	•	•
365.	" fruticosa, L............			•	•	•	•	•
366.	" tridentata, Ait...........				•	•	•	•
367.	" palustris, Scop..........		•	•	•	•	•	•
368.	" procumbens, Nutt.......		•	•				

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
369.	Potentilla Pennsylvanica, L., var. strigosa		*	*	*	*		
370.	" Hippiana, Lehm				*	*		
371.	" effusa, Dougl			*	*	*		
372.	" pulcherrima, Lehm		*	*	*	*		
373.	" Pennsylvanica, L		*	*	*	*		*
374.	" nivea		*		*	*		
375.	" diversifolia, Lehm				*	*	*	
376.	" flabelliformis, Nutt					*		
377.	" glandulosa, L					*		
378.	" gracilis, Dougl	*	*		*	*		
379.	" supina, L					*		
380.	" diversifolia, Lehm., var. glaucophylla					*		
381.	" Nuttallii, Lehm					*		
382.	" concinna, Rich					*		
383.	" Drummondii, Lehm					*		
384.	Rubus Nutkanus, Mocino	*	*	*	*	*	*	
385.	" Chamæmorus, L		*	*	*	*		*
386.	" triflorus, Rich		*	*	*	*	*	*
387.	" pedatus, Smith		*	*				
388.	" arcticus, L		*	*	*	*		*
389.	" strigosus, Mx		*	*	*	*	*	*
390.	" spectabilis, Pursh	*						
391.	Rubus leucodermis, Dougl		*					
392.	" macropetalus, Dougl	*	*					
393.	Rosa blanda, Ait		*	*	*	*	*	*
394.	" gymnocarpa, Nutt	*						
395.	" fraxinifolia, Bork	*	*					
396.	" Kamtschatica, Vent	*						
397.	" Woodsii, Lindl	*	*					
398.	" ——— ?		*	*				
399.	Cratægus coccinea, L					*	*	*
400.	" tomentosa, L					*	*	*
401.	" Douglasii, T. & G	*	*	*				
402.	" rivularis, Nutt		*	*				
403.	Pyrus rivularis, Dougl	*	*					
404.	" sambucifolia, Ch. & Schl		*	*	*			
405.	" Americana, D C					*	*	*
406.	Amelanchier Canadensis, var. oblongifolia					*	*	*
407.	" alnifolia, Watson	*	*	*	*			
	XXVII. Saxifragaceæ.							
408.	Ribes hirtellum, Mx		*	*	*	*	*	*
409.	" lacustre, Poir	*	*	*	*	*	*	*
410.	" prostratum, L'Her		*	*	*		*	*
411.	" floridum, L					*	*	*
412.	" Hudsonianum. Rich		*	*	*			
413.	" rubrum, L	*	*	*	*	*	*	*
414.	" divaricatum, Dougl	*	*					
415.	" bracteosum, Dougl	*	*					
416.	" sanguineum, Pursh	*	*					
417.	" Hobbellii, Gray	*						
418.	" oxycanthoides, L				*	*	*	*
419.	" aureum, Pursh			*				

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
420.	Ribes cereum, Dougl................		*					
421.	Philadelphus Gordonianus, Lindl....	*						
422.	Parnassia parviflora, D C............			*	*	*	*	*
423.	" palustris, L.............			*	*	*		
424.	" fimbriata, Banks..........		*	*				
425.	" Kotzebuei, Cham.........			*				
426.	Saxifraga oppositifolia, L...........			*				*
427.	" rivularis, L.............	*		*				*
428	" aizoides, L.............			*				*
429.	" tricuspidata, Retz....		*	*	*	*	*	
430.	" Virginiensis, Mx..........		*			*	*	*
431.	" cernua, L................			*				
432.	" cæspitosa, L.............	*	*					*
433.	" bronchialis, L............		*	*				
434.	" ranunculifolia, Hook......		*					
435.	" integrifolia, Hook........	*	*					
436.	" Dahurica, Pall.....			*				
437.	" punctata, L..............		*	*				
438.	" heterantha, Hook.........		*	*				
439.	" vernalis, Willd..........			*				
440.	" Eschscholtzii, Stenb......			*				
441.	" controversa, Stenb........			*				
442.	" hyperborea, R. Br.........			*				
443.	Heuchera hispida, Pursh...........				*	*		
444.	" cylindrica, Dougl.........		*	*				
445.	" micrantha, Dougl.........	*						
446.	Leptarrhena pyrolifolia, R. Br........			*				
447.	Mitella nuda, L....................		*	*	*	*	*	*
448.	" pentandra, Hook...........		*	*				
449.	" trifida, Grah..............	*	*					
450.	" caulescens, Nutt............	*						
451.	Tiarella unifoliata, Hook...........		*	*				
452.	" trifoliata, L..............	*	*					
453.	Tellima grandiflora, Dougl..........	*						
454.	" parviflora, Hook...........	*	*					
455.	Chrysosplenium alternifolium.......		*					
	XXVIII. Crassulaceæ.							
456.	Sedum Rhodiola, D C. (Bourg)......			*				
457.	" spathulifolium, Hook.......	*				*		
458.	" stenopetalum, Pursh........	*	*	*				
	XXIX Halorageæ.							
459.	Hippurus vulgaris, L...............	*	*	*	*	*	*	*
460.	Myriophyllum spicatum, L.........			*	*	*	*	*
461.	" hippuroides, Nutt....	*	*					
	XXX. Onagracea.							
462.	Circæa alpina, L....................			*	*	*	*	*
463.	" Pacifica, Ascheron..........	*	*					
464.	Gaura coccinea, Nutt...............					*		
465.	" parviflora, Dougl............		*					
466.	Epilobium angustifolium, L........	*	*	*	*	*	*	*
467.	" " var canescens			*			*	

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
468.	Epilobium alpinum, L.		*	*	*			*
469.	" palustre, L., var lineare	*	*	*	*	*	*	*
470.	" paniculatum, Nutt.					*	*	
471.	" latifolium, L.			*	*			*
472.	" minutum, Nutt.		*					
473.	" tetragonum, L.	*	*	*	*	*		*
474.	" organifolium, Lam.		*			*		
475.	" palustre, var. albiflora, Hook.					*		
476.	" coloratum, Muhl.					*	*	*
477.	" ———?				*			
478.	" ———?	*						
479.	Œnothera biennis, L.				*	*	*	*
480.	" albicaulis, Nutt.					*		
481.	" serrulata, Nutt.					*		
482.	" chrysantha, Mx.					*	*	
483.	" triloba, Nutt.					*		
484.	" heterantha, Nutt.					*		
485.	" leucocarpa, Comein.					*		
486.	" strigulosa, var. pubens.	*						
487.	Ludwigia palustris, Ell.		*				*	*
	XXXI. Loasaceæ.							
488.	Mentzelia albicaulis, Dougl.	*	*					
489.	" ornata, Pursh.					*		
	XXXII. Cactaceæ.							
490.	Opuntia Missouriensis, D C.		*			*		
491.	" ———?	*			*			
492.	" ———?		*			*		
493.	Mamillaria vivipara, Haw.					*		
	XXXIII. Cucurbitaceæ.							
494.	Echinocystis lobata, T. & G.					*	*	*
	XXXIV. Umbelliferæ.							
495.	Sanicula Marilandica, L.				*	*	*	*
496.	" Menziesii, Hook.	*	*					
497.	" bipinnatifida, Dougl.	*	*					
498.	Daucus pusillus, Mx.	*						
499.	" Carota, L.					*	*	
500.	Heracleum lanatum, Mx.	*	*	*	*	*	*	*
501.	Pastinaca sativa, L.	*				*	*	*
502.	Angelica genuflexa, Nutt.		*					
503.	Thaspium trifoliatum, Gray.				*	*		
504.	Eryngium Baldwinii, Spreng.					*		
505.	Zizia integerrima, D C.					*	*	*
506.	Cicuta maculata, L.			*	*	*	*	*
507.	" bulbifera, L.				*	*	*	*
508.	Sium lineare, Mx.				*	*	*	*
509.	Cryptotænia Canadensis, D C.					*	*	*
510.	Osmorrhiza nuda, Torr.		*					
511.	" brevistylis, D C.	*	*	*	*	*	*	*

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
512.	Osmorrhiza longistylis, D C...........					*	*	*
513.	Peucedanum macrocarpum, Nutt.....	*	*			*		
514.	" ambiguum, Watson.....	*	*					
515.	" leiocarpum, Nutt.......	*	*					
516.	" utriculatum, Nutt......	*	*					
517.	Ferula dissecta, Gray..............		*					
518.	" multifida, Gray............	*						
519.	Carum Gairdneri, Benth...........					*		
520.	Ligusticum apiifolium, Gray.......		*					
	XXXV. ARALIACEÆ.							
521.	Aralia nudicaulis, L................				*	*	*	*
522.	" hispida, Mx.................					*	*	*
523.	Echinopanax horrida, Decaisne......	*	*	*				
524.	Adoxa Moschatellina, L............		*					
	XXXVI. CORNACEÆ.							
525.	Cornus Canadensis, L..............	*	*	*	*	*	*	*
526.	" stolonifera, var. ——— ?....		*	*	*	*		
527.	" " Mx............				*	*	*	*
528.	" Nuttallii, Audubon.........	*	*					
529.	" sericea, L., var. ——— ?.....	*	*					
530.	" paniculata, L'Her..........					*	*	*
531.	" circinata, L'Her...........					*	*	*
	XXXVII. CAPRIFOLIACEÆ.							
532.	Linnæa borealis, Gronov...........	*	*	*	*	*	*	*
533.	Symphoricarpus racemosus, Mx......	*	*	*	*	*	*	*
534.	" occidentalis, R. Br..	*	*	*	*	*	*	
535.	Lonicera involucrata, Banks........	*	*	*	*	*	*	
536.	" occidentalis, Hook........	*	*					
537.	" hispidula, Dougl..........	*						
538.	" parviflora, Lam..........		* ?		*	*	*	*
539.	" oblongifolia, Muhl........				*	*	*	
540.	" cærulea, L..............				*	*	*	*
541.	" hirsuta, Eaton...........				*	*	*	
542.	" ciliata, Muhl............					*	*	*
543.	Diervilla trifida, Mœnch...........					*	*	*
544.	Sambucus pubens, Mx..............	*	*	*	*	*	*	*
545.	" Canadensis, L..........					*	*	*
546.	Viburnum pauciflorum, Pylaie.......		*	*	*	*	*	*
547.	" Opulus, L...				*	*	*	*
548.	" Lentago, L.............					*	*	*
549.	" pubescens, Pursh........					*	*	*
550.	" ellipticum, Hook........	*						
	XXXVIII. RUBIACEÆ.							
551.	Galium triflorum, Mx..............	*	*	*	*	*	*	*
552.	" trifidum, L................		*	*	*	*	*	*
553.	" Aparine, L................	*					*	*
554.	" boreale, L.................	*			*	*	*	
555.	Houstonia purpurea, L., var. ciliolata.					*	*	
556.	" angustifolia, Mx..... ...					*		

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
	XXXIX. VALERIANACEÆ.							
557.	Valeriana sylvatica, Rich		*	*	*	*	*	*
558.	" capitata, Willd	*	*					
559.	Plectritis congesta, D C	*	*					
	XL. COMPOSITÆ.							
560.	Liatris scariosa, L					*	*	
561.	" punctata, Hook					*		
562.	Eupatorium purpureum, L				*	*	*	*
563.	" perfoliatum, L					*	*	*
564.	Nardosmia palmata, Hook		*	*	*	*	*	*
565.	" sagittata, Benth		*	*	*	*	*	
566.	" córymbosa, Hook				*	*		
567.	Adenocaulon bicolor, Hook	*	*				*	
568.	Sericocarpus rigidus, Lindl	*	*					
569.	Aster macrophyllus, L					*	*	*
570.	" conspicus, Lindl			*	*	*		
571.	" lævis, L				*	*	*	
572.	" ascendens, Lindl				*	*		
573.	" alpinus, L			*	*			
574.	" Lindleyanus, T. & G				*	*		
575.	" montanus, Rich			*	*	*		
576.	" laxiflorus, Nees			*	*		*	
577.	" salsuginosus, Rich		*	*	*			
578.	" graminifolius, T. & Gr			*			*	*
579.	" miser, L					*	*	*
580.	" multiflorus, L				*	*	*	
581.	" ptarmicoides, T. & Gr					*	*	
582.	" falcatus, Lindl				*	*		
583.	" præcox, Lindl				*	*		
584.	" angustus, T. & Gr				*	*		
585.	" pauciflorus, Nutt					*		
586.	" laxus, var. borealis (D.)		*					
587.	" mutatus, T. & Gr				*	*		
588.	" simplex, Willd				*	*	*	*
589.	" Lamarckianus, Nees				*	*	*	
590.	" Douglasii, Lindl	*	*					
591.	" puniceus, var. vimineus, Gray				*	*	*	*
592.	" Engelmannii, Gray	*	*					
593.	Erigeron Canadense, L				*	*	*	*
594.	" acre, L				*	*	*	
595.	" strigosum, L				*	*	*	*
596.	" glabellum, Nutt				*	*		
597.	" pumilum, Nutt			*				
598	" alpinum, L			*				
599.	" compositum, Pursh			*				
600.	" speciosum, D C	*						
601.	" filifolium, Gray		*					
602.	" canescens, T & Gr			*				
603.	" micranthum, Nutt			*				
604.	" uniflorum, L			*				
605.	" Philadelphicum, L		*	*	*	*	*	*
606.	" compositum, var. discoideum		*					
607.	" grandiflorum, Hook			*				
608.	" lonchophyllum, Hook			*	*			

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
609.	Erigeron ——— ?				*			
610.	Diplopappus umbellatus, T & Gr.				*	*	*	*
611.	Bellis perennis, L.	*						
612.	Gutierrezia Euthamiæ, T. &. Gr.					*		
613.	Townsendia sericea, Hook			*		*		
614.	Brickellia oblongifolia, Nutt.		*	*				
615.	" grandiflora, Nutt.			*				
616.	Solidago lanceolata, Ait.				*	*	*	*
617.	" rigida, L.				*	*	*	
618.	" Virga-aurea, L., var. multiradiata				*	*		*
619.	" Virga-aurea, L., var. alpina.			*	*	*	*	*
620.	" Canadensis, L.				*	*	*	*
621.	" nemoralis, Ait.				*	*	*	*
622.	" stricta, Ait.				*	*	*	*
623.	" Missouriensis, Nutt.				*	*		
624.	" serotina, Ait.				*	*	*	
625.	" gigantea, Ait.				*	*	*	
626.	" bicolor, L.				*	*	*	*
627.	" elongata, Nutt.		*					
628.	" juncea, Hook.				*			
629.	Linosyris graveolens, T. & G.					*		
630.	" viscidiflora, Hook.		*					
631.	Aplopappus lanceolatus, T. & G.					*		
632.	" spinulosus, D C.					*		
633.	" uniflorus, T. & G.					*		
634.	" Nuttallii, T. & G.					*		
635.	" acaulis, Gray, var.					*		
636.	Grindelia squarrosa, Dunal.				*	*		
637.	" integrifolia, D C.	*						
638.	" ——— ?			*				
639.	Chrysopsis villosa, Nutt.		*		*	*		
640	" hirsuta, Gray.		*					
641.	Iva axillaris, Pursh.					*		
642.	" xanthifolia, Nutt.					*		
643.	Ambrosia artemisiæfolia, L.					*	*	*
644.	" trifida, L.				*	*	*	
645.	" psilostachya, D C.					*		
646.	Franseria Hookeriana, Nutt.		*			*		
647.	Xanthium strumarium, L.					*	*	*
648.	Balsamorhiza deltoidea, Nutt.	*						
649.	" sagittata, Nutt.		*					
650.	Heliopsis lævis, Pers.				*	*	*	
651.	Echinacea angustifolia, D C.					*		
652.	Rudbeckia laciniata, L.					*	*	
653.	" hirta, L.					*	*	
654.	" fulgida, Ait (D.).					*	*	
655.	" ——— ?				*			
656.	Helianthus atrorubens, Nutt.					*		
657.	" giganteus, L.				*	*	*	
658.	" divaricatus, L.				*	*	*	
659.	" rigidus, Desf.				*	*		
660.	" lenticularis, Dougl.					*		
661.	Hymenopappus tenuifolius, Pursh.					*		
662.	Bahia leucophylla, D C.	*						
663.	" lanata Nutt., var. tenuifolia	*	*					
664.	Lepachys columnaris, Pursh.					*		

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
665.	Bidens Beckii, Torr................				*	*	*	
666.	" chrysanthemoides, Mx......				*	*	*	*
667.	" frondosa, L................				*	*	*	*
668.	" connata, Muhl..............					*	*	
669.	Gaillardia aristata, Pursh...........				*	*		
670.	Coreopsis rigida, var...............					*		
671.	" palmata, Nutt...........					*		
672.	Actinella Richardsonii, Nutt........					*		
673.	" acaulis, Nutt., var. glabra..					*		
674.	Helenium autumnale, L............				*	*	*	
675.	Rigiopappus leptocladus, Gray......							
676.	Madia racemosa, T. & G............	*	*					
677.	Amida hirsuta, Nutt................					*		
678.	Achillæa millefolium, L............	*	*	*	*	*	*	*
679	" multiflora, Hook..........				*	*		
680.	Leucanthemum vulgare, Lam.......	*					*	*
681.	Matricaria discoidea, D C...........		*		*			
682.	Artemisia dracunculoides, Pursh.....				*	*		
683.	" Canadensis, Mx		*	*	*	*	*	
684.	" caudata, Mx					*	*	
685.	" Ludoviciana, Nutt.......		*		*	*	*	
686.	" " var gnaphaloides...............		*		*	*	*	
687.	" biennis, Willd...........				*	*	*	*
688.	" discolor, Dougl..........		*		*			
689.	" cana, Pursh.....					*		
690.	" frigida, Willd...........		*	*	*	*		
691.	" trifida, Nutt.............		*					
692.	" Douglasiana, Bess	*	*					
693.	" arctica, Less.............			*				
694.	" scopulorum, Gray........			*				
695.	Gnaphalium palustre, Nutt.........	*	*					
696.	" luteo-album, L.........	*						
697.	" polycephalum, Mx					*	*	
698.	" uliginosum, L.........				*	*	*	*
699.	Antennaria dioica, Gærtn...........		*		*	*		
700.	" " var. rosea........		*	*	*	*		
701.	" alpina, Gærtn..........		*	*				
702.	" plantaginifolia, R. Br...		*		*	*	*	*
703.	" margaritacea, R. Br.....		*			*	*	*
704.	" dimorpha, T. & G		*					
705.	" Carpathica, R. Br.......		*	*	*	*		*
706.	" " var. pulcherrima................				*	*		
707.	" racemosa, Hook........		*					
708.	Senecio palustris, Hook............				*	*		
709.	" triangularis, Hook.........			*	*	*		
710.	" lugens, Rich...............		*	*	*	*		
711.	" canus, Hook...............		*			*	*	
712.	" eremophilus, Rich..........				*	*		
713.	" exaltatus, Nutt............			*				
714.	" auræus, L.................		*	*	*	*	*	*
715.	" " var. obovatus, T.& G.			*	*	*	*	*
716.	" " " borealis, T. & G.			*	*			
717.	" resedifolius, Less..........			*				
718.	" Fremontii, T. & G.........			*				
719.	Erechthites hieracifolia, Raf.........					*	*	*

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
720.	Arnica angustifolia, Vahl...........		*	*				
721.	" Chammissonis, Less..... ...		*	*	*	*		
722.	" mollis, Hook...............		*	*				*
723.	" cordifolia, Hook............	*	*		*			
724.	" latifolia, Bong..............			*				
725.	" moutana, Hook.............			*				
726.	" ——— ?..................			*				
727.	Saussurea alpina, D C..............			*				
728.	Circium discolor, Spreng...........					*	*	*
729.	" muticum, Mx............					*	*	*
730.	" arvense, Scop.............					*	*	*
731.	" foliosum, D C.............	*	*					
732.	" Drummondii, T. & G......				*	*		
733.	" undulatum, Spreng........		*		*	*	*	
734.	Tetradymia canescens, D C..........		*					
735.	Hieracium, Scouleri, Hook..........	*	*					
736.	" Canadense, Mx........ ..		*	*	*	*	*	*
737.	" albiflorum, Hook........			*				
738.	" triste, Willd., var. detonsum		*	*				
739	" venosum, L. (D.)........					*	*	
740.	Nabalus albus, Hook................					*	*	*
741.	" racemosus, Hook..........		*		*	*	*	*
742.	Crocidium multicaule, Hook........	*						
743.	Lygodesmia juncea, Don...........					*		
744.	Taraxacum dens-leonis, Desb........	*			*	*	*	*
745.	" palustre, D C............		*	*	*			
746.	Malcothrix Californica, D C.........	*						
747.	Crepis runcinata, T. & G....				*	*	*	
748.	" elegans, Hook..............			*	*	*		
749.	" glauca, T. & G..............			*	*			
750.	" occidentalis, Nutt, var. Nevadense..................		*					
751.	" occidentalis, var. gracilis.....		*					
752.	" nana, Rich. (Bourg)..........					*		
753.	Macrorhynchus, glaucus, Watson....	*						
754.	" " var. laciniatus......... ...	*						
755.	" troximoides, T. & G.				*	*		
756.	" grandiflorus, T. & G.		*					
757.	Mulgedium pulchellum, Nutt.......			*	*	*		
758.	" leucophæum, D C.......				*	*	*	*
759.	Sonchus oleraceus, L...............				*	*	*	*
760.	Machæranthera canescens, Gray (D.).					*		
761.	Troximon, cuspidatum, Pursh.......				*	*		
	XLI. Lobeliaceæ.							
762.	Lobelia spicata, Lam...............					*	*	
763.	" Kalmii, L.................					*	*	*
764.	" inflata, L..................					*	*	*
765.	" cardinalis, L...............					*	*	*
766.	" Dortmanna, L.............				*		*	*
	XLII. Campanulaceæ.							
767.	Campanula rotundifolia, L..........			*	*	*	*	*
768.	" aparinoides, Pursh......				*	*	*	*

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
769.	Campanula uniflora, D C.			*				
770.	Specularia perfoliata, A. D C.	*					*	
	XLIII. Ericaceæ.							
771.	Vaccinium cæspitosum, Mx.		*	*	*	*	*	*
772.	" " var. angustifolium.	*	*					
773.	" Canadense, Kalm.		*	*	*	*	*	*
774.	" oxycoccus, L.		*	*	*	*	*	*
775.	" parviflorum, Smith.		*					
776.	" Vitis-Idæa, L.			*	*	*	*	*
777.	" myrtilloides, Hook.	*	*	*				
778.	" myrtillus, L. (Bourg.).			*	*			
779.	" uliginosum, L.			*			*	*
780.	" corymbosum, L. (Bourg.).			*		*	*	*
781.	Chiogenes hispidula, T. & G.			*	*	*	*	*
782.	Arctostaphylos uva-ursi, Spreng.	*	*	*	*	*	*	*
783.	" alpina, Spreng.			*				
784.	" tomentosa, Dougl.	*	*					
785.	Epigæa repens, L.			*			*	*
786.	Gaultheria Shallon, Pursh.	*	*					
787.	" myrsinites, Hook.	*	*					
788.	" procumbens, L.					*	*	*
789.	Cassandra calyculata, Don.		*	*	*	*	*	*
790.	Andromeda polifolia, L.		*	*	*	*	*	*
791.	" tetragona, L.			*				
792.	Menziesia ferruginea, Smith.	*	*					
793.	" Grahamii, Hook.			*				
794.	" glanduliflora, Hook.			*				
795.	" globularis, Salisb. (Borgess)			*				
796.	Arbutus Menziesii, Pursh.	*	*					
797.	Kalmia glauca, Ait.		*	*	*	*	*	*
798.	Ledum palustre, L.		*	*	*			
799.	" latifolium, Ait.				*	*	*	*
800.	Rhododendron albiflorum, Hook.		*	*				
801.	" Lapponicum, Wahl.			*				*
802.	" ——— ?		*					
803.	Pyrola minor, L.			*	*	*	*	
804.	" chlorantha, Swartz.	*	*	*	*	*	*	*
805.	" secunda, L.	*	*	*	*	*	*	*
806.	" rotundifolia, L.		*	*	*	*	*	*
807.	" elliptica, Nutt.		*			*	*	*
808.	" picta, Smith.	*	*					
809.	" aphylla, Hook.	*	*					
810.	Pterospora Andromedea, Nutt.		*			*	*	
811.	Moneses uniflora, Gray.		*	*	*	*	*	*
812.	Chimaphila umbellata, Nutt.	*	*	*	*	*	*	*
813.	" Menziesii, Hook.	*	*					
814.	Monotropa uniflora, L.					*	*	*
	XLIV. Plantaginaceæ.							
815.	Plantago major, L.	*				*	*	*
816.	" maritima, L.	*						*
817.	" pusilla, Nutt. ?	*				*		
818.	" eriopoda, Torr.				*	*		*

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
819.	Plantago lanceolata, L.............	*					*	*
820.	" Patagonica, Jacq., var. gnaphaloides........ .		*			*		
	XLV. PLUMBAGINACEÆ.							
821.	Armeria vulgaris, Willd............	*	*					*
	XLVI. PRIMULACEÆ.							
822.	Primula farinosa, L................				*	*	*	*
823.	" Mistassinica, Mx...........					*	*	*
824.	" vulgaris, L..............	*						
825.	" vera, L..................	*						
826.	Androsace septentrionalis, L........		*		*	*		
827.	" occidentalis, Pursh.......		*	*	*	*		
828.	Glaux maritima, L................	*			*	*		*
829.	Dodecatheon Meadia, L.............	*	*			*		
830.	Trientalis Europæa, L., var. latifolia..	*	*					
831.	" " " " arctica...		*	*				
832.	" Americana, Pursh.......				*	*	*	*
833.	Lysimachia ciliata, L..............				*	*	*	*
834.	" thyrsiflora, L...........				*	*	*	*
835.	" stricta, Ait............					*	*	*
	XLVII. LENTIBULACEÆ.							
836.	Utricularia vulgaris, L.............			*		*	*	*
837.	" intermedia, Hayne......			*	*	*	*	
838.	Pinguicula vulgaris, L..............			*	*	*	*	*
839.	" grandiflora, Sm..........		*	*				
	XLVIII. OROBANCHACEÆ.							
840.	Phillipæa Ludoviciana, Don.........	*	*			*		
841.	Aphyllon uniflorum, T. & G.........	*	*			*	*	
842.	" fasciculatum, T. & G......	*	*			*		
	XLIX. SCROPHULARIACEÆ.							
843.	Collinsia parviflora, Dougl..........	*	*			*		
844.	" grandiflora, Lindl.........	*	*					
845.	Verbascum Thapsus, L.............					*	*	*
846.	Tonella collinsioides, Nutt..........	*	*					
847.	Pentstemon Menziesii, Hook........	*	*	*				
848.	" confertus, Dougl., var. cærulea-purpureus....		*	*	*	*		
849.	" acuminatus, Dougl., var. nitidus..............					*		
850.	" gracilis, Nutt..........					*		
851.	" attenuatus, Hook.......			*		*		
852.	Mimulus ringens, L................					*	*	*
853.	" luteus, Willd............	*	*	*				
854.	" alsinoides, Dougl..........	*	*					
855.	" floribundus, Dougl........	*	*					
856.	" moschatus, Dougl.........	*	*					
857.	" Lewisii, Pursh...........		*	*	*			

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
858.	Mimulus luteus, Willd., var. alpinus..		*	*				
859.	Gratiola ebracteata, Benth.........	*						
860.	" Virginiana, L............					*	*	*
861.	Limosella aquatica, L..............				*	*		
862.	Veronica Americana, Schu.........	*			*	*	*	*
863.	" Anagallis, L..............	*		*		*	*	
864.	" peregrina, L.............	*			*	*	*	*
865.	" Alpina, L...............		*	*				*
866.	" serpyllifolia, L...........	*	*	*	*	*	*	*
867.	" scutettata, L.............				*	*	*	*
868.	" Virginica, L.............					*	*	*
869.	" arvensis, L..............	*					*	
870.	" Stelleri, Pall.............	*?						
871.	Gerardia purpurea, L..............					*	*	*
872.	Castilleia coccinea, Spreng.........					*	*	
873.	" pallida, Kunth..........	*	*	*	*	*	*	*
874.	" " " var. miniata.	*	*	*	*	*		
875.	" sessiliflora, Pursh........					*		
876.	" parviflora, Bongard.......	*	*					
877.	Orthocarpus pusillus, Benth.........	*						
878.	" attenuatus, Gray.......	*						
879.	" bracteosus, Benth......	*	*					
880.	" hispidus, Benth........	*	*					
881.	" luteus, Nutt..........		*	*	*	*		
882.	Euphrasia officinalis, L.............			*			*	*
883.	Rhinanthus Crista-galli, L..........		*	*	*	*	*	*
884.	Pedicularis Canadensis, L..........					*	*	*
885.	" lanceolata, Mx..........					*	*	
886.	" bracteosa, Benth........					*		
887.	" Grænlandica, Retz., var. surrecta		*	*	*			
888.	" racemosa, Dougl........	*	*					
889.	" euphrasioides, Steph.....				*			
890.	" Langsdorffii, Fisch......			*				
891.	Melampyrum Americanum..........					*	*	*
	L. Verbenaceæ.							
892.	Verbena hastata, L...............		*			*	*	*
893.	" urticifolia, L............					*	*	*
	LI. Labiatæ.							
894.	Mentha Canadensis, L..............		*		*	*	*	*
895.	" viridis, L.................	*					*	*
896.	" piperita, L...............	*					*	*
897.	" Canadensis, var. glabrata....	*	*					
898.	Lycopus Virginicus, L............		*			*	*	*
899.	" Europæus,L.,var.integrifolia					*	*	
900.	" " " sinuatus...		*			*	*	*
901.	Monarda fistulosa, L..............		*		*	*	*	
902.	Micromeria, Douglasii, Benth.......	*	*					
903.	Lophanthus anisatus, Benth........		*	*	*	*		
904.	Nepeta Cataria, L.................	*	*		*	*	*	*
905.	Dracocephalum parviflorum, Nutt...		*	*	*	*	*	
906.	Physostegia Virginiana, Benth......		*			*	*	*
907.	Brunella vulgaris, L...............					*	*	*

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
908.	Scutellaria galericulata, L.				*	*	*	*
909.	" lateriflora, L.		*		*	*	*	*
910.	" parvula, Mx.					*	*	*
911.	Galeopsis Tetrahit, L.					*	*	*
912.	Leonurus Cardiaca, L.					*	*	*
913.	Stachys palustris, L.		*			*		
914.	" palustris, L., var. aspera, Gray.	*	*					
915.	" ciliata, Dougl.	*	*			*	*	*
	LII. Boraginaceæ.							
916.	Lithospermum canescens.					*	*	
917.	" angustifolium, Mx.					*	*	
918.	" longiflorum, Spreng.			*	*	*		
919.	" pilosum, Nutt.		*			*		
920.	" arvense, L.					*	*	*
921.	Mertensia paniculata, Don.		*	*	*	*	*	
922.	Myosotis alpestris, Hook.			*		*		
923.	" verna, Nutt., var. microcarpa.	*	*					
924.	Onosmodium Carolinianum, var. molle					*	*	
925.	Eritrichum Californicum, A. D C.	*						
926.	" Chorisianum, A. D C.	*	*					
927.	" ——?		*					
928.	" glomeratum, D C.					*		
929.	Echinospermum Redowskii, Lehm.		*	*	*	*		
930.	" deflexum, Lehm., var.		*	*	*	*		
931.	" Lappula, Lehm.					*	*	*
932.	Cynoglossum Virginicum.			*		*	*	*
933.	" Morisoni, D C.					*	*	*
934.	" officinale, L.					*	*	*
935.	" grande, Lehm.		*					
936.	Echium Menziesii, Lehm.	*	*					
	LIII. Hydrophyllaceæ.							
937.	Nemophila Menziesii.		*					
938.	" parviflora, Dougl.	*						
939.	" ——?	*						
940.	Ellisia Nyctelea, L.					*		
941.	Phacelia circinata, Jacq.		*					
942.	" Franklinii, Gray.				*	*	*	
943.	" sericea, Gray		*					
	LIV. Polemoniaceæ.							
944.	Collomia linearis, Nutt.		*	*	*	*	*	*
945.	" gracilis, Dougl.	*	*					
946.	Gillia inconspicua.		*					
947.	" parviflora	*	*					
948.	" bicolor, Nutt.					*		
949.	Phlox Hoodii, Rich.					*		
950.	" aristata, Mx.					*		
951.	" pilosa, L. (D.).					*		
952.	Polemonium cæruleum, L.		*	*	*			

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
	LV. CONVOLVULACEÆ.							
953.	Calystegia sepium, R. Br.					*	*	*
954.	" spithamæa, Pursh					*	*	
955.	Cuscuta arvensis, Beyr					*		
956.	" umbrosa, Engl	*						
957.	" Gronovii, Willd					*	*	*
	LVI. SOLANACEÆ.							
958.	Solanum triflorum, Hook					*		
959.	" nigrum, L					*	*	*
960.	Physalis grandiflora, Hook					*	*	
961.	" Pennsylvanica, L. var. lanceolata					*		
	LVII. GENTIANACEÆ.							
962.	Gentiana Amarella, L		*	*	*	*	*	*
963.	" detonsa, Fries			*	*	*	*	*
964.	" affinis, Smith		*	*	*	*		
965.	" crinita, Frœlich					*	*	*
966.	" glauca, Pall			*				
967.	" arctophila, Griesb			*				
968.	" propinqua, Rich			*	*	*		
969.	" ventricosa, Griesb				*	*		
970.	" Saponaria, L					*	*	*
971.	Halenia deflexa, Griesb			*	*	*	*	*
972.	Pleurogyne rotata, L			*	*			*
973.	Menyanthes trifoliata, L	*	*	*	*	*	*	*
	LVIII. APOCYNACEÆ.							
974.	Apocynum androsæmifolium, L		*	*	*	*	*	*
975.	" cannabinum, L		*	*	*	*	*	*
	LIX. ASCLEPIADACEÆ.							
976.	Asclepias incarnata, L					*	*	*
977.	" verticillata							
978.	" speciosa, Torr	*	*			*		
979.	" ovalifolia, D C					*		
980.	" viridiflora, Ell					*	*	
981.	" Cornuti, Decais					*	*	*
982.	" variegata, L				*	*	*	
	LX. OLEACEÆ.							
983.	Fraxinus Americana, L					*	*	*
984.	" viridis, Mx					*		
	LXI. ARISTOLOCHIACEÆ.							
985.	Asarum Canadense, L					*	*	*
986.	" caudatum, Lindl		*					

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
	LXII. NICTAGINACEŒ.							
987.	Oxybaphus nyctagineus, Sweet.....					*		
988.	" hirsutus, Hook.........					*		
989.	Abronia arenaria, Menzies.........	*						
990.	" cycloptera, Gray..........					*		
	LXIII. CHENOPODIACEÆ.							
991.	Chenopodium album, L...........	*			*	*	*	*
992.	" glaucum, L.........				*	*	*	
993.	" hybridum, L........				*	*	*	*
994.	" album var. leptophyllum..............					*		
995.	" humile, Hook.......					*		
996.	Blitum capitatum, L..............				*	*	*	
997.	" maritimum, Nutt..........					*		
998.	Atriplex arenaria, Nutt...........		*		*	*	*	*
999.	Corispermum hyssopifolium, L.....				*	*	*	
1000.	Salicornia herbacea, L.............	*	*		*	*		*
1001.	Eurotia lanata, Moq...............					*		
1002.	Monolepis chenopodioides, Moq....					*		*
1003.	Obione canescens, Moq............					*		
1004.	" argentea, Moq............					*		
1005.	Suæda depressa, Ledeb............					*		*
1006.	Sarcobatus vermiculatus, Torr.....					*		
1007.	Endolepis Suckleyana, Torr.......					*		
	LXIV. AMARANTACEÆ.							
1008.	Amarantus retroflexus, L..........		*			*	*	*
1009.	" albus..................					*	*	*
	LXV. POLYGONACEA.							
1010.	Polygonum aviculare, L...........	*				*	*	*
1011.	" " var. erectum..					*	*	*
1012.	" tenue, Mx............	*			*	*	*	
1013.	" amphibium, L. aquaticum		*	*	*	*	*	*
1014.	" " var. terrestre	*	*		*	*	*	*
1015.	" Persicaria, L..........	*			*	*	*	*
1016.	" cilinode, Mx..........					*	*	*
1017.	" Convolvulus, L........	*			*	*	*	*
1018.	" viviparum, L..........		*	*	*	*	*	*
1019.	" ramosissimum, Mx.....					*	*	
1020.	" Paronychia, Cham.....	*	*					
1021.	" dumetorum, Meis......					*	*	*
1022.	" sagittatum, L.........					*	*	*
1023.	" hydropiperoides, Mx...					*	*	*
1024.	" articulatum, Willd.....					*	*	
1025.	Rumex acetosella, L..............	*	*				*	*
1026.	" acetosa, L.................	*	*	*			*	
1027.	" salicifolius, Weinn.........	*	*	*	*	*	*	*
1028.	" venosus, Pursh............					*		
1029.	" maritimus, L..............				*	*	*	*
1030.	" Patientia, L...............					*	*	
1031.	" longifolius, D C...........				*	*		

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
1032.	Oxyria digynia, Campd............		*	*				
1033.	Erigonium parviflorum, Smith.....					*		
1034.	" ovalifolium, Nutt......					*		
1035.	" flavum, Nutt..........					*		
1036.	" androsaceum, Benth....			*				
1037.	" hieracleoides, Nutt.....		*					
	LXVI. Elæagnaceæ.							
1038.	Elæagnus argentea, Pursh.........		*	*	*	*		
1039.	Shepherdia argentea, Nutt.........					*		
1040.	" Canadensis, Nutt......		*	*	*	*	*	*
	LXVII. Santalaceæ.							
1041.	Comandra umbellata, Nutt........			*	*	*	*	*
1042.	" livida, Richard.........		*	*	*	*	*	*
1043.	" pallida, D C............		*					
	LXVIII. Loranthaceæ.							
1044.	Arceuthobium Oxycedri, Brieb.....				*	*		
1045.	" abietinum Englm., (D.)............		*					
	LXIX. Ceratophyllaceæ.							
1046.	Ceratophyllum demersum, L.......				*	*	*	*
	LXX. Callitrichaceæ.							
1047.	Callitriche verna, L...............	*	*		*	*	*	*
1048.	" autumnalis, L..........	*	*		*	*	*	
	LXXI. Euphorbiaceæ.							
1049.	Euphorbia glyptosperma, Engl.....		*		*	*	*	
1050.	" serpyllifolia, Pers.......		*					
1051.	Acalypha Virginica, L.............					*	*	
	LXXII. Empetraceæ.							
1052.	Empetrum nigrum, L.............		*	*	*	*	*	*
	LXXIII. Urticaceæ.							
1053.	Ulmus Americana, L..............					*	*	*
1054.	Urtica gracilis, Ait................	* ?			*	*	*	*
1055.	Celtis occidentalis, L.............					*	*	
1056.	Parietaria Pennsylvanica, Muhl.....		*				*	
1057.	Laportea Canadensis, Gaud........					*	*	*
1058.	Humulus Lupulus, L					*	*	*
	LXXIV. Cupuliferæ.							
1059.	Quercus alba, L.var. Gunnisonii,Torr.					*		
1060.	" rubra L.,.................					*	*	*

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
1061.	Quercus Garryana, Dougl..........	*						
1062.	Corylus Americana, Watt..........		*		*	*	*	*
1063.	" rostrata, Ait..............				*	*	*	*
1064.	" rostrata, Ait.var. Californica	*	*					
	XXXV. MYRICACEÆ.							
1065.	Myrica Gale, L..................				*	*	*	*
1066.	Comptonia asplenifolia, Ait........					*	*	*
	LXXVI. BETULACEÆ.							
1067.	Betula occidentalis, Hook..........	*	*	*	*	*		
1068.	" glandulosa, Mx............			*	*	*	*	*
1069.	" nana, L..................			*				*
1070.	" pumila, L............			*	*	*	*	*
1071.	" papyracea, Ait.............		*	*	*	*	*	*
1072.	" alba, var. ?...............			*	*			
1073.	Alnus viridis, D C...............		*	*	*	*	*	*
1074.	" incana, Willd				*	*	*	*
1075.	" rubra, Bong................	*	*					
1076.	" incana, Willd, var glauca....				*	*		
	LXXVII. SALICACEÆ.							
1077.	Salix candida, Willd..............		*	*	*	*	*	*
1078.	" cordata, Muhl...............	*	*	*	*	*	*	*
1079.	" nigra, Marshall..............		*		*	*		*
1080.	" glauca, L.....		*		*	*		
1081.	" livida, Wahl. var. occidentalis.		*	*	*	*	*	*
1082.	" longifolia, Muhl	*	*	*	*	*	*	*
1083.	" " var. pedicillata.....		*					
1084.	" " var. argophylla.....		*			*		
1085.	" discolor, Muhl...............		*	*	*	*	*	*
1086.	" petiolaris, Smith.............				*	*	*	*
1087.	" lucida, Willd................				*	*	*	*
1088.	" Myrtilloides, L..............		*	*	*	*	*	*
1089.	" pyriofolio, Ledeb............				*	*	*	
1090.	" Drummondiana, Barratt.......			*	*	*		
1091.	" Hookeriana, Barratt..........		*			*		
1092.	" speciosa, Hook		*		*	*		
1093.	" Barrattiana, Hook	* ?	*	*		*		
1094.	" Myrsinites, L			*	*	*		
1095.	" reticulata, L................			*				*
1096.	" cordata, Muhl. var. angustata..				*	*	*	*
1097.	" phlebophylla, And...........		*					
1098.	" petularis, Smith, var. gracilis..				*	*		
1099.	" chlorophylla, And		*				*	
1100.	" chlorophylla, var. pellita......		*					
1101.	" arctica, R. Br................		*	*	*			
1102.	" glauca, var. alpina...........		*					
1103.	" Mackenzieana, Barratt				*			
1104.	" vestita,Pursh ? (Mount Selwyn)			*				
1105.	" nivalis, Hook ? "			*				
1106.	" arbuscula, L			*	*			
1107.	" herbacea, L. (Mount Selwyn)..			*				
1108.	Populus tremuloides, Mx..........	*	*	*	*	*	*	*

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
1109.	Populus balsamifera, L.			*	*	*	*	*
1110.	" " L. var. angustifolia	*	*					
1111.	" trichocarpa, Torr.		*					
1112.	" monilifera, Ait.					*	*	
	LXXVIII. Coniferæ.							
1113.	Pinus contorta, Dougl.	*	*	*	*			
1114.	" Banksiana, Lamb				*	*	*	*
1115.	" Monticola, Dougl.	*	*					
1116.	" Strobus, L.					*	*	*
1117.	" resinosa, Ait					*	*	*
1118.	" ponderosa, Dougl.		*					
1119.	Abies nigra, Poir			*	*	*	*	*
1120.	" alba, Mx.		*	*	*	*	*	*
1121.	" balsamea, Marsh.		*	*	*		*	*
1122.	" Mertensiana, Lindl.	*	*					
1123.	" Douglasii, Lindl.	*	*	*				
1124.	" Menziesii, Lindl.	*	*					
1125.	" Englemanni, Parry.		*	*				
1126.	" amabilis, Dougl. (Forbes).		*	*				
1127.	" grandis, Lindl.		*	*				
1128.	Larix Americana, Mx				*	*	*	*
1129.	" Lyallii, Parl.		*	*	*			
1130.	" occidentalis, L		*	*				
1131.	Thuja occidentalis, L.					*	*	*
1132.	" gigantea, Nutt.	*	*					
1133.	Taxus brevifolia, Nutt.	*	*					
1134.	" baccata, var Canadensis.				*	*	*	*
1135.	Cupressus Nutkatensis, Lamb	*	*					
1136.	Juniperus occidentalis, Hook.	*	*					
1137.	" communis, L., var. alpina.		*		*			
1138.	" Virginiana, L.					*	*	*
1139.	" Sabina, var. procumbens.		*	*	*	*	*	
	LXXIX. Araceæ.							
1140.	Acorus Calamus, L.				*	*	*	*
1141.	Calla palustris, L.				*	*	*	*
1142.	Arisæma triphyllum, Torr.					*	*	*
1143.	Lysichiton Kamtschatense, Schott.	*	*					
	LXXX. Lemnaceæ.							
1144.	Lemna minor, L.		*		*	*	*	*
1145.	" trisulca, L.				*	*	*	*
1146.	" polyrrhiza, L.		*		*	*	*	*
1147.	" ——— ?		*					
	LXXXI. Typhaceæ.							
1148	Sparganium eurycarpum, Eng				*	*	*	*
1149.	" simplex, Huds., var	*	*		*	*	*	*
1150.	" " var. androcladum.			*	*	*	*	*

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
1151.	Sparganium minimum, Bauhin.....		*	*	*		*	*
1152.	Typha latifolia, L................				*	*	*	*
	LXXXII. NAIADACEÆ.							
1153.	Potamogeton amplifolius, Tuck....				*		*	
1154.	" gramineus, var. heterophyllus............		*		*	*	*	*
1155.	" natans, L..........		*		*	*	*	*
1156.	" pectinatus, L........		*	*	*	*	*	*
1157.	" perfoliatus, L., var. lanceolatus........		*	*	*	*	*	*
1158.	" prælongus, Wolfen...				*		*	*
1159.	" pusillus, L. var. vulgaris		*		*	*	*	*
1160.	" rufescens, Schrad....		*	*	*		*	
1161.	" compressus, L.......		*	*	*		*	*
1162.	Zannichellia palustris, L...........		*			*	*	*
1163.	Naias flexilis, Rostk................				*	*	*	*
	LXXXIII. ALISMACEÆ.							
1164.	Alisma Plantago, L., var. Americanum		*		*	*	*	*
1165.	Triglochin palustre, L.............	*	*	*	*	*	*	*
1166.	" maritimum, L..........	*	*	*	*	*	*	*
1167.	Scheuchzeria palustris, L..........				*		*	*
1168.	Sagittaria variabilis, Engelm.......	*	*		*	*	*	*
	LXXXIV. HYDROCHARIDACEÆ.							
1169.	Anacharis Canadensis, Planchon....		*			*	*	*
	LXXXV. ORCHIDACEÆ.							
1170.	Habenaria hyperborea, Lindl.......		*	*	*	*	*	*
1171.	" psychodes, Gray........					*	*	*
1172.	" obtusata................		*	*	*	*	*	*
1173.	" rotundifolia............		*	*			*	*
1174.	" dilatata, Gray...........		*		*		*	*
1175.	" Hookeri, Torr..........					*	*	*
1176.	" viridis, R. Br., var. bracteata..............		*			*	*	*
1177.	" virescens, Spreng		*		*		*	
1178.	" fœtida, S. Watson.......	*	*				*	
1179.	" elegano, Lindl..........	*	*					
1180.	Goodyera repens, R, Br............		*	*	*		*	*
1181.	" Menziesii, Lindl.........	*	*				*	
1182.	Spiranthes Romanzoviana, Chapm..	*	*		*	*	*	*
1183.	" gracilis, Big............					*	*	
1184.	Listera cordata, R Br...............		*	*	*		*	*
1185.	" convallarioides, Hook......		*	*	*		*	*
1186.	Calopogon pulchellus, R. Br.......					*	*	*
1187.	Calypso borealis, Salisb...........	*	*	*	*	*	*	*
1188.	Corallorhiza innata................	*	*	*	*	*	*	*
1189.	" multiflora, Nutt......		*		*		*	*
1190.	" Mertensiana, Bong....	*	*					
1191.	Cypripedium occidentale, S. Watson.		*					
1192.	" pubescens, Willd.....				*	*	*	*

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
1193.	Cypripedium parviflorum, Salisb....				*	*	*	*
1194.	" acaule, Ait...........					*	*	*
1195.	" passerinum, Rich.....		*	*	*	*	*	
1196.	" arietinum, R. Br......					*	*	
1197.	Amplectrum hyemale, Nutt........					*	*	*
1198.	Microstylis ophoglossoides, Nutt...					*	*	
	LXXXVI. Amaryllidaceæ.							
1199.	Hypoxys erecta, L.................					*	*	
	LXXXVII. Iridaceæ.							
1200.	Iris tenax, Dougl.....		*					
1201.	" versicolor, L..................					*	*	*
1202.	Sisyrinchium Bermudiana, L.......	*	*	*	*	*	*	*
1203.	" grandiflorum, Dougl..	*	*					
	LXXXVIII. Smilaceæ.							
1204.	Smilax herbacea, L...............					*	*	*
	LXXXIX. Liliaceæ.							
1205.	Trillium grandiflorum, Salisb......	*	*				*	*
1206.	" cernuum, L.............						*	*
1207.	" ovatum, Pursh...........	*	*			*		
1208.	Zygadenus glaucus, Nutt.			*	*	*	*	*
1209.	" Nuttallii, Gray.........		*			*		
1210.	" paniculatus, Gray	*	*					
1211.	Veratrum album, L...............		*	*		*		
1212.	Xerophyllum tenax, Pursh, (D.)....		*	*				
1213.	Tofieldia glutinosa, Willd..........		*	*	*	*	*	*
1214.	" palustris, Huds..........			*			*	
1215.	Prosartes Hookeri, Torr...........	*	*	*	*			
1216.	" trachycarpa, S. Watson ..		*					
1217.	Streptopus amplexifolius, D C	*	*	*	*	*	*	*
1218.	" roseus, Mx		*	*		*	*	*
1219.	Uvularia grandiflora, Smith........					*	*	*
1220.	" sessilifolia, L					*	*	*
1221.	Clintonia borealis, Raf					*	*	*
1222.	Smilacina racemosa, Desf..........	*	*	*	*	*	*	*
1223.	" stellata, Desf............	*	*	*	*	*	*	*
1224.	" trifolia, Desf............		*		*	*	*	*
1225.	" bifolia, Fleur...........	*	*		*	*	*	*
1226.	" uniflora, Menzies.........	*	*	*				
1227.	Polygonatum giganteum, Dict......					*	*	
1228.	Lilium Canadense, L..............		*?			*	*	
1229.	" Philadelphicum				*	*	*	*
1230.	Fritillaria lanceolata	*	*					
1231.	" pudica..................	*	*					
1232.	" Kamtschatensis, Fisch...		*					
1233.	Erythronium grandiflorum, Pursh...	*	*					
1234.	Allium cernuum, Roth............	*	*			*		
1235.	" stellatum, Nutt............		*		*	*		
1236.	" Schœnoprasum, L..........		*		*	*	*	*
1237.	" reticulatum, Fraser........	*	*			*		

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
1238.	Allium acuminatum, Hook	*	*					
1239.	Lloydia serotina, Rich	*	*					
1240.	Camassia esculenta, Lindl	*	*					
1241.	Milla maritima, Torr	*	*					
1242.	" grandiflora, Baker...........	*	*					
1243.	" hyacinthina, Baker..........	*	*					
1244.	Stenanthium occidentale, Watson..		*	*				
	XC. JUNCACEÆ.							
1245.	Luzula pilosa, Willd..............	*				*	*	*
1246.	" parviflora, Desb. var. melanocarpa..............		*	*	*	*	*	*
1247.	" campestris, D C............	*	*			*	*	*
1248.	" spicata, Desb..............	*	*	*		*		
1249.	" comosa Meyer............	*	*				*	
1250.	" spadicea, D C..............	*	*	*				
1251.	" arcuata, Meyer............			*				
1252.	Juncus effusus, L.................		*			*	*	*
1253.	" filiformis, L		*	*	*	*	*	*
1254.	" nodosus, L. var. megacephalus				*	*		
1255.	" alpinus var. insignis, Fries..				*	*	*	*
1256.	" acuminatus, Mx. var. fraternis		*		*	*		
1257.	" Balticus, var. montanus, Eng.		*	*	*	*		
1258.	" Drummondii, E. Meyer.....		*	*				
1259.	" bufonius, L..............		*		*	*	*	*
1260.	" longistylis, Torr...........		*		*	*		
1261.	" Mertensianus, Bourg.......	*	*	*				
1262.	" xiphioides, E. Meyer, var. montanus	*	*	*	*	*		
1263.	" Canadensis, var. coarctatus..					*	*	*
1264.	" tenuis, Willd. var secundus.		*		*	*	*	*
1265.	" " " " congesta .		*		*	*	*	
1266.	" " "				*	*	*	*
1267.	" Vaseyi, Eng................					*	*	
1268.	" arcticus, Willd		*					
1269.	" nodosus, L					*	*	*
1270.	" biglumis, L................			*	*			
1271.	" triglumis, L			*				
	XCI. CYPERACEÆ.							
1272.	Cyperus inflexus, Muhl............		*			*	*	*
1273.	" filiculmis, Vahl...........					*	*	
1274.	" strigosus, L...............					*	*	*
1275.	Dulichium spathaceum, Rich.......					*	*	*
1276.	Eliocharis acicularis, Torr.........	*	*		*	*	*	*
1277.	" palustris, R. Br.........	*	*	*	*	*	*	*
1278.	" obtusa, Schuttes				*	*	*	*
1279.	Scirpus cæspitosus, L.............				*	*	*	*
1280.	" maritimus				*	*		*
1281.	" pungens...................		*		*	*	*	*
1282.	" sylvaticum, L.............				*		*	
1283.	" Eriophorum, Mx..........					*	*	*
1284.	" atrovirens, Muhl					*	*	*
1285.	" validus, Vahl...............		*			*	*	*
1286.	" subterminalis, Torr........			*	*		*	

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
1287.	Eriophorum alpinum, L.			*			*	*
1288.	" polystachyon, L.			*	*		*	*
1289.	" vaginatum, L		*		*	*	*	*
1290.	" capitatum, L.		*	*				*
1291.	" gracile, Rith.					*	*	*
1292.	" latifolium, Hoppe			*				
1293.	" Virginicum, L.					*	*	*
1294.	Carex gynocrates, Wornuk.		*	*	*	*	*	*
1295.	" scirpoidea, Mx.			*	*	*	*	*
1296.	" filifolia, Nutt.			*		*		
1297.	" Nardina, Dew.		*	*				
1298.	" obtusata, Lilg		*	*	*	*		*
1299.	" polytrichoides, Muhl		*	*	*	*	*	*
1300.	" Backii, Boott.	*	*		*	*	*	*
1301.	" tenella, Schk.				*	*	*	*
1302.	" chordorhiza, Ehih.		*	*	*		*	*
1303.	" stenophylla, Wahl.	*	*	*		*		
1304.	" anthoxantha, Presl.	*	*					
1305.	" nigricans, C. A. Meyer.		*	*				
1306.	" Pyrenaica, Wahl.			*				
1307.	" affinis, R. Br.				*			
1308.	" Lyoni, Boott.			*				
1309.	" pauciflora, Light.		*	*			*	
1310.	" Hookeriana, Dew.					*		
1311.	" disticha, Huds.		*			*	*	
1312.	" siccata, Dew.		*	*	*	*	*	*
1313.	" stipata, Muhl.	*	*			*	*	*
1314.	" marcida, Boott.		*		*	*		
1315.	" Douglasii, Boott.	*	*	*		*		
1316.	" terctiuscula, Good.		*	*	*	*	*	*
1317.	" prairia, Dew.					*	*	
1318.	" trisperna, Dew.		*	*		*	*	*
1319.	" Deweyana, Schw.		*	*	*	*	*	*
1320.	" vitilis, Fries.		*	*	*	*	*	*
1321.	" canescens, Torr		*	*	*		*	*
1322.	" arcta, Boott					*		
1323.	" lagopina, Wahl.			*				
1324.	" festiva, Dew.		*	*	*	*	*	
1325.	" Liddoni, Boott		*	*	*	*		
1326.	" scoparia, Schk.		*	*	*	*	*	*
1327.	" lagopodioides, Schk.		*	*		*	*	*
1328.	" arida, Torr.					*		
1329.	" cristata, Schw.					*	*	*
1330.	" straminea, Schk.		*	*	*	*	*	*
1331.	" adusta, Boott.		*	*	*	*	*	*
1332.	" sychnocephala, Carey.					*	*	
1333.	" Willdenovii, Schk					*		
1334.	" tenuiflora, Wahl		*	*		*	*	*
1335.	" alata, Torr.					*		
1336.	" panicea, L.					*		
1337.	" alpina, Swz.		*	*	*	*	*	*
1338.	" atrata, L.		*	*	*		*	*
1339.	" Buxbaumii, Wahl.			*	*	*	*	*
1340.	" Parryana, Dew.		*		*	*		
1341.	" debilis, Mx					*	*	*
1342	" gracillima, Schw.					*	*	*
1343.	" Mertensii, Pres.	*	*					

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
1344.	Carex pedunculata, Muhl..........			*		*	*	*
1345.	“ rigida, Good................		*	*				*
1346.	“ aperta, Boott..........	*	*			*	*	
1347.	“ stricta, Good...............		*			*	*	*
1348.	“ lenticularis, Mx.............				*	*	*	*
1349.	“ aquatilis, Wahl.............			*	*	*	*	*
1350.	“ salina, Wahl...............	*	*			*		*
1351.	“ physocarpa, Presb...........	*	*					
1352.	“ Hoppreri, Boot.............				*	*		*
1353.	“ maritima, Muhl.............				*	*		*
1354.	“ crinita, Lam................					*	*	*
1355.	“ Sitchensis, Pres.............	*	*					
1356.	“ amea, Nutt.................		*		*	*	*	*
1357.	“ “ var. androgyna........					*	*	*
1358.	“ Magellanica, Lam...........		*	*	*	*	*	*
1359.	“ limosa, L..................		*	*	*	*	*	*
1360.	“ atrata, var. nigra, Boott......		*	*			*	
1361.	“ Ragnoddsii, Dew............		*					
1362.	“ concinna, R. Br.............		*	*	*	*		
1363.	“ Rossii, Boott...............	*	*	*	*			
1364.	“ vulgaris, Fries..............					*	*	*
1365.	“ vaginata, Tausch...........		*	*	*		*	*
1366.	“ umbellata, Schk............	*	*	*		*	*	*
1367.	“ Novæ-Angliæ, Schw.........				*	*	*	*
1368.	“ Pennsylvanica, Lam.........	*	*	*	*	*	*	*
1369.	“ varia, Muhl................		*	*			*	*
1370.	“ Richardsonii, R Br..........		*	*	*	*	*	*
1371.	“ filiformis, L................				*		*	*
1372.	“ lanuginosa, Mx.............		*		*	*	*	*
1373.	“ Houghtonii, Torr...........				*	*	*	*
1374.	“ livida, Willd...............		*	*	*		*	*
1375.	“ supina, Wahl...............			*	*			*
1376.	“ Œderi, Ehrh...............					*	*	*
1377.	“ flava, L...................					*	*	*
1378.	“ pallescens, L...					*	*	*
1379.	“ laxiflora, Lam..............			*		*	*	*
1380.	“ eburnea, Boott..............		*	*	*	*	*	*
1381.	“ capillaris, L........		*	*	*	*	*	*
1382.	“ riparia, Good...............				*	*	*	*
1383.	“ oligosperma, Mx...........				*		*	*
1384.	“ utriculata, Boott............			*	*	*	*	*
1385.	“ vesicaria, L............ ...		*		*	*		
1386.	“ intumescens, Rudge.........					*	*	*
1387.	“ retrorsa, Schw..............				*	*	*	*
1388.	“ pseudo-cyperus, L...........				*	*	*	*
1389.	“ aristata, R. Br..............				*	*	*	
1390.	“ longirostris, Torr...........			*	*	*	*	
1391.	“ Torreyi, Boott..............					*		
1392.	“ alopecoidea, Tuck...........					*		
1393.	“ lupulina, Muhl.............					*	*	*
1394.	“ rosea, Schk................		*			*	*	*
1395.	“ Crawei, Dew...............					*	*	
1396.	“ granularis, Muhl............					*	*	*
1397.	“ stellulata, L................		*	*	*	*	*	*
1398.	“ vulpinoidea, Mx............		*		*	*	*	*
1399.	“ Racana, Boott..............				*			
1400.	“ Hoodii, Boott......	*	*					

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
1401.	Carex arthrostachya, Olney........	*	*					
1402.	" fænea, Willd...............					*		
1403.	" glareosa, Wahl.............		*					
1404.	" Jamesii, Torr...............			*				
1405.	" cryptocarpa, Meyer..........	*	*					
1406.	" Emmonsii, Dew............		*	*		*	*	*
1407.	" anthericoides, Presl.	*		*				
1408.	" incurva, Light..............			*		*		
	XCII. Gramineæ.							
1409.	Leersia oryzoides, Schw...........					*	*	*
1410.	Zizania aquatica, L...............					*	*	*
1411.	Aleopecurus aristulatus	*	*		*	*	*	*
1412.	" geniculatus, L........	*	*				*	
1413.	" alpinus, L............		*	*	*			
1414.	Phleum pratense, L..............	*	*		*	*	*	*
1415.	" alpinum, L...............		*	*				
1416.	Vilfa cuspidata, Torr..............					*		
1417.	" depauperata, Torr...........	*	*					
1418.	Sporobolus heterolepis, Gray.......					*	*	
1419.	Agrostis exarrata, Trin............	*	*	*				
1420.	" verticallata	*	*					
1421.	" scabra, Willd	*	*	*	*	*	*	*
1422.	" æquivalis, Trin..........	*				*	*	
1423.	" alba, L..................	*	*				*	*
1424.	Cimea arundinacea, L. var. pendula		*			*	*	*
1425.	Muhlenbergia glomerata, Trin......					*	*	*
1426.	Calamagrostis longifolia, Hook....					*		
1427.	" Canadensis, Beauv ..		*	*	*	*	*	*
1428	" Langsdorfii, Trin....					*	*	
1429.	" sylvatica, D C.......		*	*		*		
1430.	" stricta, Trin		*	*	*	*	*	
1431.	" arenaria, Roth.......					*	*	*
1432.	" Aleutica, Trin.......		*					
1433.	Ericoma cuspidata, Nutt...........		*			*		
1434.	Oryzopsis asperifolia, Mx..........		*	*		*	*	*
1435.	" Canadensis, Torr........		*			*	*	*
1436.	Stipa, Richardsonii, Link..........				*	*	*	
1437.	" spartea, Trin...............				*	*	*	
1438.	" comata, Trin......					*		
1439.	" viridula, Trin................				*	*		
1440.	" occidentalis, Thurb	*	*					
1441.	" sitigeræ?	*						
1442.	Spartina cynosuroides, Willd		*			*	*	*
1443.	" gracilis, Hook............					*		
1444.	Bouteloua oligostachya, Torr.......					*		
1445.	Dactylis glomera a, L.............	*					*	*
1446.	Kaleria cristata, Pers..............	*	*		*	*		
1447.	Eatonia obtusata Gray............				*	*	*	
1448.	MelicaPoæoides, Nutt=bulbosa, Geyer	*	*					
1449.	Glyceria airoides, Nutt					*		
1450.	" Canadensis, Trin				*	*	*	*
1451.	" nervata, Trin............		*		*	*	*	*
1452.	" aquatica, Smith..........				*	*	*	*
1453.	" fluitans, R. Br		*		*	*	*	*

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
1454.	Glyceria distans, Wahl............					*		
1455.	" pauciflora, Presl	*	*	*				
1456.	" aquatica, var ?..........			*	*			
1457.	Brizophrum spicatum, Hook.......	*	*		*	*		
1458.	Catabioza aquatica, Beauv..........					*		
1459.	Poa annua, L....................	*	*			*	*	*
1460.	" pratensis, L...................	*				*	*	*
1461.	" tenuifolia, Nutt.............		*	*	*			
1462.	" alpina, L.....................		*	*		*	*	
1463.	" serotina, Ehrb................	*	*		*	*	*	*
1464.	" cæsia, Smith, var. fertilis......		*					
1465.	" " "		*			*	*	
1466.	" alpina var. minor, L..........		*					
1467.	" laxa, Hænke..................		*					
1468.	" borealis, Kth		*					
1469.	" stenantha, Trin.............		*					
1470.	" Andina, Nutt................		*	*				
1471.	" compressa, L.................					*	*	*
1472.	" flexuosa, Muhl...............					*	*	
1473.	Graphephorum, Fischeri ?.........					*		
1474.	" melicoides, Beauv...					*	*	
1475.	Festuca scabrella, Hook...........	*	*					
1476.	" tenella, var. microstylis....	*	*					
1477.	" rubra, L................	*	*					
1478.	" bromoides, L.............	*	*					
1479.	" ovina, L....		*	*		*	*	
1480.	" ovina, var. duriuscula, Gray.			*		*	*	
1481.	" brevifolia, R. Br..........							*
1482.	" borealis, Mert............		*					
1483.	" occidentalis, Hook (?).....	*						
1484.	Bromus Kalmii, Gray.............		*		*	*	*	
1485.	" ciliatus, L................		*	*	*	*	*	*
1486.	" racemosus, L.............	*	*					
1487.	" brevi-aristatus, Thurb.....							
1488.	" carinatus, Hook (?)........		*					
1489.	Phragmites communis, Trin.......		*		*	*	*	*
1490.	Lepturus paniculatus, Nutt........							
1491.	Lolium perenne, L................	*	*					
1492.	Triticum repens, L................	*	*	*	*	*	*	*
1493.	" dasystachyum, Gray......		*	*	*	*	*	
1494.	" violaceum, Horneman.....					*	*	
1495.	" caninum, L..............	*	*	*	*	*	*	*
1496.	" repens, var..............		*					
1497.	" strigosum, Steud.........		*					
1498.	Hordeum jubatum, L.............				*	*	*	*
1499.	" pratense, Huds		*					
1500.	Elymus Sibericus, L..............	*	*			*		
1501.	" mollis..................					*	*	*
1502.	" condensatus, Presl........		*			*		
1503.	" Canadensis, var., L.......	*						
1504.	" striatus, Willd............				*	*		
1505.	" Virginicus, L............				*	*	*	*
1506.	Gymnostichum Hystriæ, Schreb....					*	*	
1507.	Danthonia spicata, Beauv..... ...				*	*	*	*
1508.	" sericea, Nutt...........				*	*		
1509.	Aira atropurpurea, Wald..........	*						
1510.	" elongata......................	*	*					

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
1511.	Aira caryophyllea, L.	*						
1512.	" latifolia, Hook.	*	*					
1513.	" præcox, L.	*						*
1514.	" cæspitosa, L.		*			*	*	
1515.	Avena striata, Mx.					*	*	*
1516.	Trisetum subspicatum, Beauv., var.	*	*		*	*	*	
1517.	" cernuum, Tries.	*	*	*				*
1518.	Hierochloa borealis, Roem.		*		*	*	*	*
1519.	Phalaris arundinacea, L.		*	*	*	*	*	
1520.	Beckmannia erucæformis, Hook.			*	*	*		
1521.	Panicum virgatum, L.					*	*	
1522.	" xanthophysum, Gray.					*	*	*
1523.	" capillare, L.					*	*	
1524.	" pauciflorum, Ell.					*		*
1525.	" depauperatum, Muhl.					*	*	*
1526.	" dichotomum, L.					*	*	
1527.	" Crus-galli, L.					*	*	*
1528.	Setaria glauca, Beauv.					*	*	*
1529.	" viridis, Beauv.					*	*	
1530.	Andropogon furcatus, Muhl.					*	*	
1531.	" scoparius, Mx.					*	*	
1532.	" glaucum.					*		
1533.	Sorghum nutans, Gray.					*	*	
	XCIII. Equisetaceæ.							
1534.	Equisetum sylvaticum, L.		*		*	*	*	* *
1535.	" pratense, Ehrh.		*	*	*	*	*	*
1536.	" arvense, L.	*	*	*	*	*	*	
1537.	" Telmateia, Ehrh.	*						
1538.	" palustre, L.		*			*	*	*
1539.	" limosum, L.		*	*	*	*	*	
1540.	" lævigatum, Braun.		*			*		*
1541.	" hiemale, L.		*	*	*	*	*	
1542.	" variegatum, Schleicher.		*	*	*	*	*	*
1543.	" scirpoides, Mx.		*	*	*		*	
1544.	" robustum, Braun.		*					
	XCIV. Filices.							
1545.	Polypodium vulgare, L.	*	*		*	*	*	*
1546.	Gymnogramma triangularis, Kaulf.	*	*					
1547.	Chilanthes lanuginosa, Nutt.		*					
1548.	Allosorus acrostichoides, Sprengel.	*	*		*		*	*
1549.	Pellæa gracilis, Hook.		*	*	*	*	*	
1550.	" atropurpurea, Link.		*	*	*		*	
1551.	" densa, Hook.	*	*					*
1552.	Pteris aquilina, L.	*	*			*	*	*
1553.	Adiantum pedatum, L.	*	*			*	*	
1554.	Lomaria Spicant, Den.	*	*					*
1555.	Asplenium viride, Huds.			*			*	*
1556.	" Trichomanes, L.		*	*			*	*
1557.	" Filix-fœmina, Bernh.		*	*	*	*	*	
1558.	Camptosurus rhizophyllus, Link.				*	*	*	*
1559.	Phegopteris polypodiodes, Fée.				*	*	*	*
1560.	" Dryopteris, Fée.		*	*	*	*	*	
1561.	Aspidium Lonchitis, Swz.		*	*			*	

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
1562.	Aspidium minutum, Kaulf.........	*	*					
1563.	" fragrans, Swz............			*	*		*	*
1564.	" marginale, Swz..........			*	*		*	*
1565.	" cristatum, Swz..........					*	*	*
1566.	" aculeatum, Swz.........		*					*
1567.	" spinulosum var. dilatatum. Grey...............			*	*		*	*
1568.	" Filix-mas, Swz..........		*	*			*	
1569.	Struthiopteris Germanica, Willd....				*	*	*	*
1570.	Onoclea sensibilis, L..............					*	*	*
1571.	Cystopteris fragilis, Bernh..........	*	*	*	*	*	*	*
1572.	" montana, Bernh........			*			*	*
1573.	Woodsia Ilvensis, R. Br...........					*	*	*
1574.	" glabella, R. Br				*		*	*
1575.	" hyperborea, R. Br........					*	*	*
1576.	" scopulina, D C., Eaton....		*	*				
1577.	" Oregana, D C., Eaton.....		*	*	*	*	*	
1578.	" obtusa, Torr					* ?		
1579.	Osmunda regalis, L					*	*	*
1580.	Botrychium simplex, Hitch........					*	*	*
1581.	" Lunaria, Swz..........			*	*	*	*	*
1582.	" ternatum var					*	*	*
1583.	" Virginicum, Swz.......					*	*	*
1584.	Ophioglossum vulgatum, L........					*	*	*
	CXV. LYCOPODIACEÆ.							
1585.	Lycopodium Selago, L............			*			*	
1586.	" lucidulum, Mx					*	*	*
1587.	" annotinum, L				*	*	*	*
1588.	" dendroideum, Mx.....					*	*	*
1589.	" clavatum, L..........		*	*	*	*	*	*
1590.	" complanatum, L					*	*	*
1591.	" alpinum, L..........				*			
1592.	Selaginella selaginoides, Link......			*			*	
1593.	" rupestris, Spring	*	*	*		*	*	*
1594.	Isoetes lacustris, L					*	*	
	XCVI. MUSCI.							
1595.	Sphagnum cymbifolium, Ehrh.....		*	*	*		*	*
1596.	" squarrosum, Pers........				*	*	*	*
1597.	" acutifolium, Ehrh	*	*	*		*		*
1598	" " var. fuscum.				*	*	*	*
1599.	" " var. purpureum				*		*	*
1600.	" subsecundum, Nees.....				*	*	*	
1601.	" cuspidatum, Ehrh.......				*		*	
1602.	" recurvum, Beauv.......				*	*	*	*
1603.	" rigidum, Schimp........				*		*	
1604.	" Mulleri, "	*						
1605.	" ——— ?...............				*			
1606.	Gymnostomum curvirostre, Hedw ..				*		*	
1607.	" rupestre, Schw.....				*		*	
1608.	Weisia crispula, Hedw............		*					
1609.	" cirrhata, Hedw............	*	*	*	*			
1610.	Dicranum crispum, Hedw.........	*						
1611.	" subulatum, Hedw.......		*					

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
1612.	Dicranum heteromallum, Hedw....	*	*		*		*	*
1613.	" Canadense, Mitt........			*				
1614.	" strictum, Schl.........		*		*	*		
1615.	" flagellare, Hedw........		*		*	*	*	*
1616.	" fuscescens, Turner......	*	*		*	*	*	*
1617.	" scoparium, L...........	*	*		*	*	*	*
1618.	" palustre, La. Pyl........	*	*	*	*	*	*	*
1619.	" undulatum, Turner.....	*	*		*	*	*	*
1620.	" Drummondii, C. Muller.				*	*	*	*
1621.	" Schraderi, Schw........		*	*	*	*	*	*
1622.	" longifolium, Hedw......					*	*	
1623.	" virens, Hedw..........		*		*		*	*
1624.	" Schreberi, Hedw........		*				*	
1625.	" pellucidum, L..........	*	*					
1626.	" varium, Hedw..........		*		*	*	*	*
1627.	" rufescens, Turner.......		*					*
1628.	" elongatum, Schw.......				*	*		
1629.	" Muhlenbeckii				*			
1630.	" scoparium, var. rupestre.	*				*		
1631.	" scoparium, var.........		*				*	
1632.	" spurium, Hedw.........	*					*	*
1633.	Fissidens bryoides, Hedw.........				*	*	*	
1634.	" minutulus, Sulliv. var....	*	*				*	
1635.	" grandifrons, Brid........		*				*	
1636.	Campylopus, ——— ?............				*			
1637.	Pharomitrium subsessile, Brid.....		*	*				
1638.	Pottia truncata, Br., and Sch., var. subcylindrica.......		*					
1639.	" Heimii, Hook.............		*	*		*		
1640.	Anacalypta latifolia, Nus. & Sch....		*	*	*			
1641.	Desmatodon cernuus, Wahl........		*		*	*		
1642.	" latifolius, Br. & Sch. var. glacialis........		*	*	*			
1643.	" flavicans, Br. & Sch...			*				
1644.	Didymodon rubellus, Roth.........	*	*	*	*	*	*	*
1645.	" luridus, Hormh........	*					*	
1646.	Barbula subulata, Dill.............	*	*	*	*			
1647.	" lævipila, Br. & Sch........	*						
1648.	" ruralis, Dill..............	*	*	*	*	*	*	
1649.	" Muelleri, Bruch...........	*						
1650.	" mucronifolia, Schw........			*	*		*	
1651.	" anomala, Br. Eur..........	*						
1652.	" tortuosa, L...............		*				*	*
1653.	" fallax, Hedw.............			*			*	
1654.	" vinealis, Brid............	*	*					
1655.	" brevirostris, Br. & Sch.....		*					
1656.	" unguiculata, Dill.........		*				*	*
1657.	" gracilis, Schw............	*	*					
1658.	" convoluta, Hedw..........	*	*				*	
1659.	Distichium capillaceum, L	*	*		*	*	*	*
1660.	" inclinatum, Hedw.....				*	*	*	
1661.	Ceratodon purpureus, L...........	*	*	*	*	*	*	*
1662.	Trichostomum rigidulum, Smith...	*					*	
1663.	" tophaceum, Brid....				*			
1664.	" flexicaule..........		*	*	*			
1665.	" rubellum, Roth.....			*				
1666.	Tetraphis pellucida, Dill...........	*	*	*	*	*	*	*

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
1667.	Encalypta vulgaris, L.		*				*	
1668.	" ciliata, Hedw...........	*	*	*	*	*	*	
1669.	" streptocarpa, Hedw......							
1670.	" rhabdocarpa, Schw......		*	*	*	*	*	
1671.	Schistostega osmundacea, Dicks....		*					
1672.	Orthotrichum pallens, Bruch.......	*	*					
1673.	" strangulatum, Beauv.		*				*	
1674.	" anomalum, Hedw....					*	*	*
1675.	" obtusifolium, Sch....		*		*	*	*	
1676.	" Jamesianum, Sulliv..		*					
1677.	" speciosum, Nees.....	*	*		*	*	*	*
1678.	" Texanum, Sulliv.....		*					
1679	" " var. globosum.		*					
1680.	" elegans, Schro.......		*					
1681.	" Lyallii, Hook. & Tay.	*	*		*	*		
1682.	" Kingianum, Lesq....		*					
1683.	" pulchellum, Smith...	*						
1684.	" consimile, Mitt......	*	*					
1685.	" alpestre, Hornx., var.		*	*				
1686.	Ulota phyllantha, Bruch...........	*						
1687.	Grimmia Scouleri, C. Mull.........		*					
1688.	" apocarpa, L............	*	*		*	*	*	*
1689.	" " var..........				*		*	
1690.	" conferta, Funk..........				*			
1691.	" ambigua, Sulliv.........				*	*		
1692.	" pulvinata, L............	*	*		*			
1693.	" trichophylla, Grev.......	*	*					
1694.	" calyptrata, Hook.........		*	*				
1695.	" obtusa		*					
1696.	" leucophæa, Grev.........		*					
1697.	" alpestris, Schl..........		*					
1698.	" ovata, Web. & Mohr......			*			*	
1699.	" ———?		*					
1700.	" ———?			*				
1701.	Racomitrium aciculare, L..........	*	*		*		*	
1702.	" sudeticum, Funk.....	*	*				*	
1703.	" fasciculare, Brid......		*				*	
1704.	" heterostichum, Hedw.	*	*					
1705.	" varium, Mitt.........		*					
1706.	" canescens, var. ericoides	*	*					
1707.	" lanuginosa, Dill......	*						
1708.	Hedwigia ciliata, Dicks...........	*	*		*		*	*
1709.	" " var. leucophæa....	*						
1710.	Braunia Californica, Lesq..........	*	*					
1711.	Zygodon, ——— ?................	*						
1712.	Physcomitrium pyriforme, L.......		*				*	
1713.	Buxbaumia aphylla, Haller........		*					*
1714.	Atrichum undulatum, L...........	*	*		*		*	*
1715.	" parallelum, Mitt.........		*	*	*	*		
1716.	" angustatum, Br. Eur......		*				*	*
1717.	Pogonatum alpinum, Dill	*	*	*			*	*
1718.	Oligotrichum aligerum, Mitt.......		*	*				
1719.	" Lyallii, Mitt.........		*	*				
1720.	Polytrichum juniperinum, Hedw...	*	*		*	*	*	*
1721.	" " var. strictum.		*		*	*		
1722.	" commune, L., var.....		*	*	*			*
1723.	" piliferum, Schreb.....	*	*				*	*

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
1724.	Timmia megapolitina, Hedw.......	*	*		*	*	*	*
1725.	" Austriaca, Hedw..........		*					
1726.	" Bavarica, Br. & Sch.......		*	*	*			
1727.	Aulacomnion androgynum, L......	*	*					
1728.	" palustre, L..........	*	*	*	*	*	*	*
1729.	Mnium insigne, Mitt...............	*	*					
1730.	" medium, B. & S...........	*	*	*	*	*		
1731.	" affine, Bland...........		*	*			*	*
1732.	" venustum, Mitten..........	*						
1733.	" cuspidatum, Hedw.........	* ?		*	*	*	*	*
1734.	" spinulosum, Br. & Sch.....	*	*		*	*	*	*
1735.	" umbratile, Mitten..........	*	*	*				
1736.	" punctatum, Hedw.........	*	*				*	*
1737.	" subglobosum, Br. & Sch....				*	*		
1738.	" rostratum, Schw...........		*	*			*	*
1739	" Drummondii, Br. & Sch....						*	*
1740.	" orthorhynchum, Brid.......	*	*	*	*		*	*
1741.	" Menziesii	*	*					
1742.	" senatum, Schrad...........				*	*	*	*
1743.	Bryum nutans, Schreb.............		*	*	*	*	*	*
1744.	" crudum, Schreb............		*	*	*	*	*	*
1745.	" longicollum, Schw.........		*		*	*		
1746.	" albicans, Wahl.............		*		*	*	*	*
1747.	" Ludwigii, Spreng..........		*					
1748.	" pyriformis, L.............	*	*	*	*	*	*	*
1749.	" arcticum, Brown...........	*	*	*	*			
1750.	" purpurascens, Brown.......	*	*	*	*			
1751.	" uliginosum, Br. & Sch......			*	*	*		
1752.	" Brownii, Br. & Sch........	*	*	*				
1753.	" cæspiticium, L.............	*	*		*	*	*	*
1754.	" pallescens, Schl...........		*					
1755.	" bimum, Schreb............	*	*	*	*	*	*	*
1756.	" pseudotriquetrum, Hedw....			*	*		*	*
1757.	" Duvalii, Voit..............		*		*	*	*	
1758.	" turbinatum, Hedw..........		*	*	*	*	*	
1759.	" capillare, L................	*	*			*	*	*
1760.	" argenteum, L..............	*		*	*	*	*	*
1761.	" pendulum, Hsch...........			*	*	*		
1762.	" inclinatum, Swz...........				*		*	*
1763.	" intermedium, Web. & Mohr.				*	*	*	*
1764.	" Lescivianum, Sulliv........		*	*				
1765.	" annotinum, Schreb.........				*	*	*	
1766.	Funaria hygrometrica, L....	*	*	*	*	*	*	*
1767.	Cotoscopium nigritium, Brid.......				*	*	*	
1768.	Meesia uliginosa, Hedw...........		*		*	*	*	
1769.	" tristicha, Br. & Sch........		*					
1770.	Discelium nudum, Brid...........		*					
1771.	Anæctangium Hornschuchianum,Ty.		*					
1772.	Amblyodon Macounii, Austin......				*			
1773.	Bartramia fontana, Brid...........	*	*	*	*	*	*	*
1774.	" Menziesii Turner.......	*	*					
1775.	" pomiformis, L..........	*	*		*	*	*	*
1776.	" ithyphylla, Brid........		*	*				
1777.	" Œderi, Swz...........	*	*	*	*		*	*
1778.	Tetraplodon mnioides, Br. & Sch...		*	*	*	*	*	
1779.	" angustatum, Br. & Sch.		*	*	*	*	*	
1780.	Splachnum sphæricum, Hedw......		*					

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
1781.	Tayloria senata, Hedw		*					
1782.	" splachnoides		*	*				
1783.	Fontinalis antipyretica, L	*	*	*	*	*	*	*
1784.	" Novæ-Angliæ, Sulliv				*		*	
1785.	" squamosa, L					*	*	
1786.	" Dalecarlica, Br. Eur				*		*	
1787.	" Lescurii, Sulliv		*					
1788.	Dichelyma uncinatum		*					
1789.	" capillaceum, Br. Eur		*				*	*
1790.	Leskea obscura, Hedw		*	*	*		*	
1791.	" polycarpa, Ehrh	*	*				*	*
1792.	Pterigynandrum filiforme, Hedw		*				*	
1793.	Platygyrium repens, Br. Eur		*		*	*	*	*
1794.	Climacium dendroides, Web. & Mohr.		*		*	*	*	*
1795.	Pylaisæa polyantha, Schimp			*	*	*	*	*
1796.	" heteromalla ?				*			
1797.	Neckera oligocarpa, Br. & Sch	*	*	*	*			
1798.	" Menziesii, Hoch	*	*	*				
1799.	Myrinia pulvinata, Br. & Sch				*			
1800.	Antitrichia curtipendula, vr. gigantea	*	*					
1801.	" Californica, Sulliv	*	*					
1802.	Alsia abietina, Hook	*	*					
1803.	Omallia obtusata, Mitten	*	*					
1804.	Pseudoleskea atrovirens		*					
1805.	Mymella julacea, Br. Eur				*		*	
1806.	Thudium gracilis, Br. & Sch				*	*	*	
1807.	" abietinum, L			*	*	*	*	*
1808.	" Blandovii, Web. & Mohr		*	*	*		*	
1809.	" delicatulum, L					*	*	*
1810.	" cuspifolium, Hook	*	*					
1811.	Eurhynchium strigosum, Hoffm		*		*	*	*	*
1812.	" Stokesii, Turner	*	*					
1813.	" Oreganum, Sulliv	*	*					
1814.	Brachythecium asperrimum, Mitt	*	*					
1815.	" rivulare, Br. &. Sch.			*			*	*
1816.	" collinum, Schl	*	*	*	*			
1817.	" salebrosum, Hoffm		*		*	*	*	*
1818.	" albicans, Neck	*	*	*	*			
1819.	" nitens, Schreb		*	*	*	*	*	*
1820.	" lutescens, Hedw	*			*			
1821.	" commutatum, Hedw.				*			
1822.	" Nuttallii, Wil	*	*					
1823.	" Œneum, Mitt	*	*					
1824.	" radicosum, Mitt		*		*	*		
1825.	" œdipodium, Mitt		*			*	*	
1826.	" declivum, Mitt		*					
1827.	" acutum, Mitt		*					
1828.	" lætum, Brid				*		*	*
1829.	" pratense, Koch				*		*	
1830.	Amblystegium serpens, Dill		*		*	*	*	*
1831.	" radicale, Beauv		*	*	*	*	*	*
1832.	" compactum, C. Mull.		*	*	*	*	*	
1833.	" confervoides, Sulliv.				*		*	*
1834.	" minutissimum, Sulliv		*		*	*	*	
1835.	" riparium, L			*	*	*	*	*
1836.	" fluviatile, Swz				*			
1837.	" varia, Hedw		*			*		

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
1838.	Limnobium palustre, L...........				*	*	*	*
1839.	" obtusifolium, Hook&W.		*					
1840.	" arcticum, Sommerf....		*	*		*		
1841.	" ochraceum, Turner....				*		*	*
1842.	Hypnum pallescens, Schimp......			*	*		*	
1843.	" uncinatum, Hedw.......		*	*	*	*	*	*
1844.	" aduncum, Hedw........			*	*		*	*
1845.	" filicinum, L............		*	*	*	*	*	
1846.	" Kneiffii, B. & S.........			*		*	*	
1847.	" vernicosum, Lind.......	*	*					
1848.	" Schreberi, Willd........	*	*			*	*	*
1849.	" cuspidatum, L...........		*				*	
1850.	" giganteum, Schimp.....		*	*	*		*	*
1851.	" chrysophyllum, Brid....		*			*	*	*
1852.	" hispidulum, Brid.......		*			*	*	*
1853.	" chryseus, Hornsch......	*	*	*				
1854.	" rubellum, Mitt.........	*		*				
1855.	" reptile, Mx...............		*				*	*
1856.	" plicatilis, Mitt..........	*		*	*			
1857.	" circinalis, Hook........	*						
1858.	" plumifera, Mitt..........	*	*	*				
1859.	" crista-castrensis, L......					*	*	*
1860.	" robustum, Hook.........		*					
1861.	" stoloniferum, Hook.....	*	*					
1862.	" spiculiferum, Mitt.......		*					
1863.	" aggregatum, Mitt.......	*	*					
1864.	" Haldanianum, Grev.....					*	*	*
1865.	" stellatum, Schreb.......				*	*	*	
1866.	" rugosum, Ehrh.........			*	*		*	*
1867.	" diversifolium, Br. Europ.		*		*	*	*	
1868.	" Sendtneri..............		*		*			
1869.	" Spruceii, Bruch.........				*			
1870.	Hylocomium triquetrum, L........	*	*				*	*
1871.	" loreum, Dill........		*					
1872.	" splendens, Dill......	*	*	*	*	*	*	*
1873.	" umbratum, Ehrh....				*			*
1874.	Plagiothecium pulchellum, Hedw..		*	*			*	*
1875.	" turfaceum, Lind....		*		*		*	
1876.	" geminus, Mitt......	*		*				
1877.	" Donianum, Smith...		*					
1878.	" undulatum, Hedw..	*	*					
1879.	" denticulatum, L....					*	*	*
1880.	Hypnum trifarium, L..............		*				*	
1881.	" cæspitosum..............		*					
1882.	" fertile, Sendt............		*	*	*		*	
	HEPATICÆ. XCVII.							
1883.	Riccia ———, ——?..............	*						
1884.	Marchantia polymorpha, L		*	*	*	*	*	*
1885.	Fegatella conica, L........... ...	*	*				*	*
1886.	Sarcomitrium palmatum, Hedw....		*					
1887.	Metzgeria pubescens, Schrank......		*					
1888.	Fimbraria gracilis................	*	*					
1889.	Anema pinguis, Dumort...........		*	*	*	*	*	*
1890.	Anthoceros stomitifer	*						
1891.	" fusiformis...........		*					

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
1892.	Fossombronia ——— ?							
1893.	Chiloscyphus polyanthus, L		*				*	*
1894.	" Drummondii, Taylor		*	*		*		
1895.	Lophocolea heterophylla, Hook		*				*	
1896.	" crocata, Nees		*	*	*	*	*	*
1897.	" bidentata, Nees		*			*	*	
1898.	Scapania Peckii, Austin		*		*		*	
1899.	" albicans, L		*	*				
1900.	" nemorosa, L		*				*	*
1901.	" undulata, L		*	*				
1902.	" compacta					*		
1903.	" glaucophylla, Tayl				*			
1904.	" æquiloba		*					
1905.	" Bolanderi, Aust	*						
1906.	Frullania Tamarisci, L	*						
1907.	" Hallii	*	*					
1908.	" Oakessii ?		*					
1909.	Ptilidium ciliare, Ehrh		*			*	*	*
1910.	Lepidozia reptans, L		*		*	*	*	*
1911.	Radula complanata, L		*			*	*	*
1912.	Madotheca navicularis, Nees	*	*					
1913.	" lævigata, Schrad	*	*					
1914.	" platyphylloidea, Nees		*					
1915.	" dentata		*					
1916.	" platyphylla, Dumort		*		*	*	*	*
1917.	Mastigobryum ambiguum, Lind		*					
1918.	" Californicum, Aust	*						
1919.	Jungermania connivens, Dicks				*	*	*	*
1920.	" divariacatus, Smith		*				*	
1921.	" barbata, var. Flærkii		*				*	*
1922.	" incisa, Schrad	*	*		*		*	*
1923.	" exsecta, Schmid		*		*	*	*	*
1924.	" ventricosa, Dics	*	*		*	*	*	
1925.	" lycopodiodes, var. Schraderi		*		*	*		
1926.	" sphærocarpa, Hook				*	*		
1927.	" crenulatum, Smith		*					
1928.	" Taylori, Hook		*		*	*		
1929.	" Helleriana, Nees				*		*	
1930.	" Schraderi, Mart		*		*		*	*
1931.	" pulchella		*	*				
1932.	" trichophylla, L		*		*	*	*	
1933.	" Trichomanis, Corda				*		*	
1934.	" Sullivantii, Aust				*		*	
1935.	" scutata, Web				*	*	*	
1936.	" Wilsoni					*		
1937.	" bicuspidata, L		*		*		*	*
1938.	" Michauxii, Weber		*			*	*	
1939.	" cordifolia, Hook		*				*	
1940.	" riparia, Taylor		*					
1941.	" dentatus, Raddi		*					
1942.	" tersum, Nees		*					
1943	Liochlæna lanceolata, Nees		*					
1944.	Arema latifrons					*	*	
1945.	Geocalyx graveolens, Schrad				*	*	*	
1946.	Plagiochila asplenifolia, L		*					
1947.	" porelloides, Lindl			*	*	*	*	*

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
1948.	Plagiochila nodosa, Taylor........				*			
1949.	" ———?..............		*					
	Lichenales. XCVIII.							
1950.	Usnea barbata, Fr..................	*	*	*			*	*
1951.	" " var. hirta..........	*	*	*			*	*
1952.	Evernia jubata, Fr................		*	*	*	*	*	*
1953.	" " Fr., var............		*	*	*		*	*
1954.	" " ———?...........	*						
1955.	" vulpina, Ach.............	*	*	*	*			
1956.	" prunastri, Ach............		*				*	*
1957.	Alectoria Fremontii, Tuck.........	*						
1958.	" ochroleuca, Fr., var. sarmentosa..............		*					*
1959.	Ramalina calicaris, Fr.............		*		*	*	*	*
1960.	" farinacea, Schœr.........		*		*		*	*
1961.	" reticulata, Tuck.........	*						
1962.	Cetraria ciliaris, Ach..............		*		*		*	*
1963.	" " var. platyphylla...		*					
1964.	" Islandica, Ach............		*		*	*	*	*
1965.	" nivalis, Ach..............		*	*				*
1966.	" cucullata, Ach...........		*	*	*			
1967.	" sepincola, Ach...........		*					
1968.	" " var. allophylla..		*					
1969.	" glauca, Ach..............		*					
1970.	" juniperina, Ach..........		*					
1971.	" pinastri, Sommerf........		*				*	
1972.	" Fahlumensis, Ach........	*					*	*
1973.	Nephroma lævigatum, Ach.........		*				*	
1974.	" tomentosum, Hoffm.....		*				*	
1975.	" Helveticum, Ach.......		*				*	*
1976.	Peltigera venosa, Hoffm...........	*	*			*	*	*
1977.	" canina, Hoffm...........		*				*	*
1978.	" polydactyla, Hoff., var. scutata...............		*				*	*
1979.	" rufescens, Hoffm.........	*	*				*	*
1980.	" apthosa, Hoffm..........	*	*				*	*
1981.	Solorina saccata, Ach.............		*				*	*
1982.	Sticta pulmonaria, Ach...........	*	*		*	*	*	*
1983.	" scrobiculata, Ach...........		*				*	*
1984.	" fuliginosa, Ach.............		*					
1985.	Parmelia saxatilis, Ach............	*	*		*	*	*	*
1986.	" " var. omphalodes, Fr..		*				*	*
1987.	" physodes, Ach...........		*				*	*
1988.	" " var. enteromorpha...		*				*	*
1989.	" conspersa, Ach..........		*				*	*
1990.	" olivacea, Ach............		*				*	*
1991.	" " var. sorediata....		*				*	*
1992.	" ambigua, Ach...........		*					
1993.	" elegans, Ach............		*				*	*
1994.	Physcia pulverulenta.............		*				*	*
1995.	" stellaris, Wahl...........		*				*	*
1996.	" " var. hispida Fr...		*				*	*
1997.	" obscura, Fr..............		*				*	*

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
1998.	Pannaria lepidiota, Fr	*	*					
1999.	Collema plicatile, Ach	*	*					
2000.	" multipartitum, Sm		*					
2001.	" pulposum, Ach	*	*					
2002.	Leptogium palmatum, Ach	*	*					
2003.	" lacerum, Fr		*				*	*
2004.	" myochroun, Erh	*	*					
2005.	Placodium cervina, Sommerf	*	*				*	*
2006.	" Jugermanniæ, Vahl		*					
2007.	" sinapispermum, D C		*					
2008.	" ferrugineum		*					
2009.	Lecanora pallescens, Fr		*				*	*
2010.	" subfusca, Fr		*				*	*
2011.	" " var. discolor Fr.		*					*
2012.	" gelida, Ach		*					
2113.	" rubra, Ach		*				*	*
2014.	" athrocarpa, Duby		*					
2015.	" rufa-nigra		*					
2016.	Rinodia minarœa, Ach		*					
2017.	Pertusaria rhodocarpa, Koerb		*					
2018.	Stereocaulon tomentosum, Fr		*				*	*
2019.	" denudatum, Flœrk		*				*	*
2020.	Pilophorus acicularis, Ach	*						
2021.	Cladonia furcata, Flœrk var. racemosa		*					
2022.	" rangerifina, Hoffm		*				*	*
2023.	" " Hoffm., var. sylvatica		*				*	*
2024.	" rangerifina var. alpestris,							
2025.	Flœrk		*				*	*
2026.	" cenotea, Scher		*					
2027.	" Botrytis, Hoffm		*					
	" bellidiflora, Schœr		*					
2028.	" cornuta, Fr		*				*	*
2029.	" cornucopioides, Fr		*				*	*
2030.	" squamosa, Hoffm		*				*	*
2031.	" straminæ ?		*					
2032.	" pycidata, Fr		*				*	*
2033.	" gracilis, Fr		*				*	*
2034.	" gracilis, var. hybrida, Fr		*				*	*
2035.	" furcata var. crispata, Fl		*				*	*
2036.	" furcata var. subulata, Flœrk		*				*	*
2037.	" ——— ?		*					
2038.	" amaurocrœa, Fr		*				*	*
2039.	Bæomyces æriginosus, Scop		*				*	*
2040.	Biatora rufo-nigra, Tuck		*				*	*
2041.	" decipiens, Ehrh		*					
2042.	" russula, Ach		*					
2043.	" cinnabrina, Sommerf		*					
2044.	" artyta, Ach		*					
2045.	" sphæroides, Nyl		*					
2046.	" globulosa	*	*					
2047.	Lecidea ——— ?		*					
2048.	Buellia, geographica		*		*		*	*
2049.	" parasema, Ach		*				*	*

Nos.		I.	II.	III.	IV.	V.	VI.	VII.
2050.	Hylographa parallcla, Ach.........		*					
2051.	Coniocybe furfuracea Ach		*					
2052.	Pyrenula ——— ?		*					
2053.	Sphærophorus globiferis, D C......		*					
2054.	Umbellicaria erosa, Hoffm ?........	*	*					*
2055.	Endocarpon miniatum, Ach	*					*	*

The following is a Synopsis of the Total Distribution, with the Number of Species and Genera of each Order:—

No.	Orders.	Total Genera.	Total Species.	Vancouver Island.	British Columbia. West of Rocky Mountains.	Rocky Mountains.	Peace & Athabasca River Districts.	Saskatchewan Country.	Ontario.	Eastern Provinces.
	Dicotyledones.									
1.	Ranunculaceæ	14	68	19	29	27	24	37	29	26
2.	Menispermaceæ	1	1	....	....	....	....	1	1	1
3.	Berberidaceæ	3	4	4	4	1	....	....	....	....
4.	Nymphæaceæ	3	5	....	1	....	1	4	4	4
5.	Sarraceniaceæ	1	1	....	....	....	1	1	1	1
6.	Fumariaceæ	2	5	2	4	2	2	2	2	2
7.	Papaveraceæ	3	3	2	2	....	....	1	1	1
8.	Cruciferæ	17	51	23	27	13	17	23	20	16
9.	Capparidaceæ	2	3	1	1	....	....	3	....	....
10.	Violaceæ	1	14	6	10	3	5	7	7	5
11.	Cistaceæ	2	2	....	....	....	1	2	2	1
12.	Droseraceæ	1	2	....	....	1	1	2	2	1
13.	Hypericaceæ	2	2	1	1	1	....	1	1	1
14.	Caryophyllaceæ	9	40	18	22	20	12	12	11	16
15.	Portulacaceæ	4	12	10	7	....	....	....	1	1
16.	Malvaceæ	3	3	1	1	....	....	2	....	....
17.	Tiliaceæ	1	1	....	....	....	....	1	1	1
18.	Linaceæ	1	2	....	1	1	1	2	1	....
19.	Geraniaceæ	5	11	5	3	4	3	7	5	4
20.	Anacardiaceæ	1	4	....	1	....	....	3	3	1
21.	Vitaceæ	2	2	....	....	....	....	2	2	2
22.	Rhamnaceæ	3	5	1	3	3	....	4	4	3
23.	Sapindaceæ	2	6	2	3	1	....	3	3	2
24.	Polygalaceæ	1	4	....	....	....	....	4	4	2
25.	Leguminosæ	17	81	27	31	27	23	43	18	19
26.	Rosaceæ	16	76	22	41	33	32	47	29	32
27.	Saxifragaceæ	11	48	15	26	28	11	11	10	14
28.	Crassulaceæ	1	3	2	1	2	....	....	....	1
29.	Haloragaæ	2	3	2	2	2	2	2	2	2
30.	Onagraceæ	5	26	6	9	7	8	16	9	9
31.	Loasaceæ	1	2	1	1	....	....	1	....	....
32.	Cactaceæ	2	4	1	2	....	1	3	....	....
33.	Cucurbitaceæ	1	1	....	....	....	....	1	1	1
34.	Umbelliferæ	16	26	11	12	3	7	15	11	10
35.	Araliaceæ	3	4	1	2	1	1	2	2	2
36.	Cornaceæ	1	7	3	4	2	3	4	4	4
37.	Caprifoliaceæ	4	19	8	8	6	11	16	16	12

No.	Orders.	Total Genera.	Total Species.	Vancouver Island	British Columbia. West of Rocky Mountains	Rocky Mountains.	Peace & Athabasca River Districts.	Saskatchewan Country.	Ontario.	Eastern Provinces.
38.	Rubiaceæ	2	6	3	2	2	3	5	5	3
39.	Valerianaceæ	2	3	2	3	1	1	1	1	1
40.	Compositæ	62	204	24	59	52	93	130	71	44
41.	Lobeliaceæ	1	5	....	....	....	1	5	5	4
42.	Campanulaceæ	2	4	1	....	2	2	2	3	2
43.	Ericaceæ	18	44	14	28	28	18	21	23	22
44.	Plantaginaceæ	1	6	4	1	....	1	4	2	4
45.	Plumbaginaceæ	1	1	1	1	....	....	....	....	1
46.	Primulaceæ	6	14	5	5	2	7	10	6	7
47.	Lentibulaceæ	2	4	....	1	4	2	3	3	2
48.	Orobanchaceæ	2	3	3	3	....	....	3	1	....
49.	Scrophulariaceæ	15	49	23	22	16	13	26	18	15
50.	Verbenaceæ	1	2	....	1	....	....	2	2	2
51.	Labiatæ	14	22	7	14	2	7	17	17	16
52.	Boraginaceæ	8	21	4	9	6	4	15	9	5
53.	Hydrophyllaceæ	3	7	2	3	....	1	2	1	....
54.	Polemoniaceæ	4	9	2	5	2	2	5	1	1
55.	Convolvolaceæ	2	5	1	....	....	....	4	3	2
56.	Solanaceæ	2	4	....	....	....	....	4	2	1
57.	Gentianaceæ	4	12	1	3	9	8	9	6	7
58.	Apocynaceæ	1	2	1	2	2	2	2	2	2
59.	Asclepiadaceæ	2	7	1	1	....	1	6	4	1
60.	Oleaceæ	1	2	....	....	....	....	2	1	1
61.	Aristolochiaceæ	1	2	....	1	....	....	1	1	1
62.	Nyctaginaceæ	2	4	1	....	....	....	3	....	....
63.	Chenopodiaceæ	11	17	2	2	....	7	17	6	6
64.	Amarantaceæ	1	2	....	1	....	....	2	2	2
65.	Polygonaceæ	4	28	9	9	6	10	22	19	14
66.	Elæagnaceæ	2	3	....	2	2	2	3	1	1
67.	Santalaceæ	1	3	....	2	2	2	2	2	2
68.	Loranthaceæ	1	2	....	1	....	1	1	....	....
69.	Ceratophyllaceæ	1	1	....	....	....	1	1	1	1
70.	Callitrichaceæ	1	2	2	2	....	2	2	2	2
71.	Euphorbiaceæ	2	3	....	2	....	1	2	2	....
72.	Empetraceæ	1	1	....	1	1	1	1	1	1
73.	Urticaceæ	6	6	1	1	1	1	5	6	4
74.	Cupuliferæ	2	6	2	2	....	2	4	3	3
75.	Betulaceæ	2	10	2	4	7	7	7	5	6
76.	Myricaceæ	2	2	....	....	....	1	2	2	2
77.	Salicaceæ	2	36	5	21	17	21	22	15	13
78.	Coniferæ	7	27	9	19	11	10	10	11	10
	Monocotyledones.									
79.	Araceæ	4	4	1	1	....	2	3	3	3
80.	Lemnaceæ	1	4	....	2	....	3	3	3	3
81.	Typhaceæ	2	5	1	2	2	5	4	5	5
82.	Naiadaceæ	3	11	3	8	4	10	7	10	9

No.	Orders.	Total Genera.	Total Species.	Vancouver Island.	British Columbia, West of Rocky Mountains.	Rocky Mountains.	Peace & Athabasca River Districts.	Saskatchewan Country.	Ontario.	Eastern Provinces.
83.	Alismaceæ	4	5	3	4	2	5	4	5	5
84.	Hydrocharidaceæ	1	1	....	1	....	....	1	1	1
85.	Orchidaceæ	10	29	7	19	9	14	17	26	19
86.	Amaryllidaceæ	1	1	....	....	....	....	1	1	....
87.	Iridaceæ	2	4	2	3	1	1	2	2	2
88.	Smilaceæ	1	1	....	....	....	....	1	1	1
89.	Liliaceæ	19	39	20	32	12	11	21	18	15
90.	Juncaceæ	2	27	7	17	11	14	19	14	11
91.	Cyperaceæ	6	145	19	69	61	64	100	91	86
92.	Gramineæ	45	138	37	65	22	36	84	63	40
	Acrogenes.									
93.	Equisetaceæ	1	11	2	10	6	7	8	8	6
94.	Filices	19	40	9	20	16	15	22	32	27
95.	Lycopodiaceæ	3	10	1	2	4	3	7	9	6
	Anophytes.									
96.	Musci	67	319	105	197	89	141	99	146	95
97.	Hepaticæ	22	70	10	46	7	23	24	31	17
	SUMMARY.									
	Dicotyledones	369	1135	369	591	363	412	670	472	408
	Monocotyledones	101	401	97	233	124	165	267	243	200
	Acrogenes	23	61	12	32	26	25	37	49	39
	Anophytes	89	389	115	243	96	164	123	177	122
	Lichenales	32	116	22	100	7	11	6	58	59
	Total	614	2102	615	1199	616	777	1103	999	828

The distribution of the Anophytes and Lichenales is very far from being correct, as I had no means of comparing lists, scarcely anything having been done in these orders of late years.

The plants collected will be numbered on the basis of the above catalogues, so that in future collections reference may be made to it as a standard, until a more complete catalogue can be published.

REPORT

ON

EXPLORATIONS IN BRITISH COLUMBIA,

BY

GEORGE M. DAWSON, Assoc. R.S.M., F.G.S.

ADDRESSED TO

ALFRED R. C. SELWYN, Esq., F.R.S., F.G.S.,

DIRECTOR OF THE GEOLOGICAL SURVEY OF CANADA.

Sir,—I beg leave to present herewith a report, giving in brief the results of my exploration in British Columbia during the past season. Circumstances prevented me from leaving Montreal till the 19th of July. On August 4th I reached Victoria, and on the 13th, left for the interior of the Province, in conformity with your instructions, desiring me to examine the country in the vicinity of the line adopted for location by the engineers of the Canadian Pacific Railway Survey. On October 30th I returned to Victoria, and have since been occupied in reviewing the work of the season, and in completing a collection of the products of the Province for the forthcoming Exhibition at Philadelphia, A beginning has also been made in the detailed examination of the metamorphic rocks immediately surrounding Victoria. The results promise to be interesting, but are not yet sufficiently advanced to warrant any report.

I have to thank the gentlemen connected with the Railway Survey, and especially, Mr. Marcus Smith, Mr. J. Robson, Messrs Cambie, Jennings and Bell, and Mr. Glassey, for assistance and ready co-operation, without which it would have been impossible, at the late season at which field work commenced, to have gone over so great an extent of country as has been traversed. Acknowledgments.

Route pursued.

The route pursued from Victoria to Soda Creek, on the Fraser River, in latitude 52° 30′, is identical with that which you have yourself followed on several occasions, and over part of which Mr. Richardson has made careful measurements. My observations along the road were of a cursory nature, and I shall not attempt to add to what has already been written on this region. At Soda Creek, three pack-horses, two riding horses and the necessary equipments were procured, through the efforts of Mr. Glassey, and on the morning of August 23rd the Fraser River was crossed, and a departure made for the Chilcotin, my party consisting, besides myself, of F. C. Reeves and two Lillooet Indians. From Soda Creek, the trail up the Chilcotin River was followed to the crossing place, thence to the intersection of the railway location-line and the Chilanco, and thence south-westwards, following that line, to Tatlayoco Lake. From this place, after spending a few days in an examination of the rocks, a route by way of Peterson and Tatla Lakes was taken, returning to the crossing of the Chilanco, and thence following the location line northwards, by way of Chizicut and Puntzee Lakes and the Nazco River, to the Blackwater River where crossed by the old Telegraph Trail. Thence by a route parallel to the location line on the Chilacco River, but a short distance east of it to Fort George, at the great bend of the Fraser River; and from that place, in company with yourself, to Quesnel Mouth, arriving there on the 20th October, the whole distance travelled over from Soda Creek, being about 420 miles.

The geological examination of the district was necessarily of the nature of a reconnoissance. Exposures are, over considerable areas of unfrequent occurence; and the surface of the country is generally densely wooded, confining exploration to the immediate vicinity of the trail. It is, therefore, only intended to give the facts observed as succinctly as may be, without instituting comparisons with other localities, or attempting to draw general conclusions.

Character of the Country and General Description of Route.

Region examined.

The region examined lies between the Fraser River and the Cascade range, the 52nd and 54th parallels of latitude; and except where the Cascade Mountains are touched on, is a part of the geographical valley of the Fraser. It belongs in the main to the basaltic, or volcanic plateau of the interior, though in many places older rocks stand out above the general level of the igneous material, and in some instances appear in the valleys of the rivers, where it has been removed by erosion.

Opposite Soda Creek a very steep ascent is made, to the summit of the terrace or bench, which here immediately overlooks the river, and rises to a height of about 340 feet above it; or, taking the elevation of Soda Creek at 1,690 feet, 2,030 feet above the sea. In following the trail, southward towards Riske's Creek, which flows into the Fraser a short distance above the Chilcotin, the route lies for the most part along the same high terrace; which for about twenty miles, or to Meldrum's farm, is quite narrow. To the west the view is bounded by a range of rocky hills and cliffs, which in some places closely approach the river. No water was found along this part of the trail, though it is constantly necessary to cross little ravines which notch the front of the terrace; the drainage during the dry season appearing to be entirely subterranean, through the porous drift-material. From Meldrum's to Riske's, the appearance of the country is much improved, the more or less rolling surface of the terrace spreads into a wide plateau, and belts of timber alternate with large patches of open prairie covered with luxuriant grass, giving a park-like aspect to the scenery. The average altitude is probably about 3,200 feet (1,500 feet above Fraser River.) The trees forming the woods, which are usually open, are,—Douglas fir, (*Abies Douglasii*,) of medium size, and scrub pine, (*Pinus contorta.*) Aspen poplar, various willows, roses, and *Shepherdia Canadensis*, form the undergrowth. Solidagos and asters of several species abound, also a *Castilleia*, (probably *C. pallida*,) *Spiræa betulifolia*, at this date nearly past flowering, *Gentiana amarella*, *Galium boreale* past flowering, and a delicate species of *Astragalus*. In the meadows, in addition, appear *Geranium Fremontii*, *Heuchera Richardsoni ?* and in some places *Geum triflorum*. The flora shows in many points a marked resemblance to that of the fertile region along the eastern slope of the Rocky Mountains, in the vicinity of the forty-ninth parallel, at a height of 4,000 feet; and the vegetation appeared to be at about the same stage at a similar date in the two localities, comparing together the years 1874 and 1875.

Soda Creek to Meldrum's.

Meldrum's to Riske's Creek.

Flora.

A rapid descent is made from the plateau to the lower bench, on which Riske's farm is situated. Its elevation is about 2,400 feet, but fine crops are produced with irrigation. These lower terraces and valleys appear to be not only warmer, but drier than the plateau above, and the vegetation changes considerably. *Artemisia frigida* and *A. Canadensis* become abundant, and *Lynosyris*, and here and there a stunted *Cactus* appear.

From Riske's Creek, the trail passes south-westward across the plateau to the northern bank of the Chilcotin Valley. The surface of the

Riske's Creek.

Bunch-grass plains of the Chilcotin.

country is generally open-prairie and is clothed with bunch-grass, forming a fine grazing and stock-raising region, for which purpose it is already partly occupied. At about nine miles from Riske's the highest part of the plateau is reached, and from thence it slopes slightly toward the Chilcotin, affording a magnificent view south-westward. Beyond the deep Chilcotin Valley, and rising gently in receding from it, the same plain is seen to stretch for many miles, diversified with prairie and woodland. Then a bounding range of low hills, with gentle slopes wooded to the summits appear, beyond which the snow-clad peaks of the Cascade or Coast Mountains are seen at a great distance.

River valley of the Chilcotin.

About seven miles beyond the point at which the trail first reaches the Chilcotin Valley, it leaves the plateau and goes down into the valley bottom, which it then follows. Opposite the place of descent is a conspicuous mountain, apparently in great part composed of limestone, which forms the southern side of the valley, and rises to a considerable height above the general level of the plain. From this place to the junction with the Chilcotin of Alexis' Creek—fifteen miles—the valley has a pleasing appearance, being wide, and though in some places hummocky, with much level land, forming broad terraces at a small height above the river. These are generally prairie-like and covered with bunch-grass. The vegetation of the lower levels of the valley, as a whole, resembles that of Riske's Creek, above mentioned. At Alexis' Creek, are a few Indian houses, and farming on a very limited scale is attempted. On the night of August 25th a sharp frost was experienced, and on the 27th the tops of potatoes in the Indians' gardens were observed to be killed down. The area of cultivable land in this part of the Chilcotin valley may be about 7,000 acres. The plateau above the river is here generally densely wooded, and the rim of the valley from a short distance above Alexis' Creek, probably to its junction with the Fraser, is very definitely formed, by almost continuous cliffs of basalt.

Alexis' Creek.

A mile and a-half west of Alexis' Creek, the valley becomes narrowed, and almost gorge-like, a prominent hill, which may be called Battle Mountain, from an Indian legend associated with it, projecting from the northern bank. Immediately west of this hill, high cliffs of columnar basalt front on the river; they are extremely rugged, and some of their softer layers are worn into caves, at a great height above the trail. Beyond these, the valley again opens out, though not to so great a width as before, and about four miles west of Battle Mountain the Chilco River from the south-west, joins the Chilcotin in a pretty extensive flat—a fine view of the Cascade Mountains being obtained through the gap formed

Battle Mountain.

Confluence of the Chilco and Chilcotin.

Photo. Lith. by the Burland Desbarats Co. Montreal.

CHILCOTIN VALLEY AND PLATEAU, LOOKING SOUTH-WEST—CASCADE MOUNTAINS IN THE DISTANCE.

by its valley in the plateau. The Chilco is a rapid stream, several times the volume of that which continues to bear the name Chilcotin, and is filled with turbid milky water, no doubt issuing from glacier streams in the mountains. The Chilcotin, above this point is clear, with brownish water, derived from swamps and lakes.

The Chilcotin valley, from the junction of the Chilco to the mouth of the Chilanco—ten miles—is not attractive. Though still wide, there is little meadow-land, the greater part of the flat being occupied with swamps, bearing willow and alder bushes. The plateau above is thickly wooded. At the junction with the Chilanco, the trail crosses the Chilcotin, and after passing through a meadow of quite limited size, but with grass in some places three feet high and abundance of vetches, continues for fourteen miles to follow the north bank of the first named river at a greater or less distance, when it joins the located line of the Canadian Pacific Railway. The Chilanco is at first a rapid brook, but becomes smaller, and soon shows long reedy pools, connected by short stretches only of running water. The country passed over is useless for agriculture, and with very small patches of grazing land. It is chiefly covered with a light growth of *Pinus contorta*, the soil being sandy and gravelly. About four miles east of the crossing of the Chilanco by the railway line, the last low cliff of basalt is seen, and at the same time boulders of this rock become rare, and the general aspect of the country changes, its surface ceasing to be a nearly uniform plateau, and becoming diversified with rolling hills.

Chilcotin valley to mouth of Chilanco.

Country near Chilanco River.

From this point, a nearly level area of triangular form stretches west south-westward, the acute apex of the triangle touching the Chilanco River, while its base reaches the flanking range of the Cascade Mountains, and its northern and southern sides are more or less perfectly defined by low hills, rising above the general level. This wide valley contains two nearly parallel depressions, the northern of which is the deeper, and is occupied by Tatla Lake, eighteen miles in length, and Long Lake; the southern is not so uniform in character, but holds Eagle, Buckhorn, Loon and LeBlanc Lakes, from west to east. The drainage of the whole valley converges eastward, and enters the Chilanco by the Tatla Lake Stream. The location-line runs by the southern tier of lakes, and following it westward, for the first few miles, the surface of the country is very gently undulating, with coarse sandy soil, supporting *Pinus contorta*, which seldom attains eighteen inches in diameter. On approaching LeBlanc Lake, the country becomes rather hilly, and continues to have a similar appearance to the eastern end of Loon Lake.

Flat area including Tatla and Eagle Lakes, &c.

Southern tier of lakes.

Moraine mounds.

No rock in place is seen, and the arrangement of the drift material is evidently that of little modified moraines. The nearest point of the flanking range of the Cascades, is about twenty-four miles distant. Loon Lake, a mile and a-quarter long, has abruptly sloping banks of drift material, not distinctly terraced, but irregularly moundy. Its western end has been filled with detritus, and forms a marshy flat. From this place to the east end of Eagle Lake, the surface bears a similar growth of scrub pine, and has the same moraine-like character, which between Buckhorn and Eagle Lakes, however, becomes much more distinct. Loon Lake drains eastward, while Eagle Lake discharges northwestward into Tatla Lake, and in the intermediate region lie the Buckhorn Lakes or ponds, These have no apparent outlets, but occupy basins and hollows enclosed in a very remarkable manner by steep, irregular and perfectly preserved moraine mounds and ridges, many of them transverse to the general direction of the valley. The division between Loon and Eagle Lakes may probably be entirely due to this heaped up material. For about a mile before reaching Eagle Lake, the trail winds among scattered rock masses lying in all positions, and some of them equalling small cottages in size. They are derived from the two rocky hills between which the eastern end of the lake lies, and of which the southern is a spur of the low range before mentioned as bounding the valley to the south. The banks of Eagle Lake are high, especially on the southern side, and the slopes, though apparently composed of drift material only, rugged and tree clad. Between the west end of Eagle Lake, and Cochin Lake, six miles south westward, the watershed separating the tributaries of the Fraser from those of the East Homathco, is passed over. The valley becomes quite narrow in one place from the encroachment on it of rocky hills, but without attention it would hardly be known that so important a feature in the general hydrography of the country existed there. Whitewater Lake occupies a depression near the summit, is surrounded by drift material, and has no outlet. It is lower than either Cochin or Eagle Lake.

Watershed between Fraser and East Homathco Rivers.

Tatla Lake.

Tatla Lake, lying north of the line just described, is long and river-like, being seldom more than a mile in width though eighteen miles in length. It is enclosed between rather steep banks of drift-material eighty or one hundred feet high, and above the abrupt ascent the country on both sides slopes up very gradually as it recedes from the lake. The drift is apparently not of the nature of moraine matter, or has been subsequently modified by water. The north side of the lake is open and well covered with bunch-grass, forming a good grazing region; the south bank is generally wooded. The plateau above is also timbered, chiefly with the scrub pine, and on leaving the immediate valley of the lake the soil is invariably found to be sandy and barren. The lake is narrowest and most closely hemmed in by its banks, at its eastern end, and for about five miles is quite shallow. The remainder of the lake is deep, and its western end has been partly filled in, forming an alluvial, though swampy flat several miles in length. The brook which runs through this flat probably has its source in Peterson Lake, a small sheet of water about four miles west of Tatla Lake. Beyond Peterson Lake a rather extensive area of flat land, with good grass in some places, stretches westward, and in a few miles the sources of the West Homathco are reached; the height of land between these waters, which flow to the Pacific directly through the Cascade Mountains, and those tributary to the Fraser River, being, as before, inconspicuous, but characterized by drift-material and moraine mounds. The whole region from the crossing of the Chilanco to the eastern base of the mountains, shows little land which may be of value for agriculture, and no great areas even fitted for stock raising.

Peterson Lake.

Watershed region.

Returning to Cochin Lake, the source of the east branch of the Homathco, the trail and located line follow the valley of the stream, along which there is a little good grazing land, south-westward for nine miles; when the northern end of Tatlayoco Lake is reached, and at the same time, the eastern base of the first range of the Cascade Mountains. The lake has a general direction of S., 10° W., and with an average width of about a mile, stretches fourteen miles into the mountains. The elevation of the lake is 2,747 feet; its waters are clear, and apparently very deep. The mountains on the west side rise steeply from the waters edge, and tower to a great height, with broken summits. The eastern side however, is less abrupt, though attaining, at a distance of one to two and-a-half miles from the lake, a height of about 2,000 feet. The mountains here are composed of stratified and fossiliferous rocks, and are not serried and rugged like those of the opposite shore, but more resemble a gigantic escarpment. They show well marked, though narrow terraces at several different levels, the highest being probably about 1,500 feet above the lake, or 4,250 above the sea.

Cochin Lake to Tatlayoco Lake.

Tatlayoco Lake.

High terraces.

The Douglas fir is the most abundant timber of the valley of Tatlayoco Lake, but does not attain a great size. In one place, the high-bush cranberry (*Viburnum pauciflorum*) was found in abundance. Bunch-grass finds its western limit at the northern end of the lake. Near the western end of Tatla Lake cactus of very stunted growth was seen to

Flora.

occur sparingly. *Elæagnus argentea* was observed forming thickets near Cochin Lake.

Chilanco crossing to Puntzee Lake.

Returning again to the Chilanco crossing, and following the location line northward for four miles, Puntzee Lake is reached. It is wide at its southern end, but tapers rapidly north-westward, and is surrounded by sloping land, which, at a variable distance from the lake, rises rather suddenly to the general level of the country. The soil of the upper levels is in general light and sandy, though occasionally clayey, and almost always supports a growth of scrub-pine. Some pretty, sloping bunch-grass meadows, however, stretch along the shores of the northern part of the lake, but are quite limited in size. The valley in which Puntzee Lake lies, is seen to be continuous south-eastward to that of the Chilanco, and beyond; the Cascade Mountains lying between the two branches of the Homathco—forty miles distant—being visible from its northern end. The water, whatever its former course may have been, now flows north-westward through Puntzee Lake to the upper part of the Chilcotin River. Near the northern end of the lake are some remarkable ridges and mounds, for which it is difficult to account, unless it be supposed that the Cascade Mountain glaciers stretched even this far at one period.

Puntzee Lake to Chilcotin crossing.

Eight miles north of Puntzee Lake, the Chilcotin River is crossed, near its source in Chizicut Lake. The intervening country is of the character usually met with above the more fertile benches and bottoms immediately surrounding rivers and lakes; being slightly undulating, sandy and stony, and covered with an open growth of *Pinus contorta*. Near Chizicut Lake the Chilcotin valley, now quite shallow, is of rather pleasing appearance, with some fine meadows. A few Indians were found camped here, busily drying trout and a small species of white-fish for winter use. After crossing the stream, some fertile and pretty extensive meadows, with occasional grassy swamps, are found in the vicinity of the Clinch-in-tam-pan stream, but several miles before reaching Temapho Lake the country again becomes undulating and hilly, and is covered with a tangled growth of woods. The form of the surface is, no doubt, due to the arrangement of the drift-material, as no rock in place is seen, though the ground is stony and boulder-strewn. Near Temapho Lake is a pond or small lake without outlet, the waters of which are unpleasantly saline.

Watershed between Chilcotin and Nazco Rivers.

Leaving Temapho Lake, which drains into the Chilcotin, in three miles the summit between that river and the Nazco is reached, at an elevation, according to the railway survey of 3,680 feet. It is marked by an extremely perfect display of terminal and lateral moraines, probably of local origin, though there are no hills of great height in the neighbourhood. Tongues of ice from the south-east and north-west have at one period nearly met in this vicinity, and have piled up between them a mass of transported rubbish which now forms the watershed. In their retreat, each has left a tier of more or less complete crescentic mounds, concave in the direction from which the glacier has come, and with the intervening hollows now occupied by swamps and ponds. Eight miles north-westward from the watershed, is a chain of lakes forming the upper part of the Nazco, but before reaching these about a mile-and-a-half of very rugged country is passed over, being a moraine composed of large boulders and masses of basalt, thrown together in the utmost confusion. This appears to have been formed by the retiring glacier when it became low enough to receive the debris of the crumbling basaltic cliffs of the river valley. Moraines.

From Temapho Lake to this point, and three miles beyond to Tzazate Mountain, in latitude 52° 30′, the country is quite unfit for pastoral or agricultural occupation, as it is not only rugged, but covered with dense forest or tangled windfall and *brulé*. Tzazate Mountain. Poor country.

South of Tzazate Mountain, the Nazco River is represented by a long succession of reedy pools and narrow lakes, with constrictions separating them, in which flowing water is found. Beyond Tzazate Mountain the river takes a north-eastward course for about nine miles, to the point of entrance of Tautree Creek. For about five miles the river valley is not in any place more than about a mile in width from rim to rim, and is much encumbered by lateral moraines, composed of great masses of basalt derived from the low cliffs, which, in a ruinous condition, more or less continuously bound it. These moraines are often plastered up against the sides of the valley, but sometimes form long roof-like ridges, separated from the banks by narrow crevices, strewn with angular blocks and thickly wooded. Four miles below Tzazate Mountain, the Nazco Fall, which, according to railway levelling, is forty feet in height, occurs; and below this, the river flows with a sluggish current for about half a mile in a deep cañon with perpendicular walls of basalt. From the cañon to the mouth of Tautree Creek, the basaltic sides of the valley are very much broken, and their debris, probably in some places partly owing its arrangement to glacier action, strews the slopes, and gives the river an extremely desolate and gloomy appearance. The river valley is evidently the work of a much larger stream than that now flowing in it, or has at one time had a more rapid fall, as it is not now deepening its Nazco River from Tzazate Mountain to Tautree Creek.

bed, but rather tending to fill it in, in this upper part of its course. The plateau above, wherever observed, is rough, stony, and thickly covered with scrub pine in various stages of growth and decay.

Nazeo from Tautree Creek to Clisbaco River.

Tautree Creek joins the Nazco from the east. Here the basalt is replaced by sandstone and conglomerate rocks, and from this point to the mouth of the Clisbaco—joining it from the south-west twenty miles northward—it does not present the same rocky and forbidding character. Its banks slope more gently, and show comparatively little bare rock, and are often grassed, and but lightly clad with timber and brush. Some small glades and meadows with fine grass occur along the sides of the stream; but most of them seem to be subject to overflow in the spring. The aspen poplar forms thickets in many places. At Cinderella Mountain, however, there is a remarkable exception, the valley being for a short distance much narrowed by cliffs, composed of both conglomerate and igneous rocks. There is here a more than usually fine display of moraine mounds and ridges, which, though not in so rough a form as before, still continue to characterize it. Some of the ridges occupy the middle of the valley, and are parallel with its direction, and generally somewhat rounded or flat-topped in transverse section, while, longitudinally, they may either run some distance with a nearly level summit, and fall rapidly at the ends, or may slope away gently in both directions, forming 'hog backs.' Some of these may be based on solid rock, but it seldom or never appears. Others are pressed against the sides of the valley, and from a sharp ridge-like top slope steeply both towards its centre and the bank. It may be difficult in all cases to prove that these last are not the result of extensive slips of the hillside; but some of them are certainly not of this character.

Moraine mounds.

From Clisbaco River to junction with the Blackwater.

The Clisbaco almost equals the Nazco in size, but when followed upward, rapidly gains a considerable elevation, and probably rises from lakes and ponds on the surface of the plateau at no great distance. From this point, the Nazco pursues a northerly course to its junction with the Blackwater, and its valley continues to present an appearance not dissimilar to that last described. While a great part of its area is occupied by ridges and benches of gravel and sand, generally covered with scrub pine, there are now occasionally more extensive meadows with fine grass along the river side. Several small lakes and many depressions and little enclosed valleys lie along, nearly parallel with the river, and between it and the steep banks. Some of these are possibly formed by old lateral moraines, others the result of land-slips. Before reaching the Blackwater, the valley opens out considerably, and the

Photo Lith. by the Burland Desbarats Co. Montreal.

MOUNDS AND RIDGES IN THE NAZCO VALLEY.

(The greater part of the foliage omitted for greater clearness.)

benches are observed to become somewhat more extensive and regular. The Indian trail from Quesnel to Cluscus Lake crosses the Nazco fifteen miles south of the Blackwater. The plateau on the eastern side of the river valley, is here of rather better character than usual, with some meadows and open woods with grass; most of the surface is, however, still covered with *Pinus contorta*, replaced in damp hollows by dense groves of black spruce. A fine view was obtained from a point a few miles west of the Nazco, on the Cluscus Lake trail, from which it would appear that an extensive group of high, and sometimes rugged hills occupies the country west of the Clisbaco, and that part of the Nazco immediately north of it. These hills are, without doubt, composed of older rocks, which project above the general level of the basalt. They are covered from base to summit with dense coniferous forest.

Blackwater from mouth of Nazco to Upper Canon.

The Blackwater, above its junction with the Nazco, carries probably four times the volume of water of the latter stream, but is easily fordable in some places. The united streams form a considerable river, which, turning abruptly from the former course of the Blackwater, runs nearly north for about ten miles. The valley is wide and flat-bottomed, with occasional grassy meadows, but in general well timbered. The western seems, as a rule, to be steeper than the eastern bank, and the stream winds from side to side, and occasionally cuts into both, showing a great thickness of rounded gravel deposits. A deep valley with a string of lakes and ponds follows nearly parallel to the river, a short distance west of it, for some miles, and though now largely filled with drift-material, has the appearance of being a former channel of the river itself.

The blueberry (*Vaccinium* sp.) and white birch, seen rarely if at all since leaving the immediate neighbourhood of the Cascade Mountains, were again met with in some abundance near the mouth of the Nazco.

Blackwater Upper Canon.

Where the Blackwater resumes its westward course, it breaks through a range of high hills, which cross it with a nearly north and south direction. Its valley here becomes narrow and rocky, though seldom precipitous, and has been called the Upper Blackwater Cañon. On approaching the hills from the west the surface becomes more broken, and much angular rock debris derived from them is mingled with the drift. From the eastern slope of the hill, where the Bella Coola trail commences its descent, after having reached an elevation of nearly 1,000 feet above the river,—an extensive, and apparently nearly level plain is seen to stretch eastward. It includes the country lying north of the Blackwater, about the southern sources of the Chilacco, and

Level plain north of the Blackwater.

is bounded only by the mountains beyond the Fraser River, at a distance of twenty miles. Where crossed by the location line its average elevation is 2,660 feet, and it has all the appearance of a region either underlaid by a soft or little disturbed formation, or levelled up with a great thickness of drift. On descending to the plain, the growth of timber is found to improve much, and groves of large Douglas firs frequently occur. The surface is generally undulating, with a sandy or clayey soil, with moist hollows supporting large alders, and might be valuable agriculturally in some places, if not too high. The valley of the Blackwater is now of great size, and depressed at least three hundred feet below the general level of the country. It is usually flat-bottomed, terraced along the sides in some places, and densely wooded, few good meadows appearing. It retains this character to the crossing place of the old Telegraph Trail, a distance of six miles. Below the bridge at the crossing is the Lower Blackwater Cañon, where the river again breaks through older disturbed rocks, and flows for some distance between perpendicular rocky cliffs, more than 100 feet in height. I succeeded in getting from the bridge, eastward, to within about six miles from the junction of the Blackwater with the Fraser. The valley does not again open out, and hard rocks frequently occur near the margin of the river. As seen from the Fraser River, it has the same gorge-like character at its mouth. West of the bridge there is a very fine display of terraces at many different levels, which, near the cañon, successively approach the river and contract the valley.

Blackwater Valley and Lower Canon.

Blackwater Bridge to Fort George.

From Blackwater Bridge to Fort George the direct trail, which crosses the plateau and ridges lying between the Fraser and Chilacco, was taken. The location line follows the Chilacco Valley in a nearly parallel direction at a few miles distance. Twelve miles north of the Blackwater is Pun-chaw Lake, a pretty sheet of water nearly two miles in length, which, according to the Indians, discharges south-eastward into the Blackwater. The intervening country is gently undulating, but becomes hilly toward the lake, and is thickly covered with scrub pine and Douglas fir of medium size. Passing for fourteen miles further northward over a succession of mounds and ridges, probably for the most part composed of drift, a small running stream is reached, which, the Indians say, rises in two large lakes to the north-east, called Chus-wuz, and, after joining two other streams west of the trail, flows westward into the Chilacco. Four miles beyond the brook is a very prominent rocky hill called Tsa-whuz, of which the probable height, by a single aneroid observation, is 3,240 feet, and which rises about 800 feet above the surrounding

Pun-chaw Lake.

Photo. Lith. by the Burland Desbarats Co. Montreal.

LOOKING UP BLACKWATER RIVER FROM NEAR THE BRIDGE.

country. From its summit a very extensive view was obtained. Stretching eastward to the Fraser River is a triangular area of low and nearly flat land, but in all other directions the surface is broken by hillocks and ridges. The whole country is forest-clad, mostly with coniferous trees of small or medium growth, but many limited patches of aspen poplar were very apparent from their bright autumnal tint. Tsa-whuz, though when viewed from the south appearing conical, slopes gently away northward, its longest axis being N. 60° W. (Mag.) in direction. Besides the more prominent ridges, the general surface of the country is lumpy, the longer axes of all the elevations and depressions lying approximately north and south. This is especially apparent in the region immediately south of the mountain, where small ridges run S. 1° E., and are very closely packed, the valleys between them being steep and narrow. These minor elevations also very generally show a 'crag and tail' form, the longer slopes being, like that of the mountain itself, northward. In some cases small surfaces of rock appear, but in general only drift material is seen. View from Tsa-whuz Mountain.

Six miles northward of Tsa-whuz the trail passes about a mile west of a large lake, known to the Indians as Nads-il-nich. Five miles further on the brook flowing from this lake to the Chilacco is crossed, and in eleven miles Fort George, at the confluence of the Fraser and Nechacco Rivers, is reached. After crossing the second of two prominent ridges which lie one on either side of Lake Nads-il-nich, and run nearly north and south, the surface of the country slopes rapidly northward towards a low level horizon. The ridges, which do not here appear to have any very definite direction, are composed of well rounded shingle, and the hollows intervening become larger in proportion, with a clayey soil, and support a dense growth of black spruce, with occasional large birches, balsam poplars and Douglas firs. There is continued evidence of approach to a region with greater rainfall in passing from Blackwater to Fort George. Mosses and various species of *Lycopodium* begin to grow abundantly in the woods, and a few miles before reaching Fort George specimens of *Ledum latifolium* were seen for the first time. Nads-il-nich Lake. Greater rainfall northward.

Surrounding Fort George is an area of probably from 2,000 to 3,000 acres, elevated only about thirty feet above the Fraser River, and bounded to the south and west by the escarpment of the high-level plain above. Such crops as have been tried succeed well. Arable land about Fort George.

Summary of Geological Observations.

Arrangement of observations.

In giving an outline of the geological structure of the country traversed the rocks will be arranged, as far as possible, under the provisional classification adopted by you in the report for 1871-72, p. 54. The region examined, though geologically interesting, presents great difficulties, owing to the tangled and almost inpenetrable character of the forest, by which great areas are covered, and the impossibility of satisfactorily connecting many isolated observations.

Region underlaid by gneiss, diorite, &c.

Cascade Mountain Crystalline Series.—Rocks probably referable to the highly crystalline gneisses, granites and diorites typically developed about Yale, were first met with on the line of this summer's exploration at the east end of Eagle Lake, and probably underlie a broad stretch of country, including the whole of this lake and Tatla Lake, with the exception of a small portion of its eastern end, and also stretch westward, probably to Peterson Lake, and perhaps down the valley of the West Homathco. South of this river they appear to underlie the eastern flanking range of the Cascade Mountains, and to form the floor of the anticlinal valley in which Tatlayoca Lake lies—at least as far as the northern end of the lake. They also, no doubt, occur extensively in the higher mountains of the range at this part of its course.

Exposures on Eagle Lake.

Exposures over this area are, however, few. At the east end of Eagle Lake the rocks are highly crystalline hornblendic, and sometimes gneissic mica-schists, of pale to dark grey colour. They have a somewhat spotted aspect, the mica or hornblende—generally dark in colour—being irregularly mingled with white feldspar. Small veins of white quartz traverse them in all directions, but did not appear to hold any minerals, save occasionally those of the surrounding beds. Rocks very similar occur in the hills west of Eagle Lake, and appear to have there an east-north-east dip. On the north bank of Tatla Lake, eight miles west of the lower end, is an exposure of fine-grained, fissile, yellowish-grey gneiss, with a strike of N. 65° E., nearly on edge, and traversed by granitic and quartz veins. Six miles further west a point projecting from the drift shows a dark, silky gneissic mica-schist fissile, on edge, with a strike nearly north and south, and holding veins of milky quartz. A short distance further west a small island in the lake appears to be composed of similar rocks, with a dip east-north-eastward. These last localities lie in the direction of the continuation of the ridge of a prominent hill south of Tatla Lake, which may be called Pilot Mountain, and is no doubt composed of rocks of the same series. The whole of the

Exposures on Tatla Lake.

localities above mentioned must represent a single formation, though it may be questionable whether the rocks most closely resemble those of the Cascade series as ordinarily developed, or the older granites, gneisses and mica-schists of No. VII. of the classification above referred to.

In a ravine west of Whitewater Lake, seen from a distance, and which cuts the eastern front of the flanking range, a considerable thickness of whitish and light-coloured rocks, probably belonging to this series, are followed in ascending order by red beds, and then by a great mass of dark rocks, the whole having a high westerly dip. Other localities.

Three miles from the north end of Tatlayoco Lake, on the east side of the valley, a mass of pale and very compact syenite or diorite appears from below the Porphyrite series, which seems to rest on it unconformably. A similar rock is seen forming the lower part of the mountains on the opposite side of the valley, and apparently there also underlying the Porphyrites.

Lower Cache Creek Group.—Rocks, probably of this group, are those which most usually form hills above the general level of the basaltic plateau, and appear to have, as a rule, a strike a few degrees west of north. They were first met with near Soda Creek, where they form, on the west side of the Fraser, for some miles southward, a rocky ridge, which bounds the terraces immediately overlooking the river. Seven miles south of Soda Creek greyish-blue compact limestone is first met with, and continues for nearly two miles. The beds are inconstant in attitude, but in the main appear to be not far from horizontal, and are succeeded by cliffs of greyish, finely laminated quartzite of rather cherty appearance, and with faces lustrous from the development of a small quantity of some talcose mineral. They are in places decomposed to some depth, like the rocks of the Lower Cache Creek group in their typical localities, and from their dip may overlie the limestone. On Riske's Creek, a short distance above his farm, cliffs again show similar slaty rocks, unconformably overlaid by red trap or basalt, with a gentle dip westward. Eight miles south-west from Riske's a rather prominent hill rises above the plateau. Its summit is rocky, and from its colour and the massive character of the beds, it is probably composed of limestone. Ten miles further west the mountain on the south bank of the Chilcotin, already referred to, is also formed in great part of limestone, which, in some places at least, is grey, fine-grained, and almost resembles a marble. It has a general dip of west-south-west. In the direction of its strike, southwards, there are some low hills, and another elevation seen to the north-west, beyond the north bank of the river valley, may

Rocks near Soda Creek.

Rocks on Riske's Creek.

Limestone hills.

probably also be on the continuation of the same outcrop. It further seems not improbable that Alexis Mountain and other hills rising above the level of the basaltic plain, north and south of the western sources of the Nazco—and about thirty miles north-westward from this place—may represent a northern extension of the same fold of the Cache Creek series; which may again appear, fourteen miles still further north-westward, in the low hills between the Nazco and Clusco Rivers.

Mount Palmer

Mount Palmer, on the north side of Puntzee Lake, is also probably composed of rocks of this series. As seen near the lake, they are hard shales or slates, with compact fine-grained quartzite, and massive, slightly calcareous rocks coloured with epidote. Some of the quartzites are sub-translucent and cherty, and all the beds are much shattered and iron-stained. Dip N. 42° W., $<$ 52°. The direction is abnormal. The area between the western edge of the basalt and the east end of Tatla Lake, affording no exposures, may conceal rocks of the Cache Creek group from the number of masses in the drift.

Nazco River.

The Lower Cache Creek rocks are probably represented, as above stated, near the sources of the Nazco, but in following that river no further exposures of these beds are found, with the exception of a single locality eight miles south of the Blackwater, where a bluish, finely-bedded quartzite appears below the basalt.

Rocks of Upper Blackwater Canon.

The upper cañon of the Blackwater, already referred to, seems to be excavated in rocks of this series, which, forming a range of high hills, cross the river valley nearly at right angles, with a breadth of about eight miles in the river bed. The strike of the rocks nearly follows the direction of the range, being, where observed near the head of the cañon, N. 45° W., and very constant. The dip is generally south-eastward, though the strata are often nearly on edge. The rock most largely represented near the west end of the cañon is a hard and fine-grained slate, of bluish-black colour, which does not seem to have suffered very intense metamorphism. It is traversed—as are all the rocks—by a multiplicity of jointage planes, and also by irregular veins of white calcite. It is further intersected by occasional igneous dykes, which follow the bedding very closely, though sometimes departing from it sufficiently to show their intrusive character. The dykes are invariably decomposed superficially, assuming a pale dun colour, and are probably feldspathic. Toward that which is the upper part of the series here represented, unless overturn has taken place, the black slates become interbedded with rocks which seem to contain some serpentine, and occasionally with soft serpentinous schists, and hard green dioritic and

Photo Lith. by the Burland Desbarats Co Montreal.

From Photo, 10th June, 1875.

ROCKS AT ENTRANCE OF LOWER BLACK WATER CANON.
(LOWER CACHE CREEK GROUP.)

epidotic beds, some of which have probably been contemporaneous volcanic products. A compact, white, impure dolomite was also observed, though not in great mass. It shows small cupreous stains throughout, and after the removal by acid of soluble carbonates, a coherent siliceous or argillaceous mass remains. An irregular conglomerate or breccia, with fragments of a similar limestone enclosed in a blackish matrix, occurs at one place. Dolomite.

Three miles above Blackwater Bridge rocks of this group appear in several localities in the bed of the river, protruding through the Lignite formation. They are quartzitic, but apparently coloured with epidote, much shattered and traversed by minute chalcedonic veins. In one exposure they were observed to dip N. 15° E., at an angle of 20°. At Blackwater Bridge, at the head of the lower cañon, Lower Cache Creek rocks again appear, and in their general aspect and attitude much resemble those of the upper cañon. Serpentinous rocks are, however, rare, and igneous intrusions were not noticed; and while blackish slaty rocks preponderate, there is a large proportion of pale cherty quartzite, which breaks with an irregular conchoidal fracture, has a dull, wax-like lustre, and under the microscope is seen to be composed of clear quartz grains imbedded in a formless siliceous matrix. The whole formation is in beds of no great individual thickness, and is much shattered by jointage planes, and impregnated throughout with iron pyrites, so that when exposed to the weather, surfaces are almost always covered by a film of iron oxide. Calcite veins do not occur, but small seams of quartz, often containing iron pyrites, abound. About fifty yards below the bridge, on the south side of the river, occurs a remarkable material, simulating in its appearance and relation to the surrounding rocks, a bed of anthracite coal. It is black in colour, and divided by cleavage planes and slickensided surfaces, into small rubbly fragments. On heating to redness, the small percentage of carbon burns out superficially, a strong sulphurous odour being at the same time evolved, and a coherent whitish or reddish mass of the original form and size remains. The rocks in this vicinity have a general dip westward, at angles of 45° to 70°, but are so much broken and disturbed, that it is almost impossible to see the true position of the coaly layers with reference to them. There are innumerable small faults, and the beds are not only vertically but horizontally displaced in various directions, and show evidence of it in the bending of the edges of the strata against the fault lines. The general strike would carry the coaly beds across the river, but on the north bank they are scarcely recognizable, and have either been pinched out by mechanical violence or

Rocks near Blackwater Bridge and in the lower canon.

Bed with anthracitic carbon.

the outcrop concealed by faulting. The coaly layers, besides forming well marked beds, seem to follow some of the faulting cracks in thin streaks; and have probably been ground into them during the movement of the rocks. There appear to be two beds of this material on the south bank of the river, but this may be due to repetition consequent on the disturbances above mentioned. The greatest observed thickness was about ten feet, including a few quartzose intercalations. These beds are only of interest as showing the possibility of the occurrence of true coals in these old rocks in some other locality. The south-eastern continuation of these rocks, forms a range of hills stretching towards Quesnel Mouth; while north-eastward, their strike, combined with the abundance of more or less angular fragments of similar appearance in the drift of the plateau, leads to the belief that in this direction also they underlie a considerable area.

Rocks referred to this group on lithological grounds.

A more detailed examination of the rocks here included in the Lower Cache Creek group, in localities better fitted for that purpose than those I have visited, may possibly lead to their subdivision and reference to several formations; at present, in the absence of fossils, it is only possible to group the rocks of the several localities on lithological grounds, and by the degree of metamorphism which they have experienced relatively to other beds.

Porphyritic and feldspathic rocks.

Porphyrite Group.—This name may be provisionally employed to designate a series of rocks, chiefly feldspathic and often porphyritic, though also including diorites of varied texture, the reference of which to any of the groups formerly defined, seems uncertain. They are best seen about Tatlayoco Lake, where they overlie unconformably the Cascade crystalline rocks, and appear to underlie the beds of the Jackass Mountain series. The whole of the rocks of this group seem to be of igneous origin, though some of them may owe the arrangement of their material to water. At the outlet of Tatlayoco Lake, on the eastern side, a fine-grained, purplish feldspathic rock occurs, which is followed, in ascending order, by a great volume of pale-greenish diorite, compact, but very imperfectly crystallized, and, in the arrangements of its constituents, resembling a metamorphosed fragmental rock. Two miles northward, and probably much higher in the series, a compact dull bluish or purplish porphyrite appears. The matrix is homogeneous, and contains small glimmering feldspar crystals scattered through it. It is scarcely fusible, even in thin splinters, under the blow-pipe, and is probably orthoclastic. Here also occurs a rock similar in colour to the last, but distinctly brecciated. The fragments and matrix are both

Porphyrites and diorites of Tatlayoco Lake.

porphyritic, with white feldspar crystals, and slightly calcareous. The matrix seems to have been vesicular in places, and shows irregular lines of flow, the whole having the aspect of the scoriaceous surface of a lava bed in a metamorphosed state. Half a mile from the lake up Cheshee Creek, rocks of the same series, and probably overlying the last, were again found. Some beds here resemble a dull red quartzite, but on close examination, are seen to be fine-grained porphyrite, in which very small whitish feldspar crystals are thickly scattered in a purplish-red matrix. Other beds, with a similar colour, have an almost earthy fracture, and appear to consist of indurated feldspathic mud, in which very few distinct crystals have been developed. A hornblende-porphyrite was also observed, forming a very compact rock, in which dark hornblende crystals, with whitish feldspar particles, are scattered in a purplish mass. Most of the rocks are here much jointed, and in the cracks, epidote in thin films constantly appears. They are distinctly bedded in this place, and dip N. 65° E., < 35°; an attitude which would appear to place them conformably below the Jackass Mountain series of the higher parts of the mountains of the vicinity. In following the shore of the lake northward, rocks of the porphyrite series are again found, with a similar relation to the Jackass Mountain beds, at its upper end, and probably form the greater part of the low range of hills extending to Cochin Lake. They are, however, much broken and disturbed in this neighbourhood, and in some places rocks belonging to the upper series were also seen, and it is even possible that these may preponderate. In Prospect Creek, seven miles north of the lake, the strata are more than elsewhere confused and broken, and are traversed by many small quartz veins. Here men employed in the Railway Survey found abundant 'colours' of gold in the drift.

Hornblende-porphyrite.

Disturbed region.

From the quantity of fragments of rocks referable to the Porphyrite group in the superficial deposits along the eastern slopes of the Cascade Mountains, it is probable that it occurs in many places in that range. It appears extensively in the mountains on the west side of Tatlayoco Lake, and, also, probably, in the flanking range between Tatlayoco and the West Homathco Valley. Mr. Tiedemann, of the Railway Survey, has given me a number of very characteristic specimens of rocks of this series, collected between Middle and Twist lakes, on the West Homathco. Five miles from the east end of Tatla Lake, beds apparently belonging to this group occur in one place, and though not observed in contact with the micaceous rocks of this region, undoubtedly overlie them. The rocks seen are compact greyish hornblende-

Other localities of porphyrites.

porphyrites, and a dull greyish-purple amygdalodal porphyrite, in which, besides well-developed felspar crystals, there are many small chalcedonic particles filling cavities.

Porphyrites of the Nazco valley.

Rocks of this series, also probably characterize a considerable length of the Nazco Valley between the Clisbaco and its mouth, and though the exposures are too few to allow any very precise definition of their area, it has been approximately represented on the map. Their relation to the Jackass Mountain beds cannot here be ascertained, the junction being covered by horizontal basalt flows. About six miles north of the confluence of the Clisbaco, they are seen in several places, and are generally pretty typical porphyrites of bluish-grey and red colours. They are often brecciated, sometimes very coarsely, the matrix and included fragments being, however, generally almost identical in composition, and the structure of the rock masses sometimes scarcely apparent till weathered. In one place they were observed to dip S. 22° W., at angles of about 45° ; at another, southward $< 60°$. In many of the exposures these rocks are crumbling and rotten, and, like all the beds of this vicinity—including parts of the overlying basalt—seem to have undergone considerable change from the action of thermal springs, or steam, rendering it difficult, in many cases, to distinguish between the older and newer volcanic products. In one place, in a porphyrite with a compact red base, the feldspar crystals are represented by a soft, yellowish, granular material resulting from their decomposition. From the drift, it is probable that these porphyrites may occur largely in the mountains west of the Nazco, at this place. Further north, though pebbles and boulders of these rocks were often found in abundance, the rocks in place were not seen, unless it be supposed that a compact diorite of imperfect crystallization, and somewhat peculiar appearance, found near Tsa-whuz Mountain on the trail to Fort George, belongs to this horizon.

Abundance of porphyrite in drift.

Volcanic rocks of Battle Mountain.

On the Chilcotin, the hill named Battle Mountain is a remarkable mass of volcanic products, chiefly brecciated, which underlies the basaltic flows, and probably belongs here. Many varieties of igneous rocks are represented, but they are nearly all more or less typical porphyrites. In some instances the whole mass is of a uniform dull red or blue colour, and extremely compact, while in other beds the fragments included are much more varied, and they hold, besides portions of volcanic rocks of many different tints, pieces of siliceous and slaty material, apparently derived from strata of ordinary igneous origin. In most cases the fragments are angular, but in some beds many are well rounded, whether from the action of water or friction in a volcanic vent does not appear. In the lowest bed seen, which besides showing many small fragments, is irregularly blotched or mottled with darker spots, impressions of plants are found, but are not sufficiently well characterized for determination, though there can be no doubt as to their vegetable nature. They are indicated on the surface by rusty patches, from the decomposition of pyrites which has gathered around them, and generally show parallel striation or ribbing, like that of large sedge-like leaves. They have not been derived from any of the older rocks included in the breccias, as they appear without any traces of a former matrix. A very remarkable rock seen in one place may be called a slaty hornblende porphyrite, and has probably been a fine felspathic mud. It is bluish-grey and very fine-grained, but shows throughout small imperfect crystals of white felspar, and scattered hornblende crystals, acicular and black. Thin splinters are easily fusible before the blowpipe. The beds in Battle Mountain dip north-eastward at various angles.

Plant remains in volcanic breccia.

The exact position of the beds of the porphyrite group must remain a subject for future investigation. Though they have been observed in one place to pass in apparent conformity beneath the Jackass Mountain rocks, this may merely have been the result of local accident, or folding together in the same synclinal. In some cases it may be difficult to distinguish these beds from those of the basaltic series above, but they are in general very different, for though seldom or never quartzose, they are invariably more acidic than the rocks of the great horizontal flows of the interior. I can hardly doubt that these porphyrites lie between the Lower Cache Creek and Jackass Mountain groups, but whether they should be attached to the base of the latter, or considered as a part of the former, or an independent series, cannot yet be decided.

Stratigraphical position of the group uncertain.

Jackass Mountain Group.—The words used in describing the first examined and typical beds of this group in the Report for 1871-72 (p. 60), apply almost without alteration to its representative in the vicinity of Tatlayoco Lake; but the discovery of fossils in the rocks of the latter locality, now allows the age of both to be determined as lower Cretaceous, of the horizon of the Shasta group of the Californian geologists.

Cretaceous age of Jackass Mountain beds.

Along the eastern shore of the lake these rocks, as already mentioned, appear to overlie those of the Porphyrite series. They dip eastward, or away from the anticlinal axis in which the lake lies, and form, at a short distance from its eastern margin, a rampart-like wall of mountains from 2,000 to 3,000 feet high, and twelve miles in length. The beds near the water's edge dip at a greater angle than those seen in the tops of the

Quartzites and conglomerates of Tatlayoco Lake.

hills, but in the same direction, and the series is no doubt conformable throughout, the upper beds being, however, nearer the centre of a synclinal and showing a greater development of conglomerates. The rocks may be described as being compact bluish-grey quartzites or hard sandstones, and conglomerates of all grades in regard to size of particles, associated with blackish or dark coloured slaty and shaly beds, which recur frequently at different horizons. Great fragments of highly fossiliferous quartzite strew the lower slopes in some places, but fossils were only observed *in situ* about 2,000 feet above the lake, where they are found not only in the quartzite but in black shaly beds. The general strike of the rocks coincides in direction with the axis of the valley, down which very heavy glacier ice has travelled, and it is highly probable that the softer shaly beds may bear a larger proportion to the quartzites than now appears, as there are extensive hollows following the strike in which no exposures occur. Many of the beds are somewhat calcareous, and some of the shales are dark coloured from carbonaceous matter. Together with the marine fossils, in some layers surfaces are found covered with obscure plant impressions, like fragments of stems or blade-like leaves. No indications of coal were, however, observed. The thickness of the entire series, as shown on the east side of Tatlayoco Lake, probably does not fall short of 7,000 feet.

Plant remains.

Thickness of series.

Other localities in Cascade Mountains.

Beds of this series also seem to occur in many other places in this vicinity. The mountains on the south-east bank of the East Homathco, some miles below the lake, have an appearance like that of those just described. A mountain two miles west of the lower end of the lake is capped by similar rocks dipping south-westward; and a broad-topped summit, probably seven miles distant, seen up the valley of the Ottarasco glacier stream, also seems to be in great part composed of these rocks, with a similar dip. It is further probable from their appearance, as seen from a distance, that at least the upper parts of the flanking ranges between the north end of Tatlayoco Lake and Peterson Lake, and west of the latter locality, consist of these rocks, and that they are very extensively developed in the eastern portion of the Cascades, in this part of their course.

Jackass Mountain beds on Nazco River.

The Jackass Mountain beds were next seen on the Nazco River near the mouth of Tautree Creek, where they appear from below the basalts, first in the river bed, but gradually rise till at about picket 3,000 (C.P.R.S.,) they form the tops of the banks of the valley, the basalt disappearing from its vicinity; where first found on the trail they are greyish-blue and pale red sandstones and conglomerates, the red tints local, and due no doubt to the action of the basalt flows above. Two miles below Tautree Creek the sandstones on the east side of the valley were observed to dip N. 45° E., < 15°., while on the west they appear nearly flat. Ten miles further on similar beds dip N. 85° W., at low angles. A mile and a-half beyond, on the west bank, they dip about S. 45° W., at very low angles. At Cinderella Mountain, the beds are well shown, the conglomerates forming a prominent cliff, with a dip of S. 85° E., < 35°. A short distance below this point basalt again comes down to the level of the river, but about a mile above the mouth of the Clisbaco, a small exposure of shattered whitish quartz rock, very fine grained, appears below the basalt, and about two miles up the last named stream a dark altered shale occupies a small area. These do not resemble the rocks of the Jackass Mountain beds elsewhere seen, but have been provisionally classed as such, the strata of this part of the Nazco having been, as already mentioned, much altered by heated waters.

Beds correlated with the Jackass Mountain group thus occupy about eighteen miles of the Nazco Valley, with an unknown breadth. The rocks are much like those seen about Tatlayoco Lake, but are not so much altered, and dark coloured shaly and slaty beds rarely appear. The lower part of the series is probably not here exposed. The pebbles of the conglomerates are well rounded, and in many cases consist almost entirely of the compact quartzites of the Lower Cache Creek group, which must have been fully metamorphosed before these beds were laid down. The sandstones in many localities would afford good building material, and are easily accessible in the river banks. No fossils were found in any part of this area.

General character of the beds.

Building stone.

Disregarding the overlying basalt, the Nazco Valley is probably an anticlinal hollow in Lower Cache Creek beds, in which this area of Jackass Mountain rocks—and perhaps also the porphyrite series—is preserved, resting at low angles on the nearly vertical strata.

The Lignite Group.—Assuming that the beds of this group invariably underlie the basalts, it is the next in ascending order. It is much more recent in appearance than any of the others, and is undoubtedly Tertiary.

Drift lignite was found in several places along the Nazco River below Cinderella Mountain, but was nowhere seen in place. It also occurs in great abundance on the Blackwater, in the upper cañon, and may probably exist in place below the basalt flows west of the range of Lower Cache Creek hills. Large masses of drift lignite were also observed on the

Drift lignite.

Blackwater near the bridge, some of them so compact and pure as to form a fuel of very good quality. Rocks of the Lignite group were seen in several places on this river above the bridge, in small exposures; and though fossil plants occur, beds of lignite were not observed in connection with them. The rocks are light-coloured, chiefly pale greenish and greyish-white, and generally quite fine grained, constituting fire-clays, which are sometimes massive but often thin-bedded. Soft sandstones, and occasional beds with small pebbles, also occur. Some layers are highly diatomaceous, a species of *Melosira*, like *M. varians* being most abundantly represented All these beds rest uncomformably on a rugged surface of Lower Cache Creek rocks, which often protrude through them into the superficial covering of drift-sand and gravel. The beds of the lignite group are for the most part horizontal, but besides slight original irregularities in deposit, are sometimes gently inclined at various angles, in some places dipping as much as 20°. Obscure vegetable impressions, resembling roots or branches, are common, and in one place two stumps evidently standing where they grew, but now tilted with the including beds, were observed. They have been silicified, the wood being represented by a sort of wood-opal of brownish colour, with cavities holding light, yellowish, ashy flakes of silica. The beds turn up round the stumps and thin out toward them. The seed of some species of conifer, with that of a maple and other plant remains, were found in neighbouring exposures.

Exposures of lignite formation near Blackwater Bridge.

Stumps *in situ*.

These beds appear to have been formed in swamps and lakes separated by hills of Lower Cache Creek rocks, and no doubt vary much in character in the different basins thus enclosed. They probably underlie a considerable portion of the level country stretching eastward from the hills crossing the Blackwater at the upper cañon, but the whole region is so thickly covered with drift that it is at present impossible exactly to define their area. Some of the lignites found in loose blocks are much superior to those seen about Quesnel Mouth, and their appearance, together with the occurrence of stumps in place, gives reason to hope that beds accumulated on the area of growth, and not composed of drift timber, may be found. The actual elevation of these beds above those of Quesnel is about 330 feet.

Probable occurrence of lignites of economic value

Much drift lignite also occurs on the bars near the confluence of the Nechacco and Fraser rivers. About three miles below Fort George a small exposure of the lignite formation is seen, and it is probable that other patches of its clays and carbonaceous beds are preserved in hollows of the older rocks in several places between Fort George and

Section across the Fraser River Valley
at
Quesnel.

a. Modern River Gravel and Alluvium
b. Gravel and Sand beds.
c. Drift with Boulders.
d. Basalt

Horizontal Scale 3 inches to One Mile.
Vertical Scale 6 inches to One Mile.

e. Fine red rounded gravel
f. White and grey clay beds not well shown.
g. Tertiary lignite formation
h. {Quartzites clay slates &c much disturbed, probably Lower Cache Creek

Quesnel. From Quesnel to Soda Creek many good exposures of this formation occur, and, at low water, beds of lignite are seen in several places. These have not been examined.

The lignite-bearing formation of the vicinity of Quesnel Mouth has already been noticed in the Report for 1871-72, p. 58. Along the foot of the bank of the Fraser River, in front of the town of Quesnel, a considerable thickness of beds is shown. The lowest seen are situated about a mile above the confluence of the Quesnel with the Fraser River, and consist of impure lignites and clays, with layers of soft sandstone and ironstone concretions. These are followed in ascending order by clays and arenaceous clays of pale-greyish, greenish and yellowish tints, with a general southward or south-westward dip at low angles. These fill the trough of a shallow synclinal over which the town of Quesnel stands. On the south bank of the Quesnel River, the impure lignites and associated beds, first mentioned, rise again to the surface, and in some sections of fifteen or twenty feet the lignite may constitute about one-sixth of the whole. It is not, however, in well-defined beds, but interstratified throughout with clays, and appears to have been deposited in the form of drift-wood by somewhat rapidly flowing water, and is not so pure as to be of any economic importance. Small spots and drops of amber are abundant in some layers.

Lignite formation at Quesnel.

Character of lignite.

Amber.

The general position and relation of the lignite beds to older and newer deposits at Quesnel is represented in the section opposite, a more complete description of which will be found on page 263.

Half a mile below the mouth of the Quesnel River, on the east bank of the Fraser, a ruined cliff about 100 feet in height, is formed by the lignitiferous zone just described, with the addition of some of the overlying beds seen at Quesnel Town. The section given on pp. 58, 59, in the report above mentioned, was measured near here. From the greater part of the cliff the lignite has entirely disappeared by combustion, and the clays and sands have been baked, and caused to assume various shades of red and yellow, which give the exposure a very remarkable aspect. Rocks resembling ordinary brick, and biscuit porcelain, are most abundant, but some of the layers are semi-vitrified, and others containing much iron, have melted to a vesicular slag. The general appearance of the section, and the nature of the products of combustion, is precisely that of many localities in the lignite-bearing formation of the Upper Missouri, and elsewhere where similar action has taken place.

Combustion of lignites in place

Plant remains are found in some beds of the Quesnel lignite series, as mentioned in the report above referred to. Additional interest now attaches to the formation, from the discovery of a thin layer, in which the remains of several species of insects are very perfectly preserved. A section is given below showing the beds associated with this insect layer, which occurs in the left bank of the Fraser, at the town of Quesnel, and forms a member of the series overlying the main lignitiferous zone.

Discovery of insect remains.

The beds are as follows, in descending order:—

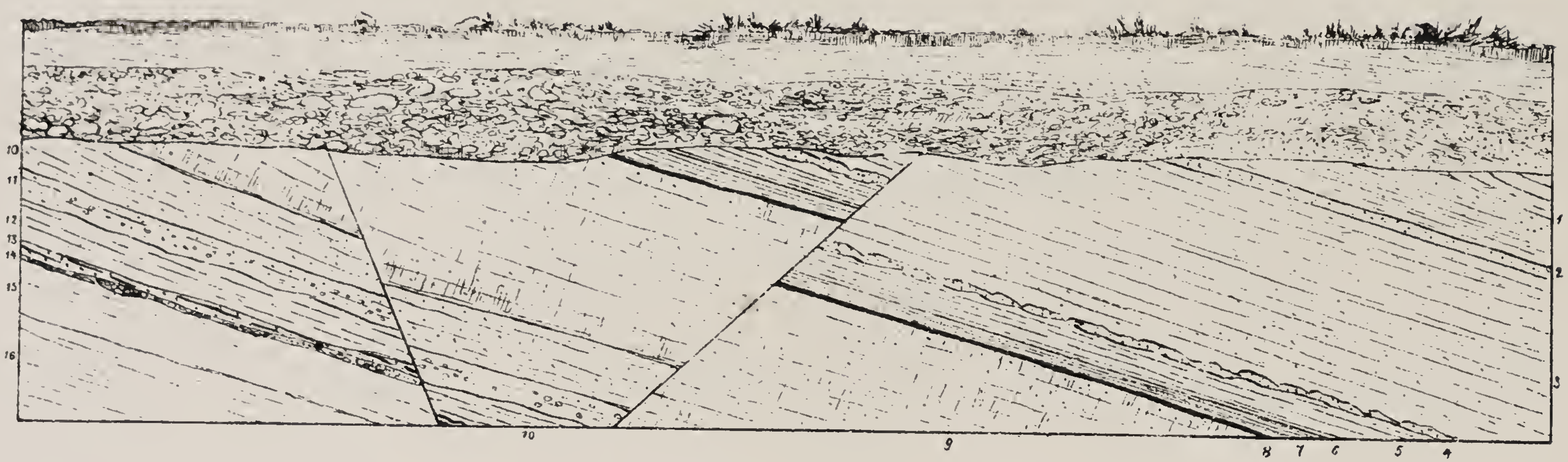
Section including insect and plant beds.

		FEET.	IN.
1.	Sands and arenaceous clays, light coloured and whitish, regularly bedded	20	0
2.	Grey sand	1	0
3.	Grey arenaceous clay, thin-bedded	11	9
4.	Ferruginous sandstone, nodular and irregular	1	0
5.	Fine grey clay, distinctly bedded	2	0
6.	Fine yellowish-grey clay	0	2½
7.	Very fine greyish and greenish-white fire-clay, in thin layers, with *coniferous* and *angiospermous* leaves, seeds, and insect remains	0	8½
8.	Carbonaceous clay, or impure lignite, in many places seen to be composed of matted leaves, mingled with clay	0	2
9.	Arenaceous clay, yellowish-grey, and much divided by rusty cracks, pretty distinctly bedded, but in thick layers	13	0
10.	Coarse yellowish-grey arenaceous clay	4	0
11.	Grey arenaceous clay with small siliceous pebbles, probably derived from rocks of the Lower Cache Creek group	1	6
12.	Grey arenaceous clay	2	0
13.	Coarse grey sand, with occasional flattened masses of lignite 6 inches to	1	0
14.	Coarse sand and gravel. A rusty irregular layer, about	0	6
15.	Yellowish clay	2	6
16.	Greyish clay	4	0
		65	4

The section is traversed by two small faults, and similar unimportant dislocations occur in other parts of the lignite formation of this vicinity. The highest beds of the section dip at an angle of about 22° in a direction oblique to that of the bank. The upturned edges of the beds have been eroded, and are covered by the gravel and sand deposits of the river valley.

Conditions of deposit.

Such a section as this cannot be affirmed through any considerable thickness of beds to represent an unbroken sequence in time; but supposing those layers immediately surrounding the insect and plant



SECTION INCLUDING INSECT AND PLANT BED.—LIGNITE-BEARING FORMATION, QUESNEL.

bed to do so, the analogy of the deposits with those which might represent a single season, in the present condition of the country, is striking. In some oozy creek, or estuary, of one of the existing lakes, the coarser deposits of the summer flood—consequent on the melting snows of the mountains—might be succeeded by a mass of the fallen leaves of autumn, which, as the season became more severe, reducing the flow of water, and, at the same time, the quantity and size of the constituent particles of the sediment, would be followed by the few remaining leaves and insects, now so distributed as to be separately recognizable. The insects from bed No. 7 of the above section were transmitted to Mr. S. H. Scudder, of Cambridge, Mass., who had kindly consented to examine them. Mr. Scudder's very interesting report on these remains is inserted separately, as an appendix to this.

Principal Dawson, who has kindly examined the plants from Quesnel and Blackwater, furnishes the following list and notes:— Note on plant remains, by Principal Dawson.

PLANTS FROM QUESNEL.

Acer. Species represented by a leaf, resembling a small leaf of *A. grossedentatum*, Herr, of the European tertiary. To this species it may not improbably belong.

Juglans nijella, Hr. This plant is also found in Alaska, and is a near ally of *J. bilinica* of the European tertiary, and of the modern *J. nigra*, or black walnut.

Juglans, sp. Nuts found in association with the above, and probably its fruits. They are allied to those of *Juglans nigra*, and resemble those called *J. nux-tauriensis* by Brogniart, which are found with remains of *J. Bilinica*.

Carya, sp. A nut, probably representing an undescribed species.

Castanea Ungeri, Hr. Found also in the tertiaries of Alaska and Greenland, and a near ally of the modern *C. pumila* of North America.

Dombyopsis Islandica, Hr. This plant is found also in Iceland, but may eventually require to be referred to some other genus.

Fagus Feroniæ, Unger. Found also in the Miocene of Europe and Alaska.

Platanus aceroides, St. Known also from the miocene deposits of Europe, Greenland, Mackenzie River, and Spitzbergen.

Quercus pseudocastanea, Goep. Found also in European and Alaska Miocene.

Quercus, sp.

Betula, sp. Nearly agreeing with *B. prisca*, Ettings., but with slightly cordate base; perhaps the same species as that identified by Heer with *B. prisca* in Alaska. Many specimens of the *samara* of a birch are associated with this leaf. The outline is round, emarginate at apex, with two mucros, seed slender, inflated above; width about 3 mm. A tri-lobed bract, with the central lobe much the longest, also occurs.

Fagus antipofi, Abich. Found also in Alaska.

Nordenskoldia borealis, Hr. Found in the Spitzbergen Miocene. A plant of uncertain affinities, which may, perhaps, eventually be included in the genus *Diospyros*, represented in the Tertiary of Greenland. Fruit.

Populus arctica, Hr. ?

Rhamnus, sp.

Rhamnus, allied to *R. alaternoides*, Hr., but an undescribed form.

Nyssidium.?

Taxodium.?

PLANTS FROM BLACKWATER.

Acer, Sp. Represented by a large winged seed, about two inches long, but very imperfectly preserved. Probably *A. macropterum*, Hr., a species found in the Alaska Miocene.

Sequoia Langsdorfii.

Taxodium occidentale, Newberry.

Thuja. Not determinable, but allied to *Th. interrupta* of Newberry.

Pinus. Two species represented by small winged seeds.

Castania Ungeri?

Fagus like *F. Feroniæ.*

Diospiros Alaskana, Sch. ? A leaf.

Beds probably Miocene.

The collections are not large, nor the specimens very perfect. It may, however, be considered certain that the formations of Blackwater and Quesnel containing these plants are Tertiary, and probably not very different in age. The plants from the Quesnel beds are, to a great extent, identical with those from the "Miocene" of Alaska, as described by Professor Heer, and they also have points of resemblance with those of Bellingham Bay, as described by Newberry. Whether the age of these beds is Miocene or somewhat older, may, however, admit of doubt.

General character of igneous flows.

Basaltic Series.—These rocks, though occupying the greater part of the region examined, do not offer many points of special interest. Where the best sections are found they are seen to consist of several or many horizontal or over lapping flows, which are sometimes very distinctly columnar, and may be either compact or vesicular in texture.

Western limit of basalts.

With the exception of those areas of older rocks protruding through them, or exposed in the river valleys where they have been cut away, they extend from the lower portion of the Chilcotin River, first examined, westward to that part of the Chilanco due south of Puntzee Lake; on the Chilco, to a point a few miles west of the 104th meridian—according to information received from Mr. Cambie—and on the Chilcotin itself may stretch to Chizicut Lake, and thence extend north-westward, their boundary nearly following the Clusco River for some distance. They characterize the greater part of the Nazco valley and the plateau extending east and west from it, and probably reach the western slope of the range of hills crossing the Blackwater at the upper cañon. East of this range, on the Blackwater or in its vicinity, basaltic rocks were not seen in place. Tsa-whuz Mountain, on the Fort George trail, may probably be an outlyer of this series, though its rocks are by no means characteristic.

The rocks exhibited in these flows are usually true basalts or dolerites of various textures, and from iron-grey to dark greenish and nearly black colours, and often contain much olivine. The vesicles are comparatively seldom filled with infiltrated minerals, though near the sources of the Nazco they are almost invariably so, the material being pale chalcedony, passing over in some instances to chrysopraze. In this vicinity, and near Cinderella Mountain, some beds are wacke-like and scoriaceous; and the soil of the water-shed region between the Nazco and Bae-zae-coh, on the Cluscus Lake trail, seems to be almost entirely composed of fine rusty puniceus fragments. Lithological character of basaltic series.

Glaciation and Superficial Deposits.—Many facts given in the preliminary general account of the country might have been included under this head; the following in addition may be recorded here, though the present imperfect knowledge of a region so much broken and diversified as British Columbia may not allow them to be connected by theoretical explanation.

The rocks of Tatlayoco Lake valley were observed to be strongly glaciated. Near the northern end of the lake furrows were found to run N. 10° E., and at the southern extremity, N. 12° E.; in both cases parallel to the axial line of the valley. Traces of glaciation were noted on several parts of the surface of the basaltic plateau, in two localities well preserved. About four miles north of Riske's farm, west of the Fraser River, striation has a direction of nearly true north and south, the approximate elevation being 3,350 feet. Near the northern edge of the Chilcotin Valley—also on the summit of the plateau—at an approximate elevation of 3,650 feet, very distinct grooves run N. 2° W., or S. 2° E., being transverse to the present great gorge of the river. In one place in the bottom of the Nazco valley, evidence of glacial furrowing is pretty clear, the direction being N. 10° W., or S. 10° E., nearly that of the valley itself. Tsa-whuz Mountain, between Blackwater bridge and Fort George, though of an easily decomposed rock, has preserved glacial Glacial striation

striation very perfectly on a slightly overhanging surface of basalt, near the very summit. The general direction indicated is a few degrees west of south, or east of north. Its summit is also hollowed with oval depressions, some of which hold small ponds of water, and their longer axes have a similar direction. The probable altitude of Tsa-whuz is 3,240 feet; its situation has been already described.

Classification of superficial deposits observed.

The superficial deposits met with seem to be divisible into three main classes, which may be thus described:—1. Clays, or arenaceous clays, forming low hills, or covering them so that rock exposures do not appear, with large and small stones and boulders, generally rounded; seldom seen in section; occuring west of the basaltic plateau and in many places over its summit. 2. Terraces and benches, often forming broad plains, and observed to occur at all elevations up to about 4,200 feet. These are extensively developed at various heights between 3,000 and 4,000 feet in connection with the basaltic plateau, and also about Tatla Lake independently of its support. Formed chiefly of gravel, shingle and sand, with large boulders at or near the surface. 3. Distinctly recognisable moraine mounds and ridges, in relation to present river valleys; the contained rock fragments mostly well rounded and waterworn. There appears to be some evidence to show that this and the preceding class were of contemporaneous origin, or very nearly so.

Composition of the drift.

In composition, the drift generally shows a clear relation to subjacent beds, and angular fragments are seldom found but in the immediate vicinity of exposures of the same rock. Boulders of the highly crystalline light-coloured granitic rocks typically developed in the Cascade Range, occur over all parts of the region examined, though sometimes rare, and seem to characterize all elevations up to at least 4,000 feet.

Basaltic boulders.

Over all parts of the basaltic plateau, fragments of basalt and accompanying rocks are very abundant. Westward from the crossing place of the Location Line and Chilanco River, they become scarce, and near the mountains are quite rare. Following the Line northward from the same point on the Chilanco, and obliquely entering the basaltic region, rounded fragments first appear in some abundance on the west side of Puntzee Lake, and culminate in size and number about the sources of the Nazco. The surface of the range of hills crossing the Blackwater at the upper cañon with an elevation of about 3,500 feet, are thickly covered with drift-material, irregularly deposited. The boulders and gravel are chiefly of the rocks of the hills themselves, of which the smaller specimens are often well rounded. There is also, however, much

basalt in large angular masses, and occasional samples of rocks of the Jackass Mountain and Porphyrite series.

The rivers being rapid and liable to heavy floods, the material of the gravel bars is often considerably different from that of the surrounding drift deposits. In the Blackwater near the bridge, fragments of the beds seen in the upper cañon abound, specimens of porphyrites of many different varieties, probably from the Porphyrite series, occasional pieces of Jackass Mountain rocks, basalts, rare boulders of Cascade granites, with partially rounded fragments of the hard clays of the lignite formation are also found. The section opposite page 257 shows the relation of the superficial deposits to the lignite Tertiary and the Fraser valley. It is drawn from measurements made by Mr. Webster, and your own notes. The gravels at *E.* may very probably be the representatives of the yellow gravels of the Blackwater, &c., while the white and grey clay beds at *F.*, though not well seen in the bank, were supposed to belong to the Lignite Tertiary series. River drift. Section at Quesnel.

The lowest portion of the thick detrital deposits underlying the plain near Blackwater bridge, when exposed by the river, are found to consist of nearly horizontal sands and sandy clays, with conglomerates containing small pebbles, chiefly of Lower Cache Creek rocks, all very compact and sometimes as hard as the underlying beds of the lignite formation. Where the two formations are in contact, however, the overlying beds are seen to rest uncomformably on those of the lignite group, and to contain rolled fragments of their hardened clays. The two series of beds are here also easily distinguished by colour, the gravels and sands above being darker and generally yellowish. A short distance below Blackwater bridge, cliffs, nearly 100 feet high, are formed of these gravels, and near the base a few specimens of wood were found imbedded. The wood is partly pyritized but is not dark coloured like that of the lignite beds. Above these hard yellowish sands and pebble beds, and on their worn surface lie the ordinary gravels of the river valley. Yellow gravels of the Blackwater.

High banks of similar material occur along the Fraser River in several places between Fort George and Quesnel, where, though generally horizontal, they are sometimes affected by false bedding on a very large scale, or slight folding subsequent to deposit. The material of the gravels is generally small and subangular, and is chiefly derived from Lower Cache Creek rocks, the pyritous character of which causes them in some places to assume rusty colours, like the decomposed parts of the Cache Creek series itself. Sections on the Fraser show over 200 feet of these beds. They are sometimes seen to be overlaid by pale brownish Gravels of the Upper Fraser.

Overlying earthy drift.

and yellowish-brown sand and clay beds of earthy appearance, though with some layers of gravel. These occasionally rest with an appearance of conformity on the yellowish gravels below, but often fill eroded hollows in them, or lap round elevated masses. In the Great Slide above Quesnel fully 200 feet, of earthy beds belonging to this group must be exposed. On them rest gravels formed by the river itself when at a higher level, and sometimes finer deposits of river drift.

It is quite probable that the yellow gravels above described pass below the basalt flows, and are, therefore, pre-glacial. This relation has not, however, been actually observed, as in the case of the very similar gravel deposits opposite Quesnel, above described.

On the Nechacco near Fort George, and between Quesnel and Soda Creek on the Fraser River, very extensive gravel deposits are shown in numerous fine sections. These differ considerably in their character and appearance from the yellow gravels and may probably form a portion of the true drift deposits. These gravels are seen near Quesnel to overlie the lignite formation uncomformably, and to hold large rolled masses of the lignite coal.

Travelled pebbles of altered sedimentary rocks occur to the summit of Tsa-whuz Mountain. On its northern slope, and ridges north of it, many boulders are lodged, some of Cascade Mountain granite, others apparently of Lower Cache Creek rocks, and also for the first time, a considerable proportion of 'Quartzite drift,' consisting of whitish, purplish, pinkish and yellowish compact or saccharoidal quartzite, and precisely resembling the material designated by this general name in my "Report on the Geology and Resources of the Region in the Vicinity of the Forty-ninth Parallel." In continuing northward, and descending toward Fort George, this quartzite material soon largely preponderates, forming mounds and ridges of clean well-rounded shingle. Specimens of all the other rocks previously seen on the plateau, are still, however, found. The contour of the country, with the position of the southern edge of the 'Quartzite drift,' would seem to indicate that at the time of its transport and deposit here, an extensive sea covered the flat land to the north.

Quartzite drift.

Travertine deposits.

Calcareous tuff, or travertine, occurs in several places on the Chilcotin as a recent deposit, and was observed to hold pebbles like those of the drift in one locality. On the Nazco, in a lateral ravine five miles below the mouth of the Clisbaco, a mass of this material over twenty feet thick appears. Since its deposit the stream has cut a new channel through the travertine and underlying rock, and the gravel beds of the brook at a higher level are seen in section below the calcareous mass.

The travertine shows both compact and porous varieties, and holds imbedded many sticks and logs, which are unchanged. Where the wood has decayed, passages are left, which are inhabited by a species of marmot, and from the decomposition of the excrement of these animals, nitre has been formed, and fills many of the little holes and cavities as a white granular powder. This material has since been examined by Mr. C. Hoffmann, who finds it to consist almost entirely of potassic nitrate, with small quantities of nitrates of soda, lime and magnesia and traces of a sulphate and chloride. In the event of railway construction, this calcareous deposit would be useful as a source of supply of lime in a region which is otherwise apparently deficient in this substance. Nitre.

I have the honor to be,

Sir,

Your obedient servant,

GEORGE M. DAWSON.

VICTORIA, B. C.,
February 22nd, 1876.

APPENDIX

TO

MR. GEORGE M. DAWSON'S REPORT.

THE INSECTS

OF THE

TERTIARY BEDS AT QUESNEL,

BY

SAMUEL H. SCUDDER.

The fossil insects obtained by Mr. George M. Dawson in British Columbia, are better preserved, as a general rule, than any that have been obtained from other American localities. Naturally, little of a general nature can be said of so small a collection, but one cannot fail to be struck by the almost entire absence of Coleoptera, while the facies of the Diptera seems to be very different from that of any other known locality, whether in Europe or America. Besides fragmentary indeterminate remains, of which no mention will be made, there are twenty-four species, or more, which can at least be referred to families. It is remarkable that, where we may speak with confidence from the perfect state of the specimens, no two individuals belong to the same species. In determining the affinities of the Diptera, I have been greatly assisted by the hints and criticisms of my friend, Edward Burgess, Esq.

HYMENOPTERA

FORMICIDÆ.

Formica arcana.—A single fragment of a wing (No. 10 a), exhibiting, however, all the important parts of the neuration, is to be referred to the genus Formica (s. str.). *Pimpla senecta* lies on the same stone. The discoidal cell is of medium size, subquadrate, a little broader below than above; the single closed cubital cell is about three times as long as the discoidal cell, being a little produced (to considerably less than a right angle) at the tip, where the transverse vein, coming obliquely from the stigma, strikes the cubital vein exactly where it branches, forming a minute stigma, from which four veins radiate almost symmetrically; the wing is of a uniform, faint fuliginous colour, the stigma of medium size, darkest along its lowest border, and all the veins dark, the scapular vein even black, and margined on its apical half with testaceous. The wing is 3 mm. in width, from the anal emargination to the base of the stigma, and the tip of the basal internomedian cell is 4·25 mm. distant from the apex of the closed cubital cell, making it probable that the entire length of the wing was nearly 12 mm.

Hypoclinia obliterata.—There are two specimens to be referred to Hypoclinia, and both are very fragmentary. One (No. 8) consists of the partial remains of the wings of one side overlapping; the other (No. 14) of similar remains, but so faintly impressed on the stone that some of the veins cannot be traced at all, and since in all essential features it agrees with the more distinct fragments, I have considered it as belonging to the same species, although it is of slightly greater size.

The essential portions of the fore wing remain, showing the neuration to be that of Hypoclinia; the second cubital cell is triangular, and the vein which marks its outer limit arises from the upper branch of the cubital vein a little beyond the cross-vein depending from the stigma; the discoidal cell is of about the same size as the second cubital cell, and is subquadrate, the vein marking its outer margin a little curved, and the apex of the cell itself separated by but a short space from the base of the second cubital cell. The scapular vein is more darkly coloured than the others, and a faint fuliginous cloud appears to surround the rather dark stigma. Length of fragment of wing 5 mm.; distance from base of wing to tip of stigma 4 mm.

Aphænogaster longæva.—A single very obscure and fragmentary specimen, and its still more obscure reverse (Nos. 33, 33 a) are the sole representatives of this species; they exhibit a crushed and confused mass of head, thorax, legs and antennæ, and the larger part of a single front wing, apparently of a male. The wing is faintly infumated, especially beyond the stigma, and the stigma itself is only a little deeper in tint; the wing is also covered very sparsely with excessively delicate and very short microscopic hairs. The cubital vein forks beyond the discoidal cell by only one-third the width of the latter, and both the veins run to the tip of the wing, although very faintly; this cell is shaped exactly as in *A. Berendti* Mayr, found in amber, and is distant from the scapular vein by only half its width; the costal margin of the wing is more convex beyond the stigma than in the amber species mentioned. The base of the wing is lost, but its probable length is 7 mm., and its greatest breadth is 2·3 mm., length of stigma ·8 mm.

ICNEUMONIDÆ.

Pimpla saxea.—This species is represented by a single specimen (No. 31), presenting a shattered thorax, the first four abdominal segments viewed from above, and the front wing. These abdominal segments are pretty uniform and regular, rather strongly convex, pale testaceous, with a broad, blackish fuscous, basal, transverse band, occupying fully one-third of each segment; the segments are quadrate, broader than long and smooth. The metathorax is pale testaceous, and very delicately scabrous. The wing is uniformly hyaline, or shows the slightest trace of infumation, especially at the extreme tip, and is uniformly and rather sparsely covered with microscopic hairs, averaging ·04 mm. in length in the third median cell, seated upon little chitinous annuli ·008 mm. in diameter; the veins are black, and the basal part of the stigma black, but beyond it is dark fusco-castaneous; the castaneous portion (lying beyond the tip of the first median cell,) is three times as long as broad, extending half way down the upper border of the first subcostal cell; the third costal cell is comparatively narrow at tip, and the tip of the wing is somewhat pointed; the vein separating the areola or second subcostal cell, from the third costal cell is partially obliterated, and the areola is rather small, subquadrate, broadest at the open side; there is the slightest possible trace of the lower extremity of the vein separating the united first subcostal and second median cells, but the vein bordering the upper side of the third median cell is perfect throughout; the vein separating the third and fourth median cells is gently curved, subsinuate and partially obliterated in the middle. Length of fragment of body, 5·5 mm., length of wing, 8·75 mm., breath of wing beyond stigma, 2·9 mm., greatest width of third costal cell, ·35 mm.

Pimpla senecta.—A single specimen and its reverse (Nos. 10 b and 12), show little beside the greater part of the front wing, and the tip of the hind wing; crushed chitinous masses represent parts of the abdomen, and perhaps of the thorax; the wing is uniformly hyaline, with the slightest possible trace of infumation next the base, and is profusely covered with tapering microscopic hairs, averaging ·065 in length in the third median cell, seated upon minute chitinous annuli ·01 in diameter; the veins are black, or toward the tip and on the hind wing castaneous, and the stigma is dark testaceous; most of the stigma is broken, but enough remains to show that it is apparently not so broad as in the other species here described, and it extends less than half-way down the upper border of the first subcostal cell; apically the third costal cell is comparatively broad, and the tip well rounded; the vein separating the areola from the third costal cell is nearly obliterated, and the areola is rather small, and shaped as in *P. saxea;* there is no trace whatever of the vein separating the united first subcostal and second median cells, although the vein above the third median vein is bent where it should join it, as in the preceding species; the same vein is partially obliterated in the middle of the portion below the first subcostal cell; the vein separating the third and fourth median cells is strongly curved, subsinuate and distinct throughout. Length of wing, 8·4 mm., breadth beyond the stigma, 2·4 mm.; greatest width of the third costal cell, ·4 mm. *Formica arcana* lies on the same stone.

Pimpla decessa.—The remains of this insect (No. 9 a) consist of crushed thorax and abdomen, and the two wings of one side of the body, superimposed; upon the same stone, at a slightly higher level, is the specimen of *Boletina sepulta.* The thorax and abdomen are entirely crushed and black, but the last segment of the latter bears the closest possible resemblance to the abdomen of the male of *Pimpla instigator* Fabr. The wing is uniformly infumated, and the margins of the anal excision infuscated; it is covered very profusely with short microscopic tapering hairs, more irregularly distributed than in the other two species described, averaging in the third median cell ·03 mm. in length, and seated on chitinous annuli varying in size, some being but half as large as others, the larger ones measuring about ·007 mm. in diameter; the veins are black, and the large triangular stigma almost as dark, a little paler toward either extremity; the stigma is about twice as long as broad, and extends more than half-way down the upper border of the first subcostal cell, the vein being partially obliterated beyond it; the third costal cell is rather narrow apically, although the tip of the wing is pretty well rounded; the species may readily be distinguished from those described above by the shape of the areola, which is pretty regularly quadrate, twice as long as broad, and has the vein next the third costal cell obliterated only at the ends; there is no trace of the vein separating the united first subcostal and second median cells, and the vein separating these cells from the third median cell is bent in the middle, and nearly obliterated in the middle half; the vein separating the third and fourth median cells is strongly curved, not at all sinuate, and slightly indistinct at its upper extremity. Length of fragment of body, 8·5 mm; length of wing, 7·7 mm; breadth of same beyond the stigma, 2·6 mm; greatest width of third costal cell, ·27 mm.

BRACONIDÆ.

Calyptites (nov. gen.)

This name is proposed for a genus of fossil Braconidæ, which seems to be distinct from any described living forms. It is related to Calyptus, but differs from it, in the neuration of the front wings, mainly in the shortness of the first submedian cell, the division between which and the second submedian cell, lies much before the lower extremity of the first median cell; and still more in the shape and position of the first subcostal and second median cells; the vein which separates them is in straight continuity with that separating the second subcostal and third median cells, so that the subcostal cells and the median cells lie in parallel lines along the longer diameter of the wing; the second median cell is scarcely more than half as large as the first subcostal cell, subquadrate, broadest below; the first subcostal cell is angulate, but broadly oval, its larger diameter along the wing almost twice as long as broad.

Calyptites antediluvianum.—Represented by a single fore-wing (No. 7) in perfect preservation. It is uniformly and scarcely infumated, the anal cell decidedly fuliginous, the stigma also fuliginous, and centrally infuscated; as preserved on the stone, the veins are pale and delicately edged with black, and accompanied by a very narrow and delicate infumated margin, especially in the basal and lower halves of the wing; the median vein does not reach the margin of the wing next the anal excision, but bends and runs in a straight course to the outer border; the second median cell has numerous brief shoots from the nervures along its lower and outer margins, and one is found at the middle of the upper margin of the second subcostal cell, and another below the middle of the vein separating the first and second subcostal cells. Length of wing, 6 mm.; breadth of the same beyond the costa, 2·1 mm.

DIPTERA.

CHIRONOMIDÆ.

There are several fragments of flies in the collection, which must be referred to this family, but the parts which are preserved are so uncharacteristic that nothing further can be said about them. They generally show a lateral view of the thorax and abdomen, sometimes accompanied by obscure fragments of wings (Nos. 18, 21), with no important parts of the neuration; in one instance, with the larger part of the legs (No. 18), and again with the head and indications of the antennæ (No. 27); still others are pupæ (Nos. 22, 23, 25, 26), and apparently all are to be referred to this family.

MYCETOPHILIDÆ.

All the species found belong to the group of Mycetophilinæ, as defined by Winnertz.

Boletina sepulta.—A fragment of a single wing and a portion of the abdomen represent this species (No. 9 b). It is accompanied by *Pimpla decessa.* The wing is moderately broad, and faintly fuliginous; the costal, auxiliary and first and second longitudinal veins are heavily impressed, broad, black, and devoid of the microscopic hairs which uniformly cover the membrane of the wing and the other veins; these latter are faintly impressed, slender and testaceous. The costal vein is bristly; the base of the wing is broken, so that only the tip of the auxiliary vein can be seen, which terminates on the costal margin scarcely before the small transverse vein; the latter is conspicuously oblique, directed from above, downward and outward; the first and second longitudinal veins are pretty strongly curved downward at tip; the veins below these fork a little further out than in the scheme of Boletina, as figured by Winnertz, and the sixth longitudinal vein terminates just beyond the junction of the fourth and fifth longitudinal veins. Length of fragment, 3·75 mm.; estimated length of wing, 6 mm.; breadth of wing, 2·15 mm.

Brachypeza abita.—This species is represented by a single specimen (No. 3), and its reverse (No. 16), in which the wings and an obscure and detached fragment of the abdomen are present. The wing appears to be devoid of markings. The auxiliary vein does not fairly impinge upon the first longitudinal vein, but bends toward it and then vanishes; in other respects the neuration of the base of the wing is precisely as figured by Winnertz for Brachypeza; so, too, are the origin, course and position of all the principal veins and the cross-vein, but the branches of the fifth longitudinal vein unite perhaps a little further from the base, viz: scarcely nearer the base than the point of separation of the united third and fourth longitudinal veins from the second; the sixth longitudinal vein is perfectly straight, and terminates quite as far from the base of the wing as the small transverse vein; the anal vein is regularly curved, about as long as the sixth longitudinal vein, runs parallel to the border beside it, and terminates on the lower margin. Length of wing, 4 mm., breadth of same, 1·35 mm.

Brachypeza procera.—The single specimen of this species (No. 4) is in a very fair state of preservation, almost the entire neuration of the wings being preserved, as well as fragments of the body and other appendages. The wings are fuliginous, more deeply next the costal border. The neuration of the extreme base is lost, and the remainder differs from that of *Brach. abita* only in the lower half of the wing; the branches of the fifth longitudinal vein unite nearer the base than in that species, resembling, in this respect, the illustration of Brachypeza given by Winnertz; the lower branch curves strongly toward the tip, diverging unusually from the upper branch; the sixth longitudinal vein is straight, and runs far past the forking of the fifth vein, fully two-thirds the way to the margin of the wing; the anal vein curves but gently, and appears to vanish before reaching the margin of the wing. Length of wing, 3·5 mm; breadth of same, 1·5 mm.

Trichonta Dawsoni.—A very well preserved though fragmentary specimen (No. 6) must unquestionably be referred to this genus, and is named for its discoverer. The greater part of one wing, the basal half of the other, including between them all the characteristic parts of the neuration, with crushed fragments of the thorax and abdomen, make up the remains of the creature. The veins of the wing are black, especially the upper ones, which are heavily marked; the wing is covered with microscopic hairs, and slightly infuscated throughout, but on the apical quarter becomes dark fuliginous. The neuration agrees in every particular, to the minutest degree, with the figure of Trichonta given by Winnertz, excepting that the fifth longitudinal vein forks considerably nearer the base, and the sixth longitudinal vein extends further into the middle of the wing. Estimated length of wing, 4·75 mm., breadth of same, 1·85 mm.

DOLICHOPODIDÆ.

A single specimen (No. 11) must be referred to this family, and apparently to the genus Dolichopus (s. str.), but so little a fragment of the insect is preserved, that no specific description can be given. The specimen is preserved on a side view; the head, thorax and abdomen can all be distinguished, together with the upper portion of one of the wings, attached to the body, but in a reversed position. The structure of the male abdomen, peculiar to the Dolichopodidæ, is indicated by some obscure markings beneath the apparent tip of the abdomen, while the first and parts of the second and third longitudinal veins of the wings indicate its generic relations, although, of course, with some question.

ANTHOMYIDÆ.

Two species unquestionably belonging to this group, are referred hesitatingly to the genus Anthomyia, although they probably should not be generically associated. This is the only genus of Quesnel Diptera which has before been stated to be found in a fossil state, three species having been referred to Anthomyia by Heer, in his classic work on the Tertiary Insects of Europe, although none of his species, to judge by his figures alone, are congeneric with those here described. It can hardly be right to place the two species from Quesnel in the same genus, but, until the family is well monographed, it would, perhaps, be best to retain them together.

Anthomyia inanimata.—This species is pretty well represented by a single individual, and its reverse (Nos. 30, 32), showing the superior view of the insect with the wings (excepting the extreme base), most of the abdomen, and parts of the head, thorax and legs. The wings are rather narrow and regularly rounded; the bristly costal vein extends to the tip of the fourth longitudinal vein; the first longitudinal vein terminates before the middle of the costal border, just above the small transverse vein; the auxiliary vein is distinct throughout, and remains in close contiguity with the first longitudinal vein, curving first downward and then upward, and diverging from it only near the tip, and then but little, being scarcely separated from it at its tip by more than the thickness of the costal vein; the transverse shoulder vein is slightly oblique; the third longitudinal vein strikes the tip of the wing, and the second divides the space between this and the costa, running for the greater part of its length parallel to the latter, turning slightly upward at the tip; the third and fourth longitudinal veins are pretty closely approximated, and parallel as far as the transverse vein in the middle of the wing; from this to the large transverse vein they diverge gently, and are again parallel beyond; the small transverse vein is placed a very little before the middle of the wing; the large transverse vein is straight, nearly perpendicular to the costa, its lower extremity distant from the margin by about half its own length, its upper extremity dividing, just before the middle, the part of the fourth longitudinal vein lying beyond the transverse vein; the fifth longitudinal vein vanishes just before reaching the border; the two small basal cells are nearly equal in size, in length about midway between the lengths of the two transverse veins. The wing is covered pretty abundantly, veins and membrane, with delicate microscopic hairs, and appears to be uniformly hyaline, though a little fuscous on the stone. The specimen appears to be a male, and the tegulæ are distinctly marked, leaving no doubt that it belongs to this group of Muscidæ. Probable length of body, 6 mm.; length of wing, 6·2 mm.; breadth of same, 2·25 mm.; length of hind tibia, 1·45 mm.

Anthomyia Burgessi.—The single specimen (No. 29) of this species shows an upper view of the whole body in a somewhat fragmentary condition. The broad and rounded abdomen indicates that it is a female. The wings are uniformly faint fuliginous, probably hyaline in life however, covered with microscopic hairs over both membrane and veins; they are short and broad and well rounded; the veins in the upper half of the wing are rather darker than those in the lower; the costal vein is bristly and extends to the tip of the fourth longitudinal vein; the stout first longitudinal vein strikes the costal at the middle of the front margin; the auxiliary vein appears to be confluent with the first longitudinal vein, half way from the base of the wing to the tip of the former; then, rapidly curving forward, diverges from it, and at its tip is as distant from the first longitudinal vein as the second longitudinal is from the third above the short transverse vein; the transverse shoulder vein is slightly curved and a little oblique and lies directly above the base of the small basal cells; the direction and relation of the longitudinal veins is the same as in *A. inanimata*, but the small transverse vein lies slightly beyond the middle of the wing, so that the divergence or parallelism of the veins is more marked than there; the large transverse vein is bent slightly inward in the middle, and its general direction is about midway between perpendicular to the costa and parallel to the neighbouring border; its lower extremity is but half as far from the margin of the wing at its own length; its upper divides, a little before the middle, the portion of the fourth longitudinal vein which lies beyond the small transverse vein, but instead of being only half as long as the portion of the fourth longitudinal vein lying between the two transverse veins, as in *A. inanimata*, it is very nearly as long; the fifth longitudinal vein just fails of reaching the border, while the sixth only runs about two-thirds the distance to the border; the basal cells are moderately large, much as in the preceding species. On one side there are, apparently, remains of tegulæ, showing that the insect should be referred to this group of Muscidæ. The apical third of the hind tibia is furnished abundantly with not very long hairs, while the remainder of the tibia is bare. Length of body, 4·75 mm.; length of wing, 4·75 mm.; breadth of same, 2 mm.; length of hind tibiæ, 1·15 mm.; length of hind tarsi, 1·25 mm.

HELOMYZIDÆ.

Heteromyza senilis.—In this case we have but a fragment of one wing (No. 1), but one which exhibits most of the peculiarities of neuration, and, so far as it goes, very well preserved. The wing is slightly discoloured, but was apparently hyaline in life, covered rather profusely with exceedingly delicate microscopic hairs, which cover veins as well as membrane; the veins, excepting the costal, are testaceous; the costal vein is blackish fuscous, covered with short bristles, and extends beyond the third longitudinal vein, where the wing is broken; the auxiliary vein strikes the costa at about the end of the first quarter, and the nearly straight longitudinal vein before the middle of the wing; this vein is bare or only feebly pubescent; the slightly sinuous, toward the extremity slightly upturned, second longitudinal vein divides about equally the space between the costa and the third longitudinal vein; the latter is almost straight, scarcely bending to receive the small transverse vein at about the end of its basal third, and terminates at the broadly rounded tip of the wing; the small transverse vein lies just before the tip of the first longitudinal vein; the fourth longitudinal vein is nearly straight, only bent next the transverse veins; before the small transverse vein, it is parallel, and rather closely approximated to the third longitudinal vein; beyond, it diverges slightly and regularly from it, and beyond the large transverse vein again becomes parallel to it; only the basal portions of the fifth and sixth longitudinal veins are present, and the extreme base of the wing is lost; but the basal cells are evidently small, and their extremities lie just beneath the union of the second and third longitudinal veins; the wing is broad, ovate and well rounded; the costa pretty strongly arched. Length of fragment, 4 mm.; probable length of wing, 4·5 mm.; probable breadth of same, 2 mm.

SCIOMYZIDÆ.

Sciomyza revelata.—Although the only specimen to be described (No. 2), is but the remnant of a wing, partially overlapped by a fragment of its opposite, nearly all the characteristic parts of the neuration are preserved; the length of the costal vein, the distinctness of the auxiliary, and the large size of the small basal cells, leave little doubt that it should be referred to this group. The wing was apparently narrow, the costa but little arched, the extremity slightly angulated at the tip of the third longitudinal vein; the membrane, as well as the castaneous veins, is covered not very profusely with delicate microscopic hairs; the costal vein is bristly, (at least near the base,) and extends to the fourth longitudinal vein, although it is but faint at the extreme tip, or on the lower third of the space between the third and fourth longitudinal veins; the auxiliary vein is weak, but distinctly separated from the first longitudinal vein from its very base; the transverse shoulder vein is a little oblique, directed from below upward and inward, lying nearer the base than the union of the second and third longitudinal veins; the first longitudinal vein cannot be traced through all its course, but it is bare save the pubescence, and apparently terminates scarcely beyond the small transverse vein; the latter lies beyond the end of the first third of the wing; the second and third longitudinal veins are nearly straight, slightly sinuous, and subparallel throughout, but at their tips diverge from each other; the third longitudinal vein is regularly though but slightly arched beyond the small transverse vein; the fourth longitudinal vein is made up of three perfectly straight subequal parts, slightly bent at the transverse veins; the larger transverse vein is straight, nearly perpendicular to the costa; it is shorter than half the middle portion of the fourth longitudinal vein; the tip of the basal cells is just below the junction of the second and third longitudinal veins. Length of the fragment, 4·5 mm; propable length of wing, 4·75 mm.

ORTALIDÆ.

Lithortalis nov. gen.

The single Ortalid of the collection can certainly not be referred to any of the American genera mentioned by Loew. It is most closely allied to Ceroxys, but beside a different distribution of the spots, the neuration of the wing varies so much from that of Ceroxys, as to render it certain that it should be separated from it. The shape of the wing is much as in Ceroxys, especially as in *C. canus* Loew, to which it is also most nearly allied in markings; the first longitudinal vein has bristles upon its end only, and even here they are few and small; the fourth longitudinal vein is curved backward a little, and the posterior angle of the third basal cell is not at all produced; the third and fourth longitudinal veins diverge at their tip; while the second and third converge. In Ceroxys, the auxiliary runs beside the first longitudinal vein for some distance, and then suddenly curves, almost bends upward. In Lithortalis the separation is gradual and not abrupt. In Ceroxys the small transverse vein lies below or outside the tip of the first longitudinal vein; in Lithortalis it lies within it. In the pattern of the markings also it differs from Ceroxys, in that there are no spots whatever before the larger transverse vein, excepting that the stigma, or the space lying between the auxiliary and first longitudinal veins, is testaceous.

Lithortalis picta.—The thorax, part of the abdomen and both wings of the single specimen preserved (No. 5), show the upper surface of the body with expanded wings. The abdomen is without markings. The wings are very well preserved, the apex slightly angulated between the third and fourth longitudinal veins; the costa nearly straight on its basal half, strongly convex beyond; the stigma occupies the entire space between the auxiliary and first longitudinal veins, and is dark castaneous, deepening toward the costa to blackish fuscous; the costal vein is blackish fuscous; the other veins are luteo-testaceous, deepening to blackish fuliginous next or in the spots; the other spots are dark fuliginous, deepening toward the veins or the margin, and consist of a narrow belt following the larger transverse vein and of confluent spots at the tips of the second, third and fourth longitudinal veins, forming a narrow marginal belt from just below the tip of the fourth longitudinal vein, to half-way between the tips of the first and third longitudinal veins, broadening slightly at the extremities of the veins in rapidly narrowing shoots, which follow the veins a short distance. Length of thorax and fragment of abdomen, 3 mm.; breadth of thorax, 1·25 mm.; breadth of abdomen, 1·5 mm.; length of wing, 5 mm.; breadth of same, 1·75 mm.

LONCHAEIDÆ.

Lonchaea senescens.—A portion of the body (excluding the head), too fragmentary to be of any value, and a pair of expanded wings faintly impressed on the stone, compose the remains of the single individual of this species (No. 17). The wings are rather slender, obovate and well rounded, with the neuration of *Lonchaea vaginalis* Fall., as given by Westwood in Walker's "Diptera Britannica," excepting that the basal cells do not appear to be quite so large in the fossil species, and the fourth longitudinal vein is slightly more arched beyond the larger transverse vein; the costal vein is bristly; the wing appears to be hyaline, but there is an indication of a slight infumation along the larger transverse vein; it is covered with excessively fine microscopic hairs which also cover all the veins with a delicate pubesence; with this exception the first longitudinal vein is bare; the larger transverse vein is slightly oblique, and but little larger than the portion of the third longitudinal vein lying between the two transverse veins. Length of wing, 4·6 mm.; breadth of same, 1·8 mm.

Palloptera morticina.—An indistinguishable crushed mass of chitine and the basal half or more of a single wing (No. 20) are all that remain of this creature. The wing is small, and probably was not over three millimetres long; hyaline, with a slight infumated spot of considerable size in the middle of the wing between the two transverse veins; the basal cells are small; the auxiliary vein is very slight, and throughout very closely approximated to the first longitudinal vein; the latter appears to be short and nearly straight, bare of bristles, but pubescent like the rest of the wing; the costal vein is bristly, but like all the others is pale testaceous; the small transverse vein lies within the tip of the first longitudinal vein; the large transverse vein is straight, and perpendicular to the costa, removed from the small transverse vein by double its own length. Length of fragment of wing, 2·15 mm.

COLEOPTERA.

NITIDULIDÆ.

Prometopia depilis.—The single beetle (No. 24) of this collection belongs to the Nitidulidæ, but where it should be generically located, is a matter of some doubt. It resembles most among our American forms the genus in which I have provisionally placed it, but so few really generic features remain that one can judge by but little but accessory characters. The head is wanting and the thorax is broken, and though exhibiting the under-surface, the markings of the tegmina can be readily seen, as is frequently the case in fossil beetles. The form of the elytra and scutellum is precisely that of *Prometobia sex-maculata*, excepting that the base of the elytra is more distinctly angulate; beneath they are expanded just as there, and it is punctured in much the same irregular and minute manner, but equally so at the extreme border of the tegmina beneath, instead of being furnished at this point with transverse rugæ; the punctures are ·028 mm. in diameter, and do not give origin to hairs; the elytra are dark castaneous, and have a dull ridge along the sutural margin. The thorax is black, and proportionally shorter than in Prometopia, but otherwise it appears to have the same form, although the characteristic lateral projections of the front border are broken off, only the slightest indication of that on the left side appearing in a portion of the curve of the front border. The thorax is more minutely punctate than the elytra, and the punctæ are connected by the slightest possible impressed lines, giving it somewhat of a corrugated appearance; a few of the abdominal segments may be seen, the pygidium extending just beyond the elytra; all these joints are black, smooth and shining, without trace of hairs or punctures. Length of fragment, 5·5 mm.; length of middle of thorax, 1·25 mm.; breadth of same, 3·2 mm.; length of elytra, 3·75 mm.; breadth of united elytra, 3·35 mm.

HEMIPTERA.

APHIDÆ.

Lachnus petrorum.—A fragment of a wing (No. 19) is sufficiently preserved to show that it should be referred to this genus, while the exact position of the veins is different from that of any species I have examined. The wing is unusually slender; the costal vein thickens apically as in *L. pini* (Linn.); the first discoidal vein is straight; the second discoidal originates very close to the first, runs parallel to it only at the very base, and then bends pretty strongly outward, striking the margin of the wing nearly as far from the tip of the first discoidal vein as half its own length; the origin of the third discoidal is not clear, but it is apparently not far from that of the first, in which case it runs parallel with the second until it branches in the middle of the wing; the lower of these branches almost retains the course of the basal part of the veins, but diverges slightly from the second discoidal vein, terminating very far from it on the border of the wing; the upper branch, diverging rather widely at first, almost at once runs parallel to the lower branch, and, when it has continued a less distance than the length of the basal half of the main vein, divides, the two forks diverging but slightly at base, and then very gradually converging, until they are no further apart than the bases of the first and second discoidal veins, and the upper fork almost touches the vein which curves downward from the stigma; together they diverge a little from the lower branch of the third discoidal vein; the stigmal vein is very conspicuous, passing by a broad sweep into the heart of the wing, diverging from the costal vein at a greater angle than does the second discoidal; unfortunately the tip of the wing is broken, and more than the apical half of the outer border is also wanting. Length of the fragment, 4 mm.; estimated length of wing, 5 mm.; width of same, 1·65 mm.

NEUROPTERA.

ODONATA.

A specimen (No. 28) and its reverse, show a distinct impression and relief in which the outline and contours are perfectly distinct, but in which all marks of appendages or sutures are effaced. They are evidently the front view of the head of one of the Libelluline Odonata, closely allied to, and of about the same size as, *Diplax minuscula* (Ramb.).

REPORT

ON THE

BORING OPERATIONS IN THE NORTH-WEST TERRITORY, SUMMER OF 1875.

BY

R. W. ELLS, M.A.

ADDRESSED TO

ALFRED R. C. SELWYN, Esq., F.R.S., F.G.S.,

DIRECTOR OF THE GEOLOGICAL SURVEY OF CANADA.

Sir,—Having received your instructions in April last to proceed to the North-west in order to superintend the boring operations about to be carried on in the Saskatchewan district, and also to collect as far as possible a suite of specimens representing the Economic minerals of the Territory for the Centennial Exhibition. I left Montreal on the 27th April. On my arrival at Petrolia, I purchased a supply of drift-boring tools and casing, which the engineer, Mr. John Highman, who had been out the previous season as assistant with Mr. A. McDonald, deemed necessary, and having shipped them by the lake boats for Fort Garry we left Sarnia for the scene of operations on the 1st May, *via* Chicago and St. Paul. Owing to various delays we did not reach Winnepeg till the 14th, when I at once despatched Mr. Highman to Burnside, to bring in the stock belonging to the Department that had been wintered there. He found, on collecting the animals, that of the oxen two were dead and the rest so reduced by disease and other causes as to be utterly useless for freighting, and our horses were in nearly the same condition. Under these circumstances, and from the high price of stock, due to the outfitting of so many parties, I was obliged to hire freighters for the greater part of our machinery and supplies. Having secured the necessary number of men, Mr. Highman started for the Saskatchewan on the 21st May, in order to get the heavy machinery that had been stored at Fort Ellice

Instructions.

Transport of machinery and supplies.

last season under way. The late opening of navigation in the lakes prevented our boring tools from reaching Winnepeg till the 5th June, when I at once started them with our supplies for the Elbow of the North Saskatchewan. On arriving at Fort Ellice on the 15th, I was surprised to find Mr. Highman and party still there, they having been detained two weeks from the difficulty of obtaining freighters to transport the boiler and engine with their accompanying machinery, weighing in all some 10,000 pounds. He had, however, secured a responsible person at a fair rate on the day of my arrival, and on the next day the train started. At the crossing of the Qu'Appelle River the boiler was put in the H. B. Company's scow, but owing to its great weight, and the leakiness of the scow, the latter filled and sank at the further side with the boiler resting partly on it and partly on the bed of the river, about six inches of the smoke-stack only being above water. Our thanks are here due to the members of the Mounted Police force encamped at Fort Ellice, who kindly allowed us the use of a large coil of strong rope, without which our boiler must have been for some time a fixture in the river bed, but with a strong force of men and oxen we succeeded in getting it on to the western bank. Another day was spent in rebuilding the scow, which had been smashed to pieces in the attempt to get the boiler out, and on Monday, 21st, we reached the prairie level west of the Qu'Appelle River, the immense beds of sand on the slope of the hill rendering the task very difficult. On examining the boiler it was found that the iron hub of one of the wheels was completely split, and it was accordingly taken back to the fort and secured by iron bands. This was the only damage the machinery sustained during its long transport. The great weight of the boring apparatus, with the poor condition of the stock, rendered travelling so slow, that in the journey from Fort Ellice to the Elbow the teams did not average more than fifteen miles per day, while the crossing of soft swamps with a boiler weighing 3,000 pounds, and waggons loaded with 2,500 pounds each, made the trip very fatiguing both for men and cattle. The train reached the upper crossing of the South Saskatchewan (called Gabriel's Crossing), nine miles above the old or Batachis Crossing, on the 13th July. Here two days were spent in getting the freight over, the current being very strong and the crossing bad. This done, Mr. Highman and I, accompanied by an Indian guide, started for the Elbow of the North Saskatchewan to select a site for the drill. We explored the country for two days, and found the immediate vicinity of the Elbow and up along the river as far as Eagle Creek very unfavourable for boring operations, the soil being full of boulders in many places; no

Crossing the Qu'Appelle River.

Reach the South Saskatchewan.

water available except at the river's edge, the approaches to the shore very steep and difficult for machinery, and a deep covering of drift everywhere. We, however, selected a spot for work about ten miles above the Elbow as known in that part of the country, and which is the extreme eastern angle made by the river where it bends sharply to the north in its long straight stretch to Fort Carleton. This was the first place where we could find timber of sufficient size for our framework.

Selection of site for boring.

At Carleton, a few days before, I had heard rumors of the opposition contemplated by the Indians to all Government parties who should enter their country west of the South Saskatchewan, and expected to see some of them at the crossing of the South Branch. No opposition was made at this point, however, and no Indians were seen till we reached the Elbow of the North Branch. We were here met by a detatchment of some twenty-five Indians under the guidance of their chief, Mistiwassis ("The Little Child"), who requested us to halt and refrain from going further into their country until we should have had a conference on the subject. A council was at once called, at which the Indians stated that they were a deputation sent by the great body of the Plain Crees to put in a protest against any Government party carrying on work in their country before a treaty had been made with them for their lands; that they had been advised of our coming, and they could not give us permission to go on with the work for fear of the consequences from the rest of the tribe; and, further, if we chose to go on in opposition to their expressed wishes, we did so at our own risk, which, as some of them plainly hinted, would be loss of horses and anything else they could appropriate. Under such circumstances, not wishing to incur the danger of having the machinery and supplies destroyed, and as they had also put a stop to telegraph construction west of the South Branch, I deemed it best to order the return of the party to Carleton. Here, through the kindness of Mr. Lawrence Clark, Chief Factor of the district, we were allowed to place everything inside the fort; and judging it better to put a hole down there rather than abandon all attempts for the season, by Mr. Clark's permission boring works were erected, and everything was ready for drilling on the 12th of August.

Stopped by the Indians.

Return to Carleton.

The site of the fort (see your report 1873-74) is about twenty feet above the surface of the river, and 200 feet below the level of the plain at the back. The spot selected for boring was in an old well thirty-five feet deep, and this gave us a starting point below, or on a level with the bed of the river. There being no bed rock at the surface, work was commenced with the boring tools brought from Petrolia. The engine belonging to the "diamond drill" being too weak to drive the drift boring tools, the power was increased as much as possible by attaching a fly wheel and by enlarging the diameter of the driving wheel, but it was still necessary to use ninety pounds of steam to get up the required power, which, with a suitable engine, should have been accomplished with forty pounds.

Boring at Carleton.

Owing to the lateness of beginning operations we decided on putting down, if possible, one hole with the common boring tools to the depth of 500 feet, only using the "diamond bit" to take out sample cores at intervals when the bed rock should be reached. This, however, we could not carry out on account of the great depth of drift encountered. For passing through the drift we had brought from Petrolia twenty-eight feet of five and-a-half inch casing and 171 feet of four-inch, inside measure. Having exhausted the five and-a-half inch casing without reaching the bottom of the drift, at a total depth (including the well twenty feet) of forty-eight feet, the four inch casing was introduced, and this was put down to a total depth of 175 feet, The casing, owing to the thick beds of sand passed through, had to be driven nearly the whole way. The various strata of drift passed through were as follows:—

	FEET.
Clay and Sand of well	32
Silt and Sand	10
Coarse Gravel	10
Blue Clay	8
Greyish Sand—Quicksand	40
Blue Clay	28
Sand, as before	40
Coarse Gravel	7
Total	175

In passing through the sand much delay was caused by its boiling up inside the piping as soon as the sand-pump was removed, and frequently on resuming work in the morning it was found necessary to sand-pump forty to seventy-five feet of sand that had filled in during the night. Water was struck in plenty at a depth of about fifty feet, and though not a flowing well, yet the water rises to within about eight feet of the top, and can be easily pumped. From the bed of gravel at the bottom, where we were obliged to stop work through lack of casing, pebbles of gneiss, granite, and garnitiferous rock of Laurentian age, hornblende and mica schists and diorites, probably Huronian, quartzites and cream-coloured limestones (Silurian), and numerous small pieces of iron pyrites and sandstones, probably Cretaceous, were found.

Abundant supply of water.

The depth of drift between the two Saskatchewans must be very great. In many places the surface is strewed with large blocks of limestone and gneiss, and at the Elbow of the North Saskatchewan, the slopes of the hills rising from the river, where the mould has been removed by the action of water, show an unusual amount of boulders, forming in places almost a solid pavement of stones. Great depth of the drift.

The time during which the drill was in actual operation was from the 12th of August to the 8th of September. The rate of drilling was slow, owing to the necessity of driving the casing almost constantly, and the fact that the weight of our driving gear was insufficient to overcome the resistance made by the constant boiling up of the sand. With two heavy sinkers representing a weight of seven and eight hundred pounds, the progress, except through the clay, was not more than from two to five feet per day. Delay was caused also by the frequent bursting of the rubber hose connecting the boiler with the engine, owing to the very heavy pressure of steam necessary to work at all, and it will be necessary, if future boring operations are carried on, to make use of iron connecting pipes instead of rubber. Slow progress.

Five men were engaged with the drill during the season, the engineer, two assistants, one man cutting and hauling wood and one hauling water and attending the boiler. With the diamond drill one man could be dispensed with, but both drills are requisite in the North-west, unless it should be in the vicinity of Victoria or Edmonton, since the diamond drill is useless in boring through the drift, and can only be of use after the bed rock is reached and for taking out cores.

In carrying on boring operations in the North-west great difficulties are encountered. The great weight of the boring tools and machinery to be moved over a country without settlers; the difficulty of moving at all to selected spots unless situated on a good trail; the great delay in getting freighters, even in the vicinity of the forts, and the necessity of keeping a large amount of stock for moving from place to place when operating away from them, the trouble of finding good locations for suitable frame and derrick timbers, and a good supply of fuel and water; all these have to be considered in the selection of a site for boring. For these reasons it would probably be best to depend in future operations on the common boring tools entirely. The result might not be quite so satisfactory, but a large saving in the expense could be effected. Difficulties met with in boring in the North-west.

In carrying on operations further west great delay and trouble can now be saved by employing the Hudson Bay Company's steamboat for transport, as Mr. Graham, the Chief Commissioner, kindly expressed to me last summer his willingness to assist us in any way by allowing the machinery to be carried in their boats. In fact, in the present condition of the boiler trucks and the bad state of the trail west of Carleton, it will be impossible to move it further in that direction by land without incurring very great expense.

But by far the greatest delay has been incurred by the system of sending parties out every spring from the east to resume work. This is especially the case as the scene of operations is moved further west. Fully two to three months are lost in the spring and summer in getting the working party to the spot, and if they return home in the fall another month must be lost in their return; thus fully one half the working season is spent in travelling, and, as a consequence, the amount of work done bears but a small proportion to the expense involved. Could a small party—say two or three men—be wintered there, work could be resumed early in April and continued to November at least.

Suggestions for conducting future operations.

In regard to continuing operations at Carleton, it will be necessary to start with a new hole from the surface, owing to the small size of the casing in the bore hole. The casing used last season still remains down through want of proper machinery to extract it. A couple of jack-screws would in all probability start it up, and a part at least might be saved for future operations.

In regard to the second part of your instructions, as the season was pretty well advanced on my arrival at Carleton, as soon as I had arranged matters so that the engineer could proceed with the boring, I set off for Edmonton to collect the specimens for the Exhibition. The geological features of the country passed over from Fort Garry, westward, have been already described in your report for 1873-74, and as the trail along the south side of the Saskatchewan was from the opposition of the Indians decidedly unsafe, I was obliged to relinquish the plans I had formed for exploring the country along Battle River and thence west, and keep to the north side of the Saskatchewan all the way. I accordingly left Carleton on the 27th July with only one man and a buck-board*, having an Indian for guide as far as Fort Pitt. Crossing the river we branched off from the main trail, about nine miles out, and took the trail by Redberry Lake. The route lay to the southwest over an extensive plain for the most part destitute of timber; the surface was quite free from stones, but the soil was light and fresh water very scarce. A number of salt water lakes were met with on this plain, beyond which the

Collection of specimens for Philadelphia Exhibition.

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* A light vehicle on four wheels, the axles connected only by thin boards or bars, which act as springs, and on which one or two seats are fixed transversely.

country becomes hilly and broken. Passing the Redberry Creek, where the crossing is quite good, the soil improves, the hills are nicely wooded, and many small and pretty fresh water lakes are seen in the hollows, with abundance of good grass. At a distance of about thirty-five miles from Carlton we came in sight of Redberry Lake (salt), a magnificent sheet of water, surrounded by a fine rolling country, equalling in beauty that of the Touchwood Hills, with the high timbered land which forms the Mitonass Hill, rising from it to the eastward. After passing the undulating country to the west of the lake, the trail leads over an extensive salt plain in which wood and fresh water are very scarce, the soil very poor, and the surface broken by frequent gravel ridges. The timbered slopes of the Thickwood Hills are seen to the north. Numerous salt lakes and alkali ponds abound on this plain, which extends for about seven miles west of Goose Lake, near which the trail passes. The water in this lake is fresh, or but slightly brackish, and the shores are thickly strewed with boulders of gneiss and granite, mica and hornblende schists and diorites, with a few small pebbles of cream-coloured limestone. Crossing this plain the country again becomes rolling and covered with frequent clumps of timber, both willow and poplar. Hay swamps of large size are numerous, and the soil, which is of a reddish sandy loam, is better, though there are occasional gravel ridges. Similar country extends to and beyond Jackfish River, beyond which the trail continues about two miles in a north-west course, till it joins the main trail that passes through the Thickwood Hills. From the forks we continued to Fort Pitt, and thence to Edmonton by the trail described in your report of 1873-4.

Character of the country.

Salt lakes.

Hay swamps.

At Fort Pitt I remained a day, but could find no exposures of rock *in situ* that would furnish us with a suitable place for boring, and from the evidence of the officer in charge, we should probably find a deep covering of drift here, since in digging their well at the Fort they did not reach the bed rock at a depth of ninety-five feet.

Well at Fort Pitt.

We left Fort Pitt on Tuesday *en route* for Edmonton, arriving there on the following Tuesday. The streams for the greater part of the way were very high, the season west of Carlton having been unusually wet. The surface of the country was thoroughly saturated and in many places covered with water. Arriving at Edmonton, I was fortunate enough to secure the services of George Gullion, your former guide, a man thoroughly acquainted with the river; but could get no boat nor crew to go up stream as far as the "big coal seam," the high state of the water rendering poling or tracking impracticable. I, therefore, took Gullion and an Indian to bring back the horses, and having secured a couple

Leave Edmonton for Rocky Mountain House.

of picks, the only mining tools the fort afforded, started for Rocky Mountain House on horseback. We found the trail very bad and in places completely grown up, the swamps under water and the rivers bank high. Arrived at Rocky Mountain House, we were fortunate in finding a skiff of sufficient size for our purpose, and sending the horses back by the Indian we embarked for our river trip. On reaching the upper exposure of the "big seam," we landed, and made a careful examination, in order to find the best spot for cutting out the section required. The seam showed at the time of my visit, when the river was high, seven feet above the water at the upper and fourteen feet at the lower end, a clean spot of about 300 feet having been stripped by land slides. The clay was cleaned off from the top of the seam in its thickest exposure, and a cut made to a depth of about four feet, but the coal was found so tender and soft, from long continued action of air and water, that it was impossible to cut out a piece of any size; I was therefore compelled to move to the upper and thinner end, and found the coal much firmer. I succeeded in cutting out from this place a section extending back five feet, taking out a column fifteen inches square, down to the water level. Part of this section, I am sorry to say, I was obliged to throw overboard in Cedar Lake in order to lighten my boat on my return home. The coal in the cutting I found grew more compact as I went into the seam, and pieces piled on the shore and kindled with a little wood, burned nicely, and with a pleasant resinous odor. Samples that I brought down to Carlton to try in the forge at the boring works did not give good results in welding, but this may have been due to their being taken from the outside and weathered part of the seam. Mr. Brown, guide to the C.P.R. party under Mr. McLeod, stated to me, that in his exploration on the Brazeau River, some one-hundred miles to the west, he had seen in a sandstone cliff, three seams, one over the other, varying from fourteen to twenty-six feet thick. It might, therefore, be important to put a bore-hole on this Saskatchewan exposure, in order to ascertain if the "Big seam" may not be the upper one of the Brazeau section in its extension eastward. This could easily be done with the diamond drill.

Column of coal.

Coal seams on the Brazeau River.

The high state of the river and the strength of the current prevented my landing at the lower and second exposure, (see photo., your report 1873-4), so we continued on to Edmonton, making collections of clay iron ores at various points. Hence, with but one man whom I had brought from Fort Garry, and who had never been on the river before, we ran to Carlton, drifting night and day, and making the distance in seven and one half days. At different places between Edmonton and Victoria I collected iron-stones, and a recent land slide, about one mile above Victoria, had disclosed a new coal seam, of which about two and one-half feet were visible at the time of my visit with a considerable quantity of clay iron-stone associated. Another exposure of coal is seen in the stream flowing into the Saskatchewan opposite Victoria, but whether it is a continuation of that last mentioned I could not say. Coal and iron-ore.

While at Edmonton I arranged with Mr. Richard Hardisty, Chief Factor of that district, for a sample of fine gold, unamalgamated. During the past two seasons the river has continued so high that not more than six weeks could be profitably employed in washing, and some of the miners were preparing for operations in the Red Deer country to the south, where better prospects are reported. While at Carlton I also arranged with Mr. Graham to have forwarded from the Athabasca country two bottles of petroleum. Gold washing on the Saskatchewan.

At Victoria and Edmonton magnificent crops of barley, oats and wheat were being harvested in August, the wheat giving an average yield of twenty bushels for one sown. Of vegetables, the garden of the Wesleyan Mission at Edmonton presented as fine specimens as one could wish to see. On my arrival there, (August 10th), the Rev. Louis Warner, who was at that time in charge of the mission, had potatoes nine inches in circumference, and had been using them for three weeks; carrots fifteen inches long, cauliflower and cabbage in splendid condition, tomatoes nearly ripe, green peas, and, in fact, every kind of vegetables one could desire, were in great plenty. The wheat was being harvested on the 20th August in fine order. Good gardens were also seen at Victoria; a new feature there being a number of young maples, growing from seed sent from the vicinity of Lake Winnipeg. Grain and vegetables. Maples.

On my return to Carlton, I went with the late Rev. Geo. McDougall, who was at that time arranging on behalf of the Government for a treaty with the Crees, down to the Prince Albert Mission, about fifty miles below Carlton. Here we found a very prosperous settlement, extending some fourteen miles along the river. On the road down we reached a belt of firs about twelve to fourteen miles, and extending about four miles. The soil of this section is light and sandy, but after passing the strip of timber, it improves; and, judging from the appearance of the grass and the strong growth of the vetches, this tract of country, embracing the whole area between the two Saskatchewans and extending

Rich soil.

nearly to the Forks, is excellently suited for agricultural purposes. The soil consists of a covering of deep brown mould, fourteen to fifteen inches deep, overlying a whitish clayey gravel, and, though not heavy, is of good quality. There, as at Edmonton, the crops of oats, barley, wheat and potatoes were looking splendidly; but from using a late variety of grain they were about two weeks later in harvesting than at Edmonton, and, in consequence, narrowly escaped the heavy frost of the 8th September. The potatoes at this Mission were excellent in quality, and gave large yields to the acre. With careful farming this district will become very valuable; but, under the system pursued by the Half-breeds of raising continuous crops of the same kind, the soil soon becomes exhausted, not having the great depth and clayey qualities of that of Manitoba. A new steam and grist mill is now being erected, and will be of great benefit to the settlers.

Steam grist mill.

The existence of a coal bed at a place called Red Bank,* seven miles below the H. B. Co.'s Fort, being reported, I went down to ascertain if such were the fact; but, after careful examination of the locality, which is simply a steep cliff of sand and clay, I could find nothing but small oval pieces of lignite at the base of the cliff. The pieces do not seem to have been washed from any great distance, and the report of a bed of coal just below the forks of the Saskatchewan, by the pilot of the H. B. Co.'s steamboat, but which I could not see myself, would indicate that lignite beds probably occur below Carlton.

Obliged to abandon the borings at Carlton, as already mentioned, through lack of casing, I left there by boat on the 13th September with two men, but did not reach the Grand Rapids till the 30th, having been detained on Cedar Lake by storms and head winds for a week, during which time we were driven off into the great bay on the north side of the lakes. This bay extends from the entrance of the lake to Rabbit Point; it stretches back for a long distance to the north, and is full of large and small islands. They are all composed of cream-coloured limestone, holding Silurian fossils, and well wooded with birch, spruce, cedar and poplar. A few small pieces of black hornblende rock were seen at the entrance of the lake, but none *in situ*.

Silurian limestone with fossils.

Arrived at the Grand Rapids, we took passage with the H. B. Co.'s propeller "Colville," and reached Lower Fort Garry after a run of thirty-six hours.

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* See note on Mr. Selwyn's map of the Saskatchewan River. Report of Progress, 1873-74.

My thanks are due to the officers in charge of the various Hudson Bay posts for their unvarying kindness and assistance. Acknowledgments for assistance.

Having disposed of the greater part of the stock, and shipped my specimens, I left Winnipeg on the 26th October, and arrived in Montreal on the 9th November.

I am, Sir,
Your obedient servant,
R. W. ELLS.

GEOLOGICAL SURVEY OFFICE,
MONTREAL, *May*, 1876.

BORING

MADE ON

SWAN RIVER, NEAR FORT PELLY,

IN 1875.

First boring at Fort Pelly.

In 1874 an agreement was made with Mr. Fairbank, of Petrolia, to make a boring at Fort Pelly on the Assineboine River—see page 25, Report of Progress, 1874-5. The party for this work left Petrolia on the 30th June, 1874, but, owing to various unforeseen delays, did not reach Fort Pelly till the 24th of August. By the latter end of October, they had, with much difficulty, succeeded in boring to a depth of only one hundred feet, when, very cold weather setting in, the work was abandoned, and the party returned to Petrolia, reaching Sarnia on the 3rd of December.

In April, 1875, a fresh arrangement was entered into with Mr. Fairbank to complete the boring at Fort Pelly (mentioned page 3 Report of Progress 1874-75) to a depth of 500 feet. The party started from Sarnia on the 15th of May, and reached the site of the bore-hole on Swan River on the 29th of June. On the 6th of July operations were commenced, and on the 9th of October the depth of 501 feet was reached.

Second boring, 501 feet.

Good water.

At twenty-eight feet from the surface abundance of fresh water was found. It rises to within fifteen feet of the surface, and three feet higher than the level of the river.

The specimens of the strata taken out are nearly all of dark blue, grey or black shale, and hold inoceramus. At 259 feet a calcareous band about nine feet thick, was passed through. This and the lowest twenty feet of shale, rather slaty, shows organic remains,—small spines and fish scales; the beds are probably Lower Cretaceous, about the same horizon as the similar dark shales so largely exposed on Peace River and its tributaries, Smoky River and Pine River, and where they are overlaid by upwards of six hundred feet of sandstones and shales, associated with some thin seams of lignite-coal, and hold cretaceous fossils. From about ten miles below the crossing place on Swan River, Mr. Spencer states there is a fall of from 450 to 500 feet to Swan Lake, and as the beds are dipping slightly to the westward, those in which the boring terminated are probably considerably above the lowest exposed beds seen by Mr. Spencer on Swan River (Report of Progress 1874-75, pp. 64 and 65), and the lignite beds of Sanders River may come in between, but these do not appear to be of a character to make them of economic value in a region where wood is abundant. Lignite on Sanders River.

ALFRED R. C. SELWYN.

REPORT

ON AN

EXPLORATION IN 1865 BETWEEN JAMES' BAY AND LAKES SUPERIOR AND HURON,

BY

ROBERT BELL, C.E., F.G.S.,

ADDRESSED TO

ALFRED R. C. SELWYN, F.R.S., F.G.S.,

DIRECTOR OF THE GEOLOGICAL SURVEY OF CANADA.

Region explored.

Results.

SIR,—I beg to submit the following report of my labours during the past season, performed in pursuance of the instructions which I had the honour of receiving from you in the spring. The region explored, as indicated by the above title, lies between the southern prolongation of Hudson's Bay and the Great Lakes. In my preliminary report, submitted in November last, a narration was given of the operations of the season, but as these were of secondary importance compared with the results obtained, I shall confine the present report principally to the latter. Among the more important ot these the following may be mentioned: I am now enabled to demonstrate that an immense area of Huronian rocks, the largest as yet known in the Dominion, runs northward from Lake Huron through the greater part of the distance lying between it and the area of unaltered rocks of the south-west side of James' Bay; also that the Michipicoten belt of these rocks is much more extensive than had hitherto been supposed. Some deposits of economic minerals were discovered, and others, which had been little known, were examined. In the Moose River basin a remarkable set of wide-spreading trap dykes was found to exist. The occurrence of Tertiary lignite on this river was not previously known to the public, although a few persons living in the country were aware of the fact. The flat-lying rocks of this region had been previously represented on geological sketch-maps as continuing up the eastern side of James' Bay, but I found this supposition to be erroneous. A track-survey was made of a somewhat circuitous route, from Lake Huron to Moose Factory, at the south-western extremity of James' Bay, a distance of some 600 miles, with the exception of that portion of it nearest Lake Huron, which had been already more or less correctly mapped. A similar survey was also made of the whole route from Moose Factory to Michipicoten, on Lake Superior, a distance of about 400 miles, or about 300 miles in a straight line. Observations were made, many of which may prove important, in regard to the physical geography, the climate, soil, timber and resources generally of the whole region explored, and notes were also taken in reference to its botany and zoology. An exploration of the valley of the Goulais River was made in order to ascertain the boundaries between the Laurentian and Huronian rocks in that part of the country. Besides investigating the geology of the fundamental rocks, particular attention was always paid to the phenomena of the superficial deposits, which are elsewhere now occupying so much of the attention of geologists; and a portion of my time, especially in the autumn, was devoted to making a collection of specimens of the economic minerals of the northern shores of Lakes Huron and Superior for the Philadelphia International Exhibition.

Boundaries of Huronian formation.

On the northern side of Lake Huron the western limit of the Huronian rocks is in the neighbourhood of the Sault Ste. Marie, whence they extend eastward as far as Shebaonaning (or "Killarney"). Here they come in contact with those of the Laurentian system, which occupy the whole northern side of Georgian Bay. These Huronian rocks have been examined by Mr. Alexander Murray, formerly of this survey, to an average distance of eighteen miles inland from Lake Huron. The same gentleman has traced their eastern boundary for about eighty miles northward from Shebaonaning, and a continuation of this boundary was again met with by the late Sir W. E. Logan at the foot of Lake Temiscamang, on the Ottawa. Further on, to the north-east, the line marking the junction of the two formations has been laid down by the late Mr. McOuat, in the region between Lakes Temiscamang and Abittibbi.

First exploration inland in 1875.

My first exploration inland was from the shore of Lake Huron, by way of the Whitefish River, the Wanapiti River and Lake; thence through a chain of lakes to the upper part of the Sturgeon River, which falls into Lake Nipissing. From the forks of this river, above Paul's Lake, I followed a series of lakes across the height of land to White Beaver Lake, at the head of the east branch of the Montreal

River, a tributary of the Ottawa. This branch was followed down to its junction with the main river, on reaching which I turned up stream and followed the Montreal River as far as Pigeon Lake, from which, by a series of long portages, we struck the waters of Grassy River, flowing to the northward, and followed them as far as Lake Shatagami. From this lake we made a portage nearly six miles long to Mattagami Lake, on what is styled the south branch of the Moose River on the Geological Survey map, but in the country itself it is known by the same name as the lake. The word Mattagami is a contraction for Mattawagami or Mattawagamangue, which means branch or fork lake. The shores of this lake were carefully examined to its southern extremity. I next passed down the Mattagami River to Kenogamissee Lake, and thence to the junction of this river with the western or Missinibi branch of the Moose River. I then descended Moose River to Moose Factory, examining every exposure of rock, as well as making a track survey the whole way.

Geology of Route from Lake Huron to James' Bay.

Geology. I shall now proceed to describe the geology of the above route from Lake Huron to James' Bay, with the exception of the first eighty miles, of which an account is given in the reports of Mr. Murray for 1848–58. I may, however, here mention the occurrence of a band of Huronian limestone at the Island Portage, on the Wanapiti River, about four miles below the outlet of the lake of the same name, which is not described by Mr. Murray. This band has a width of at least 300 feet across its general strike, but owing to the undulation of the strata, it was difficult to ascertain its exact thickness. The greater part of the rock consists of a rather light greenish-grey, fine-grained, soft, impure limestone, weathering to a brown colour. In some parts the weathered surface is marked by small corrugated ridges, resulting from the weathering out of minute streaks or beds. An exposure of the limestone at the head of the portage shows a more massive variety, and has a brownish-grey colour, on fresh fracture.

Band of Huronian limestone.

Quartzite. The prevailing rock on the east side of Wanapiti Lake is a thickly-bedded, light, greenish-grey quartzite, which usually weathers white. The beds are generally so massive and free from lines of stratification as to render it difficult to ascertain the strike. A similar rock prevails (with only two observed exceptions) along the route above described as far as the first of the portages which we came to on the Sturgeon River, about two miles above the point at which we struck it. The general run is northward until Wabisheep (white duck) Lake is reached, where it appears to be east and west. From the northern extremity of Lake Mattawagamishing, the massive greenish-grey quartzite has usually a very coarse texture, and contains much light-red feldspar in the form of grains, constituting a kind of pegmatite. One of the above mentioned exceptions to the prevailing quartzite was met with at the south-western extremity of Lake Mattawagamishing, where the rock is a greenish-drab, massive argillite, having a smooth conchoidal fracture, and resembling the rock around Poplar Lake, on the northern boundary line of Minnesota, described in my report for 1872. The other exception occurs at the first lake south of Anigookiwagamog (Hurry-up) Lake, at the south end of which there is an exposure of soft, greenish ribboned slate, striking S. 10° E., while, at its northern extremity, a massive dark green crystalline diorite is seen. Coarse quartzite.

On ascending the Sturgeon River from the portage, by which we reached it, we first passed over massive light greenish-grey quartzite, full of decomposing feldspar grains, and at the first portage above referred to, came upon a finely arenaceous greenish-grey felsite in beds which dip S. 55° E. < 15°. About one mile further up, two short portages occur close together, and at both of them similar greenish felsite is exposed. In some parts it is shaly, but generally massive, and breaks into rhombohedral blocks. The dip is S. 20° W. < 70°. Sturgeon River.

About ten miles below Paul's Lake the Sturgeon River falls about fifty feet in a succession of *chutes* within a distance of 200 or 300 yards. Here the rock consists of light greenish-grey quartzite, both of massive and slaty varieties, the latter having glossy surfaces and sharp chisel-like edges. The stratification is vertical and runs S. 70° E. Most of the rock is full of grains of red and white decomposing feldspar, and some of it holds small white quartz pebbles in great abundance. A dyke of dark finely crystalline diorite, twenty feet in width, and running east and west, cuts these rocks near the foot of the falls. At a small *chute* six miles below Paul's Lake, a bed of greenish-grey rough micaceous quartzite, in a vertical attitude and striking S. 70° E., runs diagonally across the river. The light greenish-grey quartzite of the ordinary varieties is exposed at intervals along the river for two miles further up, or to within four miles of the above lake, where a rather coarse dull red syenite is met with. It is composed principally of red feldspar and white quartz, but some parts also contain a good deal of dull green hornblende. The uniformity of the rock is broken by strings and patches of white quartz. This syenite is flanked to the eastward by a rather soft, tough Paul's Lake.

finely crystalline green diorite, containing specks of iron pyrites. The line of junction of the two rocks is distinct and runs north and south.

Gneiss.

The last portage before entering Paul's Lake is about 300 yards long, and occurs about one mile below the foot of that sheet of water. It passes over reddish-grey gneiss, composed of feldspar quartz and hornblende, with some mica. The beds are contorted and cut by intersecting veins of reddish quartzose granite, but the general run is S. 65° E. and the dip is to the southward side. Between the portage and the lake the river passes among great masses of gneiss, which have tumbled down from the cliffs on the north-east side. Gneiss occurs again in the hill on the east side of the forks of the river about three miles in a straight line above Paul's Lake, which is about two miles long.

Sturgeon River to Montreal River.

The canoe-route, which I followed from the forks of the Sturgeon River to White Beaver Lake at the head of the east branch of the Montreal River embraces ten lakes and ponds with portages between them. The height of land between Lake Huron and the Ottawa passes between the ninth and tenth of these sheets of water. The fourth, which is the largest of them, is marked by a narrow neck about midway between its extremities. Around this lake, and on the portages at either end of it, are numerous exposures of coarse light greenish-grey quartzite, holding many small pebbles of white quartz and rarely one of red jasper. At the northern extremity of the seventh of these lakes, and at a distance of about three miles south of White Beaver Lake, there is an exposure of massive ribboned purple and green felsite, dipping north-westward at an angle of 30°. On the west side of the eighth lake, which is of small size, a massive, tough, heavy, crystalline, dark green diorite occurs. On the east side of the ninth lake, or the last on the south side of the height of land (also very small), the light grey quartzite reappears in very massive beds, which seem to strike S. 70° E.; but what is supposed to be the bed-planes, may be joints. A more slaty variety of the quartzite is found on the Height-of-land Portage and along the north side of the small lake between it and White Beaver Lake, being the tenth and last of the chain. On the portage the rock appears to run about north and south and is divided into pieces, having slickensided surfaces and sharp edges, while on the lake referred to it is slaty, and runs N. 15° E. and dips westward at an angle of about 80°.

Diorite.

White Beaver Lake.

White Beaver Lake measures about four miles from south to north, and has an average width of about one mile. The last portage of the canoe route leading from Sturgeon River, terminates at its southern extremity. A number of rounded hills on the west side of this part of the lake are composed of massive crystalline green diorite. On the same side of the lake a promontory, which begins about one mile from the extremity and continues for about a quarter of a mile, is formed of fine grained quartzite in both thick and thin beds, some of each of which are light and others dark grey. There are also some reddish-brown and some greenish shaly beds and partings. Ripple-marks were observed on some of the green beds. The strike is S. 65° W., and the dip southward at an angle of 80° to 90° These rocks are flanked to the northward by massive greenish diorite, which also forms a high hill to the south-westward. Distinctly bedded greyish quartzites, dipping east at an angle of 45°, and showing ripple-marked surfaces, again appear at the next point northward on the west side of the lake. On both sides of the lake, near the outlet, the rock consists of a finely granular dark greenish-grey felsitic quartzite, mostly thinly bedded and weathering to an olive colour. Some of the beds are of a uniform cherty character, but are made up almost entirely of small compact elongated fragments of a fine olive colour, somewhat lighter than the matrix and of all sizes, from mere grains up to two inches in length. This beautiful rock has a smooth conchoidal fracture, and breaks readily into thin chips. The beds run very straight and dip S. 40° W. < 50°. At two miles below the outlet of White Beaver Lake the river passes over light grey sandstone or open-grained quartzite, of a very massive character, the bedding being indistinguishable. One mile further down, massive dark greenish-grey crystalline diorite is exposed on the west side of a lake-like expansion of the river, and a similar rock is met with on the east side, at a distance of about six miles, following the river, below White Beaver Lake. In a hill on the west side, at about ten miles, a ribboned reddish-purple and dark green felsite occurs in almost horizontal beds. Diorite, similar to that last described, is extensively developed two or three miles, in a straight line, further north.

Olive-coloured chert.

Fifteen or sixteen miles, in a straight line, below White Beaver Lake, the east branch of the Montreal River falls into a very beautiful-shaped expansion, about three miles long, which I named Lady Dufferin Lake. The river enters the southern arm of this lake. About one mile and a-half above the entrance there is a portage, a quarter of a mile long; and 300 yards above this, another of the same length. At the latter, the river flows in a V-shaped notch between light grey quartzite on the west, and crystalline greenish-grey diorite on the east side. The quartzite has a light, glossy, green tinge, and occurs in massive beds.

Lady Dufferin Lake.

It is of a coarse texture, and holds rounded pebbles of white quartz, and occasionally a thin bed of these pebbles, with some of red jasper and black chert. The dip is due east, at an angle of 20°, and where the quartzite comes into contact with the diorite on the opposite side of the notch, the latter rock has a splintery character, which it loses a short distance off. This quartzite, having the same dip, is continued at the lower portage. On the eastern side of the entrance to Lady Dufferin Lake, a fine grained or compact quartzite occurs in grey, reddish and greenish beds, but between this point and the lowermost of the above portages, and again at half-a-mile above the uppermost, there is met with a massive grey silicious felsite, occasionally holding small red spots. At the last named locality the beds run N. 10° W. and dip eastward at an angle of 70°.

Slate conglomerate.

In the north-east bay of Lady Dufferin Lake the rock is a dark greenish-grey argillaceous slate-conglomerate, the pebbles of which are generally widely scattered, but in some parts closely crowded together. They consist principally of red syenite, but there are also some of white quartz and of soft green slate. The majority of them are as small as peas and marbles, but many larger ones are observed, some of which would measure as much as six or seven inches in diameter. They are mostly rounded, but some are angular. What appears to be the stratification runs nearly north and south, and the rock is divided by joints into rhombohedral blocks.

Leaving Lady Dufferin Lake, the river passes through two smaller lakes, each about one mile long, and then enters a third about five miles in length. All these lakes are connected by short rapids. At the foot of the five-mile lake a branch enters from the west. The rocks in the interval between this point and the foot of Lady Dufferin Lake consist principally of the light grey quartzites, which, in some places, have a sandstone, and in others a conglomerate character. The strike varies from N. to W., 15° N., and the dip, which is always eastward, from 20° to 45°. Dark grey and greenish-grey diorite, probably belonging to large dykes, is met with here and there in the midst of this quartzite region. At a point on the west side of the lower half of the five-mile lake, crystalline diorite, dioritic schist, and a fine-grained red syenite are jumbled together and pass into each other.

Hornblende schist and pegmatite.

From the foot of the last named lake the river turns eastward for three or four miles, and flows over hornblendic schists running S. 70° E., and dipping southward at high angles. Irregular veins of fine-grained grey pegmatite, from one to six feet thick, run with the stratification, and in some parts the whole rock merges into this character. The schist is thickly spotted with granular white quartz, and many veins and patches of vitreous quartz cut both varieties of rock. Crystalline greenish-grey diorite is also exposed on this part of the river.

At the end of the above distance the river resumes its northern course, and flows for several miles among hills of syenite, which varies in colour from red to dull red and grey, in texture from coarse to fine, and in composition from quartz and feldspar with little hornblende to a mixture of almost equal parts of all three minerals. It is often mixed with irregular dykes and large masses of crystalline green diorite. Newer dykes and patches of syenite sometimes occur in the older trap. Trap dykes are met with at nearly all the falls and rapids. The rocks along the river for some distance to the northward of the syenite area consist of great alternating masses of grey quartzite and dark coloured diorite, both of which are frequently of a coarse conglomerate character, the pebbles consisting of syenite, quartzite and various Huronian slates, mostly rounded and crowded together in great bunches. These massive beds are interstratified with sandstone and clay-slate. The dip is from E. to E. N. E., at an angle of about 30°. Syenite hills. rap dykes. Massive conglomerates.

At a distance of about ten and-a-half miles by the stream from the junction of this (east) branch with the main Montreal River, these rocks are traversed by a belt of quartz veins, spreading over a breadth of a quarter of a mile. These veins vary in size from mere strings up to a width of thirty or forty feet. They run S. 70° E. and N. 70° W., and were traced for two miles west of the river, in which direction they show a tendency to converge. Some of the large ones have, in places, a brecciated character, holding fragments of syenite and slate. The majority of them contain more or less bright crystalline specular iron, and in some I found promising indications of copper pyrites. Mr. Hoffmann finds the sample of the specular iron which I brought home to contain 39·41 per cent. of metallic iron. Two miles north of its intersection with this group of veins, the river enters a lake upwards of two miles in length, surrounded by hills of massive compact green diorite. This rock is followed to the northward by hornblende schist, running N. 20° E., and dipping eastward at a high angle. Between two and three miles from the main Montreal River, the rocks on the east branch consist of dark silicious slates and quartzites, which are somewhat disturbed, but run generally north and south. Quartz veins. Specular iron and copper pyrites.

In ascending the main Montreal River from the junction of the east branch, the rocks along the west side in the first mile consist of greenish-grey silicious slaty diorite, weathering black, except where the Main Montreal River.

surface has been burnt over by forest fires, when it turns red. For the next two miles, a range of hills on the same side, consist of a rather fine-grained crystalline green diorite or syenite, consisting of feldspar and hornblende, with a very little quartz. At three miles above the junction of the east branch, there is a rapid with a portage 220 yards in length, and at about four miles and three-quarters another rapid, at which the trading posts of the Hudson's Bay Company and one Dokis are situated. The rock at the first of these rapids is a reddish-grey, crystalline, somewhat friable diorite. Eight miles further are the Falls of Matatchewan, forty feet in height, which mark the great northern bend of the Montreal River. The narrow and straight lake-like expansion of the river above the trading posts continues three or four miles past the foot of the falls, and terminates in a *cul de sac* (which does not even receive a small brook) close to the height of land separating the waters of Hudson's Bay from those of the Ottawa. The rocks along both sides of this stretch consist of compact green diorite, holding specks of iron pyrites and forming cliffs from fifty to 100 feet high. The portage past the Falls of Matatchewan is 350 yards long. At one mile above the falls a dark coloured diorite of a slaty character is exposed, but at the Beaver Portage, nearly three miles from the falls, the diorite becomes compact again. On the east side of the river, at three-quarters of a mile above Beaver Portage, there is an exposure of light greenish-grey silicious brecciated diorite, probably a volcanic ash; while at double this distance a friable reddish-grey spotted diorite occurs.

Great northern bend.

Diorite.

Mistinago Lake.

This is at the foot of Mistinago Lake, along which, for four miles, the rock is a fine-grained green diorite schist running S. 45° E., the beds being apparently vertical. This is followed, near the foot of the first island in the lake, by dark compact silicious slate, running apparently south-westward with the shores. The island referred to is two miles long. About its centre, on the east side, there is an exposure of olive to greenish-grey argillaceous or felsitic slate, the bedding of which is disturbed, but it appears to have a general south-westward strike. On the west shore of the lake, one mile south of this island, there is a bluff of greenish-grey diorite conglomerate, with smooth rounded pebbles of red syenite. The run is here due S. W., but a little further on it appears to turn south and even eastward of S. Two miles south of the island, the rock on the east side is reddish and greenish-grey silicious schist, running apparently south, the bedding being vertical, while on the west side, opposite the foot of the second island (a little further on), a greenish-grey diorite conglomerate is exposed, the pebbles of which consist of red syenite. Two miles south of the foot of the second island, which is small, the hills on the east side of the lake consist of coarse red syenite. The third island, which is also small and rounded, is formed of the same rock. On the opposite side is a massive silicious greenish-grey diorite-like rock, containing small red spots.

At the portage at the head of Mistinago Lake, the rock is of a fine-grained light red quartzite, associated with greenish silicious slate. The bedding is here nearly horizontal Two more portages occur in the next mile, at both of which the rock consists of compact greenish clay-slate, dipping N. E., < 10°. At the uppermost of these, a quartz vein three inches thick, running east, cuts the slate and carries some copper pyrites. Half a mile further on are two rapids, at both of which a similar clay-slate is beautifully stratified, and holds some pebbles of quartz and syenite, and is interstratified with thin beds (from one inch to two inches thick) of reddish quartzite. The dip is due E., < 12°. The same slate is again exposed half a mile still further on, but the dip has changed to N., < 10°. In the next eight miles, or to Pinassee's house, at the head of the expansion called Sa-wa-min-i-kong Lake, the rock consists of massive rather fine-grained greyish-red syenite, with the exception of a dyke of greenish-grey diorite at a *chute* three miles from the last mentioned locality of slate, and of an exposure of soft but massive grey or drab clay-slate, occurring on the west side, two miles north of Pinassee's. Pinassee's house.

Using Pinassee's house as a starting point of reference for distances in the next few miles, in going up the river, the next rock observed is at about one mile, where beds of fine-grained reddish quartzite with shaly layers, dip S. 10° W., < 75°. On the north-west side of the river, about a mile and a quarter further on, there is a bluff of soft, close-grained massive grey diorite. At two and one-half miles from Pinassee's there is an exposure of massive silicious greenish-grey slate, having a dioritic appearance, passing into laminated clay-slate. Silicious and clayey slates continue for the next two and one-half miles, dipping mostly E., < 20° to 30°. This is at five miles from Pinassee's, and here there is a massive bed of greenish-grey argillaceous slate, with small scales of mica in some of the partings. The rock has a strong cleavage, running S.E. Throughout the next mile and a-half the river has contracted to a width of only from three to five chains. Along the north side a surface of greenish-grey clay-slate slopes smoothly down from a height of from fifty to 100 feet and runs very straight with a dip to the south of 30° to 40°. At about six miles, following the stream, Clay slates.

Waboose (Rabbit) River enters from the south, and at less than a mile further on the great southern bend or elbow of the river is passed. Just above the junction of the Waboose, the river passes with a strong current through a narrow gap called Opanga. The rocks, which are here considerably disturbed, consist of reddish quartzite.

Great southern bend.

On the west side of the great southern elbow, the rock is a greenish-grey silicious clay-slate, sometimes finely ribboned, dipping E., < 45°. Above the elbow, the upward course of the river is N. W. for eight miles to the head of Pigeon Lake, where it again turns suddenly to the southward. Two miles above the great south elbow we come to the entrance of a very narrow lake, which runs about N. N. E., or parallel to the river below the elbow for about twelve miles, where it terminates in a *cul de sac*. All around the entrance to this lake, the rocks consist of reddish fine-grained quartzite, in beds varying from a few inches to several feet in thickness. They are interstratified with beds of greenish silicious slate, holding grains of red feldspar and transparent quartz, and dip N. 60° E. < 20° to 45°, but are disturbed in some places. At the foot of Pigeon Lake, which is about one mile further on, or three miles above the elbow, there is a portage a quarter of a mile in length, past a rapid, in which the rise is about fifteen feet. Here the rock is a fine-grained reddish quartzite, interstratified with greenish silicious slate, holding some pebbles of red syenite. The thinner beds would make good building stone. The thicker ones measure about six feet. The dip at the head of the portage is N. 65° E. < 20°.

Long narrow lake.

Good building stone.

Pigeon Lake.

Pigeon Lake is upwards of five miles long. On its north-east shore at one mile up, a fine-grained greyish-red syenite occurs. About a mile further up the same side of the lake, there is a bluff of light greenish-grey finely crystalline diorite, with disseminated grains of iron pyrites. A small island in the middle of the lake opposite to this point is composed of very dark-green serpentine, with strings of calcspar and crysotile. Fresh fractures have a somewhat mottled appearance, and occasionally present surfaces of a striated or finely columnar shining aspect. The natural surface has a rough or "lumpy" character, and weathers to a rusty colour. On analysis, Dr. Harrington finds this serpentine to contain oxide of chromium, both in the form of small grains and in chemical combination with the rest of the rock, thus resembling the serpentines of the Quebec group. In the next half mile are two more islets in the middle of the lake. The rocks of these, and of the south-west shore opposite, consist of similar and lighter green serpentine, largely mixed with calcspar, constituting

Serpentine.

in fact, a sort of limestone in the third islet. In some parts the serpentine is divided into separate pieces by thickly reticulating strings and veins of crystalline and granular light-grey calcspar, while in others the spar greatly predominates over the serpentine, leaving the latter scattered as angular fragments through the mass. Forty yards beyond the third islet is a fourth, which is composed of a beautiful porphyry, having a grey ground, very thickly speckled with opaque-white crystals of feldspar, and a few of shining black hornblende, each kind averaging about one line in length. Half-a-mile further on, or mid-way up the lake on the north-east side, there is a bluff thirty feet high, of semi-crystalline, yellowish-grey limestone, mottled with green and reddish-brown patches and full of reticulating strings of white calcspar. The weathered surface has a ferruginous crust from one half to one inch thick, showing the rock to contain a large proportion of iron. A thickness of upwards of one hundred feet of the limestone is exposed at this place, and it continues northward along the shore for a quarter of a mile or more. On the same side of the lake, a small exposure of the fine-grained, reddish quartzite occurs about one mile further on. At two miles beyond the limestone, or one-third of a mile before coming to the north-west extremity of the lake, massive reddish-grey quartzite is met with on the same shore, while nearly opposite, on the south-west side, greenish-grey clay-slate is found, dipping N.W., $< 20°$.

Limestone.

From the northern extremity of Pigeon Lake, the route which I followed passed northward over four portages and three ponds, to the eastern extremity of Kaik-kaik-ose or Little Hawk Lake. The four portages are called the Little Hawks. The first is 897, and the last 510 paces long, while each of the two intervening ones measures about one mile and a-quarter. Thick beds of red quartzite exposed on the west side of the first pond, dip E. $< 40°$. The upturned edges of a greenish-grey clay-slate, dipping E. $< 40°$, crop out along the second Little Hawk portage. At the northern extremity of the third of these portages, a greenish-drab clay-slate dips E. $< 30°$. A large angular boulder of serpentine which was observed here, indicated the existence of this rock further north. Overlooking the eastern extremity of Kaik-kaik-ose Lake, is a cliff 200 feet in height, of greyish-red fine-grained quartzite in thick beds, interstratified with others of greenish felsitic quartzite holding red grains. The dip is here E. $< 20°$ but a short distance further northward it becomes about N. E., $< 20°$. This lake lies in a north-westerly direction and is two and one-half miles in length. Greenish-grey clay-slate is exposed at two points on the north side, at one of which it holds small

Little Hawk Lake.

Quartzites.

pebbles of syenite, quartz and slate. At the outlet there is a massive light-green, felsitic, volcanic ash, marked with specks of lighter and darker colours than the matrix. Kaik-kaik-ose Lake discharges by a large brook. After flowing less than a mile, this joins another from the north-eastward, and forms the Grassy River, which, in its north-westward course of about fourteen miles to Shatagami Lake, expands frequently to form long marshes and shallow lakes.

Grassy River.

The rocks observed in this interval, consist of different varieties of greyish quartzite (sometimes of a conglomerate character) and greenish diorite. Grassy River flows out of the south-eastern extremity of Shatagami Lake, at the same cove by which it enters (the lake lying wholly to one side of the river) and joins the Mattagami River three miles below the outlet of Kenogamissee Lake. Shatagami Lake is three miles in length from S.E. to N.W., and upwards of one mile in breadth. On the west side of the narrow cove, which forms both its inlet and outlet, beds of greenish-grey clay-slate or shale, which are full of iron pyrites, are found, standing vertically, and striking S. 70°, W. About one mile up the south-west side, a soft greenish-grey rock occurs, which has a dioritic appearance, but is evidently of a magnesian character. It is rudely stratified, and beds which are on edge, run east and west. The weathered surface is very rough and uneven, being divided into angular elevations, from the wasting away of irregular calcspar strings, by which it is thickly intersected in all directions.

Shatagami Lake.

Laurentian rocks.

On the north side of Shatagami Lake, Laurentian rocks are met with for the first time since leaving Lake Huron, unless the gneiss, which has been mentioned as occurring just below Paul's Lake, belongs to this system. They consist of very massive grey gneiss, with some moderately fine-grained dark-coloured hornblendic beds. The average run of the stratification on the immediate shore of the lake, is east and west. A portage trail, five and one-half miles long, interrupted by a pond forty chains in length, about midway between its extremities, runs in a south-south-westerly course, from the northern cove of Shatagami Lake to the east side of Mattagami Lake, which it strikes about three miles north of the Hudson's Bay Companys' post, situated on the opposite shore. The trail passes over reddish-grey gneiss, which at the west-end of the half-way pond, dips S.E., < 45°. Darkly-coloured crystalline diorite, belonging to dykes, is met with in one place on each section of the portage.

Mattagami Lake extends in a nearly straight course for about nine and one-half miles south of the H. B. Company's post, and varies in

Mattagami Lake —southern part.

width from a few yards to half-a-mile. On the east side of the lake, the rocks for six and one-quarter miles from the post, consist of different varieties of gneiss, with occasional bands of hornblende schist. The stratification is sometimes disturbed, but the strike is generally from S. 70° to S. 75° W., and the dip to the southward from 75° up to 90°. At the distance stated, very massive light reddish-grey syenite with large crystals of red feldspar, is met with. This is followed by two great bands of hornblende schist, alternating with two others of dioritic schist, which fill up the interval to the narrows leading into the lagoon at the southern extremity of the lake. The strike varies from S. 25° W., to S. 80° W., the dip being south-eastward at very high angles. The hornblende schist holds veins from one foot to ten feet thick, of fine-grained grey granite, running with the strike. The rock along the east side of the lagoon consists of greenish-grey quartzite, holding transparent grains. In the northern part, the beds are massive, but southward they become more and more schistose, and have smooth surfaces and calcspar incrustations. The dip is N. 40° W., $<$ 80° to 90°. At the southern part of the exposure, a fine-grained soft, green, diorite comes in.

On the west side of this section of the lake, reddish syenite, varying somewhat in character in different places, continues from near the southern extremity to within about four miles of the post, where it is flanked on the north by dark greenish-grey hornblende gneiss, very distinctly bedded, striking S. 75° W. to due W., and dipping southward at an angle of 70° to 80°. This has a breadth of half-a-mile, and is followed to the northward by more massive varieties of gneiss.

From the southern extremity of Mattagami Lake, a portage trail one mile and ten chains in length leads south, over hills of sand and boulders, to a pond about a-quarter of a mile long, surrounded by similar hills, all covered by red and white pine.

Northern part.

Mattagami Lake forms an angle to the eastward, in the neighbourhood of the H.B. Company's post. Beyond the post, the general course of the lake is N. 12° W., with a curvature to the westward, and its width varies from a few yards to one mile. The length of this section is about sixteen and a-half miles in a straight line, so that the whole lake will measure upwards of twenty-six miles. Leaving the foot of the lake, the river takes a course bearing N. 15° E., and after flowing smoothly for between five and six miles, it plunges down a chute with a steep fall of thirty feet, followed by a rapid, giving a descent of fifteen feet more. Fishing Portage, on the west side of the river, nearly a mile in length, leads past this obstruction.

The rocks along the shores of Mattagami Lake for nine miles northward from the post, consist of massive gneiss, the strike of which varies from S.S.W. to W.S.W., the dip being usually to the S.E. side. At the above distance, reddish granite begins, and continues down the lake and river to the portage above described. The texture varies from a fine to a medium and coarse grain, all of which sometimes occur mingled together in patches, but usually the rock has a uniform coarseness or fineness over considerable areas. A great dyke of crystalline dark grey diorite, running apparently north and south, is met with at the head of the falls. Division D of the Canadian Pacific Railway exploratory line of 1873 crosses the river at this point.

About a mile and a-half below the foot of the Fishing Portage, the river enters Kenogamissee Lake, which has a total length of twenty-two miles, but is divided into two sections by a narrow neck six miles down, at which Division D of the C. P. R. exploratory line of 1871 crosses. The upper section has the same bearing as the river just above it, namely, N. 10° E., while the lower section runs more nearly north. The lake has a pretty uniform width of 400 yards, the shores of both sections being tolerably straight. Reddish granite or massive granitoid gneiss, occasionally cut by small dykes of crystalline diorite, is met with here and there for two or three miles northward of the portage, beyond which no rock was observed as far as the narrows, the shores being sandy or bouldery. The rocks of the greater part of the lower section of Kenogamissee Lake consist of massive reddish and greenish-grey gneiss, sometimes epidotic, cut by dykes of dark greenish-grey diorite. About the middle of the east side of this section, a dark-grey hornblende schist, associated with micaceous gneiss, running S. 75° E., dip northward $< 65°$, is cut by veins of fine-grained granite running north-east. A handsome flesh-coloured granite of medium grain and easily dressed, occurs on both sides of a narrow place about three miles before coming to the outlet. This granite is followed to the northward by a great breadth of crystalline schists and other Huronian rocks. It, therefore, occupies a position between the Laurentian and Huronian formations, and in this respect is like the majority of the granite and syenite areas in the great metamorphic region to the north and north-westward of Lakes Huron and Superior.

Mattagami and Moose Rivers.

In order to facilitate the geological description of the Mattagami and Moose Rivers, I shall first give a brief sketch of their leading geographical features. From the foot of Kenogamissee Lake to Moose Factory, the distance measured by straight lines along the general course of each principal stretch of the river is about 216½ miles, divided as follows:—

(1). From Kenogamissee Lake to a (first) brook at a S.E. bend, about N.E., twelve miles.

(2). From first brook to a second at a N.E. bend, about N., three miles.

(3). From second brook to a third at a S.W. bend, about W., five miles.

(4). From third brook to Muckwa Powitik (Bear Rapid), about N., sixty-six miles.

(5). From Muckwa Powitik to the foot of the Long Portage, about N. 18° W., forty-five miles.

(6). From foot of Long Portage to junction of Missinibi branch, about N. 42° E., thirty-nine and a-half miles.

(7). From junction of Missinibi branch to Moose Factory, about N. 52° E., forty-six miles.

Moose Factory is situated upon an island six or seven miles above the open bay, or mouth of the river. Eighteen portages occur in the above distance, of which the Long Portage is the last, the remaining ninety odd miles to the sea, being free from obstructions other than occasional rapids. The Long Portage was found to be about four miles in length, while the first and third portages above it measure respectively about three-quarters of a mile and a mile and one-quarter. The total fall between the extremities of the Long Portage, amounts (according to my barometer readings) to 190 feet, and that at the next three portages above to 195 feet, which, with forty feet added for the intervening spaces, would give a total descent of 425 feet in ten miles. Portages.

Immediately on leaving Kenogamissee Lake, the Mattagami River passes down a series of rapids and falls, having a descent (as calculated from the barometer readings) of 117 feet in three-quarters of a mile. The thirteen intervening portages are all short, with a comparatively slight amount of fall in the river at each. Indeed, large canoes can be taken up or down past several of them with a half-load, especially at low-water. Such places are known in the country as "demi-charges."

In each of the divisions marked (4) and (5), the river receives three considerable branches from the west and two from the east, the largest of which are the Kai-bush-ka-sing from the west, at twenty-two miles above the foot of the Long Portage, and the Ka-ko-zhishk (Woodchuck) River from the same side at five miles higher up. Below the Long Portage, the largest branches are the Missinibi, on the west side at thirty-nine and a-half miles, or forty-six above Moose Factory, and the Abittibi Sections and branches of Mattagami River.

from the east at seventeen miles above the same post. Three smaller rivers enter from the west side, between the Abittibi and Moose Factory. In regard to the above branches, it may be mentioned that the H.B. Company's establishment, known as the Flying Post, is said to be situated on a lake drained by the Ka-ko-zhishk, and that a canoe-route leads from it to the Kai-bush-ka-sing, and thence to the Missinibi River, which it joins by a brook (only about twenty feet wide at the mouth), below the "Lower Swampy-ground," to be described further on. The Ka-ko-zhishk branch is really the central trunk of the Moose River, the Mattagami and Missinibi branches running parallel to it on either side. The latter is sometimes also called the Michipicoten or the New Brunswick branch; from the fact that it forms part of the canoe-route from Moose Factory to these trading posts. The name Missinibi (Big Water), after the lake from which the river flows, is in conformity with a rule which obtains throughout the great region to the northward of Lake Superior, namely, that most rivers derive their names from the lakes at their heads. Between Kenogamissee Lake and the Long Portage, the Mattagami River does not average more than five chains in width, and consists of reaches of smooth water with rapids between, while below the Long Portage it is continuously swift and shallower, with rapids, and averages from ten to fifteen chains in breadth as far as the Missinibi branch. This character continues below the forks, from which it is almost straight, contains many islands, and increases regularly in width from a-quarter of a mile at the forks to three miles (including the islands) at Moose Factory. The channel on the east side of the factory is one mile in width.

Surface of the country.

Between the height-of-land and the rapid descent in approaching the Long Portage, the Mattagami River flows through a Huronian and Laurentian plateau, having probably an average elevation of about 1,200 feet above the sea. The general aspect of the surface is of an undulating character, but the inequalities do not often exceed one or two-hundred feet. More or less rock usually crops out in the hills and ridges, while the intervals, if not occupied by swamps or lakes, have a sandy and gravelly sub-soil, underlaid by bouldery earth or clay and having more or less vegetable loam upon the surface.

From the foot of the Long Portage to the sea, the river flows through a level region, underlaid by flat-lying unaltered rocks. In this interval the banks, which are not often high, are composed, with a few exceptions, of gravelly and bouldery earth and clay. The land immediately above the banks of the river is dry, and supports a second growth of poplar and white birch with some coniferous trees, but at a short distance back always found to be swampy and covered with small black spruces and tamaracs, growing in a deep layer of sphagnum moss. The islands and main land about the mouth of the river consist of alluvial earth well suited for cultivation.

Geology.

An account will now be given of the rocks observed between Kenogamissee Lake and Moose Factory. At the outlet of this lake, the Wa-wi-a-ton, (Round Bay) Portage on the east side of the river, leads past the falls and rapids which have been already referred to. Nearly all along the trail the vertical edges of crystalline schists are seen running N. 60° W. They consist of shining grey, nacreous mica-schist, greenish-grey silicious and dolomitic schists with rusty surfaces and edges, containing a green mineral like chlorite, which sometimes prevails so as to constitute a chloritic schist. These rocks contain veins of quartz holding crystals of highly ferruginous pearl-spar. The Huronian rocks are met with all along the river, as far as Davis' Rapid, where their junction with the Laurentian takes place. This rapid lies nearly due north (magnetically) of the outlet of Kenogamissee Lake, the distance being fifty-one miles in a straight line. The Laurentian rocks are continuous from this point to the foot of the Long Portage, a distance of seventy-three miles. This narrow neck is the only connection which may exist between the immense Laurentian areas lying on either side of Hudson's Bay, and these areas may be entirely separated by the Huronian belts between this locality and Lake Nipigon.

Junction of Huronian and Laurentian

At two miles and a-half below Kenogamissee Lake, the Mattagami River receives the Ta-ta-tchi-ka-pi-ka from the west, and half-a-mile further down the Grassy River from the east. Silicious grey slates, running W. N. W., are exposed at the junction with the former river. A fine-grained greenish-grey quartzite occurs a mile below the Grassy River, and half-a-mile further on, a bluish-grey clay-slate, of which the cleavage runs N. 80° W. This is followed to the northward by more quartzite. At the Pigeon Rapid or Sandy Portage, five and a-half miles below Kenogamissee Lake, there is a stratified, dirty, greenish-grey crystalline diorite of a somewhat schistose character. It dips northward at an angle of 80°; it is cut by irregular quartz and calcspar veins, and by strings of a bright green mineral. Below this rapid no rock was observed upon the river until reaching a point in the third of the above-mentioned reaches of the river, about two miles below the north-east bend, where grey granular felsite and silicious slates are exposed, running N. 75° W., dip northward $< 60°$. A mile further down is the Kish-ki-qua-mo Rapid with a descent of six feet. Here the rocks are grey silicious and dark bluish-grey clay-slate, with rusty surfaces, all dipping north at an angle of 60° or 70°.

uronian schists.

Half-a-mile further on, we come to the Ka-ka-bish-i (Little Owl) Rapid, with a fall of twenty-feet and a portage on the south side, fifteen chains in length. The rocks at these rapids consist of green and grey, nacreous, chloritoid and talcoid schists, dipping N. $<$ 60°. A great dyke of crystalline, greenish-grey diorite, running N. and S., or at right angles to the strike, crosses the lower part of the rapids. Near the dyke the schists are altered and have crystals of white feldspar developed in them. At half-a-mile below these rapids, the Quish-quish (Whistling) Portage, eight chains in length, is reached. The river here falls about eighteen feet over nacreous schists like the last, having also the same dip. On splitting some of the talcoid beds, the surfaces were observed to be spotted with homogeneous shining scales. The brook at the commencement of the fourth of the above reaches, enters the river from the west, about three-quarters of a mile below the Quish-quish Portage.

Four miles below the commencement of the fourth or long north-and-south reach of sixty-six miles, the Mattagami receives the Muskoota-Sagaigan (Flat Lake) River from the west. On the south side of the mouth of the latter stream, soft, tough, light greenish-grey, somewhat slaty diorite occurs, running N. 60° W., vertical, and on the other side a similar but more massive diorite is associated with chloritic schist. On the east side of the main river, thirty chains below this branch, there is an exposure of massive, grey, semi-crystalline steatitic rock, holding grains of specular iron, and cut by small veins of whitish bitter spar. This rock resembles that from which some of the ancient Indian calumets of Lake Huron and the Ottawa Valley have been carved.

pe stone.

In the next eleven miles, soft, rather light greenish-grey diorites, both massive and slaty, are exposed in several places. The slaty variety is traversed in one locality by veins of calcspar from three to ten inches in thickness, holding specks of copper pyrites. At the end of the eleven miles referred to, an outcrop of dark greenish-grey crystalline diorite, probably a dyke, crosses the river. Half-a-mile further on, there is an exposure of massive, rather dark-grey quartzite, holding specks of iron pyrites and clear quartz grains. The stratification apparently runs N. 80° W. At the end of another half-mile, a massive, light greenish-grey, silicious schist resembling diorite runs N. 75° W.

Copper pyrites.

Sturgeon Portage, four chains long, with a fall of twenty-seven feet, occurs three and a-half miles further down. The rocks here consist of hard greenish-grey, slaty diorite running N. 45° to 60° W., cut by a great dyke of dark greenish-grey, crystalline diorite, which is seen running north and south at the foot of the rapids. These rapids are remarkable for the fact that they stop the ascent of the sturgeon. The next rocks met with are at six miles below the Sturgeon Portage, where soft, greyish-green, talcoid schists are found running N. 55° W. vertical. The rock is calcareous, and is cut by strings of calcspar. The more massive-looking parts are found, on closer examination, to be divided by slaty partings into interlocking lenticular pieces.

Eight miles further down, or four miles before coming to Davis' Rapid, rocks are again met with, and consist of grey diorite or volcanic ash, holding fine sharp crystals of black hornblende, larger grains of white feldspar and small crystals of iron pyrites. The beds dip about E. N. E., and are followed immediately by greyish-green chloritic and dioritic schists.

Loon Portage, six chains long, and having a fall of about thirteen feet, is passed about a mile before reaching Davis' Rapid. The rocks at this portage consist of dark greenish-grey, hornblendic schist, granular quartz constituting about one-half of its composition. The bedding runs N. 55° W. vertical. Close to the head of Davis' Rapid, chloritic and hornblendic schists, having the same colour as the last, run N. 70° W. vertical. The fall at Davis' Rapid, which is called a "demi-charge," does not exceed six or seven feet, but the trail past it is 420 paces long. The rocks about the foot of the rapid consist of rather coarse, grey, hornblendic gneiss, dipping S. 25° E. < 88°. These are considered to mark the commencement of the Laurentian system. In the country north of Lake Superior, similar hornblendic schists are frequently found at the base of the Huronian series. Granite was not observed *in situ* at this junction of the formations, but an immense boulder of a coarse variety lies in the bed of the river at the head of Davis' Rapid.

Laurentian rocks.

As already stated, the Laurentian gneiss has a width of seventy-three miles on the river, or from Davis' Rapid to the foot of the Long Portage. In all this interval it presents few points worthy of special description. In the first twenty-eight miles, or as far as the Muckwa (Bear) Rapid, at the end of the long northward reach, it is mostly massive, seldom showing very distinct stratification; its colour varies from light to dark grey and reddish-grey, and its composition is principally feldspar and quartz, with small quantities of mica, hornblende and epidote. The strike was observed to vary in different places from S. all the way round by W. to N.W.

Characters of gneiss.

In the west north-westward reach of forty-five miles, from the Bear

Rapid to the foot of the Long Portage, the gneiss is usually distinctly bedded, and in addition to the feldspar and quartz, it generally contains considerable quantities of black mica. The prevailing strike is W., across the river, or from five to ten degrees to the north or south of that point, (more commonly the latter) and the dip, in the majority of cases, is to the northward at high angles. The most marked exception to the above rule, occurs at about five miles above the Ka-ko-zhishk (Woodchuck) River, where the gneiss runs north-westward, or with the river, and dips north-eastward at an angle of about 50°. Where we finally leave the gneiss at the foot of the Long Portage, the run, which is very straight, is N. 80° W., dip southward < 80°.

Large diorite dykes.

A conspicuous feature in the geology of the Laurentian belt just described, is the occurrence of large dykes, some of which have been noted higher up the river, of grey and dark greenish-grey, crystalline diorite. Among the localities at which they were observed, the following may be mentioned:—(1.) Yellow Fall; (2.) An island five miles below it; (3.) Smooth-rock portage; (4.) Bear Rapid; (5.) One and a-half miles below it; (6.) Ka-ti-kum-a-bik, or Ledge Rapid; (7.) At a sharp jog to the south, terminating half-a-mile above Manitou (Devil's), also called the Otter Portage; (8.) On the west side of the river, three miles from the last; (9.) Zho-men-e-neese, (Black-bird) also called Wa-ga-daning Portage; (10.) Ka-posh-kin-ik (Smoking) Falls; (11.) Foot of Long Portage. They all run north, or a little west of north, parallel with the general course of the river, with the exception of those at Smooth-rock Portage and Bear Rapid, which run north-eastward. Those marked 7, 9, 10 and 11, are probably different parts of the same great dyke. It is particularly well seen at the Blackbird and Smoking Falls portages, which are separated by an interval of only a-quarter of a mile of navigable water. The course of the dyke is N. 12° W., and it thus cuts the thinly-bedded micaceous gneiss of the country nearly at right angles, the latter running S. 85° W. The dyke here measures from 300 to 400 feet in width. It is coarser in texture, lighter in colour, and more easily denuded in the centre than towards the sides, becoming more and more dense in approaching each wall. As a consequence, the main channel of the river flows in the middle of the dyke, a smaller one running between the gneiss, on the west side, and a straight row of high islands formed out of the hard rock near the western wall. Where the dyke has been recently removed, leaving the wall-rock standing, the latter is smooth, more or less slickensided and coated with yellow oxide of iron. Between the proper sides of these dykes and the wall-rock there often intervenes a lining or "casing" of dirty-white or buff-coloured, and more or less mottled compact felsite, having a smooth conchoidal fracture. It is evidently rich in iron, as the decomposing surfaces are coated with a reddish-yellow powdery crust; it shows no effervescence, on the application of acids. In two instances, it was observed to hold small patches of strongly magnetic iron ore. These linings are, perhaps, of the nature of vein-stones, filling fissures alongside of the dykes, which had been left by the contraction of the trap on cooling. They vary from a few inches to three or four feet in thickness. At the foot of the Smoking Portage, this felsite is associated with a breccia having a soft greenish matrix. In the neighbourhood of the dykes, on this part of the river, straggling veins of whitish, compact, and also saccharoidal dolomite, weathering to a reddish-brown colour, were occasionally observed in the micaceous gneiss.

Effects of dykes on the topography,

These great dykes, of which many more, no doubt, exist in the surrounding country, have probably played an important part in producing the present geographical features of the region under description. Along the Mattagami River, and also (as already remarked) in the hydrographical basin of the Montreal River, these dykes very frequently occur at falls and rapids. The general courses of the principal stretches of the former river correspond with those of the dykes, which also coincide nearly with the direction of the glacial striæ. Mattatchewan Lake, which terminates in a *cul-de-sac* beyond the great bend of the Montreal River, is probably scooped out of an immense dyke, as it is bounded by walls of compact diorite, while a more coarsely crystalline and friable variety occurs in the centre of the valley, at the first portage below the Hudson's Bay Company's post at the foot of the lake. In my report for 1870 I referred to the relation of similar dykes to the topography of the Pic River and Long Lake region.

The general characters of the Mattagami and Moose Rivers from the Long Portage to Moose Factory have been already referred to. The banks, which usually consist of brown gravelly earth, underlaid by bluish bouldery clay, gradually diminish in height, in descending the river, from fifty feet, above high water mark, at the foot of the Long Portage, to only about ten at the junction of the Missinibi. The average difference between high and low water mark in the Moose River and its branches appears to be about ten feet, although locally it may be much greater, owing to ice jams.

The solid rock is not often seen, except under the water in the bed of the stream. Owing to the uniformly flat and undisturbed position of the strata, the river has no proper channel, but spreads out, even at low water, over nearly its whole bed, becoming, in summer, inconveniently shallow for craft no larger than canoes. Leaving the foot of the Long Portage, the first exposure of solid rock,—which is also the principal one on the river,—begins at seventeen miles, or at the head of the Grand Rapid, which is about a mile and a-quarter long, and has a fall of about twenty feet. On the northern side of the river, at the head of the rapid, there is a cliff thirty feet high, consisting of dark grey bituminous limestone, interstratified towards the bottom with earthy drab limestone, all weathering to a drab colour. Half way down the rapid, this cliff is about twenty feet, and at the bottom about forty feet in height. The thickest beds measure about two feet, and occur towards the top. A similar cliff runs along the opposite side of the rapid. The dip is south-eastward, at the rate of one in fifty to one in one hundred. Fossils are not common in these rocks.

Limestones.

Fossils.

Those collected were submitted to Mr. Whiteaves, Palæontologist to the Survey, who has furnished the following statement in regard to them:—

1. *Favosites Emmonsii*, Rominger.

"Geological Survey of Michigan, Fossil Corals," page 26, Plate VII., figs. 1 and 2.

A well preserved portion of a massive Favosite, which is precisely similar to the common species from the Corniferous of Ontario, catalogued by Mr. Billings and Dr. H. A. Nicholson as the *Favosites hemisphærica* of Yandell and Shumard. The reason why that name has been changed will be best given in Dr. Rominger's own words :—"Through misapprehension Milne-Edwards described, under the name *Emmonsia hemisphærica*, as synonymous with Yandell and Shumard's species a Favosite entirely different from the specimens originally designated by that name." "All the original specimens of *Fav. hemisph.* kept in Mr. Yandell's collection are identical with *Favosites turbinatus* of Billings." "We have to restore, therefore, the name hemisphæricus to this species, for which it originally was intended, and give to Milne-Edwards' species the name *Favosites Emmonsii*." The corallites are not filled by the matrix, and the horizontal squamæ and crowded diaphragms are, therefore, well shown. A careful study of this specimen has convinced me that the Peace River Favosite, collected by Mr. Selwyn and described on page 98, should also be referred to *F. Emmonsii*.

2. *Favosites reticulata*, Blainville.

This is the small, branching and reticulate Favosite which, like the preceding species, is abundant in the Corniferous limestone of Western Canada, and which was included by Mr. Billings as one of the varieties of *F. Polymorpha.* Out of the three sub-species into which that coral has been divided by De Blainville, it agrees best with the one named above. Only a single specimen was collected.

3. *Aulopora umbellifera*, Billings.

Quenstedtia umbellifera, Rominger.

One very well preserved example of this curiously verticillate coral. In the original description of *A. umbellifera* Mr. Billings remarks:—"It may be that this species should constitute a new genus." Dr. Nicholson has expressed a similar opinion in his first "Report on the Palæontology of Ontario," and Dr. Rominger has recently defined the genus and called it *Quenstedtia.* Unfortunately this appellation is preoccupied and cannot be retained, it having been applied by Messrs. Morris and Lycett, in 1853, to a genus of lamellibranchiate bivalves.* In order, therefore, to allow Dr. Rominger to substitute another name for *Quenstedtia*, the original designation is retained for the present.

4. *Cyathophyllum Canadense*, var.

Heliophyllum Canadense, Billings. Can. Journ., N. S., Vol. IV., page 125.

Corallum simple, short, conical, strongly curved at the pointed base, more gently arched above, widening very rapidly into a broad, open cup, with an oblique margin. Radiating septa about 144, rather more than half-a-line apart at the summit of the cup, their interstices everywhere crossed by innumerable dissepiments or concave lamellæ, which are scarcely as wide apart as the septa themselves. The septate portion of the coral is partly concealed by the matrix, and only the outer edges of the dissepiments are visible. On the outside of the coral, where the epitheca is removed and the surface worn, they appear as horizontal and concavely arched ridges crossing the rounded and riblike interseptal spaces, while on the inner face of the cup the interposition of the dissepiments between the septa produces a rather close network, whose

* "Monograph of the Mollusca of the Great Oolite." Part II., page 96. Palæontographical Society.

meshes appear nearly square to the naked eye. On a closer inspection, however, the edges of the dissepiments are seen to be concave.

The calice being partly filled with dolomite, the characters of the bottom of the cup are hidden, and the septal fossette is not exposed. The position of the latter is clearly indicated by a pinnate arrangement of the septa on the exterior, along the centre of the longest sides, and two lateral gaps are also defined by a semi-pinnate grouping of the septa above and below. No vestige of the epitheca remains, but a few rounded constrictions can be traced externally on the upper half of the specimen.

Height of the most convex side, following its curvature, three inches and a-half; height of the concave side, one inch and a-quarter; greatest diameter at the summit of the cup, two inches and eight lines.

Only a single specimen was collected, whose inner and outer surfaces are much water-worn.

After a careful study of this coral I have come to the conclusion that it is probably only a short, expanded variety of *Heliophyllum Canadense*, with exceptionally numerous septa and interseptal lamellæ. At the same time, not being altogether satisfied with the correctness of this view, I have thought it best to give a short description of the specimen. Whatever be its proper name, exactly the same variety occurs in the Corniferous formation of Ontario, and silicified examples from Port Colborne in the collection of the Survey show the characters of the interior of the cup very perfectly. The calice is rather shallow, and the septa meet in, or rather originate from its centre, where they are somewhat twisted and slightly raised. They are grouped in flat bundles of thirteen or thereabouts, and increase by interstitial additions above; their edges also are sharply denticulate. The septal fossette is clearly defined.

In Mr. Billings' paper "On the Fossil Corals of the Devonian Rocks of Canada West," he says:—"It is worthy of particular notice that no species of *Cyathophyllum* have yet been found in Canada, while the genus *Heliophyllum* affords six species." "My own impression," he adds, "is that this latter genus is only a section of *Cyathophyllum*, although, in deference to the opinion of others, I have recognized it as distinct. Dr. Rominger has recently united *Heliophyllum* with *Cyathophyllum*, and I quite agree with him in the propriety of this course.

5. *Cyathophyllum ?* species.

A piece of limestone containing a fragment of what seems to be a species of *Cyathophyllum*, scarcely distinguishable from average examples of *C. Canadense*, with its outer surface imbedded in the matrix. The specimen gives a natural and longitudinal section through the outer zone of the coral, the whole of the central area and about three-fourths of the circumference having been broken away. What remains is obviously insufficient to identify the species or even the genus by, but its shape was much more elongated than is that of the fossil last described, and it evidently had fewer septa and dissepiments.

6. *Phillipsastræa Vernueili*, Edwards & Haime.

Two fragmentary but characteristic specimens.

7. *Fenestella*, ——— ?

A mere fragment, with the minute structure too badly preserved for the species to be determined.

8. *Strophomena demissa ?* Conrad.

Two water-worn and exfoliated examples—one a ventral, and the other a dorsal valve—of a *Strophomena* of the section *Strophodonta*. They appear to me to belong to the same species as the specimens collected by Prof. Macoun at Rapid Bouillé, on the Lower Peace River, which I have doubtfully referred to *S. demissa*.

9. *Strophostylus obliquus ?* Nicholson.

"Report on the Palæontology of Ontario, 1874," page 119, Plate II., figs. 11 and 11a.

A mere cast of the body whorl, without any of the test preserved, but showing the oblique shape and peculiarly flattened whorls characteristic of this species.

10. *Macropetalicthys Sullivanti*, Newberry.*

Numerous small pieces of blackened enamel, apparently from the cranial plate or plates of a *Macropetalicthys*, and marked very distinctly on their outer surface with the peculiar stellate tuberculation character-

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* While studying this species, I have taken the opportunity to examine with some care the small series of fish remains from the Corniferous limestone on exhibition in the Survey Museum, all of which were un-named. There are apparently five species, one of which is represented only by a single large and peculiarly sculptured tooth or spine, whose generic name even I have not yet been able to ascertain, the rest seem to be as follows:—

ELASMOBRANCHII.

1. *Machairacanthus peracutus*, Newberry. Fin spines. Lot 46, Concession 1, Cayuga.
2. *Machairacanthus sulcatus* ? Newberry. Fin spines. Lot 4, Concession 4, Walpole.

GANOIDEI.

3. *Macropetalicthys Sullivanti*, Newberry. Portions of cranial plates. Rama's Farm, Port Colborne
4. *Onychodus sigmoides*, Newberry. Intermandibular crest, with remains of six teeth. The exact locality of this specimen is not known, the label being marked only "Canada West, Mr. Hagar."

istic of that genus. Similar, but much larger fragments from the Corniferous of Port Colborne, with much of the bony structure preserved and with the colour of the enamel little altered, are in the Museum of the Survey. These latter specimens and those collected by Prof. Bell are both referred to *M. Sullivanti*, not only because they accord remarkably well with the description and figures of that species in the first volume of the "Palæontology of Ohio," but also because Dr. Newberry has decided for the present to unite all the remains of *Macropetalicthys* known to him under that name.

The following were collected by Mr. Bell in the limestone *debris* near the first portage on the Missinibi River.

1. *Favosites polymorpha*, Goldfuss.

A water-worn piece of a branch of this well known species or at any rate of the Upper Canadian coral which has been catalogued under this name by Mr. Billings and Dr. Nicholson. It agrees exactly also with the figures and description of *Favosites limitaris*, Rominger.

2. *Pentamerus* (?) species.

The posterior or umbonal half of the ventral valve of a brachiopod, apparently referable to the genus *Pentamerus*. The surface is smooth, the shell is moderately convex, and seems to have been sub-circular in outline. An acute, longitudinal ridge is plainly visible in the centre of the valve, but the front part of the shell being broken off it is impossible to say how far this septum or ridge extended. The beak is of moderate size but is partly concealed by the matrix, so that it is not known whether there is any fissure or not. The shell is very unlike that of any known brachiopod from the Devonian rocks of Canada, and reminds one rather of some of the smooth European Pentameri from that formation, such as the *P. brevirostris* of Phillips.

The fossils described or mentioned above show clearly that the rocks from which they were collected are of Devonian age, also that they belong to the horizon of the Corniferous limestone.

J. F. WHITEAVES.

The blue clay at the Grand Rapid contains the first marine shells (*Tellina* and *Leda*) observed on the river. The height above the sea-level is in the neighbourhood of 300 feet. A small piece of lignite, having a bright glossy fracture, was found on the shore at the foot of the rapids.

This locality is remarkable for the occurrence of a large deposit of iron ore. Its position is on the north-west side of the river, at the foot of the rapids. It runs along the foot of the cliff for a distance of upwards of 300 yards, almost continuously, with an exposed breadth of twenty to twenty-five yards. The highest points rise about fifteen feet above the level of the river. The surface is mottled, reddish-yellow and brown, and has a rough spongy or "lumpy" appearance, like that of a great mass of bog ore. At the surface, and sometimes to a depth of several inches, it is a compact brown hematite, occasionally in botryoidal crusts, with a radiating columnar structure; but deeper down it is a dark-grey compact, very finely crystalline spathic ore, apparently of a pure quality. The brown hematite evidently results from the conversion of the carbonate. The former yields, according to the analysis of Mr. Hoffmann, 52·42 per cent. of metallic iron, while the latter shows a very small amount of insoluble matter; indeed there is, chemically, little room for impurities, since it gives rise to so rich a brown hematite. The geological relations of this singular deposit are puzzling; it may be of newer date than the limestone gorge in which it occurs. The adjacent overlooking wall of soft earthy limestone is worn into vertical caverns, with fluted and rounded walls, like the sides of great pot-holes. They are sometimes partially lined with a thin coating of a highly ferruginous carbonate. The iron ore was nowhere seen quite in contact with the rock. Iron ore.

Leaving the Grand Rapids, no rock *in situ* was observed until arriving at the "White, or Gypsum, Banks," on the main Moose River. They occur on both sides of the river, and begin at thirty-eight miles above Moose Factory. The bank on the south-east side runs for about two miles; that on the opposite side about half that distance. The gypsum consists of a bed of the ordinary hydrous saccharoidal variety, running along each side of the river and rising to a height of not more than ten feet above low-water mark. It is mostly of a light bluish-grey colour, with some whitish portions coloured or mottled with yellow and other colours. The white variety, suitable for making stucco, was not observed in sufficient quantity to be of economic value. This bed is overlaid on both sides of the river by a layer of mixed gypsum and bluish-drab marl, also about ten feet thick. The gypsum is in the form of lumps, many of which consist of transparent colourless selenite, cleavable into thin laminæ. A gypsum bank, similar to the last, runs along the south-east side of the river, between four and five miles below the extremity of the higher one on the same side. Gypsum banks.

The gypsum rests upon beds of earthy greyish and buff-coloured magnesian limestone, and in one or two places a little calcareous shale was observed resting upon it, but it is generally covered over by the superficial materials. Similar dolomitic limestones are seen along the edges and in the bed of the stream nearly all the way to Moose Factory, the dip being in the direction of the river, and at about the same rate as its descent, say ten feet per mile. The Abittibi pours into the Moose River through several rapid channels between the islands lying across its mouth. A finely granular buff-coloured dolomite occurs at these rapids which closely resembles some of the beds in the upper part of the Onondaga formation of the Saugeen River in Ontario. A species of spirifer, and what was supposed to be *Strophomena magnifica* were observed in large angular fragments of dolomite between the Abittibi River and Moose Factory.

Mouth of the Abittibi.

Rocks similar to these fragments (which are believed to be of Devonian age) are said to occur *in situ* on a creek entering the north-west side of Moose River, three miles west of the factory. In addition to the evidence afforded by the fossils and the general mineral character of the sedimentary rocks which have been described between the Long Portage of the Mattagami River and Moose Factory, their associaton with the above mentioned deposits of spathic iron and of gypsum, all go to prove them to be of Devonian age, and probably about the horizon of the Onondaga and Corniferous formations.

Devonian age.

Before returning I had an opportunity of examining the shore of James' Bay for a distance of about one hundred miles to the north-eastward of Moose Factory. I also obtained much valuable information from various officers of the Hudson's Bay Company who were well acquainted with the country around James' Bay. The southern and western shores of the bay are very low and level, and the bay itself is remarkably shallow with the exception of a channel down its centre.

James' Bay.

For long distances we found it only possible to land from a small boat at high tide. Between high tide mark and the woods there is generally a broad, open or marshy belt, interspersed with clumps of willow bushes and divided by muddy creeks. In some places this open border is raised above all but the highest spring tides, and constitutes a level prairie, supporting a rich growth of grasses and sedges. The marshy outline of the shore of the bay is often interrupted by points and peninsula-like islands, composed of boulders piled together in thousands, with scarcely any finer material amongst them.

Character of shores.

Owing to the numerous large rivers flowing into the southern portion of James' Bay, the water of this part is only brackish, and indeed in many

Brackish water.

places it is sufficiently fresh for drinking, and in some instances no taste of salt can be perceived for miles, even at a considerable distance from land. It is so shallow that a person may frequently touch the bottom with an oar, when almost out of sight of the low shore, in a small boat. The constant currents kept up by the ebbing and flowing of the tides over this shallow muddy bottom, render the water too turbid for fish to live in this part of the bay, although they are said to exist in the clearer water further out. Living sea-shells were first met with to the northward of Rupert's House, and consisted of *Mytilus edulis*, *Tellina Grœnlandica*, small myas, and two species of littorina.

Sherrick's Mount.

The first high ground met with on the eastern side of James' Bay is Sherrick's Mount, a large elevated peninsula-island. On the north-east shore of Rupert's Bay, between this locality and Rupert's River, Laurentian gneiss is exposed at several points. The colour is generally grey, and the texture rather coarse. It is composed of quartz and feldspar, with smaller proportions of hornblende and mica. The general run of the bedding varies from N. 45° W. to N. 60° W. A small island, about eighty feet high, in the middle of Rupert's Bay, called the Stag Rock, consists of reddish-grey, rather coarse gneiss, running east and west.

Rocks of east coast of bay.

The foregoing were the only fixed rocks which I observed in this region, but from information which I obtained, I should judge that a belt of Huronian schists comes out upon the East Main coast in the neighbourhood of Fort George. Further to the north, I have reason to believe that the coast for about 230 miles, or from Cape Jones, in about latitude 55°, to the south side of the promontory of Portland Point, is occupied by a series of stratified rocks, resembling the Nipigon series of Lakes Superior and Nipigon, and consisting of quartzose sandstones or quartzites, shales, flaggy argillites, bedded cherts, conglomerates, diorites and impure limestones. The conglomerates are said to be largely developed between Cape Jones and Little Whale River. At Moose Factory I was shown a pile of thick flagstones, which had been brought from an island about seven miles north of Little Whale River. This rock is a very fine-grained semi-crystalline, non-calcareous olive-grey felsite. I was given some chips of a somewhat similar but slightly calcareous rock, holding bunches of small crystals of iron pyrites, which were said to come from the same vicinity.

Minerals.

At Moose Factory, I was presented by the officers of the Hudson's Bay Company with specimens of massive iron pyrites, dark smoky chert, like that of Thunder Bay, epidosite, agate, carnelian, quartz crystals, galena, and black crystalline siderite, containing rather a large amount of manganese, all from the neighbourhood of Little Whale River. The galena is from a vein situated a few miles inland from the mouth of the river, which was at one time worked, to a small extent, by the Hudson's Bay Company. According to the analysis of Dr. Harrington, these specimens of galena contain 5·104 ounces of silver to the ton of ore. The gangue of the vein is calcspar, and the country rock appears to be a compact, finely crystalline, dark reddish-grey limestone; but the high bluffs about the mouth of the river are probably columnar trap. These bluffs form part of a high ridge which, to the south-west, runs out into a chain of islands terminating at Great Whale River; while, to the northward, this ridge appears to be continued in the long neck of land between Richmond Gulf and Nistapuka Sound. On the inland side of these is another range of high bluffs and hills also running nearly parallel with the coast. From Little Whale River a remarkable chain of long high islands runs parallel to the shore, at an average distance of three miles out, for about 120 miles to the northward. The long narrow channel inside of these islands constitutes Nistapuka Sound. The rocks of these islands, and also of the ridges along the mainland opposite, all dip to the west (or seaward) side, and present steep bluffs to the east or inland side. The whole country behind this part of the coast is described as rugged and high, but from the south side of the Portland promontory it becomes low and level as far as Mosquito Bay, forming part of the great Barren Grounds of the east side of Hudson's Bay, and indicating a different geological condition from that which obtains to the south. The rocks of this low country are probably Laurentian gneiss, with some bands of the Huronian series.

Lead mine.

Chain of islands.

Rugged country.

The remarkable chain of islands, commencing at the South Belchers, and running north for about 300 miles at a distance of nearly 100 miles from the east shore of Hudson's Bay, are described as being generally high and bold, and they have probably a common geological character, being parallel to the chain of Nistapuka Sound. They may have some connection with the north and south set of great dykes already described on the Mattagami River. To the south of the Belchers, a chain of islands runs down the same meridian as far as Charlton Island, near the head of James' Bay, making a total length of about 560 miles of islands, It may be here remarked that the ship-channel from Mansfield Island to Moose Factory, a distance of about 750 miles, lies to the west of this chain of islands, and runs due south or parallel with it.

Chains of islands.

When at Moose Factory, Captain Taylor, of the Hudson's Bay

Company, presented me with several specimens of a mineral having all the characters of a very fine anthracite, except that it contains, according to Mr. Hoffmann's analysis, only a very trifling amount of ash (*vide* Mr. Hoffmann's report, analysis number 4). The specimens were obtained by an Indian from Long Island, south of Great Whale River. I was told by Mr. James L. Cotter, of the Hudson's Bay Company, to whose intelligent observations I am indebted for much valuable information, that a similar mineral was reported by the Indians as occurring some miles inland from Little Whale River. I could ascertain nothing in regard to its mode of occurrence, further than that the Indian who brought the specimens from Long Island stated that there was plenty of it there. It appears to have resulted from the alteration of a mineral like albertite, by losing nearly the whole of its bitumen. Anthracite.

The boulders which form the points, islets, and island-peninsulas between Moose Factory and Rupert's Bay, consist of the following varieties of rock: (1) Ordinary Laurentian gneiss. (2) Dark grey (sometimes almost black), rather fine-grained quartzite, generally containing scales of mica, and often rounded and elongated spots, which weather into pits, being more easily decomposed than the rest of the rock. These boulders frequently split with a perfectly straight and even fracture across the bedding, which is seldom conspicuous. Boulders of similar rock are abundant along the Albany River, below Martin's Falls (*see* my Report for 1871).* (3) Dark greyish or blackish-green diorite, usually compact or finely crystalline. (4) Purplish amygdaloid, with small white spots widely disseminated. (5) Compact bluish or drab grey, very silicious or argillaceous limestone, with flattened nodules or lenticular layers of blackish hornstone. This rock resembles the unaltered limestone of Lake Mistassini, at the head of the Rupert River (*see* Reports of Messrs. Richardson and McOuat).† (6) Hornblendic and micaceous schists. (7) Angular fragments of soft light-grey limestone, holding an obscure *Pentamerus*. Different kinds of boulders.

THE MISSINIBI, OR WEST BRANCH OF THE MOOSE RIVER.

A description has already been given of the main Moose River, from where it divides into the Mattagami and Missinibi branches, to its mouth. An account will now follow of the route travelled from the junction of these streams, by way of the Missinibi River and Lake, and the Michipicoten River to Lake Superior. Missinibi River.

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* Geological Survey Report of Progress 1871-72, page 112.

† Geological Survey Reports of Progress 1870-71, pages 294, 295, and 1871-72, page 118.

Forks to Round Bay.

The distance from the junction of the two branches to the great bend of the Missinibi, called Round Bay (also Bull-Moose Bay), and situated four and a-half miles below the foot of the Long Portage, is, according to my plan, eighty-one miles. This section of the Missinibi may be divided into five stretches, a central and two terminal ones, each of them measuring nine miles, and having an upward course bearing nearly due west, with two intermediate stretches of thirty-three and twenty-one miles respectively, both having a bearing of about S. 57° W. The bearing of the whole eighty-one miles is about S. 67° W. In this distance, the only large stream from the south-east side is the O-pa-za-ti-ka or Poplar River (also called the Bull and Cow), which enters at the end of the second or thirty-three mile stretch. On the opposite side, five small rivers enter; the first, called the A-ta-gwaí-i-gan, at five miles; the second, the Ash River, at three and a-half miles below the Poplar River; the third at ten, and the fourth at ten and one-half miles above the same stream. The fifth is called the Wabiskagami, and enters at thirteen and one-half miles below Round Bay. The former site of (Old) Brunswick House is on the same (N.W.) side of the river, half-a-mile above the Wabiskagami, which was also called the Ka-ban-she, a name now transferred to the present Brunswick House.

Character of river.

The river, in the section above described, has a swift current, with occasionally a stony rapid, and averages eight or ten chains in width. The banks are generally low, but in many places they rise to a height of from thirty to fifty feet, and are usually composed of bluish-grey or drab clay, with boulders, pebbles, and marine shells, underlaid by blue clay, without these, and overlaid by brown gravelly and bouldery earth. In the last forty miles before reaching Round Bay, a light-coloured marl in horizontal beds was seen in some places underlying the foregoing.

Lignite.

The lignite, which is said to be seen *in situ* during very low water in the mouth of Coal Brook (which has been already mentioned) is probably associated with these marls. Fragments of lignite are strewn, often in abundance, along the bed of the river all the way from The Forks to this brook. It may occur in many places along with the light-coloured marls, which have probably the form of shallow basins, resting unconformably upon the palæozoic rocks of the great level region lying to the south-west of James' Bay. Coal Brook enters the river from the south, five and a-half miles below the great bend, and is said to be merely a small channel of the main river, which escapes from it at the head of the fourth portage. I have found fragments of similar lignite on the Mattagami, as already stated, and also on the Albany River—

Report of Progress 1871–72, page 112. It is undistinguishable from the tertiary lignite of the Dirt Hills, South Saskatchewan, described pages 77–80, Report of Progress 1873–74. Mr. Hoffmann has made an analysis of one of the specimens which I brought from the Missinibi River (see his Report, analysis No. 3). Captain Joseph Wilson, of the Sault Ste. Marie, and Mr. Thomas Richards, of Brunswick House, have both kindly sent me good specimens of the lignite of CoalBrook, above referred to.

Limestones. Above The Forks the flat-lying limestones and dolomites were nowhere seen in place, but, from the nature of the country and the abundance of their *debris* in the drift, I have no doubt they continue to Round Bay. From Round Bay to the foot of the Long Portage, the river has an upward bearing of south by west, and consists of a succession of strong rapids, giving a total rise of probably sixty or seventy feet. Throughout the whole of this interval it flows in a gorge called Hell-gate, the walls of which are sometimes 100 feet in height.

Topographical Features from the Long Portage, on the Missinibi River, to Michipicoten, on Lake Superior.

Topography. In order to facilitate the geological description of this route I shall first give a list of its principal topographical features in the order in which they are met with. The distances are measured from one to the other, so that the total length will be considerably greater than that of the general course of the route. About twenty-seven portages are usually made, but the exact number depends on the stage of the water, the size of the canoe used, and the skill of the canoemen. If a straight line be drawn from Round Bay to the outlet of Missinibi Lake, it will be found to bear S. 10½° W., and to measure about 113 miles. This represents the general course of the river, which crosses and re-crosses this line repeatedly.

Principal features. *First*—Long Portage runs south on east side of river, and is one mile long; rise between extremities about 140 feet.

Opposite head of Long Portage a river enters from the west, which is followed in going to Wabiskagami Lake.

Strong Rapid, one mile long, from head of first to foot of second portage; rise, about fifteen feet.

Second—Store-house Portage, on east side, half-a-mile long; rise, thirty-six feet.

Third—Congering-house Portage, on west side, 866 paces long; rise, eighteen feet. It is one and three-quarter miles south-east from last. Two strong rapids intervene, with a total rise of, say, ten feet.

ourth—River-side Portage, on west side, one-third of a mile above last is 673 paces long; rise, twenty feet, and five feet in a rapid just below it. Opposite the head of this portage the river gives off a small channel, said to be Coal Brook, which rejoins the river five and-a-half miles below Round Bay. The distance from Round Bay to the head of this portage is eight miles in a straight line, and the total rise is upwards of 300 feet.

Matta-wish-quai-a River, from west, seven miles south of fourth portage. The sources of this river are said to be close to those of the Wabiskagami, and also to those of one of the tributaries of the Kenogami River, a branch of the Albany, to which a canoe route passes by way of the Matta-wish-quai-a.

From last, two and a-half miles to foot of lowermost of the three Skunk Islands, opposite to which the Mukatiamik River enters from the east.

Fifth—Kettle Portage, five miles further, on west side; 100 yards long; strong rapids immediately above and below; total rise, about eighteen feet.

Tom King's Rapid, half-a-mile from Kettle portage.

Sixth—Black-feather's Rapid, three and a-half miles further (four strong rapids in the interval); usually only a demi-charge, one-quarter of a mile long, on east side; rise, ten or twelve feet.

Seventh—Rocky Island Portage, five miles from last, 160 paces across an island; rise in *chute*, ten feet.

Crow Rapid, five and a-half miles further; rise, seven feet.

Eighth—Sandy Bay Portage, on east side, five miles from last, eighty-five paces long; a smooth waterfall of twelve feet.

Ka-ka-sha-bi-ka, or Sharp-rock River, from east one and a-half miles further.

Ninth—Sharp-rock Portage, on an islet three-quarters of a mile further on; demi-charge eighty-seven paces long; rise, three feet in one short step.

Tenth—Beaver Portage, on west side, 455 paces long, two and a-half miles from last, with a short intervening demi-charge; rise in falls, thirty-six feet.

Ka-bi-sik-a-sha-ka-sing River, from west two and a-half miles further. From Round Bay to this point the general upward course of the river has been west of south. Here, however, it changes to a little east of south for thirty miles ahead. From this river to—

Demi-charge at foot of Albany Rapids, four miles.

Albany Branch from west, at head of Albany Rapids, which are one and a-quarter miles long.

The Devil's Rapid, seven and a-half miles further; rise four feet. A demi-charge of about 150 yards on east side, three-quarters of a mile above this to a—

Strong rapid half a mile long, the two worst parts of which are called The Spout and The Devil's Cap. From the head of this rapid to the—

Eleventh—Sugar-loaf Portage, a-quarter of a mile from last portage on west side, seventy-seven paces long; rise five feet.

Twelfth—Pond Portage, on east side, one-quarter of a mile further.

Small river from east, at half-a-mile.

Thirteenth—One and three-quarters of a mile further is a demi-charge (sometimes a full portage), 200 paces long on the east side, past a rapid and chute having a rise of ten feet.

Brunswick, or Ka-banshe River (the outlet of Brunswick Lake), from west two and-a-half miles further. A portage to Big Pike Lake, some five or six miles west of the river, starts in just below the Brunswick branch. Brunswick River.

Trail from river, west to a point on Brunswick Lake, opposite to the Hudson Bay Company's post on the west shore, at eight miles.

General upward course of river changes from east of south to west of south at four miles further. Here a canoe-route to Flying Post commences by a trail leaving the east side of the river.

Brunswick Portage to south end of Brunswick Lake, distant about a mile, leaves the river on the west side at six miles further; a rapid half way.

Pazhushkootai River, from west two and a-half miles above Brunswick Portage.

Fourteenth—St. Paul's Portage, on east side, 178 paces long, three and a-half miles further; steep fall of about twenty feet, called by the Indians "Thundering Water." St. Paul's Portage.

Fifteenth—St. Peter's Portage, on west side, 330 paces long, six and a-half miles from last; falls in narrow gorge of twenty-seven feet, called by the Indians "Split Rock."

Canadian Pacific Railway exploratory line crosses river at a rapid one and-a-half miles above last portage. A "reference-hub" and bench-mark here labeled 298.48 feet. C. P. R. line.

Sixteenth—Tchi-ga-qui-da-gami River, and foot of Okandaga (also called Green-hill) Portage, both on west side. This portage is 1,634 paces long, and the rise is forty-five feet. The upward course of the river makes a sudden jog, bearing east, of one and a-half miles from the foot of this portage. Between the Canadian Pacific Railway line and this portage are six rapids, two of which are demi-charges, one of them being the Calf Rapid.

Seventeenth—The Wavy Portage, on east side, at three miles from head of last; 110 paces long in high water, and 177 in low; rise, five feet. Above this portage the upward course of the river takes a remarkable turn to north north-east for two and a-half miles.

Eighteenth—Island Portage, one-third of a mile further, is 431 paces across the foot of an island a mile in length; rise, 18 feet.

Nineteenth—Foot-of-Swampy-Grounds Portage, on east side. From the last portage the distance across the northward bend is only one and three-quarter miles, but by the river it is four and a-half. Length of portage, 353 paces; rise, six feet. A brook enters from east, near head of portage.

Lower Swampy Ground.

Lower Swampy Ground, consisting of lagoons and marshes along the margin of the river, ends six miles from last portage.

Twentieth—Keg Portage (or demi-charge) on east side, 360 paces long, at four and a-half miles further; rise, six feet.

Nottawai-ainse, or Little Iroquois Brook, from west at three and a-quarter miles from last portage; three demi-charge rapids intervene, having a total rise of about thirty feet.

Flying Post Brook, from east a-quarter of a mile above last. A canoe route to the Flying Post, already referred to, leaves the river by this brook. From the mouth of the brook

The upward course of the river is south-west for four and three-quarter miles, the last three comprising the Upper Swampy Ground, at the end of which a small river enters from the south, and the course of the river bends to the north-west, forming a right angle.

Missinibi Lake.

Outlet of Missinibi Lake, four and three-quarter miles from the above angle; two demi-charge rapids in the interval. This point, as already stated, is 113 miles from Round Bay, below the Long Portage.

First hills.

The first hills seen from the rivers, since leaving Moose Factory, lie to the south of the angle at the beginning of this stretch, but from this point onward, hills of greater or less height overlook all the lakes which we traversed, and the Michipicoten River, all the way to Lake Superior.

Missinibi Lake bears S. 48° W., is twenty-four miles long, nearly straight, and varies from a-half to one and a-half miles in width. At eighteen miles from the outlet, a bay opens off the north-west side and runs back (north-east) parallel to the main body of the lake, about nine miles.

The intervening tongue of land is called Fairy Point. On the south-east side of the lake, fifteen miles from the outlet, a river falls a considerable height over the rocks into the lake. It is called Wi-a-sitch-a-wan, or "Water shining from afar."

Twenty-first—Missinibi Portage, to the north-east extremity of Crooked Lake, starts from the western bight of the nine-mile bay, above mentioned, and is 405 paces long. Crooked Lake is fifteen or twenty feet higher than Missinibi Lake, into which it discharges near this portage. Crooked Lake.

Crooked Lake, which is so-called from a sudden jog in its course, is otherwise very straight. It is eight and a-half miles long and averages less than a-quarter of a mile in width.

Twenty-second—Height-of-Land Portage, from the south-west end of Crooked Lake to the western extremity of Mattagaming (also called Dog) Lake, is low and level, and only 356 paces long. The latter lake is about twelve feet lower than the former, so that the large lakes, close to either extremity of Crooked Lake, are on nearly the same level. Height-of-Land.

Looking from the Height-of-Land Portage, Mattagaming Lake has the form of the letter T, the foot of the perpendicular portion, which runs due west, eight and a-half miles, being at the portage. The transverse portion runs north and south, and is eight miles long. At its southern extremity is the Mattagaming Lake.

Twenty-third—Little Stony Portage, 192 paces long; fall about ten feet.

Twenty-fourth—Big Stony Portage, begins half-a-mile below the last; it has a total length of 1,780 paces, but the lower third may be passed as a demi-charge; fall about seventy-two feet. Fleming's Line of 1870 crosses the foot of this portage, which is at the head of— Fleming's Line.

Lake Manitouwik, eleven miles long and three-quarters of a mile wide. From inlet to outlet it bears S. 40° W., but the lower part of the lake forms a separate lagoon, two miles in length, connected by a narrow channel with the main body. From the outlet of Lake Manitouwik to the mouth of the Michipicoten River, the stream describes one-third of the circumference of a circle, whose radius is twelve miles. The chord bears S. 63° W., and measures twenty-one and a-half miles. The convexity of the arc is to the south-eastward.

Twenty-fifth—Pigeon Portage on east side, 350 paces long; fall eighteen feet, at the head of Whitefish Lake, one mile and a-quarter below Lake Manitouwik. Whitefish Lake.

Whitefish Lake, five miles long and half-a-mile wide, forms part of the above arc.

Frenchmen's Rapid, with a fall of three or four feet at outlet of Whitefish Lake; so-called from two French servants of the H. B. Co. having been drowned here; a demi-charge trail on south-east side.

Twenty-sixth—Cat Portage on south-east side, 597 paces long, with a fall of thirty-six feet; three miles from last rapid.

She-quam-ka River from east, three-quarters of a mile below Cat Portage. Kinniwabik and Ogigaim Rivers, with an intermediate brook, all enter from the east, between two and a-quarter and two and a-half miles below last river.

Long Portage. *Twenty-seventh*—The Long Portage, on north side, commences at seven and a-half miles further. A demi-charge rapid occurs at two miles, and the Fine-sand River enters from the north, at three-quarters of a mile before reaching this point. The Long Portage is 3,704 paces (about one and two-thirds miles) in length. The total descent in the river is some 190 feet, of which about half is in a nearly perpendicular fall close to the head of the portage.

Magpie River from the north, at five miles (in a straight line) from the foot of the Long Portage. In this interval the river winds about in a triangular space between the hills to the north and south, which is occupied by great deposits of gravel and sand. The base of this triangle, measured across the mouth of the river, is about three miles; its apex is at the Long Portage.

Lake Superior. Mouth of Michipicoten River, (at Lake Superior) about one mile from the junction of the Magpie. A beautiful fall, visible from the Michipicoten, occurs on this river, a few chains up. Near the foot of the fall it receives the outlet of Lake Wawangonk, to which a trail is cut, bearing north-east, seven miles. The Hudson's Bay Company's Post at Michipicoten River is situated on the south side, nearly opposite to the mouth of the Magpie. Following the general course of each of the stretches above given, the total distance from Moose Factory to Michipicoten Post is 314 miles, according to my plan, or $281\frac{1}{4}$ miles in a straight line drawn from one to the other, bearing N. 35° 40′ E. astronomically.

Geological Features.

On the south side of the river, about a mile below the great bend, or Round Bay, a cliff about 100 feet high overlooks the river for several chains. The rocks of this cliff consist of a bluish-grey, rather fine-grained trap, with whitish and bluish-grey quartz, apparently in beds, but disturbed and mingled with a quartz and feldspar rock, like imperfect gneiss. About one-third of a mile up a brook, which enters the river at the upper end of the cliff, a grey, glistening, moderately fine-grained mica schist occurs. It is also disturbed, but the general strike is west south-west. From Round Bay to the foot of the Long Portage, the cliffs on either side consist of dark coloured crystalline schists, composed of hornblende and mica, generally mixed, but one of the minerals often predominates very much over the other. All varieties contain more or less quartz in grains. The average strike of the stratification and cleavage is east and west, and the inclination at a high angle to the south, or vertical. The cleavage is generally very even, and the mass is divided by horizontal joints. Many veins of light coloured granite run with the strike. One of them is about 100 feet thick; another fifty; many are over ten feet, while smaller ones are very common. They are made up of coarse quartz and light coloured feldspar, with some large scales of silvery mica. Black tourmalines were also observed in most of them. The above rocks may be regarded as Huronian, passing into Laurentian towards the foot of the Long Portage. From the Long Portage to a point two miles below the eighth, or Wasquagami, Portage, a distance of thirty-six miles in a straight line, the rocks consist of micaceous gneiss. The strike was taken in a great number of places in the interval, and was found to vary but little from S. 80° W., so that this Laurentian belt may be considered to have, in this section, a breadth of about thirty-three miles, at right angles to its course. It is flanked to the south by Huronian rocks, the change being marked by a more westward inclination, and a more rapid rise in the upward continuation of the river.

Hornblende and mica schists.

Granite veins.

Huronian and Laurentian.

The succeeding belt of Huronian strata continues to a point eleven miles, in a straight line, further up the river, or two miles below the Albany Branch. The breadth, however, would probably not exceed seven miles, at right angles to the strike, which varies from S. 65° W., to N. 55° W., the average being a little south of west. The rocks of this belt consist of silicious, felsitic and micaceous schists, with quartzites and diorites. A dyke of crystalline dark greenish-grey diorite, fifty feet in width, occurs at the eighth portage, and another of a similar character, and forty feet wide, at the tenth, or Beaver Portage. Here a greyish mica-schist is overlaid by a light greenish-grey quartzite. The strike is S. 70° W., and the dip northward at an angle of 75°. The river here runs on the junction of the two rocks. The grey mica-schist of the ninth, or Sharp-rock Portage, would make excellent scythe-stones.

Huronian belt.

We next meet with a band of Laurentian gneiss, measuring eight and a-half miles in width, on the general course of the river, its southern

Laurentian gneiss.

boundary being about a mile below the Devil's Rapid. In the centre of the band it is hard and massive, but towards either side it becomes micaceous and thinly-bedded. Near the north side the dip is N. 10° E., $<$ 20° to 40°, while, at its southern edge, it is S. 20° W. $<$ 80°, or towards the Huronian rocks to the north and south of it. At the latter boundary the thinly-bedded micaceous gneiss runs in a very straight course, and holds numerous crystals of garnet and black hornblende.

Huronian rocks.

This band of gneiss is followed by a belt of Huronian rocks, which, nearest their contact with it, run S. 70° W., thus forming an angle of 40° with the general strike of the former. The Huronian belt has a breadth, at right angles to its strike, of about six or seven miles on the river, its southern boundary crossing the stream at the bend marked by the junction of the Brunswick River from the west. On either side its strata consist of greyish mica-schist, while the central portion, towards the north side, shows a considerable breadth of dark grey silicious slate, and towards the south side, both fissile and massive dark green finely crystalline hornblende schist. At the *chute* called "The Spout" the silicious slate is of a blackish-grey colour, and holds a rusty dolomitic band ten feet thick.

Wide Laurentian area.

From the southern boundary of this Huronian belt, near the junction of the Brunswick River, Laurentian gneiss was found all along the rest of the Missinibi River to its source in the lake of the same name; also all along both shores of this lake, of Crooked Lake and the eastern arm of Mattagaming Lake. Huronian rocks were again first observed on the last-mentioned lake about three miles from its western extremity. This point is about seventy-three miles, in a straight line, south-south-westward from the last appearance of the Huronian rocks near the mouth of the Brunswick River.

Going southward from the northern boundary of this Laurentian area the gneiss in the exposures seen in the first twenty-four miles, in a straight line, is massive, being composed principally of feldspar and quartz, and the dip is usually to the north-westward; but in the remaining forty-nine miles, although usually massive, it is often thinly-bedded and of a micaceous and hornblendic character. In this latter part of the distance the prevailing dip is to the north-eastward, but, towards the southern side, it becomes south-westward. At St. Paul's Portage (the first below the C. P. R. line) the gneiss is fine-grained, grey in colour, and soft. Although massive, on the large scale, it is marked by fine lines of stratification, some of which are composed of black hornblende and others of small scales of silvery mica. The dip is here N. 75° E. < 60°, but the rock is divided by joints which underlie to the southward at an angle of 70°. Here a small lenticular vein of red and white quartz, from four to six inches thick, is traceable, in a N. W. direction for about twenty feet. This vein, to which my attention was directed by Mr. Thomas Richards, of Brunswick House, contains specks of yellow and magnetic iron pyrites and of molybdenite. An exposure of massive grey syenite occurs half-a-mile below the Wavy Portage. Throughout the whole breadth of the above Laurentian area dykes of dark greenish-grey crystalline diorite are met with more or less plentifully. Their direction has generally a north and south tendency.

Molybdenite.

Dykes.

From the commencement of the Huronian area, in the eastern part of Lake Mattagaming to the mouth of the Michpicoten River, the prevailing dip is to the north-eastward. This area, which contains a considerable variety of crystalline schists, is remarkable for its numerous exposures of granite and syenite. They are met with on both sides of each of the three lakes on the route, and again in a bluff from 250 to 300 feet high, overlooking the north side of the river, four miles above the head of the Long Portage. The rock at this locality is a massive light grey fine-grained granite, composed of white quartz and feldspar and black mica, On Mattagaming, Manitouwik and Whitefish Lakes, the granites and syenites vary considerably in composition, but are generally of a fine and medium-grained texture. They present every variety of colour, from light to dark grey and red, and are mostly of a good workable character.

Huronian area.

Granite and syenite.

Around Mattagaming Lake, besides the granite, a dark greenish-grey glistening hornblende schist was observed in several places along both shores, and on the islands. On the western side of the lake it has a dioritic character, and contains a considerable amount of epidote. At the Little Stony Portage at the outlet of this lake, the slates have a dioritic appearance and are rough-surfaced, fine-grained, partly massive on the large scale, dark greenish-grey, soft and calcareous.

Greenish schists.

Fissile, green, dioritic and chloritic slates are exposed along the north-west shore of Lake Manitowik. Their dip is from N. to N.W., < 60° to 70°. They are mostly calcareous, and often hold patches and strings of calcspar and quartz. Interstratifying the slates, are grey calcareous bands two or three feet in thickness, which generally present rusty weathered surfaces. These slates are associated with fine-grained flesh-coloured granite and syenite. The latter are mixed with the slates in various directions to the cleavage and bedding, and in quantities

Mixed rocks.

which vary from small masses up to bluffs one-hundred feet or more in height. The mingled slates and syenite or granite are again sometimes cut and mixed in various proportions with blackish-green crystalline diorite, the latter sometimes prevailing.

Around Whitefish Lake the rocks on both sides, as far as I observed, were exclusively flesh-coloured syenite of a medium texture, with very light grey, almost white, fine-grained granite at the upper end.

Gneiss.

Cat Portage is remarkable for the occurrence of greyish and reddish gneiss, dipping southward $< 40°$ to $60°$. The high fall at the head of the Long Portage is over grey gneiss, running N. 70° W., vertical. It is marked by spots of black mica and bluish opalescent quartz, and is cut by veins of quartz and calcspar, containing specks of copper pyrites. The gneiss of both these localities may be of Huronian age, like the rocks of the surrounding country. A bluff of massive flesh-coloured gneiss or syenite occurs on the north side of the Long Portage, about a mile west of its upper extremity. A short distance further east, a bluish diorite is exposed, while the last quarter of a mile of the portage passes over greyish, nacreous, slightly calcareous mica schist and green chloritic slates, running N. 30° W., vertical. At the foot of the portage the rocks consist of grey, glistening, calcareous, felsitic schists. They weather brown, and some of the bands, which are quite rusty, hold specks of iron and copper pyrites. Dioritic, micaceous and silicious slates were found in the hills on either side of the Michipicoten River between the Long Portage and Lake Superior.

Various schists.

Goulais River.

Goulais River.

After returning from Michipicoten, I ascended the Goulais River, in order to ascertain, if possible, the extent of the Huronian rocks which were known to occur near its mouth. This river enters the head of Goulais Bay (on the east side of Lake Superior) at the extremity of a delta, which it has formed for itself, and is remarkable for its tortuous course. Between the first fall and the mouth it winds about in an alluvial valley of a triangular form, of which the apex is at the falls, while the base, which is five miles broad, and lies at right angles to the general course of the river, is formed by the head of the bay. The first falls are about twenty miles, in a straight line from the mouth; the general upward course of the river being a little north of east.

Rocks.

The first rock which makes its appearance on the river, occurs at eight and a-half miles, in a straight line from the mouth, and consists of a dark olive-grey or drab argillaceous slate. It has a strong cleavage running N. 40° E., and underlying to the north-west at an angle of 70°, but the dip, which is marked by bands of darker and lighter shades, is south-westward at an angle of only about 20°. Further up the stream this slate is followed by a considerable breadth of dark-green crystalline hornblendic, and dark greenish-grey fine-grained dioritic schists, apparently in broad alternating bands. Their usual dip is N. 50° E., < 45°. The exact junction of the Huronian with the Laurentian rocks could not be ascertained. Between four and seven miles, in a direct course, below the first fall, the rocks consist of imperfect gneisses, containing mica-schists and fine-grained quartzose layers, which are supposed to represent beds of passage from the one to the other. At the fall itself the rock is ordinary Laurentian gneiss of a grey laminated micaceous character, dipping N. 40° W., < 30°. The descent in the river here amounts to forty feet in a succession of *chutes*.

Junction of Huronian and Laurentian.

To the westward of this fall, the junction of the Huronian rocks with the Laurentian, lying to the north of them, is supposed to occur at the head of Batchawana Bay, sixteen miles to the west-north-west, while to the east-south-east it is met with on the Mississagi River, thirty-three miles off, at a point situated twenty-two miles north of the shore of LakeHuron.

Iron pyrites.

After returning from the Goulais River I was informed that beds or veins of iron pyrites, a few inches in thickness, occur in the hills overlooking the east side of the valley at an "ox-bow," (the narrow neck of which was cut through by the river in 1873) which forms the most southern head of the stream, and is situated about eight miles in a straight line from the mouth. Some years ago I was shown a very fine specimen of a massive variety of the same mineral, which was described as coming from this neighbourhood.

Post-tertiary.

The post-tertiary deposits of the Goulais River consist of a considerable thickness of finely laminated, stiff, red clay, interstratified with grey and drab, more or less sandy clay, all resting on boulder drift, and overlaid in places by a variable depth of sand or gravel. In the lower part of the valley the red clay has, in many places, slid into the river, and at low water is found in the form of knobs, in which the laminæ are either contorted or dip at high angles. In one locality the drab clay contains great numbers of nodules, which are mostly small, flattened and circuar. At two miles, by the river, below the exposure of argillaceous slate, eight and a-half miles from the mouth, a bed of impure lignite, six feet in thickness, occurs in the north bank of the river. It rests upon red clay and is overlaid by twenty or thirty feet of grey sand.

Drift, Soil, Timber, Climate, &c.

Many of the phenomena of the superficial geology of the regions explored have been referred to in the preceding part of this report; a few points, however, remain to be noticed. Glacial striæ are almost always to be found on the surface of the harder rocks, and their course was recorded in a great number of places. All along the north shore of Lake Huron, and for some miles inland, the direction of the ice-grooves was found by Mr. Murray to be between south and south-south-west. On the whole of the route which I followed from Lake Huron to James' Bay, they rarely varied from a course lying between S. and S. 10° W. The following exceptions were observed:—A short distance below the Five-mile Lake, on the east branch of the Montreal River, their bearing was S. 20° E.; in two places, between twenty and thirty miles below L. Kenogamissee, S. 20° E., and at Smooth-rock Portage S. 5° E. No striæ were found anywhere between the Long Portage and Moose Factory, the rocks being soft and very little exposed. On the shore of the north side of Rupert's Bay they are well marked upon the gneiss, and run S. 45° W.

Glacial striæ.

From the Long Portage of the Missinibi River to Mattagami Lake the prevailing direction is south-south-west, but around this lake it varies from S. 35° W. to S. 70° W. On Lake Manitouwik it is S. 30° W., and at the last or Long Portage of the Michipicoten River, it is S. 40° W. At Wasquagami Portage two sets of striæ occur, one running S. 20° W., and the other S. 55° E. The only other exceptional case on the Missinibi River was noticed at a point about opposite the middle of Brunswick Lake, where the grooves run S. 10° E. In all parts of this great region the course of the striæ is influenced by both the general and the local contour of the country.

Surface of country.

Between the Great Lakes and James' Bay the country is of a very different character in each of the two geological areas which it embraces, namely the Laurentian and Huronian plateau, and the palæozoic and (probably) tertiary basin of James' Bay. The former is somewhat elevated, undulating and dotted with great numbers of lakes; while the latter is low, level, swampy, and, as far as known, generally free from lakes, constituting a well-marked geographical as well as geological basin, bounded by a distinct rim of hard ancient rocks for five-sixths of its circumference, since it contracts to a width of only about 200 miles, where it opens into Hudson's Bay on a line between Capes

Geological basin.

Jones and Henrietta Maria. This rim is high and has a steep slope towards the centre, all round. Owing to the unyielding nature of the rocks all the rivers running into James' Bay meet with a great and generally very rapid descent on reaching the edge of this basin. As a consequence, "the long portages" on all of them occur where they pour down this slope. The Long Portage of Rupert's River is close to the bay, while those of the Abittibi, the Mattagami and the Missinibi are met with a short distance southward of the margin of the palæozoic rocks. The Kakéami, or principal fall of the Albany, occupies a corresponding position.* The Kenogami River, flowing from Long Lake to the Albany, offers a more uniform and gentle descent into this basin than any of the other rivers which I have examined. "Long Portages."

The junction of the palæozoic with the underlying rocks to the southwest of James' Bay is not marked by great eroded depressions as it is on the southern and western limits of the Laurentian and Huronian axis, owing evidently, to the relative positions of the two classes of rocks being reversed. The ancient glaciers would pass off the almost horizontal beds in the first mentioned region without resistance from them, while on the other side of the axis their edges would be opposed to the moving ice. For the same reasons the water is found lying against the eastern but not the western margin of the palæozoic basin of James' Bay. Glacial erosion.

Although the Laurentian and Huronian plateau, between the great lakes and James' Bay, may be styled a rocky country, still, I think, the proportion of its whole area in which the bare rocks are exposed is much less than is commonly supposed. This opinion is formed after having examined it in hundreds of places, at a distance from the shores of lakes and rivers, throughout an area of nearly 200,000 square miles, between the Ottawa River and Lake Winnipeg. The high and rocky points are naturally more conspicuous in proportion to their horizontal extent than the rest of the country, while the portages, which are almost the only parts seen by ordinary travellers, are nearly always at the most rocky places in the valleys or lower levels. These circumstances combine to give casual visitors a worse impression of these regions than they deserve. Loose materials of some kind actually cover the greater proportion of the area, and in a very considerable percentage of it, the soil is more or less suited for agriculture. Its precise nature, in various sections, has been described in my reports from 1869 to the present one. As a matter of experience in this sort of country, in the district of Proportion of soil to rock.

* Geological Survey Report of Progress 1871-72, page 110.

Algoma and elsewhere, the quantity of cultivatable land, on the establishment of settlements, always proves to be much greater than it appeared while in a state of nature. In a general way there is, perhaps, a greater proportion of good soil in the plateau region northward than southward of the height of land. As to the area within the palæozoic basin of James' Bay, a too level character of the surface will prove rather a disadvantage than otherwise; for, although the land may be sufficiently elevated above the nearest river, it appears to be generally of a swampy nature, except a strip along the immediate bank of the river.

Gravel hills. In the region about the height of land, at the head of the east branch of the Montreal River, the lower levels are filled with great mounds and steep ridges of gravel and cobble-stones. The valley of this river, for some miles before it joins the main stream, is also covered with similar materials. The first limestone pebbles were observed on the Mattagami, at twenty-four miles below Kenogamisse Lake. Along the Missinibi River, for many miles above its junction with the Mattagami, a blue clay, only occasionally holding pebbles, underlies the grey and drab boulder clay, Marine shells. which is overlaid by gravel, sand and gravelly earth. Marine shells were observed here and there along this river, from the Grand Rapid, and along the Missinibi from near Round Bay, all the way to Moose Factory. They appear in most cases to be derived from a pebbly, drab clay, associated with the boulder drift. Their greatest elevation above the sea on each river would be about 300 feet, but I have found them at a height of about 450 feet, along the Kenogami River, a branch of the Albany.* At Mill Point, on the north-west side of the river, about nine miles above Moose Factory, I collected the following species from clay of this character, which was covered with water at high tide:—1. *Rhynchonella psittacea*, Gmelin; 2. *Portlandia glacialis*, Gray, (or *Leda truncata*, Wood); 3. *Leda pernula*, Moller; 4. *Cardium Islandicum*, Linn; 5. *Macoma fragilis*, O. Fabricius, (or *Tellina Grœnlandica*, Beck); 6. *M. sabulosa*, Spengler; 7. *Saxicava arctica*, Linn; 8. *Balanus crenatus*, Bruguière; 9. *Mya arenaria*, Linn; 10. *M. truncata*; 11. *Mytilus edulis*; 12. *Astarte*; 13. *Buccinum undatum*. All but the last four species above named were examined and determined by Mr. Whiteaves.

Crops. Farming and gardening has been successfully carried on by the officers of the Hudson's Bay Co. at their posts on Lakes Mattagami and Missinibi; at the latter, Mr. John McIntyre, now of Fort William, has informed me that he found spring wheat to ripen well. At Moose

* Geological Survey Report of Progress 1871-72, page 112.

Factory, although the soil is a cold, wet clay, with a level, undrained surface, farm and garden produce, in considerable variety, are raised every year. Among other crops harvested in 1874, were 1,700 bushels of good potatoes. Oats, barley, beans, peas, turnips, beets, carrots, cabbages, onions, tomatoes, &c., are grown without any more care than is required in other parts of Canada, and I was informed that some wheat which had got accidentally sown one year was found to ripen, but no experiments, as far as I could learn, have ever been made to ascertain whether this cereal might be regularly cultivated or not. Upwards of eighty head of cattle are kept at Moose Factory, besides horses, sheep and pigs.

The climate, in going northward from the height of land towards James Bay, does not appear to get worse, but rather better. This may be due to the constant diminution in the elevation more than counterbalancing for the increasing latitude, since in these northern regions a change in altitude affects the climate much more than the same amount of change would affect it in places further south. The water of James' Bay may also exert a favourable influence, the bulk of it being made up, in the summer-time, of warm river-water, which accumulates in the head of the bay and pushes the cold sea-water further north. The greater proportion of day to night, during the summer months, may be another cause of the comparative warmth of this region. I have referred to some of these points in previous reports. **Climate.**

Careful notes were kept in regard to the timber of the districts passed through, but the details would be unsuited to the present report. I may, however, mention that the species of the most importance, namely, the red and white pine, were common all the way from Lake Huron to Mattagami Lake, and ceased to be observed a short distance below Kenogamissee Lake. In coming from Moose Factory to Michipicoten they were first noticed at Missinibi Lake and were very rare between that sheet of water and Lake Superior. **Timber.**

I have the honour to be,

Sir,

Your obedient servant,

ROBERT BELL.

P.S.—Since the above report was printed I have received the following rock-specimens from the east coast of Hudson's Bay, which were kindly collected for me from rocks *in situ* by Mr. James L. Cotter of the Hudson's Bay Company, and forwarded by Dr. Malloch of Moose Factory. The localities are given in order from south to north. **Rock-specimens from Hudson's Bay.**

1. "*Paint Hills,* seventy-five miles south of Fort George."—A fine-grained, hard, dark-grey, fissile mica-schist with rusty surfaces, due to the decomposition of small grains of iron pyrites. This rock resembles a variety of mica-schist often found in the lower part of the Huronian series of the Lake Superior region.

2. "*Long Point,* thirty miles south of Fort George."—A light-grey gneiss composed of light salmon-coloured feldspar, white quartz, black hornblende and a little green epidote.

3. "*White Bear Hills,* twenty miles north of Cape Jones."—A very light-grey, rather fine-grained, binary granite, composed of bluish-grey quartz and light flesh-coloured feldspar.

4. "*Sucker Creek,* thirty miles south of Great Whale River." (This would be ten or fifteen miles north of the last locality).—A mixture of brown and red jasper with white calcspar and quartz.

5. "*Hamburg Harbour,* six miles south of Great Whale River."—This rock is made up of thin layers, averaging one-eighth of an inch in thickness, of very translucent white quartz, interrupted here and there by spots of red feldspar, and separated from each other by very thin partings of dark, chloritic material. The rock is calcareous, and in this respect resembles most of the imperfect gneisses of the Huronian series.

6. "*North Point,* mouth of Great Whale River."—A red syenite of medium texture, composed of red and white feldspar, white quartz and dark green hornblende.

7. "*Paint Islands,* Manitounik Sound, twenty-five miles north of Great Whale River."—A fine-grained, bluish-grey, argillaceous dolomite. The weathered edge of the specimen shows fine lines of stratification. It resembles the unaltered dolomite of Lake Mistassini.

8. "*Big Rock,* Manitounik Sound, thirty miles north of Great Whale River."—A very light-grey or nearly white quartzite, composed of small, rounded grains of quartz enclosing scattered specks of flesh-coloured feldspar. The rock is tinged slightly red by oxide of iron. As the strike is here evidently towards the last mentioned locality, the dolomite which has just been described is probably not far removed stratagraphically from this quartzite. In the Lake Huron region the Huronian dolomites are mostly associated with the quartzites. Quartzites or sandstones resembling this specimen are also found among the Nipigon series around Lake Nipigon and on the south-east side of Thunder Bay.

9. "*North Point,* mouth of Little Whale River."—A fine-grained green rock, holding specks of iron pyrites and grains of green epidote, and enclosing spots of bluish-white carnelian. R. B.

REPORT OF PROGRESS

IN THE

EXPLORATION AND SURVEY

OF THE

COAL-FIELDS OF CUMBERLAND COUNTY, NOVA SCOTIA,

BY

MR. SCOTT BARLOW,

ADDRESSED TO

ALFRED R. C. SELWYN, F.R.S., F.G.S.,

DIRECTOR OF THE GEOLOGICAL SURVEY OF CANADA.

SIR,—I beg to lay before you a brief statement of the progress made during the season of 1875, in the topographical and geological survey of the coal-fields of Cumberland County, Nova Scotia.

Work of previous season.

In the previous season, as you are aware, I made a topographical survey of the east side of Cheignecto Channel, from Minudie to a brook three miles west of Sand River, including the whole of the South Joggins shore. I hoped, that while making an accurate survey of this coast line, which had never been done before, I should, at the same time, have been able to study and carefully examine the rocks. I found, however, that the abrupt character of much of the coast, and the consequent necessity of taking advantage and making the most of the ebb tide, rendered it expedient that I should confine my operations, in the first instance, to the purely topographical work. This was successfully accomplished, and during the winter the whole of the measurements made were laid down, and a map constructed on a scale of twenty chains to one inch.

The Joggins section.

Last season, 1875, much of my time was devoted to a careful examination, and to making measurements of the strata included in Sir W. E. Logan's divisions, one to eight of the Joggins section; and this examination was found to be extremely valuable in connection with subsequent exploration and survey of the inland portion of the coal-field. A large collection was made of rock specimens, and of fossils from the various divisions of the coast section, and these are now in the office of the Survey for comparison with the rocks of the interior, where the general covering of superficial deposits makes it very difficult to recognize these different divisions. To prove the continuity of the coal-seams, I fixed, by careful measurements, the precise position of all the old pits, which were to be found, that had been sunk on the course of the Joggins main seam, from the shore easterly towards River Hebert village; and, in the same manner, the known out-crops in the vicinity of the Victoria and the Lawrence collieries. The road on the east side of River Hebert, from the bridge to the head of the peninsula, formed by the junction of the Maccan and Hebert Rivers, was surveyed. Here the Carboniferous Limestone, the base of the Joggins section, again crops out.

Measurements.

Shoulie River was surveyed for three miles up from its mouth, and the rock exposures noted. Various other parts of the field were visited and surveyed, and advantage was taken of the dry season to examine the beds of many of the brooks in which the outcrops, during the greater part of the year, are under water. Sufficient information has thus been secured for the construction of a number of continuous sections of the measures.

Springhill district.

In the Springhill district, the out-crop of the two feet six-inch seam, found on the south branch of the Black River, was again visited. In 1874 this outcrop had been traced by borings and shallow pits, made under the direction of Mr. J. S. Hickman, of Amherst. I now found that the distance from the river to where the work had ceased was one and one-quarter miles. The general bearing of the outcrop, from the exposure on Black River, is N. 78° W. In the various openings the following sections were measured:—Nos. 1 and 2 by Mr. James Anderson and myself, and No. 3 by Mr. Thomas Lloyd, M.E.

	ft.	in.
No. 1.—*Shaly* coal	0	3
Black, carbonaceous shale	0	7
Good coal	1	2
Black carbonaceous shale	0	8
Coal	0	4
Fire clay	0	0
Total	3	0

This was in a small slope twenty-one and a-half chains from Black River; fifteen to twenty feet deep; angle of dip 32°.

No. 2.—	*Coal*	1	9
	Black carbonaceous shale	0	11½
	Coal	0	3½
	Fire clay	0	0
	Total	3	0

In a pit thirty-four chains from Black River, visited by yourself in 1874. Mr. Anderson afterwards drove in this two feet on the dip, the angle of which is 49°.

No. 3.—Right Side.—	Soft grey shale	0	4½
	Inferior coal	0	2
	Argillaceous shale	0	2½
	Carbonaceous shale	0	4½
	Grey argillaceous shale	0	9
	Slaty coal	0	4½
	Hard coal	0	5
	Clay	0	1½
	Coal	0	3
	Fire clay	0	0
	Total	3	0½
Left Side.—	Dark grey shale	1	11½
	Inferior coal	0	8
	Fire clay	0	0
	Total	2	7½

In a slope, eighty-five chains from Black River, made by Mr. Hickman and carried down to forty feet from the surface. Angle of dip, N. 37° E. magnetic.

Early in the spring of 1875 a boring was made on the Springhill and Parrsboro Mining and Railway Company's area, with the English diamond drill, to prove the thirteen-feet six-inch seam which lies to the dip from the pit sunk on the supposed continuation of the eleven-feet seam on the south side of the fault, mentioned page 156, "Report of Progress, 1873-74." The bore-hole, which is twenty-eight chains west of the pit, above mentioned, was carried to a depth of 320 feet, and cut two seams of coal, supposed to be each about three feet in thickness, with fifty-seven feet of strata between them. The upper seam was cut at 214 feet 9 inches, and the next at 272 feet. By some persons these seams are thought to be different from any previously known. I have, however, reason to believe that they represent the thirteen-feet seam on the other side of the fault. A number of shallow borings and two or three pits Bore-hole 320 feet.

were also made, extending to about twenty chains south of the deep bore-hole. Coal was cut in some of them, but, as they were not carried through it, the thickness and quality of the seam or seams are not known. The sites of these pits and borings were carefully fixed by measurement, and the respective depths recorded. On the supposed eleven-feet seam the crop was traced, by boring, for a distance of nine chains from the pit first above-mentioned, on a line bearing S. 7° E. magnetic; and at ten chains beyond this a pit was sunk ten to fifteen feet deep, and "several" feet of coal found. As the seam was not sunk through, and as the pit was full of water at the time of my visit, I am unable to give any particulars respecting either the thickness or the quality of the coal. The dip is stated by Mr. Anderson to be S. 50° W. magnetic, < 19°. The work was done by Mr. Anderson, and directed by Mr. E. R. Sharp, secretary to the company.

Pits and borings.

On the lease to the south of the Joggins Coal-Mining Association's area, at the junction of the Joggins and Shoulie roads, about ninety chains from the coast and fifty-two chains to the dip of the Joggins main seam, a boring was made during the summer with an American diamond drill, under the direction of Mr. James Logan, of Pictou. I am informed that at a depth of 1028 feet the Joggins main seam was struck, which proves that the measures are very regular, and agree closely with the thickness, as measured on the coast by Sir W. E. Logan. The main seam had already been proved for thirty chains from the coast, and worked for fifteen or twenty chains, only three faults having been met with, the largest throwing the measures about sixty feet. Thus the object of this boring was not very obvious. Mr. Logan, however, informed me that his employers expected that the main seam would be reached at 400 feet. This I told him was impossible, pointing out that the coast section was very clear, and showed that at the lowest estimate he was 800 or 900 feet above the main seam. The average dip of the measures is 16° 30', and the calculation for the depth of the main seam at the boring gives 1010. 304 feet. Under the circumstances this work could only be regarded as a foolish waste of labour. At eighty feet, a strong spring was cut and a constant stream of good water now issues from the hole.

Bore-hole on the Joggins main seam.

Artesian spring.

Some time was spent in collecting specimens for the Philadelphia Exhibition, and after my return from the field, on the 19th of November, I was engaged plotting and arranging my own field work and that of the late Mr. Walter McOuat, in the adjoining district. The map and report of the country examined will be ready for publication next year, and

Map and report.

will embrace an area of about 500 square miles, bounded on the west by the Cheignecto Channel from Minudie to Shoulie; on the south by the Cobequid Hills; on the east, by a north and south line crossing the Intercolonial Railway near Oxford Station; and on the north by a line running west to Minudie. This area includes the whole of the productive measures of the Springhill and the Joggins coal-fields.

I have the honour to be,

Sir,

Your most obedient servant,

SCOTT BARLOW.

MONTREAL,

May, 1876.

REPORT

OF

GEOLOGICAL OBSERVATIONS IN SOUTHERN NEW BRUNSWICK,

BY

PROF. L. W. BAILEY, A.M., AND MR. G. F. MATTHEW, F.G.S.,

ASSISTED BY

R. W. ELLS, M.A.,

ADDRESSED TO

ALFRED R. C. SELWYN, Esq., F.R.S., F.G.S.,

DIRECTOR OF THE GEOLOGICAL SURVEY OF CANADA.

Sir,—I have the honour to submit herewith a report of geological observations made in southern New Brunswick during portions of the years 1872-75, by Mr. Geo. F. Matthew and myself, with the assistance of Mr. R. W. Ells.

Map. The map accompanying the report is that alluded to in your Summary Report for the years 1873-74 as being in course of preparation, embracing the counties of Queen's and Sunbury, and designed to illustrate especially the position and extent of the Grand Lake coal-fields, but including as well the metamorphic region immediately adjacent thereto.

In presenting this map the authors desire to state that they have, in its compilation, made free use of such pre-existing materials as were available for the purpose, and particularly of "Wilkinson's Map of New Brunswick," the Admiralty charts of the St. John River, and the Surveys of the Crown Lands Department at Fredericton. As these latter were, however, to a great extent deficient in minor topographical details, such as roads, small streams and other land-marks, by which the limits of the different formations could be traced, besides being the work of many different surveyors, whose results are far from being accordant, we have made a careful odometric survey of the entire district, including all the travelled roads within the counties alluded to, and the whole has been plotted, in connection with the materials above referred to, on a scale of 100 chains to an inch. From the larger map thus constructed the present one,* on the scale of four miles to one inch, has been reduced. For the use of the valuable, and, as we believe, very reliable instrument by which our measurements were made, as well as for other favours, we are under obligations, and would now return our thanks to the officials of the Crown Land Department of New Brunswick.

Measurements.

Acknowledgments for assistance.

In the determination of the geological features, special care has been taken in fixing the position of the formations, where the latter are exposed to view upon the roads which traverse them, as well as by the ascent and measurement of all practicable streams. The age assigned to the different groups, where not ascertainable by fossils, is that which, in our opinion, best accords with the general geological structure of the district as well as with the lithogical characters of the included rocks.

Having in a former report (1872-73) described in detail the distribution and peculiarities of the Carboniferous rocks, we now propose to consider the older formations which rise from beneath the latter along the southern margin of the Carboniferous area.

I have the honor to be,

Sir,

Your obedient servant,

L. W. BAILEY.

FREDERICTON, N.B.,
May, 1876.

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* The publication of the Map referred to has been deferred, as some further examination and surveying is required to render it complete.

REPORT.

The Pre-Carboniferous rocks of Queen's and Sunbury counties, which form the subject of this report, lie along a part of the southern border of the great Carboniferous area of New Brunswick. They may be divided into two principal portions, viz.:—1. *Granite*,—Which occupies most of the triangular area east of the Charlotte county line, described in the Report of Progress for 1870–71; and 2. *Stratified rocks*,—Which extend throughout a curving lenticular tract, beginning at the south-west corner of Sunbury county, and terminating on the Queen's county line, opposite the head of the Washademoak Lake. There are also several detached areas of these rocks exposed in the eastern part of the county, which will be referred to in the course of the report.

Divisions and range of formations.

Among the sedimentary rocks three formations appear to be represented, viz.:—Coldbrook Group (Huronian?), Upper Silurian and Devonian.

COLDBROOK GROUP (HURONIAN?).

Only a few outcrops of rocks, which may probably be referred to the Huronian series, occur within the limits described in this report. They appear along the southern border of Queen's county, in Hampstead and Petersville, and are a group of abrupt hills projecting through the Upper Silurian slates. Broke-neck and Blue Mountain, two of these hills, were described in the report of 1871, but there are several other hills west of these which had not then been examined. These, where they come in contact with the Silurian slates, exhibit clearly the difference in age between the two formations. Along the northern base of the westernmost of these hills, where Jones' creek flows by it, there is a clear contact. Angular points of the felsite rock project into the Silurian slates, and thus make it evident that, prior to the deposition of the latter, the felsites must have presented a broken, irregular surface, which was subsequently filled with mud of the Upper Silurian seas. In this deposit, molluscs, corals and trilobites of the period, and fragments of encrinal stems, were buried in contact with small fragments of the felsite rock. The lowest Silurian beds visible are fine-grained, white-weathering, feldspathic grits, in which small fragments of the felsite abound. At this point the layers

Hampstead and Petersville.

of the felsite rock, which is of a dark-grey colour, vary from a vertical position to a dip of S. 30° E. $<$ 70°, while the slates which rest upon them dip N. 80° E. $<$ 20°.

Synclinal structure.

The structure of these hills, so far as can be made out from the few and obscure dips obtained, appears to be synclinal, and the arrangement of them shows that in this part the Huronian rocks have been thrown into a series of low undulations nearly at right angles to the general strike of the Silurian slates.

Piskahegan River to Shin Creek.

An undulating ridge of land, of considerable elevation, traverses the wilderness country between the settlement on the Piskahegan River and Shin Creek, an affluent of the south branch of Oromocto River. Along the south side of Shin Creek this range rises boldly in steep hills, composed for the most part of hard, feldspathic rocks of various kinds, the most abundant being a quartziferous porphyry having a fine-grained paste of a dark-brown colour, replete with dull orange-red crystals of feldspar and angular grains of limpid quartz, about the size of swan and duck shot. In other varieties the paste is violet-grey or purplish-red, and many of the feldspar crystals are soft and cellular; these varieties also have cavities and fissures filled with a soft earthy, greenish-white mineral. To the west of these porphyries there are masses of dark olive-grey, porphyritic felsite, pale brown-weathering, and a hard fine-grained cream-weathering trachytic rock, having a faint reddish tinge in the fracture and possessing small geodic cavities filled with white crystalline quartz.

Felsites.

Along the northern flank of these porphyry hills from McDougall's Brook, a branch of Shin Creek, westward, there is a lower range of hills consisting of schistose rock, the constituent minerals of which are the same as those of the quartziferous porphyries; but while the grains of quartz are quite as lustrous and angular as those of the rocks in the higher hills, the feldspar crystals are entirely kaolinized, and the beds of rock pass, by increasing fineness in the size of the grains, from a dark lilac-grey, violet-weathering grit, to a dark sandstone, and finally to a purplish slate with minute grey specks. Still further west, near the source of the Piskahegan River, the same belt of rocks has, among other varieties, a grey trachyte and porphyries of a dark-red colour, with beds of dark red slate and fine-grained flinty felsite of a grey colour clouded with purple.

No ledges of diorite were observed along the northern slope of this range, for the dark basic rocks along Shin Creek belong to the overlying Lower Carboniferous formation, and are described in the Report of 1872-3, Diorite.

(pp. 187-188); but there are numerous pieces of a fine, dark diorite, mingled with felsite and orthophyre fragments in the surface drift which covers the Devonian slates south of this range of hills, showing the existence of masses of diorite among the higher eminences of the belt not yet visited. All the usual rocks of the Coldbrook-Huronian series are, therefore, present in this ridge, and arranged in such a way as to indicate that its structure is synclinal.

The rocks of this range resemble the central mass of quartziferous porphyries of Harvey in York county, described in the Reports of 1866-69, (page 180); and as in Harvey, so here, fragments of the prophyries abound in the conglomerates of the Lower Carboniferous formation at the northern base of the felsite hills. These fragments are often of large size, and are usually more or less angular.

This felsite and slate formation is uncomformable to the Devonian slates and sandstones which extend to the east, west and south of it, and probably older; but owing to the forest-clad condition of the country in which it lies, no clear case of superposition on the Devonian slates was discovered.

Ornamental stones.

Many of the feldspathic rocks of this range would yield handsome stones for ornamental purposes.

UPPER SILURIAN.

Oak Bay and Mascareen area.

In the report on the "Mascareen series" of Upper Silurian rocks submitted last year (Report of Progress, 1874–5), the thickness of the Upper Silurian slates and sandstones of Oak Bay and of the Mascareen area was given at 2,000 feet, and they fully maintain this bulk in Queen's county; but, as at Oak Bay, the thickness of the lower members is very difficult to estimate. There are no clear sections where the thickness of these slates can be measured with any approach to exactness, for when the dip can be ascertained with tolerable certainty, the beds are pitched at such a high angle that repetitions by faulting may often occur without being suspected. The thickness given below for the lowest group of the Upper Silurian series is, therefore, only approximate.

Thickness of the series.

The argillites of this series, which are at the base, and correspond to Division 1 of the Mascareen section, are amply represented in the south part of Petersville. It is supposed that there is at least 400 feet in thickness of these beds, of which the lower part is paler and more calcareous than the upper.

The beds of Division 2 have, in the southern part of Queen's county very much the same aspect as at Passamaquoddy Bay in Charlotte county, for they are largely composed of distinctly banded dark-grey and black silicious slates; but in the more northern exposures these slates are more argillaceous and more fissile, though still retaining their dark colour.

The next group (Division 3) is a more variable one. Three bands of it cross the parish of Petersville; the southernmost is a continuous one extending from Douglas Mountain, on the Nerepis River, to Sargeant Mountain, on Jones' Creek, in King's county. The great body of the rock in this band is a highly feldspathic sandstone of purplish, dark-grey colour, fine-grained, sonorous under the hammer, and breaking with a sub-conchoidal fracture. The second band appears on the Thompson road, where it is cut off by the granite, north of Douglas Mountain. It crosses Queen Brook and Long Lake, and a terminal fragment of it appears in the hill on the St. John River, next the southern side of the granite in Hampstead. At the extremities of this band, where the rocks are in contact with granite, the more silicious beds resemble those of the southernmost band in colour, hardness, &c., but in the intervening space they are of a grey colour and softer. In the northernmost band, which extends from Gaspereaux Lake, near the north-east corner of Charlotte county, to Queen Brook, the sandstone beds are grey and pyritous, and many beds of coarse, fissile black slate are intercalated with them. This band is concealed in the east part of Petersville and in Hampstead by Devonian and Lower Carboniferous rocks, but emerges on the east side of the St. John River, at Golding's landing, where it presents to view similar sandstones and slates. Division 3.

At this point in the series there appears to be added to the strata of the northernmost band a group of chloritic and feldspathic rocks, seemingly of chemical or volcanic origin, which are very prominent in the more easterly exposures of Pre-Carboniferous rocks along the southern margin of the coal-fields. Through the "dark argillites" north of the principal granitic area in Charlotte county, we have connected the main feldspathic band with Division 5 of the Mascareen section; but in Queen's county there is an additional set of beds, which swell the volume of this part of the formation much beyond the thickness observed at Passamaquoddy Bay. In the report of 1871, the strata belonging to this group of beds, which appear in Kars and Wickham, were described in connection with the Huronian formation, on account of the resemblance borne to the crystalline sediments of that group. Divisions 4 and 5.

With these additions, supposing them to be correctly placed here, the

Upper Silurian series in the south part of Queen's county may be described as follows, in ascending order :—

Tabular view of the Divisions.

		Thickness.
Division 1.	Grey clay slates, mostly of a pale colour and generally somewhat calcareous. Darker grey clay slates, some of which are carbonaceous	about 400 feet.
" 2.	Black and dark-grey, argillaceous or silicious clay slates, with very regular sedimentary bands	" 600 "
" 3.	Dark-grey and greenish-grey, (purplish near the granite) earthy sandstones ; the lower part in compact masses ; the upper part more slaty, greenish-grey and calcareous, or black and fissile	" 600 "
" 4.	Ash-grey and greenish-grey, schistose beds, generally chloritic and calcareous, sometimes amygdaloidal and dioritic	" 300 "
" 5.	Alternations of grey and dark-grey felsites (often porphyritic) with compact dark-grey, feldspathic rock, clouded with green and purple, and with beds of dark and pale-green chloritic schist. There is a mass of felsite about 150 feet thick near the base, and a breccia conglomerate at the summit	800 feet or more.

Structure.

Three principal folds.

The metamorphic region in the south part of Queen's and Sunbury counties is in part covered, in the latter, by the Upper Silurian formation. The strata are thrown into many sharp folds, among which three important axes—two anticlinal and one synclinal—have been traced. The southernmost of these runs along the north side of a spur of the Nerepis range of granite hills, and, passing between it and the small area of granite in Hampstead, extends onward to Mistake Cove in King's county. The middle axis, which is synclinal and contains Devonian beds, originates beneath the Lower Carboniferous plateau of Jerusalem, in Hampstead, and crossing the St. John River at Hampstead village, passes over into King's county, south of London settlement. The northern axis is covered by Carboniferous rocks, and only the schist and felsites on the southern slope are exposed as far east as Boyd settlement, beyond which, in English settlement, the reversed measures on the northern slope appear. Broken monoclinal strata and minor undulations fill up the spaces between these important folds.

Southern anticlinal.

An ascending series of beds may be seen on both sides of the southern anticlinal, but is most easily traced on the south side, where the slates form a broad band, extending from the northern shoulder of Douglas Mountain, past the southern face of Broke-neck Mountain, into King's county. South of these slates there is a low range of hills of Division 3 sandstones, at the base of the granite mountains. On the north side of this axis the arrangement of the strata is more complicated, for there is a synclinal at the western end bringing in the sandstones again on the line of the Thompson road, and two other synclinals, or repetitions of monoclinal beds, between this road and the Enniskillen settlement. A section of the measures on Queen Brook, in this part of the parish of Petersville, fairly illustrates the complex structure of this district. Queen Brook joins the Nerepis River about three-quarters of a mile above Fowler's falls, through or near which runs the main anticlinal which traverses the Upper Silurian measures in the south part of Petersville. The section begins where the post-road to Gagetown crosses Queen Brook. Section on Queen Brook.

	FEET.	FEET.
In ascending the stream from the bridge the measures are concealed for a distance at right angles to their strike of...		1,525
Dark-grey clay slates are the first rocks seen, and cover a space measured across the strike of....................		515
Measures concealed..................................		385
Chloritic clay slates and dark-grey, feldspathic sandstones, with obscure fossils (corals ?). Dip, N. 5°, W. < 80°..........	65	
Dark-grey clay slates. Cleavage, N. 30°, W. < 70°..........	105	
Calcareous, chloritic clay slate (having fragments of hard, grey, feldspathic rock freely scattered through it), with beds of calcareous, chloritic conglomerate and diorite	395	
	———	565
Dark-grey clay slates, dioritic beds and feldspathic quartzite in alternating beds. Dip, N. 5°, W. < 90°.............. Division 3.	550	
Hard, dioritic beds and feldspathic quartzites................	95	
Dark-grey clay slates....................................	25	
	———	670
This group is on the line of strike of the purple quartzites seen in the hills on the Thompson road, and probably comprises most of the beds in Div. 3.		
Measures concealed. [A small brook comes in on right bank]		450
Black clay slates and dark-grey clay slates, with a few beds of grey sandstone. Dip, N. 10°, W. < 80°, and N. < 70°. Cleavage of slates, N. 35°, W. < 60°....................		900
Measures concealed, except one bed of fine-grained, grey sandstone, about 100 paces from the last exposures. Dip, N. 5° W. < 75°. [This space includes the bridge on the post road to Fredericton and the dam of a grist mill]........		570
Coarse, compact, grey clay slate. Dip. N. 5°, W. < 90°......	45	
Coarse and fine-grained, compact, grey and greenish clay-slate holding fossils—*Strophomena* 4 sp. *Orthis*, *Rhynchonella*,		

		FEET.	FEET
	Spirifer, corals and trilobites. The coarser parts of this rock contain fragments of purplish-red slate, and there are thin beds of conglomerate, containing fragments of fine and coarse, black slate and of feldspathic diorite. Dip, S. 10°, E. < 75°, and N. 5°, W. < 90°. Cleavage, N. 20°, W. < 70°	65	
	Hard, compact, dark-grey, feldspathic sandstone	190	
			300

The position of these beds, if there is not a reversion of the measures, will bring them into Div. 3.

Division 4.	Coarse, compact, chloritic slate. Part of the rock is highly calcareous, the calcspar being intimately mixed with small particles of chloritic schist. The weathering out of the calcite gives these measures the appearance of volcanic ash. Dip N. 20°, W. <80°	220	
	Dark-grey, sandy clay slates, with *Pterinea* and corals. Dip, N. 10°, E. < 80	170	
			390

These chloritic schists occupy the position of Div. 4 in the Mascareen section.

Division 5.	Fine-grained, grey, epidotic felsite, with beds of dark-grey, compact, feldspathic rock and epidotic, chloritic schist: these beds are diversified with shades of green and purple	165	
	Similar rocks, but coarser and porphyritic, with dull feldspar crystals	425	
	Epidotic, chlorite schist, dioritic sandstone and epidotic felsite, less porphyritic	140	
	Grey and dark-grey, feldspathic conglomerate	135	
			865

These rocks hold the position of Div. 5 of the Mascareen section.

Devonian argillites.	Soft, grey (grey olive-weathering) clay slates	135	
	Grey, buff-weathering felsite, with scattered grains of quartz	40	
	Soft, grey (olive grey-weathering) clay slates	315	
	Fine, grey clay slate, with dyke of diorite	80	
			570

These measures except the felsite are supposed to be a part of the Devonian series of argillites.

Coarse, green clay slates	200	
Fine, green clay slates	760	
Green, fissile clay slates	160	
Pale greenish-grey clay slate (to Poplar Brook Fork)	175	
Same slates. Dip, N. 10°, E. < 80°	75	
Dark greenish-grey clay slates. Dip, S. 10°, E. < 80°	470	
Greenish-grey clay slates. Dip, S. 10°. W. < 80°	360	

	FEET.	FEET.	
Soft, pale-grey clay slates, weathering into thin laminæ. Dip, N. < 80°..........	55		
		2,255	
In this space there is supposed to be a synclinal fold doubling the thickness of the Devonian measures.			
Ledges of compact, dark-grey clay slate. Dip, S. < 80°......	220		Silurian measures repeated.
Similar hard, dark slates. Dip. S. 10°, E. < 80°............	145		
Similar slates. Dip, S. 10°, W. < 70°....................	145		
		510	
These slates are a part of the band of "dark argillite," Upper Silurian rocks, which extends westward from this point into Charlotte county.			

For the purpose of completing the examination of the country between Queen Brook and the granite range to the westward of it, a traverse was made from the Thompson road to the band of rocks last mentioned. The hill upon which this road begins to rise, at three-quarters of a mile from the corner, is nearly on the line of strike of the 670 feet of hard beds occurring on the lower part of Queen Brook. The ledges exposed on the south slope of this hill are unmistakably beds of Division 3, being dark-purplish, feldspathic sandstone or quartzite and sandy slate, with dip N. < 70°. The top of the hill is covered with forest growth, but on its northern slope there is an exposure of dark, purplish-grey, feldspathic rock (dip N. 10° W. < 90°), and dark, fine-grained and compact feldspathic conglomerate, with small fragments of grey felsite. These are probably beds of Division 5.

Traverse from the Thompson road.

A deep and narrow valley separates this hill from a gradually rising ridge of land, which extends across to the upper end of the section on Queen Brook, given above. In this depression a few ledges of dark-grey clay slate, altered apparently in consequence of their proximity to the granite, are exposed. They are hardened, and contain seams and nodules of chlorite and epidote (dip N. 25° W. < 90°). On the southern end of this ridge, about a mile from the Thompson road, the strata consist of dark, hardened slates, with beds of fine sandstone. Much of the rock is porphyritic, and portions of it are a fine conglomerate, with pebbles of slate and grey felsite. At the top of the ridge, which is nearly two miles north of this road, the rock is chiefly a dark-grey, hardened slate, seamed with quartz and with knotted veins of the same mineral. The slates, which appear speckled when weathered—probably from the presence of small fragments of felsite—have an irregular cleavage, and dip S. < 80°. None of the Devonian slates, which cover a space of half-a-mile in the section on Queen Brook, were met with in the space traversed on these hills.

Metamorphism of the slates.

Doubling of the upper groups in Cooey's Hill.

Either from the intercalation of masses of diorite, &c., or from the doubling of the strata of Divisions 4 and 5 by folding, the feldspathic and chloritic rocks have a width of half-a-mile in the east part of Petersville, at Cooey's Hill. On the top of this hill there is coarse breccia-conglomerate holding blocks from two to three feet through, and sub-angular and rounded pebbles of grey diorite, calcareous ash rock, and earthy, amygdaloidal diorite; westward of it are beds of compact, grey, slaty rock, with a few fossils, mostly joints of encrinites (dip N. < 90°), and to the eastward, on the slope of the hill facing the parish church, the following succession of beds, proceeding northward:—

Green and purplish-red clay slate, with vesicles containing spathic iron.
Black, red-weathering, flinty felsites, accompanied by argillites having purplish shining films.
Greenish-grey, dioritic schist.
Grey, somewhat calcareous, feldspathic rock, with glassy grains of quartz, and having amygdaloidal cavities filled with oxide of iron and iron pyrites.

These beds appear to be a part of the felsitic and schistose rocks of this series, and may be concealed on Queen Brook by the 570 feet of soft, grey slates on the upper part of that stream.

Extension of these groups eastward.

Half-a-mile to the east of Cooey's Hill this set of beds is concealed by Lower Carboniferous clay-stones, but it reappears again at the head of the "north" (east) branch of the Nerepis, and extends as a low ridge to Long Lake. Near Long Lake, the strata of Divisions 4 and 5 are cut off by granite, but form hills of some height on the east side of the St. John River, in King's county. Here the felsites are gneissic, contain scales of chlorite, and are of a dull grey colour like those of the Kingston series. (Reports 1870–71).

Fault at the St. John River.

The St. John River, where it enters the highlands along the southern border of Queen's county, passes through a fault or sudden twist in the Pre-Carboniferous rocks, which marks a change in the prevailing dip of the measures, which now become reversed, and dip to the southward. Three bands of these southward dipping measures, marked by the prominence of Divisions, 4, 5, &c., intervene between the coal measures and the King's county line.

Three monoclinal bands in Wickham.

The most northerly emerges from beneath the coal-measures in the south part of Henderson settlement, and extends in a ridge of moderate elevation across the county line, running in the direction of Scotch settlement, in King's county. In this belt the dip is moderate, varying from 30° to 50°. The next band is first seen on the road going out from

Golding's landing, on the St. John River, to London settlement. It crosses this road and passes through Bald Hill into King's county, at the point where the Lawson road crosses the county line. The third monoclinal band first appears on the shore of the St. John River south of Golding's landing: it comes in view again at McRea's mill-pond, in London settlement, and passes into King's county a little west of the point where the Lawson road crosses the county line. The space between the upper groups of the series in these two bands, narrows in going eastward, so that in London settlement there is a nearly continuous succession of beds of Divisions 3–5 across the two bands. In both bands the dip of the beds near the river is about S. 10° E., < 80°, but in London settlement the dip is reduced.

On the third monoclinal band, between Golding's corner in Wickham and the county line, there are nearly continuous exposures of the beds of this series, in which the strata combine the lithological characters of the "dark argillites" in the western part of Queen's county and the schists, felsites, &c., of Wickham and Johnston.

The section may be considered as begining 2,100 feet south of Golding's corner, for which distance there are no exposures, but as a valley runs inland here, we suppose it may be occupied by the clay-slates of Division 1–2. Then follow :— Section south of Golding's corner.

	FEET.	FEET.
Dull dark-grey and black, somewhat slaty and fine-grained rocks, much stained with oxide of manganese, and dipping S. 10° E., < 60°	62	
Hard and moderately coarse-grained, greenish-grey rock, resembling diorite in aspect, but earthy, and containing numerous small specks of calcite; in contact with the slates last named	151	
Measures concealed	192	
Dull grey, slaty rocks resembling the above, but somewhat sandy, and of a lighter colour. This mass consists of narrow alternating bands of compact and slaty rock, and contains grey impressions, which in their outline resemble the stems of plants. Dip S. 10° W., < 60°; and N., < 70°	213	
		618
The beds thus far may be compared with those of Division 3, especially in other exposures east of the St. John River.		
Coarsely schistose, chloritic rock-ledges in the middle of a space of	183	

Division 4.

		FEET	FEET.
	Ash-grey and greenish-grey, slaty dioritic rock, partly amygdaloidal. Dip S. 10° E., < 70°	94	
			277
	These beds resemble the schist on Queen Brook, referred to Division 4.		
Division 5.	Fine-grained, reddish and grey, white-weathering felsite, obscurely stratified.....................	161	
	Greenish-grey, schistose dioritic rock and purple amygdaloid, (having hard, white amygdules): also thin beds of soft, dark green, schistose, chloritic rock....	69	
			230
	The presence of thick beds of felsite and chloritic schists in this space mark it as part of Division 5.		
Devonian argillites.	Measures concealed..	42	
	Dark-grey to black, thin bedded argillites dip S. < 80° to 90°..	119	
	Measures concealed..	338	
	Dull grey, very thin-bedded argillites	198	
			697
	These beds correspond to those on Queen Brook, which we have referred to the base of the Devonian series.		
	Argillites like the last, but somewhat coarser, having minute brown specks, and holding slaty fragments. Both on and across the strike they acquire a purple tinge, and graduate into bright purple and green, slaty conglomerates. Dip S., < 80°..	198	
	Measures concealed..	24	
	Dull greenish-grey, (rusty and pale-weathering) schistose rock, with films of chlorite, and seams and veins of ankerite. Toward the south side this band becomes rough, with enclosed slate pebbles and numerous fragments of purplish-brown felsite..	145	
	Space occupied partly by grey argillites. Dip S., < 80°........	146	
	Very hard, fine-grained sandstones, mostly purple, but in part greenish or mottled, and having a considerable admixture of chlorite, together with veins and nodules of brown spar. Dip S., < 80°.........................	220	
	Measures concealed, except a few outcrops of smooth, glossy, pale apple-green argillites. Dip. S. 40° W., < 80°	360	
	Argillites like the last, but varying in colour from grey to greenish-grey and bluish, or sometimes pale brown and ochreous, and more or less calcareous..................	291	
			1,384
	These beds correspond in position to the green and purplish argillites visible on the upper part of Queen Brook.		
	Grey, slaty, calcareous beds, filled with films of dark-green chlorite..	300	

	FEET.	FEET.
Schistose, chloritic beds in part gneissoid, but composed of an intimate mixture of chlorite and calcite, and having included thinner beds of finely-laminated dark-green chloritic schist. Dip S. 20° W., < 80°	150	
		450

Silurian measures again.

These are supposed to be an outcrop of Silurian schists, and resemble the measures of Division 4.

Sixty rods to the south of these schists a similar but harder rock was observed in the bottom of a small ravine, beyond which, to Jones' Cove, the only measures seen were pale-grey argillites, like those of Hampstead village. Since the report of 1870-1 was written, the examination of these schistose and feldspathic rocks has been extended eastward along the southern border of the coal measures in connection with the work on the latter formation, and some very interesting exposures have been observed. The rock of Bald Hill, which is spoken of in the report referred to as a feldspathic quartzite would be more correctly designated as quartziferous felsite, for though very hard and flinty, it is white-weathering, and composed of fine-grained, cryptocrystalline feldspar, through which minute glassy grains of quartz are distributed.

Quartziferous felsites and chloritic schists.

On Albright's Brook there are greenish and purplish-grey, chloritic schists. Dip (or underlie of cleavage) S. < 30°, which are cut by a heavy dyke of intrusive, granular felsite running parallel to the strike or cleavage planes of the schists. In ascending the brook, southward to the point where the valley narrows to a gorge, a heavy band of felsite comes in view. These beds are described in the Report of 1872-3, p. 191, and are quartziferous felsites similar to those of several other ridges, visible further east in the same belt of schists. In the lower part of the stream which runs through the next settlement (Henderson), denudation of the Carboniferous rocks has exposed a garnetiferous mica schist, well crystallized, and dipping to the south at a low angle. In this settlement the felsites do not come to the surface, but a little to the eastward, where the Henderson settlement connects with the West Scotch settlement, there is a prominent ridge of them, dip S. < 40°, extending along the county line. Chloritic schists may also be seen in the East Scotch settlement, being disclosed by the removal of overlying Carboniferous sandstones about the head waters of a small stream flowing thence to Washademoak Lake. Here, however, they exhibit greater diversity both in colour and in the kind of rock, some of the beds, like those to the westward, being hard, dark-grey, flinty and porphyritic, with small particles of quartz; while others are softer and more schistose, and with colours varying from pale flesh-red to maroon; and others again are

Henderson settlement.

West Scotch settlement.

East Scotch settlement.

marked by the presence of yellowish spots and blotches. The enclosed felsite beds show that these schists dip S. 40° E., < 60°. Here, too, there are slaty and dioritic beds, similar in their general character to those of the Henderson settlement, and similarly marked with purplish and brownish-red streaks and veins; they have the appearance of being vesicular, but this, for the most part, is due to the removal, by weathering, of numerous small crystals of brown spar, which, with grains of vitreous quartz, are more or less abundantly disseminated through the mass. Similar schists, associated with fine-grained felsites, may be seen along the road traversing the Boyd settlement, and especially where this is crossed by a small stream flowing thence toward Salmon Brook. The tufaceous schists here are well stratified, and of grey and purplish colours; in some parts they are very thinly bedded or shaly, in others hard and compact, but throughout marked, as above, by the presence of enclosed particles of quartz and crystals of spar, giving to the whole a vesicular aspect. These beds dip S. 10° E. < 50. Still better and more continuous exposures of similar schists and felsites may be seen further east in the English settlement, where the removal of Carboniferous sediments along the course of several streams has brought them into view.

Boyd settlement.

English settlement.

Near the mouth of Carmichael's Brook, in the settlement last-named, the following ascending section is visible:—

	BREADTH.
Dark purplish-grey, feldspathic sandstone or ash rock, containing in part small, pale amygdules or concretionary nodules. These beds, which dip N. 50° E., < 50°, are directly overlaid and partly concealed by nearly horizontal, red conglomerates of Lower Carboniferous age, filled with pebbles of these and the succeeding rocks, but have an exposed breadth of about.....	20 feet.
Highly feldspathic, hard beds of a light colour, filled with quartz veins, and irregularly intermingled with smaller masses of soft, white, calcareous or dolomitic rock. These beds rest directly upon the last, forming a low bluff, with a surface breadth of about	30 "
Pale pistachio-green and very soft, slaty felsites, dipping N. 50° E. < 30°, and exposed for about	150 "
Measures concealed to junction with Pearson's brook	175 "
Measures concealed..	360 "
Thick beds of flesh-red, flinty felsites, containing imbedded grains of glassy quartz, and seamed in all directions with veins of the same mineral. Dip N. 45° E. < 60°	75 "
Space without exposures upon the stream, but partly occupied upon the hills above by schists similar to those described below..	725 "

	BREADTH.
Pale pistachio-green, talco-micaceous, thin-bedded, slaty felsites, very soft and tender and highly cleavable, with unctuous surfaces. Dip N. 30° E. < 30°	320 feet.
Space without rock exposures, to junction with Ryan's brook	750 "

On Ryan's Brook, a small stream, which, with Carmichael's Brook, form two of the principal tributaries of the west branch of Long's Creek, a still better view of some of the beds embraced in the above section may be seen. In ascending the stream, the first rocks met with, at a distance of not more than a furlong from its confluence with the main branch above described, are purplish-grey slates, which are throughout conspicuously banded and clouded with paler layers, often arranged in concentric, circular, and elliptical forms, and dipping northerly at an angle of about 30°; but immediately overlying these, and apparently in concordant stratification, the felsites again come into view, and rise into bluffs upon the eastern side of the stream. These, in their lower portion, and where they rest upon the slates are rather soft and coarse-grained, with a considerable admixture of a soft, pistachio-green, talcoid mica and numerous veins of quartz, in these respects, resembling some of the beds first described in the above section on Carmichael's Brook, but in the upper part of the mass, are much harder and more compact, having the same flinty character and dark-grey, red, or white-weathering colour which characterises the similar beds of the Boyd and Shannon settlements. Here, as well as in those settlements, portions of the rock are marked by a strongly columnar structure, in consequence of which it tends to break, upon exposure, into very regular polygonal and prismatic blocks. After passing these bluffs, in ascending the stream, the only rocks met with, for a distance of about sixty rods, are Lower Carboniferous, red sandstones and conglomerates, filled with pebbles of quartziferous porphyry, grey amygdaloid, slaty felsite, &c., and having a very low dip (about N. < 4°); but towards the upper part of the stream the felsites again appear, and near where the brook is crossed by the county line, rise abruptly from its bed into hills from 150 to 200 feet in elevation. **Ryan's Brook.**

Between the junction of Ryan's Brook with the main stream of the South-west branch and the point where the latter is joined by Lunn's Brook, the distance is about 400 rods. Along this portion of its course the valley watered by the main stream is somewhat broader and mostly occupied by meadow-land, having been excavated chiefly from sandstones of the coal formation, which crown the hills upon either side, and which at one point form a series of low bluffs near the edge of the stream.

The brook is, however, crossed at several places by reefs of the older rock, consisting, for the most part, of felsites or quartziferous porphyries similar to those described above, but associated with talco-feldspathic schists thickly spotted with small, pale, oval blotches. Similar beds are also seen upon Lunn's Brook, where the associated schistose beds cover a larger space, and the succession is more complete; this stream, indeed, from the vicinity of the bridge on the post-road to its mouth, a distance of three-quarters of a mile, affording an almost continuous section of the underlying strata. The succession is an ascending one.

Section on Lunn's Brook.

	Approximate thickness of the beds.	Traverse measured along the brook in ft.
Felsites, pale red and fine-grained	20	
Space without exposures	140	
Space mostly occupied by fine-grained, pink and red felsites, but including a low bluff of greenish-grey, feldspathic rock, clouded with shades of green and red	561	320
	721	
Space without exposures	66	
Purplish-grey, feldspathic slates, spotted with paler ovoidal blotches. Dip N. 40° E., < 30°	26	
Space without exposures	165	
Grey and rather coarse-grained, feldspathic slates, more or less clouded with purple	96	
	353	160
Grey, slaty felsites. Dip N. 60° E., < 25 to 30°	291	120
Space without exposures	560	
Grey, feldspathic schists and slaty felsites. Dip N. 60° E., < 10° (N.B. The stream here makes a deep and wide bend)	361	100
Fine-grained, very pure and slaty, flesh-red felsites. Dip N. 60° E., < 20°	52	
Space having beds of grey felsite near the middle	348	
Grey slaty felsites	20	
Space without exposures	70	
Felsite, hard, fine-grained and flinty, more or less schistose, (a bluff about fifty feet high), the colour varying from pale red to black	177	
Pale red felsite well stratified. Dip N.E., < 50°	24	
	691	400
Space without exposures	75	
Purplish-grey, feldspathic schist. Dip N.E. < 49°	170	
Hard, grey felsites, having a considerable admixture of soft, yellowish-green talcoid matter, forming the inferior portion of a low bluff, above which are bright green, slaty conglomerates, with fragments of green and red slate. These slaty beds are well stratified in rather thin layers, and dip N.E. < 30°	32	150
	277	1250

The conglomerates are the last layers visible on Lunn's Brook, which here joins the main stream. Further down the stream, at the bridge above McLean's mill, other conglomerate beds appear. They consist of large rounded fragments of greenish-grey, feldspathic rock, firmly imbedded in a paste of similar composition ; the conglomerate beds alternate with others that are finer and more homogeneous; and both fine and coarse beds abound with small vesicles containing calcite, as well as disseminated crystals of the same mineral, which by weathering, give to the rock a vesicular appearance. These crystals and grains of calcite are scattered indifferently through both the pebbles and the matrix of the rock. McLean's mill.

It is quite possible that in this section on Lunn's Brook there are one or more repetitions by faulting, since, upon the St. John River we have not found more than one great mass of felsite. This feldspathic member there attains a thickness of 175 feet, but seems even more massive in the eastern part of Queen's county.

In addition to the more considerable areas described above, scattered outcrops of Upper Silurian rocks are disclosed at several points by the denudation of Carboniferous sediments along the southern border of the coal-field. Of these exposures, those occurring along the course of the Canaan River and its tributary, the North Fork, have been described in the Report of Progress for 1872-3. It only remains to consider those similarly exposed upon Long's Creek and upon Thorn's Brook ; both affluents of the Canaan River from its southern side.

Of the two branches which continue to form Long's Creek, the south-west branch has, upon an earlier page, been described as having cut its way through Carboniferous sediments down to hard feldspathic and petrosilicious beds, which also appear upon its tributaries Lunn's and Ryan's Brooks, and again near the confluence of the two main streams at McLean's mill. On the north-east branch no schists or felsites are met with, but while Carboniferous rocks are conspicuous along much of its length, and are the only surface beds seen in the settlement of Goshen, there are also disclosed some which very nearly resemble the ordinary Upper Silurian rocks of Division 3, as seen in the western part of Kars and Wickham. The best exposures are at a fall of the stream a few rods north of the point where it is crossed by the road to Leonard's mill, and embrace a considerable thickness of very hard and flinty, but highly feldspathic and white-weathering slates, alternating with others which are of a darker colour and contain much pyrites. Their dip is N. 30° W., $< 40°$. At the junction of Chapman's and Leonard's Brooks, and again upon the latter, North-east branch of Long's Creek.

are other slates and feldspathic quartzite, which are a part of the same series, but these are here more highly altered, often approaching a diorite in aspect, a circumstance probably due to their being penetrated at numerous points by dykes and veins of diorite and syenite, and which, at the extremity of the settlement are the only rocks visible.

Thorn's Brook.

Thorn's Brook, the only remaining stream to be considered, taking its rise in the parish of Havelock, in King's county, and flowing easterly for some miles, nearly parallel to the county line, enters the county of Queen's near its eastern extremity, and about a mile and a-half below where this line is crossed by the post road at Fowler's mill. For a distance of nearly three-quarters of a mile above this mill the stream is bordered by high bluffs, composed for the most part of a very hard and compact sandstone, in colour varying from grey to dark grey, and containing numerous small black specks, which, together with the colour, give to the rock something of the aspect of a diorite. Many of these specks are in reality crystalline scales of black mica, but with them are often met larger fragments of black slate imbedded in the rock, and the whole is probably of mechanical origin. This is further indicated by the alternation of these dioritic-looking beds with unmistakeable sandstones, as well as with slates, also hard and of a dark-grey colour, frequently pyritous, and dipping N. 50° E. < 25°.

Dark argillites.

Similar slates are met with at and below the mill, but while equally hard and pyritous, they are here quite black and somewhat plumbaginous, the dip being N. 15° W. < 25°. The course of the stream below the mill is very irregular, but in the course of its windings exhibits frequent exposures of similar beds (grey and dark-grey slates and sandstones), until covered by the nearly horizontal pale-grey sandstones of the coal-measures, about a mile above the confluence of this brook with Canaan River. Many of the argillites occurring here, in the fact of their being thickly studded with dull-grey specks, apparently indicating an incipient crystallization of a portion of their constituents, nearly recall some of the beds exposed on Fannen's Brook, and again on Patterson Brook on the west side of the St. John River. They are referred to the same horizon as the quartzites on the north-east branch of Long's Creek. The peculiarity in question, as well as the hardness and somewhat dioritic aspect of portions of the rock, are probably due, in part at least, to the proximity of masses of intrusive granite, one of which, of a coarsely porphyritic character and containing enclosed fragments of dioritic sandstone, forms a low bluff at the lower part of the stream, being the last exposure visible before entering the valley of Canaan River.

Intrusive granite.

LOWER SILURIAN.

There would appear to be a Lower Silurian formation on the north as well as the south side of the granitic range in Charlotte and Queen's county; for although we could not separate any slates of this age from the Upper Silurian rocks, by the evidence of fossils, small fragments of black slate, which in all probability originated from an older formation, are abundantly scattered through many of the Upper Silurian conglomerates from Petersville, in Queen's county, to St. Stephen, in Charlotte county. These fragments are often carbonaceous and sometimes soft, though usually flinty, and are mingled with quartz pebbles and with small pieces of felsite, earthy diorite and purplish-red slate.

DEVONIAN.

Certain stratified rocks, described in the report of 1871 as "pale argillites," form a part of the Pre-Carboniferous hills in the south part of Sunbury and Queen's county. They resemble, lithologically, the Cordaite group of St. John county in their pale greenish-grey colour, frequent alternations of clay slate and slaty sandstones, and in the calcareous nature of many of the beds. They cover wide areas around and beneath the coal measures, and are almost everywhere distinguished by an abundance of scales of mica distributed through the rock. Previously described as "pale argillites."

A description of the several groups in this formation will be found at p. 197 of the Report for 1870-71, but to the base of the measures described here should be transferred the "black shales with obscure plant remains" mentioned in connection with Div. 3 *c*. on page 191. This formation is probably quite as thick as the Upper Silurian, though owing to the more uniform aspect of the beds, the thickness of the different members cannot be made out with so much certainty. The slates ("Div. 4" of the report cited) alone on Queen's Brook and near Golding's landing, appear to be as much as 1,500 feet thick, and the upper group, which does not appear in these sections ("Div. 5" of same report) containing the magnesian sandstones, is apparently very much thicker.

These slates and sandstones enter the region described in this report at the western angle of Sunbury county and at Brown Ridge, where their presence has been recognized by the nature of the soil, by loose fragments in the soil and in excavations made for wells. They abut against the orthophyre hills of Shin Creek, and reappear on the lower part of the stream beyond these hills. Here the beds dip N. 10° E. < 80°, and the formation shows a considerable breadth in Sunbury county; at its Distribution. Two principal bands of slate.

eastern border, the Devonian belt is five miles wide, and rises into prominent, rolling ridges, covered with thriving settlements. From this point it gradually decreases in width, until at Kelly's Brook, fork of the Nerepis River, it does not exceed a mile. Here the Devonian ridge is cut through by the river. The eastern end of the ridge, beyond the river, is nowhere more than two miles wide, and near the parish line of Gagetown it disappears entirely beneath the Lower Carboniferous plateau in Jerusalem settlement. Another considerable band of these slates is involved in the folds of the Upper Silurian rocks in Petersville, Hampstead and Wickham, and is described in connection with the sections of that formation on Queen Brook and south of Golding's landing. Other smaller outcrops appear among the Lower Carboniferous and coal measures to the north, as in Clones, on the north side of the Nerepis River, and at Coal Creek, north-east of Grand Lake, in the parish of Chipman—the east part of the Newcastle coal field. Again, on the north side of Grand Lake, in the centre of the Newcastle coal field,—where several borings have been made to test the productiveness of the coal measures—similar slates have been struck, at depths varying from 200 to 400 feet beneath the surface.

Ridges in the centre of the coal measures.

Throughout both the principal bands of slate and sandstone of this age in the south part of Queen's and Sunbury counties, the dip of the beds is very high, and in many places nearly or quite vertical. The lower dips, by which the relations of this group to the Upper Silurian were ascertained, are in Charlotte county.

Plant remains.

There is little to add to the description of these rocks given in the report of 1871, except to notice the occurrence of plant remains at one or two points within the limits described in this report. Certain plants of this formation, discovered at Cox's Brook, in Charlotte county, are noticed in the report referred to. The most distinct of these is a fragment of a small *Lepidodendron*. Patterson Brook, within the limits of Queen's county, has also furnished some poorly preserved remains, among which a greater variety of forms occur, such as *Cordaites*, *Neuropteris* and *Cardiocarpum*. Other glazed or graphitized impressions have been found in the slates of the small outcropping ridge at Coal Creek, north-east of Grand Lake, but are too obscure to be determined.

REPORT

OF

EXPLORATIONS AND SURVEYS IN CAPE BRETON, NOVA SCOTIA,

BY

HUGH FLETCHER, B.A.,

ADDRESSED TO

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

DIRECTOR OF THE GEOLOGICAL SURVEY OF CANADA.

SIR,—In the spring of 1875 I received instructions from you to continue the survey of the Sydney coal-field, particularly with a view to the determination of the age of the Pre-Carboniferous rocks in this region, and also to make a collection to represent the economic minerals of Cape Breton at the Philadelphia Centennial Exhibition.

Country surveyed.

The summer, consequently, was spent in the examination of the country lying between Sydney River and St. Anne Harbor; further surveys were also made of the Carboniferous rocks east of Sydney Harbor, to elucidate certain doubtful points of structure, the results of which, being embodied in a map already published, (Report for 1874-5) will not again be adverted to. A visit to a copper-ore deposit at Gabarus Bay afforded an opportunity of examining the eastern Atlantic coast, from Gabarus to Louisburg, and of comparing the rocks described by you in the Report for 1874-75, p. 9, with those met with further west. Some attention was also paid to the iron deposit lately discovered by Messrs. Campbell, Mosely and Brookman, between the north shore of East Bay and Boisdale.

Acknowledgment of assistance.

In the prosecution of the survey I was assisted with zeal and ability, during the whole season, by Mr. William Fletcher, of Toronto. Besides the gentlemen whose names appear in the Descriptive Catalogue of Canadian Minerals exhibited at Philadelphia, pages 52–56, I am greatly indebted to Mr. R. N. Macdonald, Manager of the International Mines, and to Mr. John Barrington, shipping-master at the Sydney Mines loading-ground, for forwarding many of the boxes to Montreal. We have again to thank Mr. Albert J. Hill and Mr. Patrick Neville for much valuable information, as well as many of the hospitable inhabitants of the country, who were always willing to render us every assistance in their power.

Need of careful surveys.

Notwithstanding the facilities afforded by bays, estuaries, rivers and brooks for geological explorations, minute and careful surveys were necessary on account of the irregular, unconformable boundaries between the different series of rocks, the careless tracing of which by previous observers has led to great confusion. A map, on a scale of one inch to a mile, has been drawn, to embrace the results of these surveys, as well as the comparatively narrow strip of country underlaid by the Coal Measures to the west of Sydney Harbor, and already described (Report for 1874-5 p. 231-249). The delineation of several brooks and lakes, of little geological interest, in the French Vale and on Boulardrie Island, is copied from Crown-lands plans, kindly furnished by Hugh R. McKenzie, Esq., C. E., of Sydney; and the latitude and longitude of certain points, together with the survey of part of Sydney River, were taken from Bayfield's charts. With these exceptions, all the roads, shore-lines, streams, and other natural features shown on this map, are from original measurements, made by prismatic compass and chain, or by pacing.

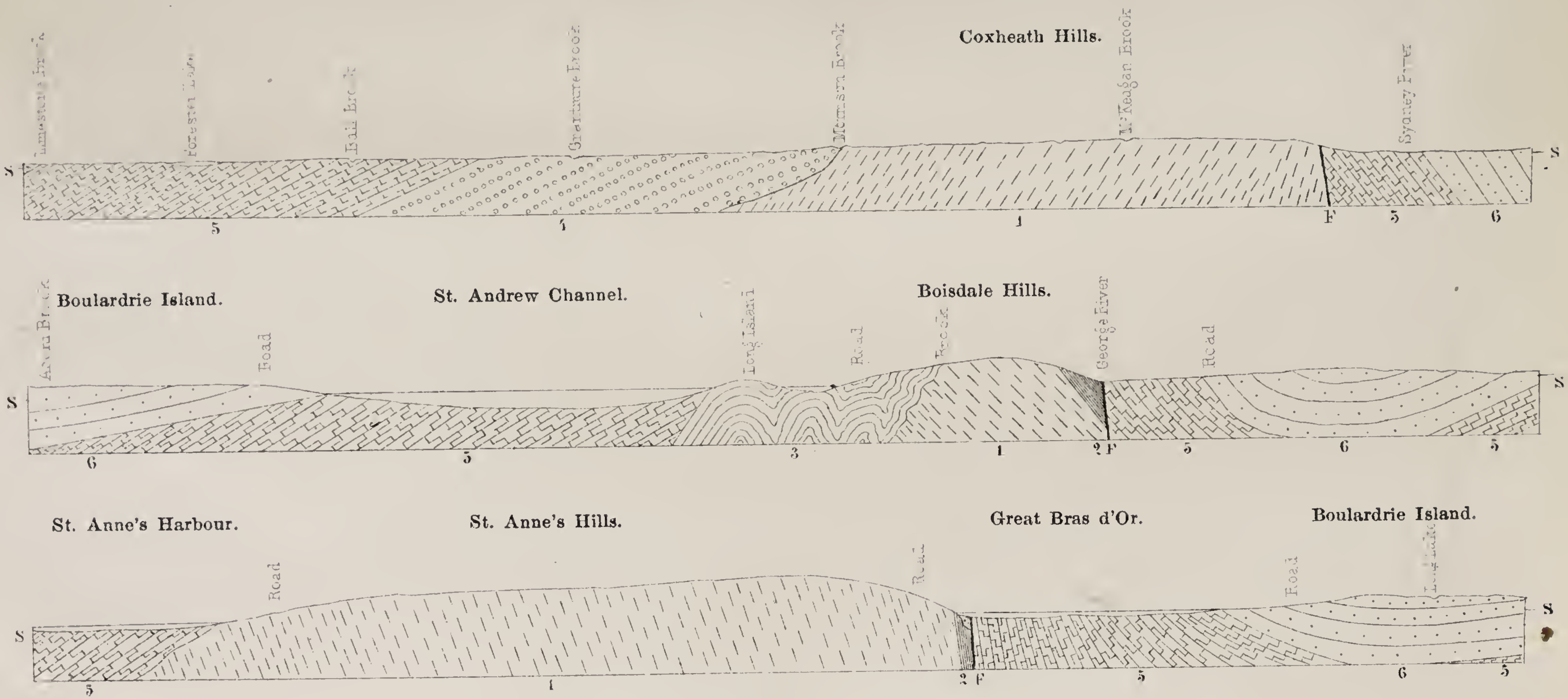
Map.

Topography of the country.

The contour of the ground is unusually diversified, and its connection with the geological structure so plain that it cannot be overlooked. Four parallel ridges, the Coxheath, Boisdale, Boulardrie, and St. Anne Hills, divided from one another by deep valleys and indentations of the sea, run from south-west to north-east,* and give much variety to the scenery. The height above the sea of the Coxheath and Boulardrie ranges seldom exceeds 550 feet; while the Boisdale Hills have in places an elevation of 890 feet, and the St. Anne Mountains of 1,045 feet; the central axis of the two latter, as well as that of the Coxheath Hills, consisting of syenitic and feldspathic rocks, flanked by Lower Silurian and Carboniferous strata. The latter are always found in the valleys, but the denudation to which they have been subjected has been so great that they now lie only in small patches on the hills. Brooks are numerous, and their general direction corresponds with that of the hills and longer estuaries; those which flow

* All the bearings in this report are astronomical; the variation is 26° west.

SECTION FROM SYDNEY RIVER TO ST. ANNE'S HARBOUR.



Horizontal and vertical scale. 1 inch to a mile.

6. Millstone Grit.
5. Carboniferous Limestone.
4. Carboniferous Conglomerate.
3. Lower Silurian rocks.
2. George River limestone.
1. Syenitic, gneissoid, and other feldspathic rocks.
S. Level of the Sea.
F. Fault.

northward are the largest, but none are navigable for any great distance from the mouth; those flowing east and west are short, mountain torrents, which cut deeply into the syenitic rocks, rendering the land rugged, and unfit for cultivation. Picturesque glens and gorges are formed by both by the erosion of the friable Carboniferous conglomerate.

Distribution of the geological formations.

The distribution of the various geological formations accords with the direction of the watersheds, which are themselves the axes of folds continuous with those already referred toas affecting the coal measures. That of the Coxheath Hills is the anticline which runs through Point Edward, and thence to Victoria mines. Instead, however, of dipping regularly from it on the south-east side, the Carboniferous rocks are broken and tilted by the Sydney River fault, which brings the millstone grit near the Forks close to the feldspathic rocks. On the opposite slope the dip is towards the valley of Leitch Brook, which flows in a basin of Carboniferous limestone and millstone grit, the rim of which is the Boisdale Hills, an extension of the anticline, previously traced from Point Aconi to Saunders Cove. Boulardrie Island forms another basin, the upper portion of which, composed chiefly of millstone grit, is alone exposed; and the last lies to the westward of the St. Anne Hills.

Faults.

These undulations are not always simple, but are accompanied by great lines of fracture and dislocation, like those found by Mr. Murray in Newfoundland. Two of these have been already described as running along the south-eastern slopes of the Coxheath and St. Anne Hills, and a third probably occupies a similar position on the Boisdale Hills, cutting out a great thickness of Lower Carboniferous strata.

The succession of the formations referred to in this report is as follows, in ascending order:—

1. Syenitic gneissoid and other feldspathic rocks.	Laurentian.
2. George River crystalline limestone.	
3. Lower Silurian rocks.	
4. Carboniferous conglomerate.	Carboniferous.
5. Carboniferous limestone.	
6. Millstone grit.	

1. Syenitic, Gneissoid, and other Feldspathic Rocks.

These rocks, exposed on anticlines in the Coxheath, Boisdale and St. Anne Hills, although preserving a general resemblance in composition and texture, differ considerably in everyone of these ranges.

Coxheath felsites.

On the Coxheath Hills, in one of the large brooks at the head of Forks Lake, bluish, greenish-grey and light-red, compact, often porphyritic, yellow-weathering, pyritous felsites, breaking readily into small pieces, are in immediate contact with Carboniferous shale, limestone and conglomerate. Similar felsites are found in another of these brooks, *Diorite.* near Donald Curry's house, but here the prevailing rock is a greenish or dark grey granitoid mixture of feldspar and hornblende, coated in the joints with hematite. The hornblende, however, is sometimes scarce, or replaced by mica; quartz is frequently present in minute grains and *Syenite.* large blotches, the rock being then a bluish or light-grey syenite. A bluish syenite, or hornblende rock of fine texture, is intimately associ- *Macbeth Brook.* ated in Macbeth Brook with a bluish-grey, red and purple, compact porphyry; and in a brook, near the outlet of Forks Lake, a red, compact *Porphyry.* porphyry is intermixed with greenish and red mottled, epidotic felsite, and soft, soapy, aluminous shales. Half-a-mile further to the north-east, the hills are composed of greyish-white, bluish, green, black, purple and red felsite and hornblendic, both coarsely granular and compact, cleaving into pieces about two inches in length. On the high land, two miles south of the Scotch road, violet felsites in laminæ, often no thicker than a knife-blade, separated by a film of calcspar, and slickensided in the direction of the bedding, dip N. 67° W. < 80°; they are much contorted, and alternate in layers from a quarter-of-an-inch to two feet thick, with red, porphyritic, and red and green, beautifully speckled felsite, holding crystals of white feldspar, occasionally half-an-inch long. The white crystals weather out, and a vesicular rock remains.

McKeagan Brook. Following the line of contact between the felsites and the Carboniferous conglomerate from the eastern slope of the hills to McKeagan Brook, the only Pre-Carboniferous rock met with is a porphyry, sometimes slaty, with white feldspar crystals in a compact red base. In McKeagan Brook the red porphyry is associated with red, green and gray, mottled, jointed, pyritous, epidotic, often granitoid felsite, sometimes laminated, or passing into porphyry. Where the ground has been *Conglomerate.* swept by a forest fire, this rock resembles a conglomerate with large, rounded pebbles, varying in colour from white to red, in a paste of fine-grained slate; both pebbles and paste, however, on being broken, prove to be red porphyry or mottled felsite. The texture is rough, numerous close set, thin, oblique plates, so interlocking as to make it difficult to break a specimen; the colour is sometimes lavender-blue, and the lustre pearly, and emerald-green and pink, blue and yellow are often finely *Dip.* contrasted. The dip of the slate is S. 63° W. < 70°, but bent round in one place to north-west; that of the less distinctly bedded rocks, which occur in jointed layers of two feet and upwards, is by no means easy to determine, one set of planes dipping N. 17° < 43°, and another in the opposite direction. Near the source of the brook, reddish, rather hard, papery argillites or slaty felsites, not unlike those from which Lower Silurian fossils were obtained near Mira River, are associated with greenish and Prussian-blue, slaty felsites, containing cavities filled with drusy bog iron ore and calcspar, but as these were not seen in place their relation to the foregoing rocks could not be made out. The surface of the country is much broken, high, bare hills or barrens running in ridges along the brooks.

Watson Brook.

Crossing the east branch of Watson brook in a direction N. 16° W., is the pure white or slightly reddish felsite, full of streaks and blotches of calcspar, and white or violet crystalline quartz, which is referred to by Mr. Robb (Report for 1873-4, p. 173), as resembling talcose slate, followed by a succession of red, lavender and green, partly porphyritic, white-weathering, slaty felsites. These are again exhibited at McMullin's house and road; and the big barren beyond this road is covered with red, compact, quartz-veined felsite, sometimes slightly porphyritic, without any apparent bedding.

Morrison Brook.

The first metamorphic rock seen in Morrison Brook, is the red porphyry once supposed to be Carboniferous (Report for 1873-74, p. 173), which dips apparently S. 26° E., < 45°, and is associated with greenish compact felsite with bands of iron pyrites, fibrous hornblende and quartz. These rocks are immediately succeeded by red felsite, containing hematite in small crystalline specks or dendritic aggregations, amethystine quartz, calcspar and scales of black hornblende. The dip is obscure. Planes dipping N. 39° E., < 67°; N. 74° E., < 56°; N. 85° E., < 64°; and S. 9° W., < 35°, were all observed; whilst two sets of striated planes dip N. 35° W., < 52°, and S. 26° E., < 53°, the striæ on the latter running S. 11° W. Higher in the brook we enter upon an apple-green, decomposed felsite, followed in turn by bluish-grey, purplish and whitish-brown or red, pyritous felsite, in obscurely horizontal beds.

McKenzie Brook.

The uncomformable contact of the Carboniferous and Pre-Carboniferous rocks is plainly shown in McKenzie Brook, where the first members of the latter are white-spotted, red porphry, and light grey and bluish, pyritous, granitoid felsite.

Grantmire Brook.

About a mile and a-half to the south-west, in a tributary of Grantmire Brook, which flows from the hills, the felsites are pyritous, light olive-green, bluish-black and purple: they weather greyish-white, break in every direction into small pieces, and contain traces of hematite and calcspar, both in the cleavage-planes and in the body of the rock.

Although often compact and sometimes porphyritic, with spots of light grey feldspar as large as a pin's head, they exhibit every gradation, from the compact to the coarsely crystalline or granular, until by the addition of black hornblende, in variable proportions, a granitoid hornblende rock is produced, of a blue, whitish, green, or pink colour, and higher in the brook this alternates in thick beds with the rocks just described. The com-

Quartzite.

pact felsites often contain granules of quartz, and sometimes merge into quartzite. A greenish-grey, calcareous conglomerate of friable texture, sometimes resembling an amygdaloid, and including crystals of quartz, calcspar and other minerals, with much disseminated green carbonate of copper, is also found in the brook. Certain beds are so pyritous as to crumble into a soft, yellow earth, and some parts of the rock having the amygdules removed, are vesicular on the surface.

At the source of Grantmire Brook the Carboniferous conglomerate rests upon granitoid and compact, grey, green and black-speckled hornblendic rocks composed of feldspar and hornblende. The feldspar is pea-green or white, and usually predominates; the hornblende, in small black grains with a glistening steel-grey reflection from the cleavage planes. Papery sheets of feldspar cut the rock, which weathers rusty-grey; and the feldspar, being the last to disintegrate, stands out to form the roughened surface of the cliffs. A considerable quantity of yellow

Copper pyrites.

and purple copper pyrites weathering into green carbonate, together with a little magnetic iron pyrites, was discovered in a thin layer of compact, grey and pink felsite, which dips W., $< 24°$

Near the same place, a bluish, light-grey and pink syenite, which weathers milk-white, and contains more or less feldspar, quartz and hornblende, is overlaid by quartzose conglomerate and argillite, the latter probably of Potsdam age. The quartz, which is vitreous and colourless, is scarce (or even absent), but shows well on weathered surfaces after the decomposition of the feldspar. Lower Silurian rocks intervene between the syenite and the quartzose conglomerate at Gillis Lake; and from the house of Allan McDonald (Gardener), to the Coxheath road are exposed in many places, in contact with a greenish-grey and flesh-red, coarsely crystalline and compact hornblende rock.

Boisdale felsites.

Separated from the Coxheath Hills by a valley less than three miles wide in the narrowest part, lies the Boisdale range, which stretches from George River toward Barra Strait at no great distance from St. Andrew Channel. The Boisdale anticline brings up in its axis rocks frequently resembling those of the Coxheath Hills, but generally containing quartz, hornblende, and sometimes mica, in addition to the feldspar of the latter

These two series are, for the present, therefore, assumed to be of the same geological age, although, as the bedding is seldom evident, their relations are obscure; but on the extension of the survey towards the south-west this obscurity will doubtless vanish. In the region already explored, these syenitic rocks are covered—either immediately, or with the intervention on the east side of a crystalline limestone series, and on the west, of Lower Silurian sediments—by Carboniferous strata, chiefly conglomerate.

At the north end of the range, the prevailing red syenite is first seen on the shore road near Moore Brook. Above the road it is accompanied by greenish felsite, grey, vitreous quartzite, with a few grains of hornblende, and grey syenite, traversed by several series of planes, one of which dips N. 26° W., < 30°; and cut by veins of white crystalline quartz. Here the Carboniferous rocks directly overlie the syenite; but in Murphy Brook, a mile and-a-half farther south, there is interposed a belt of crystalline limestone. On a mountain path from St. Andrew Channel to George River, red syenite with large crystals of hornblende and quartz dips apparently in the same direction as the overlying limestone. Red syenite, felsite and quartzite at Moore Brook.

The red syenite again comes to the shore road at Long Island ferry, and displays large masses of milky quartz with specks of clove-brown feldspar.

Porphyry and compact felsite, though not so abundant as at Coxheath, are not wanting. At Guthro Lake beds of bluish-grey felsite and syenite are intermixed; and as the Carboniferous conglomerate there contains pebbles of many of the Coxheath felsites, these will probably also be found. Porphyry and felsite

In a tributary of McLeod Brook at the end of McCormack road, pure feldspar rocks of various shades of grey, green and blue, sometimes finely granitoid, but usually compact, pass into syenite and granite by the addition of quartz, hornblende and mica. Passing up the tributary we next come upon red and grey, pyritous syenite, intermixed with grey granite and cut by a quartz vein half-an-inch in thickness. The composition of the syenite is variable: sometimes it contains much hornblende, sometimes none; it merges on the one hand into a vitreous, bluish quartzite, and on the other into whitish, granular felsite, and ranges in texture from coarsely granular to compact. The brook dashes precipitously down a beautiful gorge, and for some distance follows a joint in the syenite, the opposite walls of which are slickensided in the direction N., < 20°. The syenite and felsite, at their contact with the McLeod Brook.

soft, black and grey Lower Silurian argillites, form mural cliffs and obelisks eighty or a hundred feet high.

A bluish felsite, containing no hornblende and little quartz, is associated at Johnston Brook with bluish, red, and grey syenite, and a rock in which hornblende is almost the sole constituent.

Long Island Barasois.

The syenite near the mill at the bridge over McLeod Brook, at Long Island Barasois, is light grey, with quartz in clear, vitreous crystals. Between this point and the east side of the mountain, there occurs a syenite of a red, bluish-grey or green colour, according to the predominance of the feldspar or hornblende. The feldspar is flesh-coloured, and in larger crystals than the quartz; the hornblende greenish-black, crystalline and abundant; sometimes the component minerals are well-mixed, sometimes in distinct aggregations.

McLeod Mountain.

McLeod Mountain, which rises not far from the mill, consists in part of grey and greenish, rusty hornblende rock, composed of large specks of black, laminated hornblende and light bottle-green feldspar with little or no quartz, but a considerable quantity of iron pyrites and magnetite. In a small stream flowing from this hill, whitish and green, pyritous compact and granular felsite, Prussian-green porphyry, red syenite, and black and green hornblende rock, intersected by thin veins of pink feldspar, pass one into the other by the loss or gain of one or more of the ingredients; precisely resembling in this respect the felsites of Grantmire Brook.

Felsites in Campbell Brook.

Campbell Brook exposes a light grey, somewhat coarse and crystalline granite, generally containing hornblende, and passing by the loss of the mica into syenite. The quartz is occasionally found distinct from the pink feldspar in white, crystalline masses, sometimes six inches in diameter; the mica is sometimes golden, and occurs in large scales. This rock is succeeded by red porphyry, containing small bright scales of quartz, and a grey syenite, apparently stratified.

ourinot road.

A likeness to the St. Anne's gneisses is shown by the rocks just mentioned, and by a light grey syenite found on the Bourinot road, which contains both hornblende and mica, the latter sometimes predominating. This is accompanied by beds of bluish and dark-blue, slaty, micaceous felsite with hematite in the joints, and abundance of quartz, as well as by syenite with little hornblende, and white, compact or minutely crystalline quartz with red, blue and green streaks. The strike of these rocks appears to vary from west to north-west.

On the Boisdale road is an outcrop of nearly white, jointed granite, with small, clear grains of quartz, light flesh-red feldspar and silvery or dark-brown scales of mica, not uniformly mixed, but aggregated into little bunches. Black, fibrous, crystalline hornblende is also present. Light grey syenite, with *vugs* of white quartz and scales of golden mica, succeeds this member of the formation. The ingredients are either well mixed, and the hornblende assumes a curious waved outline, or the quartz and feldspar run in distinct bands, the hornblende being then scattered in crystalline grains through one or both. Exposures of similar rock continue as far as the Presbyterian church at McAulay's.

Gneiss and mica schist.

Between the church and the crystalline limestone of George River, blackish gneiss and mica schist, very quartzose red syenite and red granular schistose micaceous felsite passing into syenite, and syenitic granite full of spots and veins of quartz, appear in many places, with a north-east strike. It is possible that they belong to the upper or crystalline limestone series; but as they contain no beds of limestone, and as all the underlying rocks are here more or less foliated, they have been included among the latter.

Extent of the Boisdale felsites.

At the mouth of George River the syenite belt is considerably less than half-a-mile in width, but it gradually expands, until at McCormack road it is not less than two miles wide.

St. Anne's felsites.

The red syenite of the Cape Dauphin district stretches along the shore of the Great Bras d'Or from Kelly Cove to Point Jane, where the St. Anne's road leaves the water; and is the only rock met with on the path from Kelly Cove to Englishtown. Pyritous, bluish-grey granite and syenite in thick beds dipping steeply southward, are intimately associated, and alternate with fine-grained, grey gneiss and red, compact felsite and syenite on the St. Anne and Englishtown roads and along St. Anne Harbor as far as Englishtown. The gneiss is in contorted bands, alternately black and white, which vary from a mere film to a sixteenth of an inch in thickness, and weather into ridges and furrows from the unequal power of the different constituent parts to withstand disintegration. The granite is often cut by veins and blotches of red syenite. Fantastically contorted blue hornblende gneiss and diorite, with *vugs* and seams of quartz are also met with, as well as a white, blue-spotted quartzite. On the St. Anne road, near the end of the path which leads from the shore near Seal Island, a grey syenite, streaked with white quartz, and composed of about equal parts of feldspar and quartz, with a little less hornblende in small grains, dips S. 4° E., $< 75°$, and is underlaid by laminated, black and white, waved hornblende gneiss, in which the black lines are eaten out from among those of the quartz and feldspar, which form ridges. The substitution of silvery mica for the hornblende, which is altogether absent in places, gives rise to a micaceous gneiss. This syenite embeds a mass of bluish-grey rock, resembling a large pebble two feet in diameter, and made up of black hornblende and dark feldspar, which incloses in turn a fragment of grey, coarse, granular, quartzo-feldspathic rock. A bluish, fine-grained felsite was also observed; but its relation to the contorted gneiss was not determined.

Contact of the syenitic and Carboniferous rocks.

On the shore of St. Anne Harbor, half-a-mile south-west of Oyster Pond, the granites are overlaid by Carboniferous limestone. Here, a four-feet layer of greenish felsite runs S. 7° W., between two walls of syenite, and is separated from another nearly parallel band by two feet of red syenite. They run thus for several yards, then the red syenite thins out and the felsite bands come together. Masses of this felsite, often traversed by films of crystalline quartz which divide them from the red syenite, or more frequently penetrate the substance of the rock, are found in hollows and on upright faces of the syenite, but always surrounded by it. The syenite is coarsely crystalline, of different shades of green and red, spotted blood-red by the hematite contained in the joints, and roughened on the surface with small knobs of quartz.

In an adjoining cove the cliffs display finely mottled granitic rocks of red, yellow, green, blue, purple and white colours, in large blotches and veins. A red syenite, containing very little hornblende. appears in irregular streaks and vein-shaped masses among the darker rocks, nearly all of which have a more or less coarsely granular texture. The white veins are of quartz or feldspar: green and purple rocks predominate; red syenite is also abundant, but there is no continuity to any of the colours, the blotches ranging from six feet in length and two feet wide to mere films. Near the same locality, a grey, blue, and red, friable granite contains golden mica and traces of green carbonate of copper. Some of it resembles a conglomerate with large pebbles of black hornblende rock in a matrix of syenite.

Smith Brook.

At the mouth of Smith Brook are huge blocks of red syenite, with blue patches, and blue and white syenite with red streaks. At Fader Point bluish, coarse, foliated syenite and diorite, are bent round a nucleus of red syenite. The laminæ of the diorite are from half-an-inch to six inches in thickness, and among them is a layer of limestone one inch thick. In another fold, diorite forms the nucleus, and is overlaid by three feet of red syenite.

Foliated rocks.

Red syenite.

The coast from Smith Brook to Monroe Beach is occupied by red syenite, which has occasionally an obscure dip, and exhibits, on weathered surfaces, the ridged aspect of a mammoth's grinder. Near the beach it contains a bottle-green bed or vein, two feet thick, of fine though rough texture, dipping N. 85° E., < 45°, and parted from the syenite by about an inch of compact, purple, argillo-calcareous rock with a bluish-red streak. This band is traversed by veins formed of interlocking crystals of dogtooth-spar: the veins never exceed half-an-inch in thickness nor penetrate the syenite.

The Big Pond iron ore, described in the Report for 1874-75, p. 263, is contained in rocks similar to those of the Coxheath Hills, but full of calcspar in the neighbourhood of the ore. They are overlaid by Carboniferous conglomerate, and include red, green, bluish, and white porphyry and compact and granitoid felsite, streaked with quartz and spotted with hematite, together with red, greenish, and white, nacreous, soapy, aluminous slates and laminated felsites. East Bay felsite.

The rocks on the south side of Gabarus Bay consist of slaty, feldspathic sandstone and fine-grained felsite, striking N. 40° E., and on the north side, near Eagle Head, of obscurely stratified, black, green, grey and red felsites, running N. 24° E. Quartz and feldspar veins cut the rocks, which hold iron pyrites, hornblende, mica and serpentine, and are spotted with molybdenite. In an associated quartzose band is a deposit of copper pyrites, which will be referred to elsewhere. Gabarus. Copper ore and molybdenite.

Dark bluish-grey, white-weathering, compact, fine-grained and porphyritic felsites, streaked with quartz veins which contain molybdenite, range in a north-easterly course along the coast from Gabarus Bay to Louisburg Harbor. Although essentially feldspathic, they also contain scales of golden mica and much black hornblende, which sometimes enters as one of the constituents of a granitoid diorite, but is often confined to the joints. Iron pyrites is often present, and molybdenite seldom absent, being found in flat hexagonal crystals, in crystalline aggregations, and amorphous films, spotting the rock like the scales of a large fish.

Blackrock Point, near the old town of Louisburg, derives its name from a bed similar to certain of the Gabarus dark felsites, which contains generally, if not always, in addition to many imperfect crystals of feldspar, a large quantity of hornblende. Associated with this diorite are rocks of lighter colour, one of which, a greenish-grey, pyritous, porphyritic felsite, strongly resembles a porphyry seen in McKenzie Brook on the Coxheath Hills. Striking N. 62° E., parallel to the black rock and in bands with it, is a red syenite with little or no hornblende, like that of George River and St. Anne's. The parallelism of these bands is not perfect: in some places they partly blend with the diorite, from Louisburg.

which large veins penetrate the syenite. Another of these rocks is a granitoid mixture of quartz and feldspar, which differs from the red syenite only in colour and fineness of texture.

Louisburg lighthouse stands on a rocky headland composed of lavender, blue-purple, greenish and red, fine-grained, epidotic felsites, enclosing large pebbles of a reddish mixture of feldspar and quartz. All the colours are found in the same bed, in which respect, as well as texture and composition, these rocks are like the felsites of Coxheath. Quartz veins pervade many of the rocks. In the railway-cuttings between Louisburg and Catalone Lake similar rocks are exposed, including a greenish fine-grained felsite, a bluish contorted felsite, and a red conglomerate with pebbles similar to those mentioned above.

The following are a few varieties of this interesting series of rocks observed near the lighthouse :—

1. Indian-red and red-purple, rather compact, imperfectly porphyritic felsite with a fragmentary structure; the fragments being of every size up to an inch, generally flattened, but also rounded: the porphyry spots are white or pea-green. On certain lines of fracture the rock has a talcose pearly appearance: these lines are generally the bedding-planes, which are marked in the compact rock by layers of a greater or less difference in texture.
2. Compact, light pea-green felsite, with reddish bands and spots of no great thickness: very delicate lines of bedding shown by slight differences of colour.
3. Mottled, pearly felsite, fragmentary in small pieces, some of which are compact, many porphyritic: the whole rock is rather compact, but weathers rough on exposed surfaces. Colours: plum, flesh-red, pea-green, chlorite-green, with small white spots.
4. Laminated, soft, greyish rock, yielding readily to the knife; indistinctly granitoid, with small red grains among the lighter ones: small spots of quartz; feldspar crystals are often seen in the mass.
5. Laminated, bluish-grey, white-weathering rock, yielding with difficulty to the knife, with strong argillaceous smell, and resembling in general appearance a close-grained, coherent argillite; has a smooth surface, but undulates in small waves between the laminæ.
6. Compact, light-coloured, mottled felsite, showing the bedding-planes by the arrangement of the spots: weathers vesicular, but the interior is finely crystalline :—a few small quartz veins.
7. Compact, grey felsite with a slight tinge of red, and sometimes blotched red and purple so as to show the fragmentary structure. Passes into red and purple porphyry.

8. Indian-red nearly compact felsite, with large, bright sea-green blotches.
9. Greenish-yellow and grey felsite, compact and minutely granular, containing small, bright crystals of feldspar.
10. Laminated felsite, with large fragments of different shades of green and red, united to form a compact, mottled rock with a rough surface.

Among the proofs which may be advanced to show that these rocks are Pre-Silurian and stratified, instead of Devonian or Carboniferous or eruptive, as has often been asserted, are the following:— Group 1. Age of the felsites.

1. The lithological resemblance of the different members to the Laurentian system, as displayed in Newfoundland, New-Brunswick and other parts of the Dominion. In New-Brunswick as in Cape Breton, the syenitic and feldspathic series is overlaid by a group of crystalline limestones.
2. Pebbles of red syenite and felsite, apparently derived from the Boisdale Hills, are abundant in the George River limestone and in the Lower Silurian coarse sandstones of St. Andrew Channel.
3. The rocks are, without doubt, bedded, although the evidence of this is sometimes obscure.
4. Lower Silurian shales lie nearly horizontally upon the syenites and felsites without any appearance of alteration ; but containing delicate Graptolites and other fossils when in contact with them.
5. No intermixture of the Lower Silurian slates and the felsites takes place at the point of contact. No veins are sent by the syenite into the Silurian slates ; but, on the contrary, the line of separation is clearly marked in every one of the numerous instances in which it was examined.
6. The flexures of the strata already traced in Cape Breton are in continuation of the folds of the Appalachian Mountains, which bring up Huronian and Laurentian rocks in Newfoundland and New Brunswick, and may not unreasonably be expected to do so in Nova Scotia.

2. George River Crystalline Limestone.

On the south-eastern slope of the Boisdale Hills there ranges a narrow zone of rocks, seldom exceeding half-a-mile in width, and allied in geological position and mineralogical characters to the limestones of New Campbellton, already described in the Report for 1874–5, in which mention is also made of a paper by Dr. Honeyman on the George River series. Paper by Dr. Honeyman.

General description.

They consist of highly crystalline limestone and dolomite, containing serpentine, talc, mica, tremolite, plumbago, galena, hematite, magnetite, and other minerals; interstratified with felsite, syenite, diorite, mica-schist, quartzite, and quartzose conglomerate; and dipping steeply to the south of east. The colour is variable, but chiefly bluish. This formation is probably Laurentian—the age assigned to it by Mr. Hartley—or Huronian, for although the superposition of the Lower Silurian rocks has not yet been proved, yet the Lower Silurian conglomerates found on St. Andrew Channel point to an older series of limestones such as these; and the alternation of the crystalline limestone with granitic and other related rocks brings them into close affinity to the feldspathic group. From this, however, they are distinct, as is shown by the occurrence of pebbles of red syenite and felsite in the quartzose conglomerate of Murphy Brook.

The accompanying sections, measured from east to west, in the brooks which cut through and expose these strata, will show their general character. Most of them include a portion of the underlying feldspathic series, the dip being assumed to be the same in both :—

SECTION I.

CRYSTALLINE LIMESTONE IN MURPHY NORTH BROOK.

Dip South 61° *East* $<$ 62°.

	FEET.	IN.
1. Crystalline limestone of every variety of colour and texture, but chiefly bluish-grey	247	0
2. White and light-grey marble, variable in texture, although usually finely crystalline; sometimes cleavable into rhombohedrons, and jointed so that it breaks into small pieces; many cavities filled with crystals of bright-red calcspar; stained with plumbago; streaked with serpentine; magnetite and iron pyrites in pieces two feet in diameter. This bed is cut at the George River marble quarry. Thickness, probably	10	0
3. Mottled black and white conglomerate or breccia, with pebbles as large as hazel-nuts, and often larger, the white consisting of quartz; the black, of a soft rock, coloured with iron or manganese. The paste is a white, crystalline limestone, alone or mixed with other minerals; the pebbles are coated with a dark, chloritic rock; they often consist of red and bluish felsite and porphyry, and of red syenite. In the quarry, the marble frequently passed under this breccia, and was lost; at times, the latter encroached upon the marble	5	0

	Feet.	In.
4. Bluish-grey and white marble; seen only in part	100	0
5. Dark-blue felsite containing a layer of flesh-coloured felsite, very compact, often porphyritic, with streaks of white quartz	88	0
6. Bluish-grey, crystalline limestone; seams of fibrous calcspar in the joints	133	0
7. Bluish felsite, capped in places with limestone	441	0
8. Red felsite, and red and blue syenite; quartz in vitreous, colourless crystals, apple-green feldspar, and black hornblende; weathers opaque-white. At the source of the brook	220	0
Rocks similar to that last-described prevail as far as the Lower Silurian slates on the opposite side of the mountain.		
Total thickness	1,244	0

SECTION II.

CRYSTALLINE LIMESTONE IN MURPHY SOUTH BROOK.

Dip South 61° *East* $<$ 62°.

	Feet.	In.
1. Marble and conglomerate cut in the quarry. *See* Section I.		
2. Compact and granular, cleavable and shaly, crystalline limestone, chiefly bluish-grey and white, but tinted with every shade of colour—rose and flesh-red, emerald, grass, and sap-green, clove-brown, and black. It forms hills of considerable height. At an old milldam near the Carboniferous limestone quarry on George Brook, the limestone is dolomitic and pyritous, has a soapy feel, and contains scales and films of silvery talc and mica. In some parts the rock crumbles and becomes so soft as to yield to the nail	176	0
3. Bluish-white and greenish-yellow, compact serpentine-limestone	89	0
4. Bluish, finely-granular felsite, weathering reddish-grey; streaked with quartz; traces of plumbago, talc, and serpentine in the joints	17	0
5. Bluish-white, crystalline limestone, cleaving into rhombohedrons; sometimes serpentinous	71	0
6. Bluish felsite, passing by imperceptible gradations into flesh-red felsite, with a few specks of quartz and green hornblende	20	0
7. Reddish syenite, underlaid by bluish syenite, sometimes slaty	86	0
8. Bluish felsite	70	0
9. Flesh-coloured, compact syenite, with bands of porphyry and bluish and brown felsite. It sometimes consists of about equal proportions of quartz and feldspar, with spots of feldspar and streaks of white quartz scattered throughout,		

	FEET.	IN.
the quartz including transparent rock-crystal. The rock sometimes becomes a pure quartzite, sometimes pure felsite. Intersecting the syenite in various directions are veins of bluish-grey, finely crystalline or vesicular felsite ; one of these, two and a-half feet thick, runs N. 84° E., and at the west end is thrown four feet to the southward by a small fault	204	0
10. Yellowish-white, crystalline limestone, seen only on the right bank of the brook and on top of the hill, where it has been quarried. It lies unconformably on the syenites, or has been thrown into this position by a fault.		
Higher in the brook the felsites again appear.		
Total thickness	733	0

The next section contains beds of tremolite and serpentine-limestone, which may be well studied in Macdonald Brook and on the neighbouring hills. The position of the different members is alone indicated, the outcrops being too partial for exact measurement.

SECTION III.

CRYSTALLINE LIMESTONE IN MACDONALD BROOK.

Dip South 87° *East*, $<$ 52°.

	FEET.	IN.
1. Measures concealed. Large blocks of marble..............	142	0
2. Bluish and white, coarse saccharoidal limestone streaked with veins of white calcspar ; plumbago between the layers and in the joints ; a few specks of iron pyrites................	..	..
3. Measures concealed...................................	23	0
4. Bluish-grey limestone carrying iron pyrites, copper pyrites and plumbago..................................	..	..
5. Measures concealed..................................	40	0
6. Bluish-grey, pyritous limestone	..	..
7. Measures concealed..................................	8	0
8. Bluish-grey, crystalline limestone..........................	..	..
9. Measures concealed	15	0
10. Bluish-grey and red felsite, one passing into the other. The bedding is indistinct : two series of planes strike N. 9° E., and N. 54° W., but do not run far before they form a roll or abut against a wall of similar rock. A greenish variety passes into a porphyry with greenish-white spots of feldspar. The brook here falls about ten feet...............	..	..
11. Measures concealed..................................	103	0
12. White, pyritous, crystalline limestone, lemon-yellow serpentine limestone, and pale green, brown-weathering limestone, with tremolite in small fibrous tufts....................	..	..

	FEET.	IN.
13. Measures concealed	142	0
14. Bluish, porphyritic felsite	..	..
15. Measures concealed	63	0
16. Red syenite; the feldspar greatly predominating; quartz in minute white particles, hornblende extremely scarce	..	..
17. Measures concealed	94	0
18. Bluish-grey felsite	..	..
19. Measures concealed	32	0
20. Red syenite: hornblende more abundant and in large particles. Low ground.—Red syenite to the source of the brook	157	0
Total thickness	819	0

Contact of crystalline limestone and felsite.

Rocky Brook, a small tributary of George River, runs along the junction of the crystalline limestones and the syenite, and shows the nature of the contact in several places. The underlying rock consists chiefly of red syenite, of which hornblende sometimes forms a large part, but which is often characterized by the almost total absence of both hornblende and quartz: it weathers brown, and passes frequently into greenish, bluish and red porphyry, traversed by streaks and spots of quartz, and assuming in places a laminated structure. With the red syenite is associated a bluish, pyritous, quartzose gneiss, with numerous scales of white mica in radiating plates. The overlying rocks are bluish-white, violet and lavender limestones and dolomites of saccharoidal texture, often serpentinous, and black plumbaginous limestone, with many spots of iron pyrites and hematite. The trend of the line of contact is about N. 35° E.; but at one point the marble is interrupted by a dyke of greenish porphyry two and a-half feet wide, which runs east and west. On the south side the porphyry stands vertically against the marble; whilst on the north side it overlaps the marble about nine inches, a clay parting dividing the two. The dyke appears to cut the red felsite, thickening and becoming lost on entering it. In some places the marble appears to lie horizontally on the syenite.

The best section of the crystalline limestones and underlying granites was obtained in Crane Brook, and is as follows, in descending order:

SECTION IV.

LAURENTIAN ROCKS IN CRANE BROOK.

Dip North 64° *East* < 68°.

	FEET.	IN.
1. Red marl (Carboniferous).		
2. Dark-bluish, compact and granitoid felsite, of many colours—Indian, flesh, and peach-red, pea-green, grey, and white—containing in some layers much mica and hornblende. Only partly seen	74	0
3. Grey and greenish, soft and friable, finely laminated gneiss, cleaving into rhombic blocks; formed of vitreous, colourless quartz, light greenish feldspar, and white, black, and bronze mica	23	0
4. Measures concealed	210	0
5. Bluish, black, amber-coloured and colourless, laminated, vitreous quartzite; the laminæ often no thicker than the blade of a knife; iron pyrites occurs in leaves between the layers, and in the cleavage-planes which run in various directions and break the rock into small pieces; chlorite and hornblende are also occasionally present, and mica is often contained between the laminæ. Also Indian-red and emerald-green mottled quartz, free from pyrites, but containing so much white mica as to constitute in places a mica-schist, stained with soft, red patches of hematite	11	50
6. Measures concealed. Large blocks of white syenite	140	0
7. Measures concealed	32	0
8. White, vitreous, massive and laminated quartzite, seen only at intervals	400	0
9. White, vitreous quartzite, generally without lamination, forming hills thirty feet high. The brook falls here in a series of cascades	13	0
10. Bluish granite	3	0
11. Colourless, laminated quartzite, with much pyrites in the joints and throughout the mass	66	0
12. Red syenite, separated from the inclosing rocks by a variable thickness of soft, chloritic rock	2	0
13. Greenish and black, coherent, finely crystalline hornblende-rock, intersected by pea-green streaks and strings of iron pyrites	141	0
14. Red syenite	8	0
15. Black hornblende rock with syenite wedges and veins.	14	0
16. Grey, pyritous granite	21	0
17. Crystalline limestone, of white, bluish, greenish-grey and other colours	13	0

		FEET.	IN.
18.	Red syenite	8	5
19.	Greenish-grey, granitoid felsite	29	0
20.	Flesh-red felsite, underlaid by grey felsite, passing into syenite with a half-inch layer of calcspar; iron pyrites in small cubes	14	0
21.	White and bluish, thick-bedded, saccharoidal limestone and dolomite	8	0
22.	Red syenite and bluish, compact felsite, mixed	3	0
23.	Greenish, compact porphyry with spots of white feldspar	4	0
24.	Bluish-white, crystalline limestone	5	0
25.	Measures concealed	34	0
26.	White, saccharoidal limestone	11	0
27.	Red syenite	2	0
28.	White, saccharoidal limestone	22	0
29.	White, dolomitic limestone, seen only at intervals	152	0
30.	Measures concealed. Bluish, saccharoidal limestone seen in places	204	0
31.	Greenish, fine-grained felsite	37	0
32.	Greenish, pyritous granite and felsite, one passing into the other, and traversed by small quartz veins and aggregations of golden mica	112	0
33.	Measures concealed	269	0
34.	Black and white, beautifully speckled granite	18	0
35.	Measures concealed	195	0
36.	Red syenite, seen at the bridge on the Barasois road	37	0
37.	Measures not well seen, consisting of granite, quartzite and bluish, pyritous felsite	473	0
38.	White, milky quartz; dark-blue, granular quartz; bluish granite, with small grains of black mica; grey, compact quartz, and red syenite	3,794	0
39.	Black, friable Lower Silurian shales of Long Island Barasois, which lie unconformably on the syenitic rocks.		
	Total thickness	6,602	10

The continuity of this belt of crystalline limestone is broken near the head of George Brook, where it ends against the underlying gneissoid rocks. About a mile south of this point it is again seen near the Presbyterian church on the Boisdale road. This does not seem to be due to a fault, but to a lenticular distribution of the limestone, or to a fold which is obscured by the overlapping of the Carboniferous rocks. Interruption of the continuity of the limestone belt.

From the Presbyterian church the crystalline limestone keeps its south-westerly course towards East Bay, where it includes a deposit of iron ore, which will again be referred to. Iron ore.

On the Guthro road and at Guthro Lake, white and light grey marble, with specks of galena, hematite, talc, and plumbago, is exposed.

3. Lower Silurian Rocks.

Crumpled, purple, red and green slates, sandstones and limestones of Lower Silurian age, occupy Long Island, and the shore of St. Andrew Channel from near Moore Brook to Dougall Point, in a belt about a mile in breadth, covered in places by unconformable Carboniferous conglomerate or limestone.

Section along St. Andrew Channel.

Half-a-mile west of Moore Point, the beach is strewn with blocks of red syenite, grey granite, purple felsite with white feldspar veins, and greenish felsite with red syenite veins; and still further west, with pieces of white, quartzose grit, and laminated, greenish and bluish micaceous felsite. The beach then gives place to low rocky cliffs. Sections were measured on the main land and on Long Island, but being incomplete, owing to folds of the strata, by which the same beds are many times repeated, it will be better to reserve them until the rocks have been further examined and searched for fossils, and to give, in the meantime, the succession as found on the shore, beginning with the first rocks seen near Moore Brook:—

1. Red-purple, compact felsite, with bright Indian-red spots, and thick layers of light-green, soft, crumbling felsite, sometimes porphyritic, traversed by small reticulating veins of white quartz, intermixed with a granitoid or compact compound of feldspar and quartz, spotted with hematite, soft bottle-green chlorite, and large blotches of milky quartz, which are distributed without any apparent order. The rock passes in one place into a flesh-red mixture of quartz and feldspar, resembling the Laurentian red syenite, to which series it may belong. Sparkling drusy crystals of quartz stud some of the faces. The dip is undefined.
2. Sea-green and blue-purple, whitish and grey, laminated, calcareous hematitic felsites, micaceous slates and argillites, one colour passing into the other. The slates are greatly contorted and contain small cylindrical concretions, like the casts of boring mollusks. The dip of the beds and of the slaty cleavage often coincide in direction. In one place it is N. 86° W., the angle of the former being 45°, that of the latter 82°. Beds of quartzite and compact felsite occur from one to six inches in thickness.
3. Red, coarse, calcareous sandstone, in beds three feet thick and downwards; alternating with greenish, laminated, micaceous, pitted marl, in contorted rolls, from which the layers may be removed like the coats of an onion.

4. Greenish and red, thick-bedded, coarse, jointed sandstone, interstratified with thin bands of fine-grained and compact felsite and impure limestone. At the mouth of Young Brook. Young Brook.
5. Greenish and blue papery slates containing many impressions of an *Obolella*, with the head and tail of a trilobite, recognized by Mr. Billings as of Primordial or Quebec group age, but too imperfect to admit of positive determination. Fossils.
6. Fine and coarse-grained, false-bedded sandstone, mostly of some tint of lavender, but also greenish-grey, and mottled red and green. Beds of soft shaly marl, containing limestone nodules, as large as nuts. Compact obscurely bedded felsite, traversed by calcspar veins, and breaking into small fragments or sharp angular blocks. *Obolella.*
7. Greenish-grey and reddish, calcareous sandstone of rather coarse grit, dipping S. 50° E., $<$ 55°. Obscure shells.
8. Greenish-grey, coherent, jointed argillite or marl, with calcspar veins and streaks and crystals of hematite. Shells.
9. Bluish compact argillite, cut by joints and veins.
10. White, waving, close-grained quartzite and quartzose sandstone and greenish and bluish, coherent, splintery argillite.
11. Greenish-grey, feldspathic sandstone.
12. Laminated, micaceous, sandy felsite, quartzite and argillite, crumpled and cleft, of greenish-grey, bluish, or purple colour, traversed by veins and streaks of white quartz. Three sharp folds occur within a distance of a hundred feet, the axes of which run about S. 27° W., $<$ 21°.
13. Purple and bluish slates, interstratified with several beds of bluish-grey, fine-grained sandstone, from six inches to one foot thick, passing in places into quartzite.
14. Thin-bedded, calcareous sandstone composed of syenite *debris*, interstratified with a contorted two-inch bed of fine-grained quartzite. Sharp folds in the rocks.
15. Coarse and fine-grained sandstone in thick and thin beds, contorted and broken; interstratified with red and greenish-grey papery shales. The sandstone runs on the strike into chert or quartzite; it is composed in great part of syenite *debris*, but contains, in addition, pebbles of soft black argillite. Round the axes of the folds the beds are slickensided and contain films of calcspar.
16. Greenish, jointed argillite, and purplish, micaceous felsite. Two flat elliptical masses of greenish felsite, one and a-half feet by one foot by two inches, lying one above the other, resemble a flattened tree, but show no markings.
17. Red-purple, soft, contorted, micaceous argillite, with layers of very fine-grained sandstone, stained with hematite, which gives a metallic polish to the surface of the beds.
18. Red and green mottled sandstone, compact felsite and argillite, traversed by minute quartz veins; small concretions.

19. Mottled, white, green, and red, coarse pebbly sandstone, from two to six feet thick, repeated several times by folds. *Obolella.*

20. Coarse sandstone, of considerable thickness.

21. Red and green argillite.

22. Coarse sandstone, intersected by numerous quartz and calcspar veins, and covered with broken shells.

23. Purplish argillites.

24. Sandstone, ten feet.

Young Point.

25. Mottled, fine-grained, ferruginous sandstone, arenaceous shale and argillite, intersected by quartz and calcspar veins; full of shells. Young Point. The Lower Silurian Rocks are here overlaid by Carboniferous limestone, rich in fossils.

26. Grey or bluish-grey, compact and slaty felsite, sometimes calcareous, and containing calcspar films in the joints; purple slates; bluish, cleft, soft argillites; micaceous, ferruginous, feldspathic sandstone with veins and blotches of milky quartz—seen at intervals as far as the red syenite hill, which touches the shore near the south end of Long Island, and on both sides of this hill. A greenish, fine-grained felsite, with small, glittering black specks, and covered with a film of hematite, caps the syenite, fills hollows in it, and at one point stands vertically against it, running N. 40° E.

Young Brook.

The mean dip on this section is N. 60° W. and S. 60° E., the folds being at right angles to the dip. Young Brook flows across the strike of the Lower Silurian rocks, which here contain streaks of white and yellow quartz, thin bands of hard fibrous hornblende, and bright specks of hematite and mica. They consist of waved and contorted, jointed, very compact, thin-bedded felsite and light-grey quartzite, and of bluish-grey conglomerate with pebbles of quartz, feldspar and argillite, spotted with calcspar and hematite, which, by decomposition, give rise to a vesicular rock.

Long Island ferry.

At the bridge, over a large brook, near Long Island ferry, the contorted strata consist of light lavender, slaty, micaceous argillite, and bluish, micaceous quartzite, traversed by filiform quartz veins, which do not appear to have any definite direction. In an adjacent brook the axis of one of the folds comes to the shore, and displays bluish and purple, jointed, calcareous sandstone, argillite and quartzite, with a half-inch layer of limestone. Small quartz veins run northwest and south-east.

Lower Silurian rocks of Long Island.

Overlying these are the rocks of Long Island, of which the following general abstract from south to north must suffice for the present:—

1. Greenish-grey, coarse, calcareous conglomerate, made up of pebbles of red syenite, quartzite and felsites of many colours, often porphyritic; interstratified with light-grey and greenish, coarse, micaceous, hematitic sandstone, and grey, greenish, blue and purple, jointed, sometimes porphyritic felsite, dipping S. E., $< 52°$, and streaked throughout with quartz and calcspar. Seen near the ferry.
2. Bluish, jointed, slaty, vesicular felsite; much hematite; white and rose-coloured calcspar in veins and streaks.
3. Greenish, calcareous, pebbly, jointed and shaly sandstone; streaks of calcspar and hematite.
4. Dark-blue, compact felsite; Indian-red, porphyritic felsite, containing quartz pebbles, and greenish, slaty felsite, with calcspar veins and specks of hornblende.
5. Sea-green and reddish-blue conglomerate; pebbles of felsite, calcspar, sandstone and argillite.
6. Bluish, vesicular felsite, with spots of calcspar, including fourteen inches of white and rose-coloured crystalline limestone.
7. Bluish-grey limestone, veined with hematite and calcspar.
8. Red conglomerate; pebbles of limestone and felsite.
9. Bluish limestone, felsite and contorted argillite, streaked with hematite.
10. Bluish, quartzose grit, and light-grey and red conglomerate, replaced at the top by red felsite; pebbles of felsite, syenite and quartz.
11. Limestone and felsite, alternating in thin beds.
12. Bluish-grey, feldspathic sandstone.
13. Alternations of felsite, limestone and argillite, and calcareous sandstone, veined with calcspar.
14. Indian-red, sandy marl, between two beds of calcareous sandstone.
15. Bluish felsite, contorted limestone in thin beds, and light-grey, calcareous sandstone.

Fruitless search for coal and copper ore.

On the shore and in McLeod Brook, from Long Island to the Boisdale road, black, bluish and grey, soft, plumbaginous, crumbling slaty argillites, often micaceous, and weathering white, dip steeply away from the syenite. Traces of copper pyrites are reported to have been found in them, but none was seen by us, and it is not improbable that iron pyrites, which is common among the slates, was confounded with this. The resemblance of these argillites, on the road at Johnston Brook, to the black bituminous shales of the coal measures, and the presence of ferruginous water, resulting from the oxidation of the pyrites, have given rise to a mistaken belief in the existence of coal, and led to the search for it in this locality.

The argillites on the south side of the Barasois pond, in a brook at the head of the pond, and at McLeod's mill, strike N. 20° E., and crumble into fragments, sometimes nine inches long, between an eighth-of-an-inch and an inch in breadth, and no thicker than the blade of a knife. Above McCormack road in the same brook are cliffs fifteen or twenty feet high, of greenish, bluish and dark-blue, finely laminated, contorted, plumbaginous argillite, often vertical, but also dipping S. 76° E., < 20°, and N. 63° W., < 18°, or lying nearly horizontally on the syenite. They are unaltered and resemble Carboniferous shales, especially in certain layers, which have a crumbling, underclay structure, and are pervaded by rusty streaks. Many specimens of *Dictyonema* were found in the shales, but as no other fossils were collected,* and as this genus ranges from the Primordial to the Devonian formations, the age can only be inferred from the position of the rocks, which are bounded on the east by the syenite, and on the west by Lower Silurian feldspathic sandstones and slates, by which they are probably overlaid.

Dictyonema.

A range of hills with an elevation of three or four hundred feet divides McLeod Brook from the sea. In the northeast they are composed of greenish-grey, white-weathering, fine conglomerate and coarse grit, containing pebbles of various felsites, red syenite and quartz, associated with a purplish-grey porphyry with white and black spots. On the shore at McSween Brook, bluish-grey, dark-blue and purple, soft splintery, crumbling, calcareous argillite, full of limestone nodules and reticulating calcspar threads, includes a half-inch band of chert, and is underlaid by beds of quartzite, compact argillite and limestone. The limestone is plumbaginous, banded and compact, grey, greenish, yellow, and red in colour, and is overlaid by Carboniferous conglomerate, the material of which has been derived in great part from these limestones and argillites. The shales are rough in texture, covered with calcspar in the joints, and frequently brightly metallic from a thick coating of hematite.

Iron ore near McSween Brook.

Proceeding from McSween Brook to the Barasois, variegated hematitic shales and slates are again conspicuous. The calcspar of the veins is rhombohedral, but the dog-tooth variety lines the interior of many small vugs. The prevalence of hematite is remarkable; in one or two instances the rocks are so impregnated with it as to constitute beds of iron ore of variable thickness and purity, the best of which, however, on being traced, are found to degenerate.

Limestone.

Near McLean Point the rocks are so veined with calcspar as to approach limestones in character; and at the point are found bluish, grey and red, compact, thick and thin-bedded limestones, marked with minute white reticulations of calcspar. Well-defined cone-in-cone concretions characterize certain beds. A bluish-grey, pyritous limestone,

Cone-in-cone.

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* Numerous specimens of *Obolella*, and an obscure *Orthisina*, were subsequently found in these beds.

traversed by streaks of calcspar is associated, in Owl Brook, with contorted, slaty felsite, containing hematite in the joints. The calcspar veins, resisting the action of the atmosphere, ridge the surface of the beds. Between Owl Brook and Boisdale, the Lower Silurian formation, being mostly obscured by Carboniferous conglomerate, seldom appears. A limited exposure gives the following descending section :—

	FEET.	IN.
1. Bluish and greenish, violet and pink, jointed, compact limestone, containing fibrous calcspar, dark-green serpentine, rock-crystal and hematite, and pervaded by a minute network of white, crystalline calcspar....		
2. Bluish-grey, compact, jointed felsite, with patches of calcspar, hematite and white quartz....		
3. Limestone....	0	$1\frac{1}{2}$
4. Felsite....	0	6
5. Limestone....	2	0
6. Dark-blue, thin-bedded felsite....	1	0
7. Dark-grey, compact and coarsely crystalline limestone containing hematite in cone-in-cone concretions....	1	6
Total thickness....	5	$1\frac{1}{2}$

In the vicinity of Gillis Lake, beds of bluish argillite, slaty, micaceous, feldspathic sandstone and quartzite, of Lower Silurian age, overlie the reddish and grey syenite and felsite, and at McLean's mill, near the outlet of the lake, form a waterfall thirty feet high. They are like much of the so-called whin of the Nova Scotia gold-fields. Lower Silurian strata on the Coxheath anticline.

At and near Marion bridge, on the banks of Mira River, occurs a series of light-grey, slaty, fine-grained, feldspathic sandstones, associated with red and green mottled sandstone, running N. 40° E., which affords numerous specimens of *Obolella*, also characteristic of the Quebec and Primordial groups of rocks, but differing in species from that before mentioned. Their relations to the overlying Carboniferous rocks, and to the Louisburg felsites still remains to be studied; but there can be little doubt that they are of the same age as the red argillites found on the Louisburg railway, between Catalone Lake and Mira River. Mira River.

Where the evidence of fossils can so readily be appealed to for the determination of the age of these strata, it is almost unnecessary to point out lithological resemblances to well-known series; yet it may not be out of place to notice their general similarity to the Primordial rocks found by Mr. Murray in the south-eastern part of Newfoundland, and also to those examined by Mr. Richardson on the strait of Belle Isle, and described in the "Geology of Canada," page 287. Comparison with rocks in Newfoundland.

4. The Carboniferous Conglomerate.

The range of this, the lowest member of the Carboniferous series—which corresponds with the Bonaventure formation of Gaspé and the Basal conglomerate of New Brunswick and Newfoundland—being controlled by the course of the anticlines, it generally flanks the metamorphic hills which form the axes of these anticlines, and from which its pebbles have obviously been derived. Its volume is variable. It has a breadth of nearly two miles between the Scotch road and the Coxheath Hills, which gives, at an angle of 11°, a vertical thickness of 1,890 feet, whilst from the head of Watson Creek, where it is first seen, to the same hills, the distance is nearly three and a-half miles, and the thickness about 2,525 feet, the angle of dip being 7°. Near the forks of Sydney River the breadth is only ten chains, and at Young Point, on St. Andrew channel, Carboniferous limestone lies directly upon Lower Silurian slates and sandstones, without the intervention of the conglomerate.

Thickness.

This formation is not exposed on the Boisdale anticline at George River, and only 850 feet of the overlying Carboniferous limestone appears. This is partly due to a fault which, there is reason to believe, runs parallel to the river, and tilts the Carboniferous limestone at a high angle against the syenite; partly also, no doubt, to differences in the contour of the land during the deposition of these strata. Further south, however, small patches of the conglomerate have been seen at a considerable elevation among the hills, and in the valleys of the brooks. On the north-western slope of this anticline, beds of conglomerate succeed the older rocks at various points along the shore of St. Andrew channel.

The third, or St. Anne's anticline, has been so much denuded at its north-eastern end that few Carboniferous rocks remain, and the conglomerate has only been observed at Cape Dauphin, whilst on the western side it is altogether wanting.

Description.

This formation everywhere presents the aspect of a friable, Indian or brick-red, rarely green, conglomerate and sandstone, the pebbles of which range from blocks three feet in diameter to a fine sand, and exhibit great differences in composition, according to the locality in which they are found. The most common matrix is itself a fine conglomerate or coarse grit, possessing very little coherency; not unfrequently, however, it consists of calcspar, and more rarely, of hematite, and quartzite or chert. The coarser beds greatly predominate, but alternate constantly with lenticular or persistent bands of reddish, coarse and fine-grained, jointed, friable sandstone, sometimes mottled with green, and traversed by streaks of white calcspar; and with red and green marl, including an occasional layer of impure limestone. In general, but by no means always, the conglomerate is finer at the top than towards the base of the formation. A few obscure fucoids were the only fossils discovered, although many of the finer beds seem well adapted for their preservation.

At the fork of Watson Brook the following descending section of some of the higher beds of this group is exposed:— Section in Watson Brook.

	FEET.	IN.
1. Reddish, very micaceous, friable, calcareous and argillaceous sandstone, with bands of marl intermixed: sometimes rather an arenaceous limestone; fucoids	8	0
2. Indian-red, crumbling marl, with nodules of greenish limestone of different degrees of purity	6	6
3. Mottled red and green, fine-grained, friable sandstone, passing into a coarse grit, and containing irregular masses of conglomerate	10	0
4. Reddish, friable conglomerate, interstratified with beds of fine-grained, pebbly sandstone. The pebbles vary from an eighth-of-an-inch to one foot in diameter, and comprise reddish porphyry with small spots of white and pinkish feldspar; slaty felsite and quartzite of many colours; coarsely granular quartzite; olive-green, compact hornblende rock; gray granite and black mica; argillite; banded, saccharoidal and compact, crystalline limestone, and serpentine, traversed by calcspar veins. This conglomerate differs from that found higher in the brook in containing a larger number of pebbles of rocks which do not occur in the Coxheath Hills, but which have been derived from strata similar to those of George River and Kelly Cove. Of great thickness.		

A fine outcrop of the conglomerate is displayed at the bridge over the east branch of Watson Brook, on the post-road from Sydney to North Sydney. It is coarse, contains comparatively few beds of sandstone, and these for the most part of coarse grit. The paste is a fine friable conglomerate holding pebbles of various size, the principal of which consist of:— Composition of the pebbles.

1. Felsites: emerald and olive-green, and Prussian-blue, compact; pea-green and jasper-red in bands, compact, banded green and brown; dark-purple, fine-grained; white and slaty, streaked with quartz; greyish-white, broadly crystalline, with small flakes of plumbago.
2. Porphyroid rocks: including Indian-red porphyry, with crystals of white feldspar; sea-green porphyry, with blackish-brown spots; lavender porphyry, with dark spots.

3. Granites: comprising a grey granite; various mixtures of greenish and black hornblende and feldspar; greenish hornblende, white feldspar, and bronze mica; olive green hornblende, vitreous quartz and pearl-grey mica, laminated; dark-green hornblende and white feldspar, obscurely laminated; white feldspar in small quantity, with green fine-grained hornblende.
4. Quartz and quartzite: colourless and vitreous; white and compact; bluish-black, lamellar; amber-brown and jasper-red; white and coarsely crystalline, having vugs filled with the ordinary prism-pyramids of rock-crystal, and indefinite crystals of iron pyrites.
5. Limestone and serpentine: a light-coloured limestone, containing plumbago; greenish and purple, soft, slaty rocks, of doubtful composition.
6. Hematite: a large pebble or boulder of hematite in a gangue of crystalline limestone.
7. Quartzose conglomerate, similar to that found on St. Andrew Channel.

McKeagan Brook.

Marl.

Sandstone.

The lowest beds seen in McKeagan Brook are comparatively fine, the paste being in one place red marl; the dip near the contact of the felsites is N. 36° E. < 25°. In Mill Brook, another tributary of Watson Brook, the conglomerate imbeds many large wedge-shaped masses of white or greenish-white and red, calcareous, fine-grained, micaceous sandstone, sometimes approaching compact limestone. The colours are sometimes mixed, sometimes distinct, the red being the most common.

Grantmire Brook.

Arenaceous shale.

Fucoids.

False-bedding.

Grantmire Brook, the next large stream to the westward, cuts through conglomerate containing pebbles of red porphyry, felsite, quartzite, diorite, grey argillite, soapstone and amygdaloid, with soft, white amygdules. Below the fork of Morrison Brook is a bed of friable, fine-grained, micaceous, arenaceous shale, ten feet thick, part of which has been broken up and has contributed pebbles to the overlying conglomerate. It is red with greenish patches, and passes in places into mottled marl, with marks of fucoids. In the green beds are nodules of green, coherent, calcareous sandstone and limestone, and near the top runs a layer of calcspar, one inch thick and under. This layer is composed of interlocking crystals, and is sometimes divided by a thin band of emerald-green, argillaceous rock, or by a cavity filled with crystals of black calcspar. At the bridge on the Scotch road are exposed coarse reddish conglomerate and sandstone, dipping at a low angle. The pebbles consist essentially of reddish and greenish porphyry, and of greenish, bluish and white, compact and granitoid, slaty felsite; but also of quartz, quartzose conglomerate, grey granite, and other granitoid rocks. The finer layers exhibit false bedding, and are not persistent but irregularly interstratified with the conglomerate. Ascending the brook, reddish friable, micaceous sandstone is met with, imbedding a few pebbles of

Joints.

felsite; joints are rare, but where seen they run S. 60° E., about three feet apart. Immediately succeeding is a deposit of very fine, soft, more or less micaceous, laminated or compact, corrugated, Indian-red and mottled marl, with a few green spots of curious shape, sometimes circular. A doubtful fucoid and several black carbonaceous markings were observed.

McKenzie Brook.

McKenzie Brook flows for a considerable distance over a similar deposit of bright red argillaceous marl, which forms a fine hay intervale. This is succeeded by a coarse conglomerate, the pebbles of which consist, no of felsites, but of grey and red syenite and quartz, the latter being particularly numerous, and displaying a bluish, oily colour and laminated structure, or a light-red colour and granular texture. The lowest Carboniferous rock exposed in this brook is a compact red marl, interstratified with mottled red and green, pebbly sandstone, and fine, calcareous conglomerate.

Sydney River.

The conglomerate at Sydney River contains pebbles and large blocks of red porphyry and blue and other coloured felsites, such as form the underlying rocks.

Long Island Barasois.

On the left bank of the Long Island Barasois, near McLeod's mill, a red conglomerate, holding pebbles, frequently of the diameter of cocoa-nuts, and almost wholly composed of fragments of crystalline limestone and blue hematitic slate, has been cut in the road, and extends towards the outlet of the pond and across the hills to the shore. The paste, of which there is only enough to cement the mass together, consists of red and green marl, fine limestone conglomerate, or calcspar. The junction of this formation with the older rocks is visible at the mouth of McSween Brook, where it alternates frequently with false-bedded, coarse, reddish sandstone, bright Indian-red or chocolate marl, and nodular limestone, dipping N. 43° W. < 12°, from the rim of the Bras d'Or basin. At the point of contact the conglomerate is composed of the finely broken *debris* of the slate which immediately underlies, but in the higher beds crystalline limestone takes the place of the slate, and a nearly pure limestone results. A short distance north of the brook the paste is of flesh and hyacinth-red chert or quartz. Above the road a similar conglomerate, in unconformable stratification on the hills, dips N. 20° W. < 15°.

Boisdale.

Lower Silurian rocks stretch along the coast from McSween Brook to Dougall Point, capped at several points with the conglomerate, which again shows itself in volume between Dougall Point and Boisdale. In Boisdale Brook it is composed of pebbles of white, greenish-blue and red felsite; purple and greenish porphyry; red, bluish-purple and white quartzite, with large spots of feldspar; red and light-grey, coarse syenite; black diorite; and light and dark-blue, banded argillite. It is interstratified with mottled red and green marl.

5. The Carboniferous Limestone.

No clearly defined line can be drawn between this formation and the Carboniferous conglomerate, for its lower beds merge gradually into the upper beds of the conglomerate, and the line of junction is always obscured by superficial deposits; but the predominance of conglomerates over finer sediments serves approximately to determine the boundary.

Character. The general characters of the formation have been given in the Reports for 1873 and 1874. On the first anticline it occupies, as shown on the map, a narrow strip of country along Sydney River, spreads out in the northern part of the Point Edward peninsula, and in the valley of Ball and Leitch Brooks forms a belt a mile and a-half wide between the conglomerate and the millstone grit, the southern boundary of which is not well marked.

Distribution.

On the Boisdale anticline the limestone is again seen, with an easterly dip, on the banks of George River and at Saunders Cove; and, with the reverse dip, in small outcrops at Young Point and on the eastern shore of Boulardrie Island.

Small detached areas are exposed along the St. Anne's anticline on Boulardrie Island and the peninsula between the Great Bras d'Or and St. Anne Harbor.

Limestone. The most important deposit of this formation is limestone, many bands of which are indicated on the map, as well as the position of the principal quarries. The limestone may be readily traced by the ridges and blocks on the surface of the ground, which disintegrate less rapidly than the associated shales and sandstones. Oolitic varieties are common, the grains being of different size, and sometimes consisting of a central, transparent, crystalline nucleus, surrounded by concentric zones. Nearly all contain fossils, and some are almost entirely made up of them. The brooks often run under these limestones, and emerge at a lower level as clear cold springs, which have in the middle of summer a temperature of 50° F. Strong springs of this kind were seen in Crawley, Ball and Dixon Brooks.

This formation may be well studied on the banks of Sydney River, where the following section was obtained, in descending order:

SECTION.

CARBONIFEROUS LIMESTONE ON SYDNEY RIVER.

	FEET.		
1. Bluish-grey, fossiliferous limestone, made up of nodules varying in size from filberts to walnuts	6	0	
2. Measures concealed.—Dip S. 51° E., $<$ 41°	4	0	
3. Dark blue, bituminous, highly fossiliferous limestone, (*Terebratula*, *Spirifer*, *Strophomena*)	3	0	Shells.
4. Bluish-grey, shaly limestone	3	0	
5. Light brown, friable, argillaceous limestone	1	0	
6. Light grey, friable sandstone	10	0	
7. Red, compact marl, in part very arenaceous: becomes light red limestone	2	0	
8. Red, friable, arenaceous shale	2	0	
9. Measures concealed	4	0	
10. Light grey, ripple-marked, pyritous, micaceo-argillaceous sandstone: coprolites, fish-scales and teeth, calamites	6	0	Fish remains and plants.
11. Bluish-grey, slightly bituminous, compact limestone, with streaks of calcspar	2	9	
12. Measures concealed	12	0	
13. Bluish-grey, argillaceous sandstone and marl; micaceous, friable, weathering rusty and grey: specks of white gypsum.	6	0	
14. Measures concealed	29	0	
15. Red, micaceous, friable marl and light grey, micaceous sandstone.	4	0	
16. Measures concealed, probably grey, shaly bituminous limestone.	15	0	
17. Grey, thin-bedded, bituminous limestone	3	0	Celestite.
18. Bluish-grey, compact celestite, with many specks of galena	1	0	
(The above section was measured at the mouth of a mill brook, one mile above Sydney Bridge. The following strata are seen about a-quarter of a mile above the bridge, and may be assumed to underlie the preceding, with or without a slight interval. Dip S. 26° E., $<$ 50°.)			
19. Bluish-grey limestone, containing streaks of calcspar and bands of a dark, bituminous substance of lustrous aspect	12	3	
20. Dark, bituminous shale	0	4	
21. Dark grey limestone in flaggy layers	3	0	
22. Grey, calcareous sandstone	0	10	
23. Light grey and green sandstone and marl	6	11	
24. Red and green, arenaceous marl	9	2	
25. Measures concealed	12	0	
(The section is here transferred to the left bank of the river.)			
26. Bluish and black, bituminous limestone	2	0	
27. Mottled red and green marl and sandstone	31	0	
28. Measures concealed	18	6	

	Feet.	In.
29. Black, highly bituminous limestone, full of broken *Producti* : *Spirorbis* common ; probably a thick band, but shows only.	2	0
30. Soft rocks concealed..	2	0
31. Red-purple, coarse, pebbly sandstone in half-inch and inch layers..	2	0
32. Greenish and red, crumbling conglomerate ; pebbles of pea and egg size..	2	6
33. Greenish and red sandstone, of coarse grit ; pebbles of white quartz..	0	8
34. Egg-conglomerate in a sandstone paste ; pebbles of red porphyry, quartzite etc..............................	1	3
35. Red-purple, micaceous, coarse, false-bedded sandstone........	2	0
36. Mottled greenish and red conglomerate, with large pebbles..	4	0
37. Red, soft, crumbling marl..............................	26	0
38. Red, friable, micaceous, arenaceous shale..................	8	9
39. Red marl..	11	0
40. Green marl..	2	6
41. Black, highly bituminous limestone......................	1	0
42. Red and green marl. Perhaps a small gap in the section here.	10	0
43. Mottled limestone of red, green, blue and other colours. Has been burned, and makes good lime....................	10	0
44. Bluish, bituminous limestone..............................	2	0
45. Light grey limestone..................................	0	6
46. Purple marl..	1	0
47. Light grey, compact limestone..............................	1	0
48. Red-purple, soft, crumbling marl, with green spots..........	4	0
49. Light emerald-green, coarse, calcareous sandstone, with small pebbles of pink feldspar. A fair building stone.........	6	0
50. Red and green mottled, friable sandstone.................	2	0
51. Measures concealed..................................	4	0
52. Mottled, impure limestone..............................	4	0
53. Indian-red, soft marl, holding nodules of micaceous limestone ; becomes limestone..............................	46	0
54. Emerald-green, and Indian or chocolate-red, friable, coarse sandstone..	16	0
55. Measures concealed..................................	7	4
56. Mottled, red, greenish, grey and blue compact limestone.....	4	0
57. Red and green marl, greenish limestone and grey sandstone blocks, not well seen..............................	8	0
58. Bluish-grey, bituminous limestone in three beds............	1	2
59. Shaly limestone....................................	2	0
60. Greenish and black, bituminous shale, sometimes arenaceous: becomes limestone..............................	2	0
61. Bluish, compact, shaly limestone..........................	2	6
62. Greenish marl, with compact limestone nodules............	1	9

	FEET.	IN.	
63. Bluish-black, compact splintery limestone	1	6	Fossils.
64. Black, bituminous shale, full of broken shells, *Spirorbis*, etc.	1	6	
65. Black, bituminous limestone, in nodules varying from an inch to a foot in diameter; mixed with black, soft marl. *Spirorbis*, *Cythere*, coprolites, of variable thickness	3	3	
66. Greenish, waving limestone, marl, and fine-grained sandstone mixed	1	0	
67. Greenish-grey, arenaceous, micaceous fire-clay; weathering ochre-yellow, crumbling	0	3	
68. Greenish, calcareous, pyritous, argillaceous shale	1	6	
69. Red marl, with spots of hematite	2	0	
70. Greenish, calcareous, argillaceous, pyritous, micaceous shale	1	0	
71. Bluish-grey and mottled, jointed limestone, full of white calcspar; sometimes compact and in blocks two feet wide; separated from one another by grooves, like a number of loaves of bread laid side by side	15	0	
72. Measures concealed: Mottled, compact limestone, two feet Red marl and friable sandstone Purplish, nut and egg conglomerate; pebbles of red porphyry, quartzite, etc. Red marl and sandstone, occasionally seen. Measures concealed.	490	0	
73. Red and purple conglomerate	6	0	
74. Mottled, crumbling limestone, with layers of green, pebbly sandstone	8	0	
75. Coarse, pebbly sandstone with limestone nodules	4	0	
(Here occurs a break in the section, but probably no interval; the next beds are seen near Sydney bridge.)			Sydney bridge.
76. Indian-red or chocolate, micaceous, arenaceous shale, spotted with green	4	0	
77. Red, micaceous sandstone	2	0	
78. Red marl with green spots, full of nodules of greenish and red limestone, from four inches to one-eighth of an inch in diameter; a crumbling bed, consisting chiefly of the nodules	4	8	
79. Red, friable, micaceous sandstone	1	4	
80. Greenish-white, coarse sandstone, irregularly streaked with red.	0	2	
81. Red and green, mottled sandstone and marl	10	0	
82. Measures concealed	18	0	
83. Red, micaceous, fine-grained sandstone, passing into marl. A dark marking one-sixteenth of an inch wide, of considerable length, composed of three parallel thread-like markings	4	0	
84. Red marl with green spots	3	0	

	FEET.	IN.
85. Measures concealed	10	10
86. Mottled reddish, bluish and green, compact limestone, in waving layers of from one inch to two feet in thickness, some beds having a rough, mammillated surface, and bright red and white colour	10	10
87. Fine and coarse, false-bedded sandstone and conglomerate; the pebbles of pea and egg size	27	0
Total thickness	1041	6

The highest bed in this section is a-quarter of a mile, or between seven and eight hundred feet vertically, from the millstone grit; but as the Sydney River fault intervenes, its distance below that formation can only be vaguely estimated. As no limestones were met with below 86, this may be regarded as the lower limit of the Carboniferous limestone. Another section of the lower members of this formation was obtained above tidewater, in Crawley Brook. It corresponds with part of Section II. (Report for 1874–75, p. 173), and is as follows:—

SECTION.

CARBONIFEROUS LIMESTONE IN CRAWLEY BROOK.

Dip, N. 74° *E.*, < 6°, *to N.* 34° *E.*, < 14°.

Columnar limestone.

	FEET.	IN.
1. Greenish, impure, concretionary limestone, with a rough cone-in-cone structure	0	6
2. Sap-green, emerald-green, and Indian-red mottled, compact, splintery limestone, arranged in polygonal columns which lie in a direction S. 2° E., < 55°; and, although varying greatly in size, average six inches in diameter, and three and a-half feet in length. The columns weather bronze-yellow; they break in the bedding planes, as well as in the direction of certain broad striæ, like those of the cone-in-cone concretions, which run parallel to the longer axes, and are often coated with a film of bright red hematite. Many of the columns are built up round a central axis of whitish, crystalline limestone, much of which is also scattered through the rock; some of them are composed of several smaller columns, an inch thick and downwards	3	6
3. Limestone, in one bed, resembling 2, except in structure	2	1
4. Reddish-grey, nodular limestone, in a paste of green and red marl. The nodules vary in size from peas to walnuts; are round or elliptical, with sometimes a central nucleus of crystalline calcspar	0	6
5. Indian-red and green clay-marl; becomes grey, argillaceous limestone	0	5

		FEET.	IN.
6.	Grey limestone, in half-inch to three-inch layers, with surface markings	1	7
7.	Red, friable, micaceous, arenaceous shale, with green spots	0	6
8.	Grey, red and green, slaty limestone	0	8
9.	Grey, compact limestone, in one bed	1	5
10.	Grey, areno-calcareous shale, holding nodules as large as cocoa nuts, composed of smaller nodules	0	6
11.	Grey, reddish and green, compact, impure limestone, in three layers	2	0
12.	Bluish-grey clay-marl, containing half-inch nodules of grey, bituminous limestone	0	1
13.	Bluish-grey, compact, nodular, bituminous limestone	0	2
14.	Greenish, jointed, argillaceous shale	0	6
15.	Bluish-grey, nodular, bituminous limestone	0	1
16.	Grey, jointed, micaceo-calcareous, argillaceous and arenaceous shale	1	2
17.	Bluish-grey, bituminous limestone, in large nodules. Sometimes parted by three inches of argillaceous shale; undulating, and variable in thickness	1	6
18.	Red and green mottled sandstone, passing into arenaceous limestone	4	0
19.	Mottled red and green, bituminous, oolitic limestone	2	0
20.	Mottled and green clay-marl, with one-inch nodules of mottled limestone; becomes impure, nodular limestone	1	0
21.	Grey, arenaceous limestone	0	9
22.	Bright red and green mottled, impure limestone	5	6
23.	Greenish-grey, arenaceous limestone, spotted red with hematite, and showing a minutely oolitic structure on weathered surfaces	2	7
24.	Measures concealed	28	0
25.	Limestone	18	0
26.	Measures concealed	29	4
27.	Reddish, fine-grained sandstone	5	6
28.	Red and green mottled, fine-grained sandstone, with patches of coarse grit	3	6
29.	Reddish conglomerate: pebbles from half-an-inch downwards.	1	6
30.	Red, micaceous, fine-grained sandstone, mixed with mottled red and green sandstone	10	0
31.	Fine and coarse sandstone, indefinite. Seen above the bridge on the Point Edward road.		
	Total thickness	128	10

The following is a more detailed section of the rocks of Grantmire Creek than that given in last year's report, page 174:

SECTION.

CARBONIFEROUS LIMESTONE IN GRANTMIRE CREEK.

Dip N. 17° *W.*, < 19°.

	FEET.	IN.
1. Red and green marl; reddish and green, false-bedded sandstone, of coarse grit; layers of pea and nut conglomerate. Seen only on the reefs................................	24	5
2. Egg and nut conglomerate: the paste a green and red, fine shingle; pebbles of quartz, grey granite, red syenite, greenish, friable, laminated, hornblende rock, feldspathic rocks, dark coloured slate. In some places a coarse sandstone...	1	8
3. Red, friable sandstone, of coarse grit......................	1	10
4. Impure, rather friable limestone, in nodular blocks; generally of a green colour, but with blotches of lavender and Indian red. (Report for 1874-5, page 174, line 17)..............	2	1
5. Purple and green mottled sandstone, of coarse grit, containing a few large pebbles and green coherent nodules of the same material..	5	6
6. Red sandstone, with small streaks of green, friable and fine-grained sandstone; becomes red and green marl, with red and green nodules..................................	20	0
7. Red and green marl, full of nodules of red and green limestone as large as hazel nuts..........	5	0
8. Measures concealed: probably red marl....................	4	0
9. Red, pebbly sandstone of coarse grit......................	1	0
10. Red, soft, argillaceous shale..............................	1	0
11. Red, friable sandstone, of coarse grit; weathers purple......	2	0
12. Red, friable sandstone, with greenish blotches and irregular layers of more coherent sandstone.....................	2	[illegible]
13. Light red conglomerate: with a few greenish-grey streaks; pebbles (generally varying in size from peas to nuts, but often larger) of quartz, grey granite, felsite, etc. Part of this, as well as the succeeding bed, is replaced by coarse sandstone of variable thickness........................	4	3
14. Red marl, with pea and egg nodules of red and green, coherent limestone. Passes into thin alternations of red marl and green, impure, nodular limestone. Sometimes the nodules are absent; sometimes shaly and micaceous............	5	0
15. Red and green mottled, nodular bed.......................	3	6
16. Red, fine-grained, micaceous sandstone....................	4	0
17. Red and green mottled sandstone of coarse grit............	5	6
18. Red, fine-grained, micaceous sandstone....................	0	9

		FEET.	IN.
19.	Red, pebbly sandstone, of coarse grit, with green blotches and bands, which run for a few inches or feet and then die out.	4	0
20.	Red and green mottled, arenaceous shale, with egg nodules and layers of greenish, impure limestone	2	0
21.	Red sandstone, of coarse grit	3	9
22.	Red, coarse sandstone and pea and nut conglomerate, containing larger pebbles, principally of quartz, and feldspar of different colours	1	0
23.	Measures concealed	21	4
24.	Red and green mottled, friable, arenaceous shale, containing many nodules of the same material, but more coherent than the rest of the bed; becomes reddish and green mottled pea and nut conglomerate, with pebbles of quartz, bluish felsite and granitoid rocks	6	6
25.	Red, fine-grained, coherent, micaceous sandstone	0	6
26.	Green and red mottled, nodular marl	4	0
27.	Red marl	5	6
28.	Sea-green, concretionary marl with red blotches, holding green nodules of impure, sandy limestone, sometimes as large as a hen's egg	1	0
29.	Indian-red, friable marl	6	0
30.	Greenish pea-conglomerate	0	9
31.	Indian-red, coarse, friable, arenaceous shale	1	0
32.	Red marl with green blotches	6	0
	Total thickness	157	2

A belt of limestone, which has been traced from the Scotch road to Grantmire Creek, seems there to abut against conglomerate. Another outcrop, perhaps of the same bed, occurs at the quarry near Watson Creek, but this is itself limited. There appears to be either some dislocation of the strata or want of conformity between the limestone and conglomerate, which the natural exposures are too few to disclose. *Appearance of unconformity.*

Alternating layers of limestone, marl, sandstone and conglomerate are seen at many points in the French Vale. Not far from the source of Limestone Brook, at the contact of the Carboniferous limestone and millstone grit, reddish and bluish limestone, interstratified with layers of greenish marl, dips N. 43° E. < 11°. Blocks of conglomerate also abound in this locality, the paste as well as the pebbles being of bituminous limestone, which, in a cross fracture, exhibits a highly crystalline structure. The pebbles of conglomerate stand out and form a rough surface, whilst the more crystalline paste is removed by weathering. *French Vale. Limestone Brook.*

Moore Point.

From the source of Limestone Brook this formation extends along George River to Moore Point, where a small outcrop of bluish-grey and reddish, highly bituminous limestone, streaked with numerous white calcspar veins, forms the headland. Its whole width at the quarry near the schoolhouse is sixteen chains, which, with the dip S. 81° E. < 54° of the quarry limestone, gives a vertical thickness of only 854 feet. It is possible, therefore, that the uplifting of the strata on this anticline has been accompanied by a fault, which ranges along the eastern slope of the Boisdale Hills.

Thickness at George River quarry.

Possible fault.

George Brook.

In the valley of George Brook, a quarter-of-a-mile east of the confluence of Crane Brook, is an outcrop of red, micaceous marl and sandstone, with spots of green and grey limestone. Half-a-mile south of the confluence of Rocky Brook the same stream cuts through a small but interesting exposure of yellowish-grey, soft marl, associated with light-grey, bluish and black, highly bituminous, nodular, slaty and thick-bedded, pyritous limestone. It contains hollows filled with crystalline calcspar, and lavender and blue fluorspar, and holds patches of bright, cubical coal three inches long and half-an-inch thick. An analysis of a specimen of this coal gave:—

Fluorspar and coal.

Volatile matter	36·72
Fixed carbon	46·64
Ash	16·64
	100·00

Does not coke. The ash is very ferruginous and calcareous, and may be in great part derived from the inclosing rock.

Long Island Barasois.

On the outer bar of Long Island Barasois pieces of grey, bituminous limestone strew the shore, but a sandy beach conceals the bed-rock, and the source from which they have come is unknown.

Tracing the formation still further towards the west, it is again developed on the crown of the Boisdale anticline, around Saunders Cove. Another outcrop occurs near Black Brook, and a third begins at Roderick Head and skirts the shore of Boulardrie Island for several miles. The prevailing dip is inland, but the rocks are much contorted, and some of the estimates in the following section, measured in Saunders Cove, are, consequently, more or less arbitrary:—

Boulardrie Island.

SECTION.

CARBONIFEROUS LIMESTONE IN SAUNDERS COVE, BOULARDRIE ISLAND.

		Feet.	In.
	Millstone Grit		
1.	Measures concealed: dip N. 31° W. < 8°	110	0
2.	Measures concealed: limestone blocks; dip N. 31° W. < 27...	150	0
3.	Bluish-grey, columnar limestone: thickness doubtful........	136	0
4.	Measures concealed..................................	50	0
5.	Green marl..	9	0
6.	Black, bituminous, nodular limestone; grey, compact limestone; mottled greenish and red, very compact limestone, in thick beds, some of which are full of calcspar. Forms cliffs twenty-five to forty feet high......................	55	0
	This limestone keeps the coast for half-a-mile, from Shawfield Point to a circular pond about twenty-five yards in diameter, resembling a plaster-pit. Here it is folded and dips S. 55° E. < 30° to 60°, and the rolls are afterwards so numerous as to prevent the identification of the different beds.		
7.	Grey, compact limestone, full of broken shells; nodular limestone, with a paste of greenish marl; red and green mottled limestone, marked between the layers with drusy hematite and fibrous calcspar; mottled zoned limestone; columnar limestone; red and green marl and sandstone. Many shells. Folded and dipping in every direction.................	40	0
8.	White, crumbling gypsum..............................	15	0
9.	Green, gypseous marl..................................	0	7
10.	Pink gypsum in a waving layer........................	0	0½
11.	Greenish, gypseous marl, with streaks of pink gypsum.......	0	10
12.	Pink gypsum, in a waving layer..........................	0	1
13.	Greenish, coherent, gypseous marl.........................	0	6
14.	Red, micaceous marl, with green blotches; thin, nndulating layers of gypsum..................................	7	0
15.	White gypsum in nodules, with a little marl...............	1	0
16.	Less gypsum and more red marl, traversed by small reticulating veins of white and pink gygsum........................	1	6
17.	Nodular gypsum, with emerald-green blotches and a pink layer	1	0
18.	Nodular gypsum and red, arenaceous marl, the nodules of the size of peas and nuts, and so numerous in some parts as almost to constitute layers of gypsum. At one point the gypsum is overlaid by blue, thick-bedded limestone......	3	0
	Total thickness	580	6½

Gypsum.

The gypsum mentioned in this section whitens the sea cliffs in several places, and its existence may often be inferred, even when it is concealed, from the plaster-pits by which the land is riddled. It is again seen south of Roderick Head, and in large volume on Island Point. In one of the limestones Dr. Honeyman discovered numerous specimens of

Fossils.

Beyrichia, *Estheria* and *Leperditia*.

Contact of millstone grit and Carboniferous limestone.

The contact beds of the millstone grit and Carboniferous limestone are well displayed at Roderick Head. The succession is as follows:

SECTION.

CARBONIFEROUS STRATA AT RODERICK HEAD.

Millstone Grit.

	FEET.	IN.
1. Grey, bluish-grey and brown, fine and coarse, often very micaceous, shaly and thick-bedded sandstone; in part fit for building or for grindstones, but sometimes false-bedded. Some beds contain pebbles as large as walnuts, of white, brown and dark-blue quartz and red syenite. Trunks of *Lepidodendron* and *Calamites*. (Plants.) Along the coast, between Roderick Point and Shawfield Cove, it forms cliffs fifty feet high, which rise to hills of 200 and 300 feet at no great distance from the shore. Joints run S. 62° W. and N. 27° W. vertically. Many springs of water issue from the rock.		
2. Grey, thin-bedded sandstone in horizontal layers	8	0
3. Bluish, argillaceous shale	12	0
4. Bluish sandstone, alternating with argillaceous shale	20	0
5. Bluish-grey, fine-grained sandstone, micaceous and in flaggy beds	10	0
6. Greenish and dark-blue, non-calcareous conglomerate or pebbly sandstone; pebbles of egg-size; small pieces of pyritous coal	4	0
Carboniferous Limestone.		
7. Red marl spotted with green; much mica and many minute quartz pebbles; passes in part into sandstone........	12	0
8. Greyish-brown, crystalline, compact and oolitic, contorted limestone, shaly or in thick beds; a few blotches and layers of red marl, not exceeding an inch in thickness; small patches of calcspar, and streaks of fibrous hematite. (Hematite.) Fossils abound—amongst them are: (Fossils.) Crinoids—stems circular, with circular foramen, and radii running to the circumference of the disk; some disks appear to have a double foramen. Brachiopods, much broken and filled in the interior with scalenohedra of calcspar, and embracing *Productus*, *Terebratula*, *Rhynchonella* and *Spirifer*; Corals and *Beyrichia* (?).	25	0

	FEET.	IN.
9. Red marl and sandstone, with bands of variegated limestone..	10	0
10. Reddish-grey and greyish-white, compact limestone, stained rust-red on the surface, and blotched with hematite.......	10	0
11. Red and green marl..	6	0
12. Greenish-grey, slaty and nodular limestone, resembling a conglomerate, in a paste of reddish and green, sandy marl. The nodules are as large as cocoa-nuts, or even larger, and in some layers everyone of them is marked with Indian-red and greenish, agatoid films. The slaty limestone is marked like the nodules. Small traces of hematite occur, as well as reticulating calcspar veins and streaks of considerable thickness.		
There are many undulations among these beds, broad and flat, or sharp and narrow, the axes of which are at right angles to the shore-line, and nearly horizontal. Joints run S. 65° W., and N. 25° W., and contain white, fibrous, striated calcspar.		
Total thickness............................	117	0

Undulations.

On the western shore of Boulardrie Island, rocks similar to those just described appear at the end of O'Hanley road, with a steep south-easterly dip. The limestones are rich in brachiopods, corals, encrinites and entomostracans. Gypsum frequently occurs, and the following succession of one of the outcrops was recorded:—

O'Hanley road.

	FEET.	IN.
1. Red and green marl..	1	0
2. Dark-grey, waving gypsum, containing veins and tabular crystalline masses of brown, fibrous selenite..............	3	0
3. Measures concealed...	5	5
4. White, or mottled bluish-grey and white gypsum, in thin shaly beds, with violet and lavender tints; weathers into acicular fragments...	10	0
Total thickness............................	19	5

Gypsum.

Resting on and filling up depressions in the syenite near Oyster Pond, St. Anne Harbor, are beds of bluish, compact and nodular limestone, varying from two inches to five feet in thickness. Red and green marl and limestone lie in huge rolls on the syenite, in a cove thirty yards wide, a jutting headland of red syenite separating it on the northern side from a similar basin, ten yards in width. The lowest beds often consist of fine conglomerate made up of syenite debris; but at the northern end of the larger cove the first member of this formation is a nodular fossil-

Contact of Carboniferous and syenitic rocks at Oyster Pond.

iferous limestone, which adapts itself to the contour of the underlying syenite, and dips away from it at high and variable angles.

In a cove, not far north of this, is a bed, three and a-half feet thick, of grey, nodular, botryoidal, fossiliferous limestone, often containing pebbles of granite. Underlying and irregularly mixed with this are variable beds of coarse sandstone and conglomerate, with large pebbles, hardly distinguishable from the friable subjacent granites, both containing much golden mica. At the end of the footpath to Kelly Cove, flaggy limestone, with pebbles of red and blue syenite and granite, occurs in the banks of a brook and on the hills.

A small insulated patch of grey, vesicular, contorted Carboniferous limestone, which has escaped denudation, is associated at the mouth of Smith Brook with ten feet of white, crumbling gypsum, in three beds, dipping at a low angle out to sea.

Gypsum.

6. The Millstone Grit.

Two synclines.

This formation underlies the coal measures to the westward of Sydney Harbor in two large basins. The first, bounded on the north by the productive measures of the Sydney Mines, is the south-western prolongation of the Sydney Harbor basin (Report for 1874-5, p. 223); and the second, covering the greater part of Boulardrie Island, and a limited area at Cape Dauphin, belongs to the Bras d'Or basin.

Description.

The rocks do not differ much from those described in previous reports, but consist of greenish-grey and white, coarse and fine-grained, brown-weathering, pebbly sandstone, in shaly or thick, sometimes false-bedded layers, with patches of conglomerate and broken stems of calamites and other plants. The sandstone is essentially a mixture of feldspar and quartz, the former giving, by its disintegration, a white colour, and by its removal a rough, quartzose surface to the rock. The pebbles consist chiefly of white and colourless, vitreous quartz, but also of grey and red granite and syenite, with specks of white mica.

Absence of workable seams of coal.

No workable seams of coal have been found among these strata, although search has been made in many places; nor is it probable that any such occur, since the succession of the rocks is well exposed in nearly every part of their thickness.

Limits of the millstone grit.

Limestone Brook follows the boundary between the Carboniferous limestone and millstone grit from its mouth to its source, widening in places into a narrow lake. From the source of this brook the line of contact runs north to the George River road, keeps near the road as far as the head of George Pond, down the channel of George River from the pond to the mouth, and thence to Grove Point. Near the mouth of George River are displayed coarse, yellowish-grey sandstones, with a few beds of argillaceous shale, a black, hard, pyritous rock, and streaks of coal a few inches thick containing plants. On the little Bras d'Or, some of the beds are fine-grained and false-bedded, but contain wedges of conglomerate more or less coherent, the pebbles being of quartz, flesh-red feldspar, and mica, often as large as a hen's egg. In the conglomerate are patches of coal, sometimes running in the bedding, but often crossing it obliquely; one tolerably regular layer, three-quarters of an inch thick, is split by a wedge of coarse sandstone, nowhere more than one inch thick, into two layers. The joints of the sandstone run N. 60° E., and dip to the south-east at an angle of 80°. George River. Coal. Joints.

On the eastern shore of Boulardrie Island, the rocks of this formation are similar to those of George River, and dip north-west, usually at a low angle, uncomformably overlying contorted limestones and shales. A fine-grained sandstone has been quarried to a considerable extent between Roderick Head and Shawfield Cove. It is grey and in thick beds, but spotted with iron ; and contains many spherical concretions of nearly compact sandstone, as well as coarser beds, with moulds of calamites. Ferruginous springs issue from these rocks in many localities. Boulardrie Island. Building stone. Springs.

The western coast, from Long Beach to Blackrock Point, exhibits beds of the same fine and coarse sandstone and conglomerate, one of them including a granite pebble of egg size, containing scales of silvery mica. Streaks of very pyritous coal and mineral charcoal are distributed among some of the conglomerates in patches or layers in the bedding, or as a kind of framework around the pebbles. The twisted appearance of much of this coal seems due to deposition on the irregular surfaces of the false beds. A more persistent seam an inch and a-half in thickness, is exposed half-a-mile south of McKenzie Point. Minute fragments of carbonized plants blacken the sandstone in places and give it a speckled appearance, and some of the finer layers are beautifully streaked. Casts of calamites, one inch in diameter, are very common, and larger trees also occur. The following is an analysis of a sample of coal which formed the bark of one of these fossil trees:— Coal-pipes. Fossil trees.

Analyses.

Volatile matter..................................	34·9
Fixed Carbon..................................	59·9
Ash, reddish-brown..........................	5·2
	100·0

Swells up and forms a fine, firm, vesicular coke.

A specimen taken from the pith of a tree, the rest of which was replaced by ironstone and argillaceous shale, gave:—

Volatile matter	36·70
Fixed Carbon	61·77
Ash, light brown	1·53
	100·00

Sp. gr. 1·26. Coal bright, with cubical cleavage. Cokes well.

Argillaceous shale.

Argillaceous shale is seen more frequently than on the eastern coast: it is often mixed with the conglomerate, and contains pieces of coal and mineral charcoal; and an irregular half-inch seam of coal overlies one of the shale beds. A bluish fireclay, three feet of bluish argillaceous shale, passing into a conglomerate and exhibiting impressions of *Neuropteris* and *Cordaites*, and ten or fifteen feet of red and green mottled marl, are among the finer sediments found on this coast. The cliffs are generally from thirty to fifty feet high, and hollowed out by the waves into various fantastic shapes.

Plants.

Caribou Marsh district.

In the district which lies between Sydney and Mira River, the millstone grit is exposed both on the Louisburg and on the Caribou Marsh roads. For several miles out of Sydney, grey, coarse sandstone prevails, and the country is rocky or covered with large lakes and marshes. Towards Mira River, however, fine-grained greenish-grey and reddish, feldspathic sandstone and shale, if they do not predominate, occupy at least as large an area as the coarse beds, and the land becomes more cultivable. Many of the shales are covered with carbonized black marks.

Superficial Geology.

Sand and gravel.

From the hilly nature of the country, and the depths to which the valleys have been excavated between the hills, the deposits of sand and gravel, which are occasionally found in the lowlands, have been derived in most cases, from the rocks immediately underlying; and the soil and boulders have been brought from the adjoining hills. On the north side of the Coxheath Hills the boulders are identical in character with the rocks to the southward; and on the Little Bras d'Or, below the bridge, is a large block of variegated feldspathic rock of the same nature. The masses of close-grained, pyritous, red syenite, interspersed with crystals of hornblende, found everywhere in the French Vale, have come, apparently, from the Boisdale range. Blocks of millstone grit sandstone are numerous at Battery Point, Sydney, at Sydney bridge,

Boulders.

and between Ball and Leitch Creeks, although the underlying rock is Carboniferous limestone or conglomerate; and small pieces of the peculiar grey sandstone belonging to this formation occur also among the metamorphic hills of Coxheath.

Deposits of stratified sand and gravel, often false-bedded, dip N. 65° E. $< 8°$, near the outlet of Long Island Barasois; and a coarse, rusty modern conglomerate, made up of fragments of millstone grit in a cement of bog-iron ore, is seen on the eastern shore of Boulardrie Island, about three miles south of Roderick Head, and again at Long Beach, on the western side. Stratified sand, etc. Conglomerate.

The western coast of the Great Bras d'Or, Seal Island, and the neighbouring islands and shoals, are composed of sand, gravel, and masses of various granitoid rocks obtained from the hills above. They are low, and the tide rushes past them with great velocity. Great Bras d'Or.

Glaciated rocks are seen in several places on the Scotch Lake road. The grooves seldom exceed half-an-inch in width and a quarter-of-an-inch in depth, but are very numerous, and run N. 51° E. On the back-lands road, near the head of Roach Lake, their direction is N. 64° E. On the south ssde of Gabarus Bay, where rounded and polished rocks also occur, the direction of the striæ is N. 73° E. Ice grooves.

The feldspathic hills are, for the most part, unfit for cultivation, on account of their broken and rugged outline; and even where a light covering of dry, comparatively good soil has resulted from the disintegration of the feldspar, the fertile belts are of limited extent. The high elevation and steep slopes of the country underlaid by the calcareous slates of St. Andrew Channel, generally renders it almost useless, except for grazing, notwithstanding the excellent quality of the soil. The Carboniferous conglomerate yields a rich, light-red, sandy soil, although the country is often hilly, and many blocks of feldspathic and quartzose rock are scattered over the surface. These, as well as the pebbles which abound in the brooks, can easily be traced to their original seat in the Laurentian and Silurian hills. The best farms owe their productiveness to the Carboniferous limestone. The land in the immediate vicinity of the thick limestone bands is too rocky for cultivation, except where covered by drift-soil; but these bands are not in sufficient number to materially lessen its value. Large lakes and swamps occupy a great part of the flat country underlaid by the millstone grit sandstone in the Caribou Marsh and George River districts; and wet barrens, with a deep growth of marsh-plants, moss, and tamarack, form a conspicuous feature in the scenery. These differ widely from the dry granite barrens, on Sterility of the hills. Fertile limestone lands. Millstone Grit country. Barrens.

which the plants consist chiefly of blueberry bushes, ferns, and stunted trees. The soil is rusty sand, and the surface covered with large blocks of sandstone. Small dark spruces and tamarack are the principal trees, although on the higher, well-drained parts of the interior, and on Boulardrie Island, where the land is fertile, hardwood, including birch, beech and maple abounds.

Economic Materials.

Coal.—The rumours which have been circulated from time to time about the discovery of workable seams of coal within the district examined last summer, to the westward of Sydney Harbor, have in all cases proved to be unfounded; and it may reasonably be concluded that none such exist. East of Sydney Harbor a seam of coal, supposed to be the continuation of the Tracy seam, was opened on the Morrison road. But the coal is of inconsiderable thickness, and the hopes entertained, with regard to the finding of this seam in workable condition between Mira Bay and Sydney, have not yet been realized.

Iron Ore.—The frequent occurrence of red hematite among the Lower Silurian slates and limestones of St. Andrew Channel has been already referred to, and it is possible that in some places this may be workable. Traces of magnetic iron ore, hematite, and iron pyrites are widely distributed among the marbles of George River and the limestones of Boulardrie Island.

Red hematite on the Bourinot road.

A mile south of the crossing of the French Vale and Bourinot roads, on the farm of Lauchlin Curry, about seventeen miles from Sydney, an important deposit of red hematite has been discovered in the George River limestone, and to some extent developed by Messrs. Campbell, Moseley and Brookman. The bed varies from five to nine feet in thickness, runs N. 45° E., and is said to have been followed for a distance of 150 feet by means of trial pits, and to a much greater distance by outcrops of ore on the surface; it lies between two thick beds of white and light-blue crystalline limestone (the prevailing rock of the locality), and is in some parts mixed with limestone, and weathering then to a light porous rock. A small quantity of iron pyrites was observed in drusy crystals filling small cavities, and also between the ore and a layer of chloritic rock, which sometimes occurs intermixed, and at other times forms the wall-rock. Patches of white, silvery talc and mica in large scales are found in the limestone. On the hills, which are of considerable height, the limestone appears to be interstratified with quartz a greenish felsite, associated with red syenite and other granitic rocks, and overlain by Carboniferous conglomerate, which here includes a small seam of impure coal. From its proximity to the Sydney coalfield, this ore, if of sufficient purity and quantity, must ultimately be of great importance.

Big Pond iron ore.

Nothing more has been done to develop the iron deposit at Big Pond. A box of the ore was forwarded by persons who wished to have it thoroughly tested in England, to Professor Noad, of St. George's Hospital, London, whose results corroborate those of Professor How, quoted in the Report for 1874-75, page 263,—

Analysis.

Peroxide of iron	85·6
Silica	14·0
	99·6
Iron, per cent	60·0

Foreign matter was searched for, but nothing could be found except a minute trace of phosphoric acid.

Analyses of Whykokomagh iron ore.

Three analyses of Whykokomagh iron ore (Report for 1873-74, p. 180), made by Professor Noad from a barrel selected by Mr. Gisborne from 150 tons extracted from the eleven-feet bed, gave as follows:—

	I.	II.	III.
Peroxide of iron	85·70	52·40	74·30
Protoxide of iron	.....	.....	6·70
Protoxide of manganese	0·20	None.	0·40
Water	2·00	.....	.....
Magnesia	2·40	3·32	2·75
Sulphur	None.	None.	None.
Phosphoric acid	3·56	1·50	1·00
Siliceous residue	6·09	42·80	14·80
	99·86	100·02	60·95
Metallic iron	60·00	36·67	57·20

The quantity of phosphoric acid in the ore, (as shown by the analyses) rendering it unfit for use, the mine was abandoned.

Copper Ore.—The felsites cut in the brooks which flow from the Coxheath Hills contain small traces of yellow and purple copper pyrites, but no deposit is known worthy of special mention.

Copper ore at Gabarus.

At Eagle Head, however, in Gabarus Bay, a deposit which has attracted more attention is inclosed in a belt of laminated quartz, twenty-five or thirty feet thick, intermixed with soft, decomposed feldspar rock, which coincides in strike with the feldspathic rocks already described as forming the coast between Gabarus and Louisburg. The quartz layers are of no great thickness, and sometimes contain copper pyrites; one of them, nine inches thick, is more richly charged than the rest, although even in this one the principal metallic ingredient is iron pyrites. Its very occurrence, however, is promising, and more careful search may discover deposits which will be successfully mined.

Molybdenite.—Similar quartz bands occur on the Atlantic coast, running with the strike of the felsites, and quartz veins also abound in the cleavage-planes and joints. Nearly all of these contain small quantities of molybdenite, a mineral used in the manufacture of pottery, for the production of a blue pigment, and also in the preparation of molybdate of lead.

George River lime-works.

Limestone.—Quarries have been opened on the outcrop of many of the limestone bands to supply the local demand for lime, but no works of any magnitude have been established except at George River, from which 6,000 barrels of lime, invoiced at eighty cents a barrel, were sent to St. John's, Nfld., Liverpool, Halifax and other parts of Nova Scotia.* Wood and coal for fuel are cheap, and as it can be produced for less than Rockland lime, it is expected that it will undersell the latter in the Canadian market. Two kilns have been erected, capable of producing sixty barrels of lime a day; one of these is a square kiln, burning wood; the other, round, and fed with coal. A mill for the manufacture of staves and other lumber has also been erected, and logs to supply this can be obtained on very reasonable terms. Vessels of a hundred tons burden load within four hundred yards of the mill.

Marble.—As already mentioned, white and tinted marble, exhibiting every variety of colour and texture, but usually too much broken and mixed with other rock to be available for artistic purposes, is found at George River, in the French Vale and at Kelly Cove. At George River it has been quarried to a small extent, but the quarries have been, for the present, abandoned.

Building stone.

Freestone.—The millstone grit of Boulardrie Island and New Campbellton furnishes a grey, fine-grained, strong, homogenous, non-calcareous sandstone, well adapted for building material, but sometimes spotted, on exposure to the air, by the oxidation of the iron pyrites

* Report of Commissioners of Mines for Nova Scotia, 1876. Prospectus of George River Marble and Lime Company.

which it contains. It is stated that a contract has been entered into for the delivery of 10,000 tons of this stone from the quarries on St. Andrew Channel and the Great Bras d'Or, to be used in the enlargement of St. Peter's canal.

Thick-bedded sandstone of a uniform, coherent texture, and suitable for the manufacture of grindstones, might also be obtained from the same strata.

Gypsum.—In the region to which this report refers, gypsum is found in limited quantity on both shores of Boulardrie Island and at St. Anne Harbor, associated with Carboniferous limestone rocks; but so long as the large deposits at Port Bevis, near Baddeck, are so easily accessible, it is not likely to attract much notice. Port Bevis gypsum beds.

These latter comprise the thick beds which run from the head of St. Anne Harbor to Port Bevis and Baddeck Bay, on which several quarries have been established, with an annual yield of about ten thousand tons. The gypsum lies, it is said, in irregular masses, which differ slightly in colour and texture; in thickness they range from fifty feet downwards, and are often surrounded or cut out by clay.

The most important of these quarries is that owned by Mr. Duncan Macdonald, of Montreal, and others, and is situated about four miles east of Baddeck, near the shore of the Bras d'Or Lake, with which it is connected by a railway and wharf 1,000 and 300 feet in length respectively. The total yield of this quarry during 1875 was about 5,000 tons, most of which was sold in New York, where it is used in the finishing of houses and for other purposes; it is of excellent quality, and, according to an analysis made by Professor Chapman, consists of:

Analysis.

Sulphuric Acid	46·44
Carbonic Acid	0·47
Lime	32·58
Silica	0·11
Water	20·43
	100·03

or,

Gypsum	98·85
Calcite	1·07
Intermixed sand	0·11
	100·03

Celestite.—This mineral, which is one of the sources of the strontium nitrate used in the production of red fire in pyrotechny, is found on Strontium.

the right bank of Sydney River, about a mile and a-half above Sydney Bridge, where a bluish-grey bed, about a foot in thickness, containing specks of galena, may be seen for a considerable distance along the river, overlaid by grey, slaty limestone.

Ornamental stones.

Syenite, *Granite* and *Porphyry*, differing widely in colour, texture and composition, but often susceptible of a high polish, and fit for decorative work, occur abundantly in the Coxheath, Boisdale and St. Anne Hills, and are worthy the attention of capitalists.

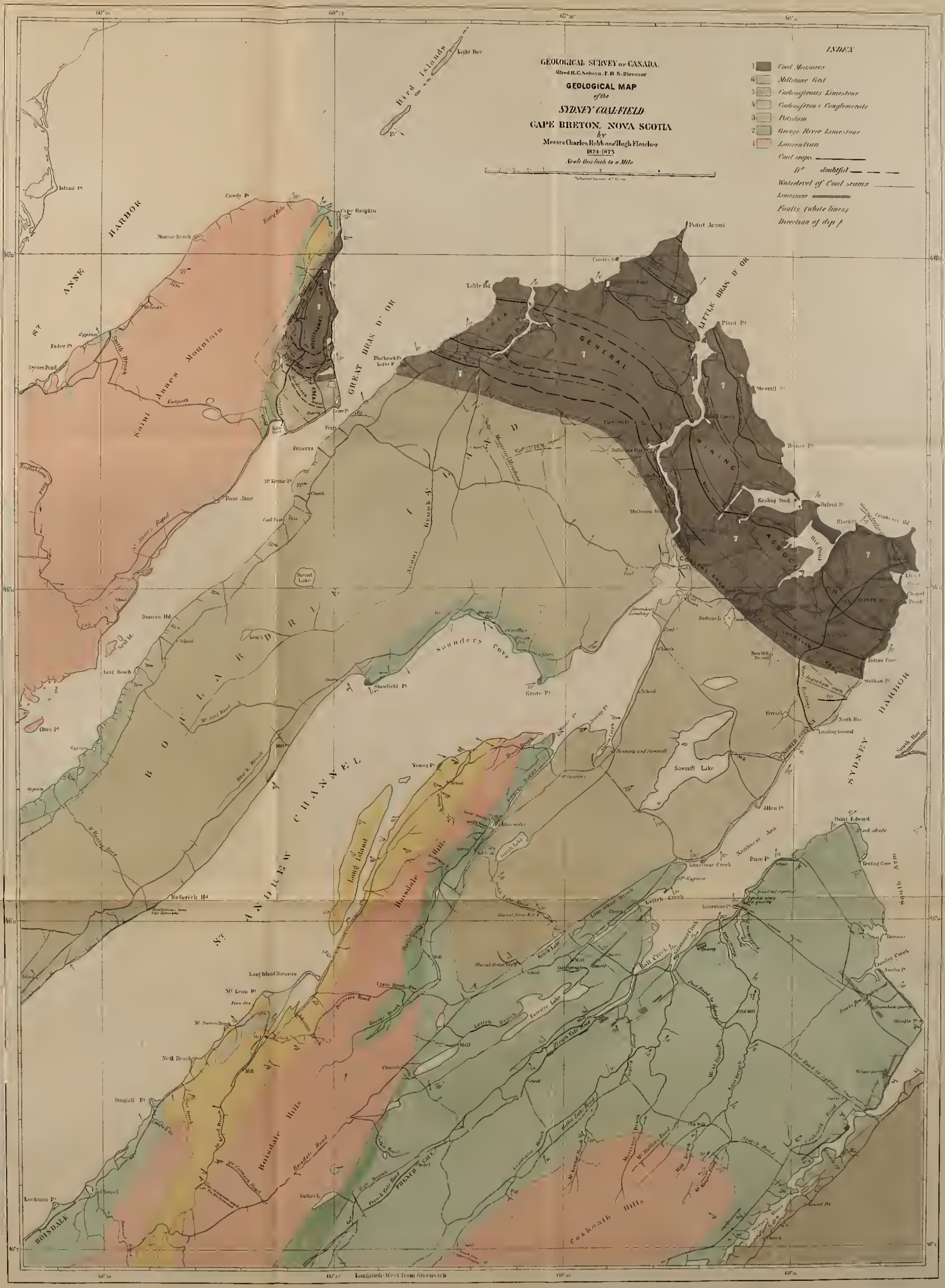
I have the honour to be,

Sir,

Your most obedient servant,

HUGH FLETCHER.

MONTREAL, *May*, 1876.



GEOLOGICAL SURVEY OF CANADA.
Alfred R.C. Selwyn. F.R.S. Director
GEOLOGICAL MAP
of the
SYDNEY COAL-FIELD
CAPE BRETON, NOVA SCOTIA
by
Messrs Charles Robb and Hugh Fletcher
1874-1875
Scale One Inch to a Mile
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Boisdale Hills
Coxheath Hills
Sawmill Lake
Point Edward
Bird Islands
Longitude West from Greenwich

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CHEMICAL CONTRIBUTIONS

TO THE

GEOLOGY OF CANADA,

BY

CHRISTIAN HOFFMANN,

ADDRESSED TO

ALFRED R. C. SELWYN, F.R.S., F.G.S.,

DIRECTOR OF THE GEOLOGICAL SURVEY OF CANADA.

Sir,—I have the honour of herewith laying before you the results obtained in the analysis of some Canadian minerals and rocks, comprising saline incrustations, fuels, and graphites; as also the results of assay of some gold, silver, copper and iron ores.

The analysis of the rock, which proved to be an altered felsite, was undertaken for the purpose of establishing its character; subsequently, and in view of its composition, as shown by the analysis, it was deemed desirable to make a few experiments, with the object of ascertaining its adaptability to the manufacture of fire-brick. The results obtained were, as will be seen, of a very promising character.

An investigation into Canadian graphites has been entered upon, and this, it is proposed, to make as complete as time and circumstances will permit. In addition to the complete chemical analysis, a practical pyrometric determination of the value of each specimen will be made, and this in view of one of the most important applications of this mineral, viz., the manufacture of crucibles. The work thus far accomplished, in connection with this subject, is of too incomplete a nature to admit of publication at present; the percentage of graphite, &c., in some of the more, if not the most, important beds of the disseminated variety in the townships of Buckingham are, however, here given, and further facts in connection with these will appear in a future and concluding report upon this subject.

A.—Rocks and Minerals.

1. *Sal-Ammoniac and Native Sulphur.*

The substance, of which the following is an analysis, constitutes a deposit on the cliffs of shale on Smoky River, North-west Territory, and is that to which Mr. Selwyn alludes in his Report, page 73.

Sal-ammoniac and sulphur from Smoky River.

The specimen varied in colour from canary-yellow to white; opaque; taste, saline and pungent; fine to coarse granular, some of the larger fragments showing a distinctly fibrous structure. The disseminated fragments of rocky matter contained in it were, as far as possible, separated from the portion set apart for analysis, which, after drying at 100° C., was found to contain:

Sulphur	46·517
Chlorine	33·445
Sulphuric acid ($S O_4$)	1·635
Potassium	0·016
Sodium	0·089
Ammonium	17·470
Calcium	0·043
Magnesium	Trace.
Iron	Trace.
Extraneous matter, consisting of fragments of an ash-grey coloured rock	0·922
	100·137

These figures correspond to the following composition:—

Sulphur	46·517
Ammonium chloride	50·422
Ammonium sulphate	1·807
Potassium sulphate	0·035
Sodium sulphate	0·274
Calcium sulphate	0·146
Sulphuric acid ($S O_4$), probably pertaining to the traces of iron and magnesium	0·014
Extraneous matter	0·922
	100·137

2. *Mirabilite.*

The following is the result of the examination of the saline incrustation mentioned by Mr. Selwyn, page 73, as occurring upon the cliffs of shale at Fort St. John, Peace River.

The specimen received consisted of effervesced granular aggregates, with intermingled fragments of a dark-grey shale. It was friable; colour, white; opaque; taste, saline and bitter; very soluble in water. Mirabilite from Peace River.

Its analysis gave the following results :—

Potassium	0·094
Sodium	14·156
Calcium	0·571
Magnesium	4·633
Aluminium	0·072
Manganese	0·158
Iron	0·205
Sulphuric acid (SO_4)	49·849
Chlorine	0·270
Water	14·748
Undissolved matter	16·325
	101·081

The undissolved matter contained:—

Silica	8·610
Alumina	3·450
Ferrous oxide	1·315
Manganous oxide	Trace.
Lime	0·675
Magnesia	0·240
Sulphuric acid (S O)	0·834
Alkalies, organic matter, &c., undetermined	1·201
	16·325

After deducting the undissolved matter, the remaining constituents, calculated for one hundred parts, correspond to the following composition :—

Potassium sulphate	0·245
Sodium sulphate (Glauber salt)	51·346
Calcium sulphate	2·281
Magnesium sulphate (Epsom salts)	26·685
Aluminium sulphate	0·527
Manganous sulphate	0·510
Ferrous sulphate	0·653
Magnesium chloride	0·424
Water	17·329
	100·000

A portion of the material was treated with water, the undissolved matter filtered off, and the clear filtrate set aside to undergo spontaneous evaporation: the crystals obtained were found to contain more than fifty per cent. of water. The amount of sulphuric acid ($S\,O_4$) required to enter into combination with the various bases, in the manner here set forth, was found to be 0·351 per cent. in excess of that actually found.

The sulphuric acid found in the undissolved matter is present as calcium sulphate; further, a small quantity of the iron found in this portion of the material is present as ferric oxide.

This incrustation consists, therefore, as shown by the above analysis, of what may be regarded as an impure Glauber salt.

3. *Lignite.*

From main Moose River, between fork of south branch and Long Portage, *vide* Report by Mr. Robert Bell, page 326.

Lignite from Moose River.

Ligneous texture very decided; tolerably tough; colour black, slightly inclining to brown; powder, dark chocolate-brown; fracture, sub-conchoidal; lustre dull, that of the freshly fractured surface resinous to shining resinous. A piece of this lignite, immersed in water for over three days, remained apparently unaffected; it had not disintegrated, nor imparted any colouration to the water.

This specimen having been kept in the laboratory for months, may be regarded as having been thoroughly air-dried.

Two proximate analyses by slow and fast coking gave,—

	Slow coking.	Fast coking.
Fixed carbon	45·82	44·03
Volatile combustible matter	39·60	41·39
Water	11·74	11·74
Ash	2·84	2·84
	100·00	100·00
Ratio of volatile to fixed combustible	1 : 1·16	1 : 1·06

Both slow and fast coking gave a pulverulent coke, showing a slight tendency to sinter. The ash had a light yellowish-grey colour, and agglutinated but very slightly at a bright red heat.

This lignite is very similar in composition to those from the Souris Valley, collected and examined by Mr. G. M. Dawson; as also to those from the Dirt Hills and Woody Mountain, collected by Mr. Robert Bell, examined and reported on by me (see Geological Survey Report, 1873–74, page 90).

4. *Anthracite.*

From an island near Whale River, east side of Hudson's Bay, *vide* Report by Mr. Robert Bell, page 325.

Anthracite from Hudson's Bay.

It is not improbable but that the mineral here spoken of may have an origin analagous to that of the black anthracitic matter which occurs in many places in the Quebec group, as also in the chert beds among the Upper Copper-bearing rocks of Lake Superior, and alluded to in the Geology of Canada, 1863, pages 525 and 68. The specimen examined was very compact, homogeneous; colour, pitch-black; powder, deep-black; lustre, bright metallic; fracture, highly conchoidal; it does not soil the fingers. When boiled in a solution of caustic potash, it was apparently unacted on; the solution remained colourless, and the powder black. Gradually heated, or when projected into a bright red-hot crucible, in either case decrepitated but very slightly.

The specimen had been kept in the laboratory for months.

The following is the mean of two very closely concordant analyses:—

Fixed carbon	94·91
Volatile combustible matter	1·29
Water	3·45
Ash	0·35
	100·00

It was scarcely changed in appearance by coking. The ash, which had a reddish iron-black colour, was attracted by the magnet; it showed not the slightest disposition to agglutinate, even at a bright red heat.

5. *Altered Felsite.*

From Coxheath Hills, Watson Brook, Cape Breton, Nova Scotia.

Altered felsite from Cape Breton.

This is the rock referred to by Mr. Hugh Fletcher, in his Report, page 373, under the designation, "white weathering slaty felsite."

It has a compact, massive, slightly foliated structure; though apparently of somewhat rare occurrence, occasional nodules of a translucent white quartz are met with in this rock, otherwise it is, to all appearances, very homogeneous in composition. Lustre, dull to almost pearly; colour, pearl-grey, with a faint pinkish tinge; streak, white; fracture, uneven, scaly; sub-translucent; feel, slightly greasy. The hardness is about 6, and the specific gravity 2·770. Before the blowpipe, slightly rounded when in very fine splinters.

An analysis of the material, after drying at 100° C., gave the following results :—

Silica	76·260
Alumina	19·152
Ferric oxide	Trace.
Magnesia	0·170
Lime	0·552
Soda	0·159
Potash	0·100
Water	4·300
	100·693

re-brick.

The following experiments were instituted, with a view of obtaining some information with reference to the suitableness of the above rock as a material for the manufacture of fire-brick.

From information received, it is inferred that there are very large deposits of this rock, forming extensive beds; and, again, that these, from their position, would admit of being both easily and economically worked.

The rock is by no means difficult to crush or grind; when reduced to very fine powder it has a somewhat soapy feel, and is slightly plastic after having been moistened with water.

In carrying out the experiments, the following method of procedure was adopted :—

The material having been triturated in a mortar and passed through a fine sieve, now received the desired addition of lime, which having been carefully intermixed, the whole was then moistened with just sufficient water to make it cohere by pressure. The mould, which was open, top and bottom, having been placed upon a moveable plate, was charged with the material, and the latter stamped down by a rammer, the face of which almost exactly fitted the mould; retaining a slight pressure upon the rammer, and grasping the sides of the mould, the same was raised up and over the former; this in turn was now slid off from the face of the moulded mass, thus leaving upon the plate a minature brick, three inches long by one inch broad, and half-an-inch thick. It being of importance that the edges should be perfectly sharp, these were examined, and, when defective, their sharpness restored by carefully fashioning them off with a knife.

The bricks were now slowly dried, and inasmuch as they were too tender to admit of handling until this process had been accomplished, they were set aside upon the plate upon which they had been moulded, and exposed, first to a dry atmosphere until they had parted with the greater part of their moisture, and then to a temperature of 100° C., after which they were regarded as ready for the next process—viz., that of firing, which was accomplished by inserting them in covered crucibles, and placing these in an air furnace, the temperature of which was gradually raised until, at the expiration of an hour, an incipient white heat had been obtained, at which temperature it was maintained for an additional two hours.

Experiment 1.—The powdered rock without any addition whatever, beyond such amount of water as was found requisite to form the brick.

Result: The edges of the brick remained perfectly sharp, and showed no indication of having undergone even the most incipient fusion; its colour was white, inclining to grey; its mass had only slightly sintered together, and readily crumbled when pressed between the fingers.

Experiment 2.—To the powdered rock added lime in such proportion as to raise the amount of this constituent in the material to one per cent.

Result: The brick was sonorous, tough and hard; the fracture uneven; the colour, both externally and internally, white inclining to grey; the edges were as sharp as at the time of insertion, and showed no indication of even an approach to fusion.

Experiment 3.—To the powdered rock added lime in such proportion as to raise the amount of this constituent in the material to one and a-quarter per cent.

Result: All that has been said of the brick in the number 2 experiment is equally applicable to the one now under consideration, with this exception, that the latter was somewhat tougher and harder.

Experiment 4.—To the powdered rock added lime in such proportion as to raise the amount of this constituent in the material to one and a-half per cent.

Result: This brick was tougher and harder than those of the two preceding experiments; its colour and fracture was in perfect agreement with the remarks recorded of them; the same may be said of its edges, which remained perfectly sharp, and showed no indication of having in the least degree suffered fusion. It was also sonorous.

From the results obtained in these experiments, it will be seen that while the attempt to make a brick from this material alone was unsuccessful, the addition of from, say, half to one per cent. of lime resulted in the production of a very refractory brick. The addition of about one per cent. having afforded the best results.

It is by no means intended to be affirmed that this is the best proportion that could be selected; indeed, it is quite possible that a slight deviation may be attended with advantage; this, however, as also the fineness or coarseness to which the material should be ground, the duration of and temperature to be employed in the firing, could be most satisfactorily ascertained by experiment on the large scale, which would likewise afford the best opportunity of observing how the bricks comport themselves on exposure to intense and long continued heat, sudden and great extremes of temperature, pressure at high temperatures, &c., thus enabling an opinion to be formed as to which of the many purposes for which fire-brick are employed, they appear best adapted, the opinion thus formed being further confirmed by an actual trial under the special conditions to which they are intended to be subjected.

6. Graphite.

A "disseminated graphite."

From the twenty-eighth lot of the sixth range of the township of Buckingham. The property of the Montreal Plumbago Mining Company. An exceedingly important deposit. The specimen examined was regarded as a fair average of one of the largest and most extensively worked beds of disseminated graphite in this whole section. The bed averages eight feet and runs across the whole of this lot and into lot twenty-seven in the seventh range.

Graphite from Buckingham.

The graphite, which occurs in scales, is so closely and evenly distributed through the rock as almost entirely to mask its nature. The mineral contains some calcite: the presence of a small quantity of pyrrhotite or magnetic pyrites was also established. The powdered-rock is attacked by hydrochloric acid; this acid, with the aid of heat, dissolved out 17·539 per cent.; the solution was found to contain:

Silica	very small quantity.	Lime	large quantity.
Alumina	" large "	Magnesia	small "
Iron	rather large "	Cobalt	trace.
Manganese	small "	Alkalies	not sought for.

The rock contains:

Graphite	27·518
Rock matter, soluble in hydrochloric acid	17·539
Rock matter, insoluble in hydrochloric acid	54·899
Hygroscopic water	0·044
	100·000

7. Graphite.

A "disseminated graphite."

From the twenty-second lot of the sixth range of the Township of Buckingham. The property of the Buckingham Mining Company. Several important beds of disseminated graphite occur towards the front of this lot. They have as yet only been uncovered. The specimen examined was considered a fair average of one of the most important beds.

The graphite, which occurs in scales, is evenly distributed through the rock; the latter was very much decomposed, and coloured brownish-yellow to reddish-brown from the presence of ferric hydrate. The rock contained no calcite; a small quantity of pyrrhotite was, however, shown to be present. Hydrochloric acid, with the aid of heat, dissolved out from the powdered rock 19·467 per cent.; the solution was found to contain:

Silica	very small quantity.	Lime	large quantity.
Alumina	large "	Magnesia	" "
Iron	" "	Cobalt	trace.
Manganese	small "	Alkalies	not sought for.

The rock contains:

Graphite	22·385
Rock matter, soluble in hydrochloric acid	19·467
Rock matter, insoluble in hydrochloric acid	56·408
Hygroscopic water	1·740
	100·000

8. Graphite.

A "disseminated graphite."

From the twentieth lot of the eighth range of Buckingham. The property of the Dominion Plumbago Company. From a large bed of disseminated graphite, probably of considerable extent. The specimen examined was considered a fair average.

The graphite is pretty evenly disseminated in scales throughout the rock; the latter contains some calcite, as also small quantities of pyrrhotite. The powdered mineral is freely attacked by hydrochloric acid, which, with the aid of heat, dissolved out 21·285 per cent.; the solution was found to contain:

Silica	very small quantity.	Lime	large quantity.
Alumina	" large "	Magnesia	moderate "
Iron	" "	Cobalt	trace.
Manganese	small "	Alkalies	were not sought for.

The rock contains :

Graphite	23·798
Rock matter, soluble in hydrochloric acid	21·285
Rock matter, insoluble in hydrochloric acid	53·741
Hygroscopic water	1·176
	100·000

9. Graphite.

From the twenty-third lot of the sixth range of the township of Buckingham. The property of the Buckingham Mining Company.

This deposit has been traced through into the seventh range. It would appear to be a bed whose position is conformable to the stratification of the beds of disseminated graphite, and connecting with the true fissure veins which cross these beds. The rock consists of quartz and a feldspar, and is traversed by more or less disconnected lenticular layers of a twisted fibrous graphite; these layers, which vary greatly in thickness, may perhaps justly be regarded as interstratified veins. As yet the ground has only been uncovered, but it is considered probable that the rock for a transverse measurement of some fifteen to twenty feet would yield largely. The specimen examined was considered a pretty fair average.

The rock contained no calcite; the presence of a small quantity of pyrrhotite was, however, established. The powdered mineral was very little acted upon by hydrochloric acid, this acid, by the aid of heat, dissolving out only 2·475 per cent.; the solution was found to contain :

Silica	trace.	Lime	small quantity.
Alumina	small quantity.	Magnesia	" "
Iron	" "	Cobalt	trace.
Manganese	very small quantity.	Alkalies	were not sought for.

The rock contains:

Graphite	30·516
Rock matter, soluble in hydrochloric acid	2·475
Rock matter, insoluble in hydrochloric acid	66·874
Hygroscopic water	0·135
	100·000

In connection with the subject of graphite, it might, perhaps, not be amiss to quote the prices of hydrochloric and sulphuric acids, recently furnished me by Alexander Cowan, Esq., Manager of the Brockville Chemical and Superphosphate Works. These are:

For hydrochloric acid (commercial) of 18° Baumé, two and a-half cents per pound. An imperial gallon of this acid weighs 11·40 pounds avoirdupois. For sulphuric acid (commercial) of 66° Baumé, two and a-half cents per pound. An imperial gallon of this acid weighs 18·46 pounds avoirdupois.

Any enterprise involving the use of these acids, if carried out in connection with the Brockville works, would have a very great advantage in being supplied with all the acids required at cost price, or much lower even than the price quoted. These conditions might often render an undertaking profitable which could not be made so if all the acid used in it had to be purchased from the works at the prices above quoted.

B.—Gold and Silver Assays.

Ores from British Columbia.

Quartz from British Columbia.

No. 1.—Tailings from Van Winkle mine, Cariboo, British Columbia.

These tailings consisted mainly of pyrite, with a little quartz and other rock matter; the whole presented the appearance of being highly water-worn.

Result: 0·073 oz. of gold to the ton of 2,000 pounds.
0·210 oz. of silver to the ton of 2,000 pounds.

No. 1.—Specimen labelled, "Vein between William's Creek and Conkling's Gulch, Cariboo, British Columbia. Vein, six to seven feet wide. A picked specimen gave nearly $200 gold and silver to the ton. This specimen considered a fair average of the vein. From Mr. P. Dunlevey, Soda Creek."

This specimen consisted of a white opaque quartz, more or less coated with ferric hydrate; it contained a little pyrite.

Result: Contained neither gold nor silver.

It is not improbable but that a specimen containing pyrite, or the result of the decomposition of the same, may have afforded gold and silver of the value stated. In the specimen forwarded for assay, very little pyrite was discernable, and the ferric hydrate resulting from its decomposition may have become detached and lost, during or subsequent to its collection.

No. 3.—Specimen labelled, "Quartz from a lode on a stream running into Manson Creek, thirty miles from the town of Dunkeld, British Columbia Vein twenty-five feet thick."

This was a white semi-translucent quartz, more or less coated with ferric hydrate, and contained a small quantity of galena.

Result: Traces of gold.

8·971 oz. of silver to the ton of 2,000 pounds.

The galena was by no means evenly distributed through the quartz; on the contrary it was confined to one or two fragments of the sample received, consequently the amount of galena contained in the average sample of the rock, as prepared for assay, must have been small, from which, in view of the amount of silver obtained, it may be inferred that the galena is very argentiferous, and if hand-dressing could be resorted to, a very satisfactory yield per ton might be anticipated.

No. 4.—Specimen labelled, "Silver ore, from Soda Creek, British Columbia. Collected by Mr. Jennings."

A black shale, containing carbonaceous matter, in parts slightly stained with ferric hydrate.

Result: Contained neither gold nor silver.

Ores from the Province of Quebec.

Accompanying the samples forwarded for assay was a hand specimen taken from the same mine and labelled, "Griffith's or Suffield mine, situated on the third lot of the eleventh range of Ascot." It consisted of copper pyrites, iron pyrites, and a little blende distributed through a white semi-translucent quartz associated with a white feldspar. Native silver was distinctly perceptible in this specimen.

The material upon which the following assays were conducted was, when received, in a state of tolerably fine powder; the ore had apparently been submitted to a partial roasting:—

No. 1.—Labelled, "Sample of ore from Suffield mine, from piles in smelting house."

Result: 5·104 oz. of silver to the ton of 2,000 pounds.

No. 2.—Labelled "Sample of ore from the Suffield mine, taken from the piles near the shaft."

Result: 5·104 oz. of silver to the ton of 2,000 pounds.

In both cases the silver was found to contain a trace of gold.

C.—Miscellaneous.

No. 1.—Labelled, "Clay iron-stone from Cretaceous rocks at intersection of Fort Pelly road and White Mud River, about fifteen miles south of Fort Pelly. Collected by Mr. Robert Bell." Iron ores.

Fracture uneven; lustre, dull, earthy; colour, light brownish-grey, blending off to a reddish-brown towards the outside, exteriorly dark reddish brown.

Result; Found to contain 34·07 per cent. metallic iron.

This clay iron-stone very closely resembles those collected by Mr. Selwyn, at Edmonton, and referred to in Report of Progress, 1873-74, page 49; as likewise those collected and examined by Mr. G. M. Dawson from the Souris and Great Valley, and described in his "Report on the Geology and Resources of the Region in the Vicinity of the Forty-ninth Parallel," page 181.

No. 2.—Labelled, "Iron ore from a large deposit on the north-west side of the south branch of Moose River, at foot of Grand Rapid, below the Long Portage. Collected by Mr. Robert Bell."

A compact brown hematite.

Result: Was found to contain 52·42 per cent. metallic iron.

No. 3.—Labelled, "Specular iron ore, from a vein ten miles up the east branch of the Montreal River of the Ottawa Valley. Collected by Mr. Robert Bell."

This specimen contained a rather large amount of associated quartz.

Result: It contained 39·41 per cent. metallic iron.

No. 4.—This ore was labelled, "Specimens of rock taken from a vein of ore situated at the head of Howe's Sound, Copper ore.

British Colmubia, distant about five miles from the water, and at an elevation of about four thousand feet."

It consisted of bornite, with which was associated quartz, small quantities of chalcopyrite, mica, and a little molybdenite.

Result: A carefully prepared average sample gave, on analysis, 44·57 per cent. of copper.

Tin ore.

No. 5.—Rock from Pollet River, four miles south of Elgin Corner, Albert County, New Brunswick. Stated to contain tin.

A coarse-grained diorite, containing small quantities of disseminated pyrite and magnetite.

Result: It contained no tin.

I have the honour to be,

Sir,

Your most obedient servant,

CHRISTIAN HOFFMANN.

Geological Survey of Canada,
Montreal, *December 30th*, 1876.