SUMMARY REPORT

OF THE

GEOLOGICAL SURVEY DEPARTMENT

FOR THE YEAR

1897

PRINTED BY ORDER OF PARLIAMENT

OTTAWA
PRINTED BY S. E. DAWSON, PRINTER TO THE QUEEN'S MOST
EXCELLENT MAJESTY
1898

[No. 13*a*—1898.] *Price* 10 *cents.*

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To His Excellency the Right Honourable the Earl of Aberdeen, Governor General of Canada, &c., &c., &c.

May it Please Your Excellency :—

The undersigned has the honour to lay before Your Excellency, in compliance with 53 Vic., Chap. 2, Section 6, the Summary Report of the Proceedings of the Geological Survey Department for the year ending 31st December, 1897.

Respectfully submitted,

CLIFFORD SIFTON,

Minister of the Interior

January, 1898.

SUMMARY REPORT

ON THE

OPERATIONS OF THE GEOLOGICAL SURVEY

FOR THE YEAR 1897.

OTTAWA, 10th January, 1898.

The Honourable CLIFFORD SIFTON, M.P.,
Minister of the Interior.

SIR,—I have the honour to submit herewith the Annual Summary Report of the Geological Survey Department for the year 1897, including, in accordance with the Act relating to the Geological Survey, an account of the proceedings and work accomplished by the Survey during the calendar year which has just closed.

Nature of this report.

This Report affords a brief record of the executive and office work of the Department and of the organization and main results of the field-work. To the latter, a greater amount of space is accorded, and the gentlemen entrusted with the carrying out of field-work are invited to thus place on record, for the early information of the public, all the more important facts observed by them, especially such as appear to possess a definite economic importance, or are likely for any reason to be of immediate value to those engaged in developing the resources of the country.

As explained in previous Summary Reports, the detailed examinations of special districts and the elaboration of reports and maps upon these, as well as other investigations carried out along particular lines, often require several years for their satisfactory completion. It has now for some time been the practice to print and publish the results of such work in separate form whenever completed, thus rendering it at once available to the public, and subsequently to issue such reports of permanent value in a collected form as a volume, properly indexed, which is distributed to Parliament and to such public institutions, libraries and exchanges as are entitled to receive it.

Annual Report, Vol. VIII.

Volume VIII. of the new series of Annual Reports was thus completed for issue in June of last year. In addition to the Summary Report for 1895, it consisted of the following parts :—

Report on the country between Athabasca Lake and Churchill River.

Report on the geology of a portion of the Laurentian Area lying to the north of the Island of Montreal.

Report on explorations in the Labrador Peninsula, along the East Main, Koksoak, Hamilton, Manicuagan and portions of other rivers.

Report of the Section of Chemistry and Mineralogy.

Report of the Section of Mineral Statistics and Mines, 1895.

This volume was accompanied by six maps, geologically coloured, and illustrated by eighteen plates and a number of cuts in the text. The French edition of the volume is now nearing completion.

Of Volume IX. (N.S.) the following parts have already been separately printed :—

Volume IX.

Report on the Doobaunt, Kazan and Ferguson Rivers and the north-west coast of Hudson Bay.

Report on the geology of the French River sheet, Ontario.

Report of the Section of Mineral Statistics and Mines, 1896.

Palæontology.

Other parts of this volume are in various stages of progress. In the palæontological series of publications, Part 3, Volume III., *Palæozoic Fossils*, has been completed by Mr. J. F. Whiteaves and printed.

Sales of publications.

Particular attention may be directed to the fact that 5843 separate publications of the Geological Survey have been sold during the past year—a number nearly twice as great as that for 1896, and very much in excess of that in any previous year. These sales are in addition to the large numbers of reports and maps gratuituously supplied to public institutions and exchanges, and often include publications issued many years ago. The demand thus shown for the reports and maps, serves to illustrate their utility and the necessity of keeping in stock, as far as possible, copies of even the older publications, for which special need may arise, in connection with particular districts, at any time.

The correspondence connected with the sale of publications is very considerable and the prices charged are, as a rule, little more than nominal; but as it may be assumed that, in all cases, the information asked for is actually required, the time and trouble involved are, it is believed, well spent.

Reprints and new editions.

The comparatively small edition printed in former years, is now resulting in the proximate or complete exhaustion of various reports

and maps, leading to the necesssity of the production of reprints or new editions. This condition is likely to increase in the future and to add to the amount of work to be carried on in the office and the expenditure in printing. Larger editions are now being printed of all the reports and maps.

Maps issued.

During the year the printing for issue of twenty different maps has been completed. This number would have been larger but for the fact that it has been found necessary to delay the preparation of colour-stones for several of the Nova Scotia map-sheets of which the geographical features are already engraved, pending the further examination in the field of some important geological questions affecting these sheets. It is hoped that the special investigations made last summer with this object in view, may render it possible to complete the information for several of the above sheets, which in that event will be promptly issued.

Preliminary edition of maps.

The production of a new edition of the geological map of the northern part of the Lake of the Woods, Western Ontario, spoken of in the last Summary Report, was pushed forward as rapidly as possible, and a preliminary edition of the corrected map was issued in June last. The complete exhaustion of the first (1885) edition of this map, with the continued and numerous demands for it, consequent on the further development of gold mining in the region, rendered its prompt re-issue desirable. It was impossible, however, at the time, to re-examine a number of new points which had arisen in connection with the prospecting and mining operations. These have now been investigated by Mr. McInnes, and it will be possible at a later date to complete the new edition of this map with further corrections.

Another map of which a preliminary edition was issued during the summer to meet immediate requirements, was that of the important Trail Creek mining district of British Columbia.

Maps supplied to Ontario Bureau of Mines.

At the request of Mr. A. Blue, Director of the Ontario Bureau of Mines, arrangements were made to furnish special editions of the Shebandowan sheet and of the map of the Lake of the Woods above alluded to, printed from the stones already prepared. These have since been issued with the Sixth Annual Report of the Bureau. A large circulation has in this way been given to these maps, covering important parts of the province of Ontario, and the expense of separate reproduction by the Bureau has at the same time been obviated.

General geological map.

A previous general geological map of Canada published in 1884, being now in many respects out of date, the compilation of a new map

of the kind was begun in 1896. Work on this map has been continued during 1897, whenever time admitted, and this map is now so far advanced that it is probable it will be ready for issue at an early date.

Reprint of Yukon Report.

The great amount of attention directed to the Yukon district during the past year, has led to the practical exhaustion of the separate copies of the Report on the Yukon District and adjacent northern portion of British Columbia with its accompanying maps, forming part of volume III. (1887-88) of the Annual Report. In view of the continued applications for this report and the map-sheets referred to, it has been decided to reprint the text of the report, together with those parts of the subsequent report by Mr. McConnell, (Vol. IV.) which relate to the Yukon district. This work, together with that of correcting the accompanying map-sheets is now in progress. The reprint will thus include practically all the available geological data for the Yukon district, which, although very far from complete, is likely to be of considerable importance to the prospectors and miners entering that country next spring.

General index.

The general index of the earlier reports of the Geological Survey, which has been in process of compilation by Mr. D. B. Dowling for some time, has now been completed, and the first part of the manuscript is in the hands of the printer. This includes the *Geology of Canada* (1863) and subsequent Reports of Progress up to the first volume of the new series of Annual Reports, dated 1885. The reports from 1843 to 1863 are not included, as the volume for 1863 embraces all the main facts covered by these, in a summarized form. The Annual Reports from 1885 to date are all separately indexed. The general index now completed contains about 31,000 references alphabetically arranged, as well as an analytical key to localities and districts geographically arranged and an enumeration of all analysis, assays and special descriptions of minerals, etc.

Issue of mineral statistics.

The annual preliminary statement of the mineral output of Canada for the preceding year (1896) was completed and sent to the printer on February 13th last. As subsequently revised, this shows a total production in minerals of the value of $22,609,825, exceeding that of 1895 by nearly two millions and being twice the amount of the total output for the year 1886, the first year for which exact and comparable figures are available.

Greatly increasing output.

Many parts of the Dominion have contributed towards this gratifying expansion, but the province of British Columbia is more particularly in evidence in this regard. The rapid and steady increase of metalliferous mining in that province still continues, and what is

already known of the output in 1897, goes to show that it will, probably, be about fifty per cent greater than the amount recorded for the previous year. In Ontario, gold mining in the western part of the province has been rapidly increasing in importance, and now that actual returns in bullion are beginning to come in from a number of mines, the future of this industry appears to be assured.

Geological information on Yukon district.

The most noteworthy feature of the past year in this regard is, however, the sudden and world-wide attention which has been directed to the Yukon district by exceedingly rich discoveries of placer gold on the Klondike and its tributary streams. Gold mining was first attempted in the Yukon basin about 1880, and in 1887 the reports from this hitherto almost unknown district were of such a character as to induce the government to despatch an expedition to it for the purpose of ascertaining the facts, and of determining, approximately, the position of the International boundary with regard to the places then more immediately claiming attention. The writer was entrusted with the control of this expedition, Mr. W. Ogilvie being particularly instructed to determine the position of the 141st meridian, while Messrs. McConnell and McEvoy of the Geological Survey were attached as assistants.

The results of this work were given to the public in a report by the writer on the Yukon District and adjacent northern portion of British Columbia, Mr. McConnell's Report on an exploration in the Yukon and Mackenzie Basins, and Mr. Ogilvie's Report entitled Exploratory survey of part of the Lewes, Tatonduc, Porcupine, Bell, Trout, Peel and Mackenzie Rivers, this latter being published in the Annual Report of the Department of the Interior for 1889.

In the first-named of the above reports, the conditions then existing were summarized as follows :—

Forecast based on work of 1887-88.

"Mining can scarcely be said to have begun in the region more than five years ago, and the extent of country over which gold has been found in greater or less quantity is already very great. Most of the prospecting has been confined to the banks and bars of the larger rivers, and it is only when their innumerable tributary streams begin to be closely searched, that 'gulch diggings' like those of Dease, McDame and other streams in the Cassiar district, and possibly even on a par with Williams and Lightning creeks in Cariboo, will be found and worked. The general result so far has been to prove that six large and long rivers, the Lewes, Tes-lin-too, Big Salmon, Pelly, Stewart and White, yield 'fine gold' along hundreds of miles of their lower courses With the exception of the Lewes, no part of the head-

waters of any of these have been prospected or even reached by the miners, and scarcely any of their innumerable tributaries have been examined. The developments made up to this time are sufficient to show that when means of access are improved, important bar-mining will take place along all these main rivers, and there is every reason to anticipate that the result of the examination in detail of the smaller streams will be the discovery of much richer auriferous alluviums. When these have been found and worked, quartz mining will doubtless follow, and the prospects for the utilization of this great mining field in the near future appear to me to be very promising."

The forecast embodied in the above quotation, resulting from a preliminary reconnaissance of the geological features of the district, has been most amply verified by the recent discoveries in the Klondike region. The entire Yukon district is now certain to be explored and prospected, and as a result of this there can be no doubt that it will soon become recognized as a most valuable portion of the Dominion—a permanently productive part of that great mineral belt which, it has been pointed out, extends within the borders of Canada from the forty-ninth parallel on the south, north-westward to the 141st meridian, with a length of some 1200 or 1300 miles.*

Character of the placer deposits.

In regard to these placer deposits, some particularly interesting questions occur, which remain to be solved by geological investigations of a detailed kind. As a result of the exploration of 1887, it was found that the north-westwardly flowing part of the Cordilleran glacier terminated along a line approximately fixed at a considerable distance to the south of both the Klondike and Forty-mile regions, neither of which have been crossed by any such confluent glacier.†

The deposits normally resulting from denudation, under varying conditions of slope and base-level, may, therefore, probably have remained practically undisturbed from a very early period in the Tertiary, beginning possibly not long after the close of the Laramie, when the latest orographic movements proved for the region occurred.

Such a prolonged and uninterrupted wearing down of rocks containing auriferous veins, may in part account for the great quantities of residuary gold now contained in the placers. Some facts already known in regard to the thickness of the pay gravels, appear, however, to suggest that successive levels may possibly have been enriched by concen-

*Annual Report, Geol. Surv. Can., vol. III. (N.S.) p. 14 R.

†Geological Magazine, vol. V., p. 347, (1888). Annual Report, Geol. Surv. Can. 1887-88, p. 40 B, 1888-89, p. 28 D. Trans. Royal Soc. Can., vol. VIII., Sect. 4, (1890).

tration taking place upon underlying frozen gravels, constituting a sort of false "bed rock" and admitting of the successive deposit of a number of superposed and richly auriferous layers. On the other hand, we have the probability, depending upon our general knowledge of the fauna and flora of the Tertiary of the West, that the climate was much less rigorous during the greater part of Tertiary time. This is borne out by observations made in regard to such of the placers of the Cariboo district of British Columbia as are distinctly pre-glacial and underlie the boulder-clay of that region.*

Important questions relating to the placers.

The question thus raised remains to be decided by further geological examination, and by the search for organic remains in association with the placer deposits. Bones of the mammoth and of other contemporary animals are known to be present in some abundance in this region north of the area formerly occupied by the Cordilleran glacier,† but their precise relation to the auriferous gravels has not yet been determined. It is also possible that the more modern gravels may have been enriched by the wearing down of antecedent placers of the Laramie rocks, with which the coals of the district are associated. Such considerations show it to be very important, if possible, that further geological work should at once be undertaken in this new region, as a scientific study of its physical conditions and history promises not only to throw much light on the conditions determining the gold-bearing alluviums, but also to connect these with the parent deposits from which the placer gold has been derived, and to establish the extent and distribution of the rocks in which these original deposits occur.

Collections of minerals prepared.

At the request of the Minister of Agriculture, a good typical collection, composed of large specimens of Canadian minerals of economic value, was prepared for the Stockholm exhibition; but at a later date, it having meanwhile been found that adequate accommodation could not be obtained for Canada at that exhibition, this collection was loaned for display in connection with immigration work in several of the Western States of the American Union, where it attracted considerable attention.

The preparation of small illustrative collections of Canadian minerals for institutions in Canada in which natural science is taught, has been continued, in so far as time and means admitted. Such collections are gratuitously supplied to approved institutions of the kind, and in a number of cases there is reason to know that they have been very highly appreciated and put to really practical use. The number of

*Summary Report, Geol. Surv. Can. 1894, p. 26 A.

†Quart. Journ. Geol. Soc. Feb. 1894.

these collections sent out during the past year has been 60, comprising in all 5164 specimens.

Commercial samples.

Special samples of various kinds likely to bring about results of commercial value, have also been sent to the Imperial Institute in London and elsewhere, and it may here be well to repeat that any such approved samples sent to the Department here, will be transmitted to the Imperial Institute, together with the trade particulars, price-lists, etc., which the producers may care to furnish.

Correspondence.

The general correspondence of the department has again greatly increased during the past year, and has included a large proportion of inquiries relating to almost every known mineral product, as well as numerous general questions of a miscellaneous kind. In reply to these it is usually possible to furnish the information desired, or at least to designate the source from which the facts may be obtained.

Necessity for new museum and offices.

The absolute necessity for additional space for the preservation of specimens accruing to the museum, and for work-rooms for material under examination, has led to the construction of temporary partitions and shelving in the two lower floors of the building on Sussex street, adjoining that belonging to the Government and already occupied by the Survey. At best, however, this provides little more than storage room of an unsatisfactory kind, and that in a building which is even more liable to danger from fire than the one occupied by the museum and offices. The need for new, fireproof and more spacious quarters for the museum, records and offices of the department, becomes more pressing every day and is one which, in the interests of the country, cannot much longer be ignored. It has been pointed out in the reports of the Director of the Survey for a number of years past, and it is not possible to omit a renewed reference to it in this Report without incurring grave responsibility.

Insufficiency of present building.

While it is believed that Parliament and the public generally would approve the expenditure necessary for the construction of a building suited to the adequate display of the mineral resources of the country, it is realized also that the economic and scientific value of the collections and records, now so inadequately housed, and the impossibility of replacing them if destroyed is not fully appreciated. Nor is it possible, in the present cramped quarters, to give any just exposition for the public eye, of the material wealth of Canada. To the numerous local visitors, the museum, even as it at present exists, affords an instructive object-lesson. To those who come, every year in increasing numbers, from other parts of the empire and from abroad, it is inspected as the only national museum maintained by the Can-

adian Government. Its value is duly recognized, but the inferiority of the accommodation accorded to it in comparison with that given elsewhere to similar collections, presents itself as a subject of criticism and of regret. Quotations from the published remarks of visitors given in previous reports need not here be repeated, and it is to be hoped that in future it may not again be necessary to cite them.

Meeting of the British Association.

The meeting in Toronto, in August last, of the British Association for the Advancement of Science, the arrangements for which were materially assisted by the Canadian Government, afforded an opportunity for the presentation and discussion by specialists of various topics connected with the geological investigation and economic development of Canada. This meeting was the second occasion on which the Association has been assembled in a city beyond the limits of the British Islands, the first having been in Montreal in 1884, and although the International Geological Congress, held simultaneously in St. Petersburg, attracted many geologists who would otherwise have been present, it was attended by a number of well known geologists, mineralogists, geographers and others, from Great Britain, the United States and other countries.

Geological excursions.

Such members of the Geological Survey as were not precluded by the remoteness of the scene of their operations at the time, were enabled to attend the sessions of the Association, and a number of papers were read by them on subjects connected with their work. At the close of the meeting, in addition to other excursions of more local interest, arrangements were made by favour of the Canadian Pacific Railway and with the aid of the Local Committee and the Provincial Governments, for a journey to the Pacific Coast, with special facilities, for the officers of sections and other prominent members. It was arranged that the third, or geological party should stop at various points of interest on the way west, and the result of this particular excursion cannot fail to exercise an important influence in making known, in the most practical way, the important developments now in progress in the country.

References to work of the Geological Survey.

In this connection it may be appropriate to allude particularly to the opening words of Professor Roberts-Austen, Chemist and Assayer to the Mint, in his lecture on Canada's metals at the Massey Hall, in which he conveyed a high tribute to the work already done for Canada by its Geological Survey; and to an article in *Nature* (London), devoted to the trans-continental excursion, in which the following passage occurs: "Then let us set down our admiration for the work of the Canadian Geological Survey. Considering the means at its com-

mand, and the positively inconvenient extent of its territory, it is marvellous how much has already been accomplished, and how clearly the general structure of the country has been brought out. It was pleasant to observe, too, how well its work was appreciated among the people for whom it was primarily intended, and how in the mining districts the geological maps we carried were quite familiar to the prospectors and mining people generally, who were usually furnished with copies."

Meeting of Geological Society of America.

The winter session of the Geological Society of America, held in Montreal on December 28th, 29th and 30th, was also attended by a number of members of the staff of the Geological Survey, several of whom contributed papers on Canadian geology.

Work of the Director.

With the increasing scope of the operations of the Geological Survey, it seems to become every year more necessary that the greater part of the time of the Director should be devoted to administrative work and official detail, rather than to original investigations in the field. A few days were devoted by me in the early summer to examinations bearing on questions which have arisen in connection with the mapping of the rocks of parts of the province of Nova Scotia, relating particularly to the age to be assigned to certain Palæozoic strata in Pictou and Colchester counties, with a view to enable the early publication of several map-sheets, which has been delayed pending the results of such critical inquiry. Further allusion is made to the points in question on a later page, where something is said by Dr. Ami on the result of the determination of the fossils upon which the interpretation of the sections largely depends. Advantage was also taken of my visit to the Maritime Provinces, at this time, to look over, in company with Professor Bailey and Dr. Matthew, the remarkable series of rocks displayed in and near the city of St. John, New Brunswick.

Visits to mining districts.

At the close of the meeting of the British Association above alluded to, I accompanied the geological party to Victoria, B.C., affording such assistance and information as was possible, and gaining in return many useful hints from several of the distinguished investigators who composed the party. Visits were made in going west, to the mining districts centring at Sudbury and Rat Portage, and one day was spent at Banff and another at Glacier; while on the way back, most of the party visited some of the centres of mining operations in West Kootenay. The party was everywhere received by the local authorities with the greatest cordiality, and I have reason to know that our scientific guests were pleased and impressed with the hopeful and im-

portant development of the mineral and other resources of the country, now everywhere in progress.

Kootenay. The advances made in regard to mining and the provision of means of communication in the West Kootenay district, which I had not myself seen since the date of my preliminary report of 1889, are most striking and remarkable. Notwithstanding the low price of silver—one of its most important products—this district is steadily and profitably increasing its output of this metal, and is also marketing very important quantities of gold, lead and copper. It is the first-developed of the metalliferous mining districts of British Columbia and as such may be taken as an example of others yet to come.

Kamloops. A short visit was also paid by me to Harrison Lake, but rather with the object of noting its general geological features than with that of inspecting the mineral deposits there being opened up. A day was also spent at Kamloops, for the purpose of gaining some knowledge of the mineral deposits which have been discovered since the date of my report upon that region, and are now being developed. Mr. W. F. Wood here kindly accompanied and guided me to some of the more promising claims. The metalliferous deposits here occur in connection with, and so far as yet opened out, may be said to be confined to, a mass composed chiefly of gabbro, about six miles long by two miles and a half wide, of which the limits are approximately defined upon my published map. Coal Hill is a prominent high part of the mass, which although apparently separated at the surface from that constituting Cherry Bluff and Battle Bluff on Kamloops Lake, is similar in character and no doubt attributable to the same Tertiary period. The Cherry and Battle Bluffs mass has been described as probably representing the central and originally deep-seated eruptive focus of a Miocene volcano, and the offshoot, or partially separate area of Coal Hill, is in all probability of the same character and date. Both have evidently been originally deeply covered by the fragmental volcanic deposits and basaltic flows of which remnants appear as ridges and escarpments in the vicinity. The metalliferous minerals seem to have been deposited by hydrothermal action marking the last stages of volcanic activity, a more or less complete decomposition of the rock itself being affected at the same time.

Ores at Kamloops. The ores met with about Coal Hill consist principally of iron- and copper-pyrites, containing more or less gold, but accompanied with but little quartz. They follow fractured and shattered zones which generally run about east-and-west (magnetic) occurring in nests and spots in the substance of the rock itself and in jointage-planes, and sometimes forming masses or sheets of pure sulphides several inches thick.

The sulphides thus appear to have partly replaced the rock-matter and in part to have filled intervening joints and spaces in the more or less brecciated mass; the latter being possibly a subsequent or concluding phase of the impregnation. Small quantities of chalcedonic quartz, resembling that abundant in parts of the ordinary volcanic rocks of the district, were observed in some places. A little native copper is also occasionally seen in small particles and leaves.

The magnetic iron ores of Cherry Bluff * may in all probability be considered as due to similar action taking place in another part of the old volcanic centre, at or about the same time. The general conditions, in fact, show a resemblance in many respects to those found in the case of the Rossland ores, but the amount of gold present appears to be less considerable than in these, and the value of the ores, in so far as yet determined, must depend chiefly upon their content in copper. The amount of development actually accomplished is not very great, but some small shipments of hand-picked ore have been made.

Parties in the field.

The field-work of the Geological Survey has, as a rule, been carried out by parties or individuals who devoted the entire available season to surveying or exploring operations; but of late years it has frequently been found necessary to initiate special investigations or surveys, on which members of the staff or assistants have been occupied for shorter periods, and it is not always easy to draw the line between these and the field-parties, properly so called. Following, however, the practice in former reports, the field-parties of the past season may be said to have been fifteen in number, distributed as follows:—

British Columbia	2
North-west Territories (boring operations)	2
Ontario	4
Quebec	1
New Brunswick	1
Nova Scotia	3
Hudson Strait	2
	15

Special examinations, *etc.*

In addition to the above-mentioned parties, special examinations, collecting and other work in the field has been carried out during the year by other members of the staff. Dr. H. M. Ami spent more than two months in Nova Scotia in palæontological examinations intended to further define the true position of certain series of rocks in that province.

* Annual Report, Geol. Surv. Can., vol. VII. (N. S.) p. 341 B.

He was also sent to western Ontario in September to investigate the reported discovery of mastodon remains in new localities there, with results given on a subsequent page. Mr. L. M. Lambe was occupied for nearly three months in the North-west Territories in collecting, and in inspecting the boring operations on the Saskatchewan. Mr. E. D. Ingall found time to visit a few mineral occurrences of interest and Mr. A. A. Cole spent three weeks in making plans of the graphite deposits opened up in Buckingham township, Que. A visit was made by Mr. W. F. Ferrier to Hastings and Peterborough counties in connection with certain minerals and rocks found there. Mr. J. White devoted nearly three weeks to running some necessary survey lines in parts of Prescott and Frontenac counties, Ont.

Mr. C. W. Willimott was also employed as usual for some time in obtaining specimens of rocks, ores and minerals suitable for school collections.

Synopsis of field-work.

The main features of the field-work of the year, may, in the first place, be alluded to in order, further details being contained in the reports given on later pages:—

In British Columbia, attention was given almost entirely to the West Kootenay district, Mr. R. G. McConnell continuing the geological work there, while the necessary topographical data were being obtained by Mr. J. McEvoy. Messrs. R. W. Brock and W. W. Leach acted as assistants. The principal object in view has been to provide a geological map embracing the main mining camps and connecting them, and so much progress has now been made in this that a considerable part of the entire West Kootenay sheet can now be compiled and engraved. The principal rock-formations of the district have been recognized and outlined and much valuable information respecting the occurrence of the various classes of ore-deposits has been obtained. An abstract of such facts, for a part of the region, is given in the explanatory notes on the preliminary edition of the Trail Creek map, already published.

In Manitoba, a short season was spent by Mr. J. B. Tyrrell in further defining and investigating the thickness and relations of the Devonian, Silurian and Cambro-Silurian strata, chiefly between Manitoba and Winnipeg lakes, the results being such as to now admit of the delineation of the several formations with proximate accuracy on that part of the map of Lake Winnipeg and its vicinity.

In the Rainy Lake district of Western Ontario, Mr. W. McInnes continued, and has completed, the surveys and examinations necessary for the area to be covered by the Manitou sheet of the geological map,

Synopsis of field-work—*Cont.*

which is now in course of compilation in the office. He reports favourably of the prospects for gold mining in that comparatively new part of the region. A portion of his time was also devoted to the revision of the geology of the northern part of the Lake of the Woods, where mining is now well established, with the object of completing the data for a corrected edition of the map of that lake and its vicinity.

Mr. A. E. Barlow and Dr. F. D. Adams report jointly on their further work in Central Ontario, on the Haliburton sheet. The chief geological problem involved in this region is, it will be remembered, that respecting the relations of the Hastings and Grenville series and the possible connection of these with the Huronian rocks. Mr. Barlow notices at some length the distribution and mode of occurrence of the corundum deposits, which constitute an interesting feature of the district and one probably of economic importance.

On the Perth and Ottawa City sheets, the position of which is indicated by the names applied to them, work was continued by Dr. R. W. Ells. These sheets include large areas both of the crystalline Archæan rocks and of the Cambro-Silurian formations, the distribution and character of which is being systematically worked out. Iron ores occur in a number of places in the crystalline rocks, and prospecting is being carried on for gold and other metallic minerals. The Cambro-Silurian strata are chiefly of value as structural materials, but their position and structure is also of importance in connection with the question of the possible occurrence of natural gas.

By Mr. R. Chalmers, work was continued on the gold-bearing alluviums of the 'Eastern Townships' of Quebec, and it is now intended to complete a report upon these. The investigation of the superficial deposits and ancient shore-lines along the St. Lawrence and Ottawa valleys, both in Quebec and Ontario, was also continued, with interesting results, of which a somewhat full synopsis is given on a later page.

Exploratory work was conducted by Dr. R. Bell and Mr. A. P. Low on the north and south shores, respectively, of Hudson Strait. This was rendered possible, and appeared to be desirable, in connection with the Hudson Bay expedition despatched under Dr. Wakeham of the Department of Marine and Fisheries.

The coast explored by Dr. Bell, extends from Ashe Inlet and Big Island north-westward to Tehorback, a length of about 250 miles, and a journey was also made by him inland from the head of Amadjuak Fiord to the vicinity of Amadjuak Lake, a distance estimated at fifty miles. The length of coast examined is fringed by numerous islands

of all sizes, and is described as rugged, and for the most part mountainous. The rocks of this coast are those of the Laurentian, including important beds of crystalline limestone, and in part no doubt referable to the Grenville series rather than to the fundamental gneiss. Graphite and mica are known to occur in association with these rocks here, but have not yet been found in deposits of economic importance. Silurian limestones are believed to occur in the interior of Baffin Land to the north of Amadjuak Lake, and Cambro-Silurian limestones, apparently of Hudson River age, were found to characterize Akpatook Island in Ungava Bay. Synopsis of field-work—*Cont.*

Mr. Low's exploration began at Douglas Harbour, about 130 miles from the west end of Hudson Strait, and included the southern shore thence eastward for a distance of about 650 miles, or to George River, Ungava Bay. This coast has been mapped with approximate accuracy and a general knowledge of its geological structure has been obtained. The rocks consist chiefly of granites and granite-gneisses, but include areas of schistose rocks which appear to represent the Cambrian of the interior of the Labrador Peninsula in a considerably altered state and have iron ores associated with them.

In New Brunswick, Prof. L. W. Bailey has been employed in visiting and examining so far as possible all the mineral occurrences of known or supposed economic importance, and is now engaged in putting his observations in the form of a systematic report.

In Nova Scotia, regular field-work has been continued by Messrs. H. Fletcher and E. R. Faribault, with assistants. Mr. Fletcher's time was chiefly devoted to the mapping of the areas to be covered by the Springhill and Joggins map-sheets, but examinations were also made in other parts of the province, particularly in Cape Breton, where additional data were required in connection with the preparation of revised editions of some of the map-sheets of the Sydney coal-field. Mr. Faribault's work was, as in previous years, in connection chiefly with the gold-bearing rocks of the Atlantic coast belt. He was instructed, however, on this occasion, to devote most of the season to a critical review and examination of the gold mining districts of the already-surveyed eastern part of the province, with a view to the preparation of a general report upon these. In his preliminary report, given on later pages, it has been thought advisable to include such detail respecting the structure and mode of occurrence of the gold-bearing veins as may be of immediate importance to the miners, much attention being at the present moment turned to the gold mines of Nova Scotia.

Experimental Borings in Northern Alberta.

Boring operations in Northern Alberta.

The circumstances under which it became necessary to cease operations at the bore-hole at Athabasca Landing, at a depth of 1770 feet were fully explained in the last Summary Report. The "tar sands" at the base of the Cretaceous, in which the occurrence of petroleum is probable, were not actually reached in this boring, but much general geological information of value was obtained.

Sites chosen for bore-holes.

In view of the facts disclosed and in accordance with the recommendation based on them and given in the last Summary Report, provision was made for work upon two new experimental bore-holes, the sites selected for these being respectively the mouth of Pelican River, ninety miles down the Athabasca below the Landing, and Victoria, on the Saskatchewan. Contracts for the work, which was to proceed as far as possible concurrently at the two places, were entered into with Mr. W. A. Fraser. It was hoped that a depth of 1000 feet would be attained in each place during the season; that depth being likely to afford all the information required at the first-named locality, while a depth of about 2000 feet will eventually be required at the second. Although the expectations in regard to depth have not been fully realized, owing to circumstances detailed in the annexed report of Mr. Fraser, very substantial progress has been made.

Boring at Pelican River.

The most interesting developments have been those in connection with the Pelican boring, where the "tar sands" appear to have been reached (nearly as anticipated) at about 750 feet and penetrated to a depth of about 70 feet. Maltha or heavy, tarry petroleum was here met with, saturating the sands and shales in a manner similar to that found in the same lower Cretaceous beds where they outcrop naturally further down the Athabasca; but at 820 feet an exceedingly heavy flow of natural gas under great pressure was struck, such as to prevent for the time being any further work in the hole.

Information gained as to petroleum and gas.

The actual knowledge thus gained of the continued presence of the maltha at a distance of some sixty miles from the nearest natural outcrop of the "tar sands," is of importance in greatly extending the area of the probably petroleum-bearing field. The great flow of natural gas would also in itself be of economic value if situated where it could be immediately utilized, but this is not at present the case in this locality. It is of particular interest, however, when taken in connection with the considerable quantity of gas met with in the Athabasca Landing boring and that found in borings made for water at Langevin and Cassels on the line of the Canadian Pacific Railway. The gas is not

found in these four places at exactly the same horizon in the Cretaceous rocks; but its occurrence goes far to prove that, particularly in the lower strata of the Cretaceous, natural gas in quantities of commercial value may be expected to occur over a vast area of the North-west, the distance between the extreme points at which its existance has now been determined (Langevin and Pelican) being about 350 miles.

The occurrence of maltha or natural tar in the rocks penetrated in the Pelican boring instead of petroleum proper, is, it must be confessed, to some extent disappointing, as it had been hoped that when at a distance from the natural outcrops which have been subjected to prolonged atmospheric influences the tarry matter would be found to be replaced by a lighter oil. It must be remembered, however, that the source of the petroleum which has saturated the lower beds of the Cretaceous is to be looked for in the underlying Devonian rocks, and even in this boring it is quite probable that in the lower layers of the "tar sands," or in the underlying formation, such lighter oil of greater commercial value may yet be found. But should this not prove to be the case here, there is still every reason to believe that these more favourable conditions will be found in other parts of the field.

Section at Pelican River.

The strata passed through so far in the boring at the Pelican may thus be summarized and classified :—

Depth from surface.		Thickness of formation.
86 feet.	Sand and gravel (surface deposits).	86 feet.
185 "	Dark bluish-black soft shales, with some sandstone in upper part. *Pelican shales*.....	99 "
465 "	Grayish sands and sandstones, and brownish and grayish shales. *Grand Rapids sandstones*....	280 "
750 "	Grayish and brownish shales, alternating with thin beds of hard sandstone and ironstone. *Clearwater shales*.....	285 "
820 "	Sands and clays often saturated with heavy oils and tar. *Tar sands*	70 " or more.

The above section may be compared with that given in the Summary Report of 1895 for Athabasca Landing, and with that found and described on the lower river by Mr. R. G. McConnell, Annual Report (New Series), Vol. V., part D.

Further operations.

It is proposed, if the discharge of gas from the bore-hole shall have by that time so far diminished as to render work possible, to continue this boring next summer to a depth of about 1000 feet, which should carry it some distance into the rocks underlying the Cretaceous and make a complete and satisfactory test for this particular locality.

Boring at Victoria.

In the boring at Victoria, only the dark overlying shales have yet been penetrated, to a total depth of 705 feet. It was known that these would have to be sunk through, and no particular results of

interest are to be looked for until a considerably greater depth has been attained. Very considerable difficulties have been encountered here by reason of the exceptionally soft and incoherent nature of these shales, which can be retained in place only by completely casing the bore-hole as it advances. It will probably be necessary to enlarge a considerable length of the boring already made here and introduce casing of greater diameter before further progress can be made in depth. It is proposed, however, if possible to complete this hole to a depth of about 2000 feet next summer.

Report on boring operations.

Mr. Fraser's report on the boring operations carried out during the past season, with particulars of the beds passed through, is as follows:

"I have the honour to submit the following report of operations conducted during the summer of 1897 at Pelican River on the Athabasca, and at Victoria on the Saskatchewan.

"Owing to the late date at which the contracts for these two borings were signed, and the necessity of a complete new outfit for Victoria, which took some time to get together, a late start in the spring was made. I arrived in Edmonton on May 24th, and the car-load of machinery destined for Victoria arrived by the same train. The Hudson's Bay Company's steamer which had been arranged for by telegram, was waiting to take the machinery down to Victoria. When I arrived the captain was inclined to leave without the machinery, as the river was falling rapidly and he was afraid that his steamer would ground, owing to the heavy load he would be carrying. The plant was, however, loaded without delay and left for Victoria on May 26th. No casing had arrived as yet, so none could be taken down with the plant.

"I had brought two gangs of trained men up with me. One of these I sent to Athabasca Landing to load the plant and machinery there upon boats and rafts for Pelican Rapids. The other gang proceeded with me to Victoria by steamer. As the captain had feared, the boat grounded twice going down and did not arrive at Victoria until June 2nd.

"After starting the men at building the rig at Victoria, I hurried back to Edmonton. The five car-loads of casing had meanwhile arrived. As the steamer would not be making another trip for some time I was compelled to send casing enough to do the first part of the work down by teams. The rate by steamer was $5 per ton, while that by team was $15. I also unloaded all of the casing from the cars, Mr. McCauley, of the Cartage Co., transporting to the edge of the river the casing destined for Victoria, and that destined for the Pelican being taken over to the north side of the river by the teamster who

had contracted to deliver it at Athabasca Landing. I then proceeded to Athabasca Landing, arriving there on June 8th. Report on boring operations—Cont'd

"There it was found that the men had just finished loading the plant, and part of the casing. With three rafts and a large flat-boat loaded with all they could carry, we left on the morning of the 10th to descend the river to the mouth of the Pelican River.

"We experienced great difficulty with the rafts when nearing the mouth of the Pelican, and were forced to leave two of them some four miles above and to proceed down with the boat and one raft. We landed these in a low, horse-shoe like flat where the Waupaska trail strikes the Athabasca, about two miles above Pelican River. There we unloaded the machinery and then brought the other rafts down. No horses or oxen could be procured, and the work had to be done entirely by hand, under great difficulties. We proceeded, however, to build the rig, and began the hole by digging.

"The river began to rise on the night of the 19th, and on the next day (Sunday) it was up about the derrick and had submerged all the machinery and tools. It was the highest flood that had occurred on the Athabasca for many years, and our work was brought to a standstill for several days.

"After the water fell back into its proper bed, I discovered that it had cut away the bank upon which the tools had been lying, and these had dropped off into about eight feet of water. Then for many days we were fishing the tools out of water. Some of the most important ones we could not find at all, as they were buried under about two feet of mud below eight feet of water. But by using some ingenuity and doing much blacksmithing we managed to get tools enough together to proceed with the work, but we did not get started until the 1st of July.

"In the first part of the bore an unexpected difficulty was encountered. All along the river it seemed as though the shale rose to the very surface, and where we had located I did not expect to encounter more than six or eight feet of sand and gravel at the most. I put in first a large square cribbing, six feet in diameter, down to about eight feet, then a wooden conductor, 15 inches in diameter, down 16 feet, and still the sand and gravel continued. I then put down the $8\frac{5}{8}$ inch iron casing to 41 feet 4 inches, but the sand and gravel still continued. This was on the 12th of July—or two weeks that we had been getting down 41 feet.

"As we were driving on the $8\frac{5}{8}$-inch casing all I thought it would stand, and as the next size—$7\frac{5}{8}$-inch—had not yet arrived, I put down

Report on boring operations—*Cont.*

5⅝-inch casing to 67 feet to see if I could get through the gravel I then pulled this out and drove the 8⅝-inch casing to 63 feet. This was all the 8⅝-inch casing I had. As the gravel and sand still continued, I put in the 7⅝-inch casing, which had by this time arrived. At 86 feet 6 inches I struck a dark-bluish shale, and had succeeded in getting through the sand and gravel at last. This was on the 16th of July.

"The different strata, as encountered after this, are set out in the subjoined log. I used some of the heavy petroleum or maltha which flowed from the well in raising steam, and it made an extremely good fuel.

"If the hard slate stratum at 821 feet 6 inches had been pierced, a great flow of petroleum might, in my opinion, have been encountered. Indeed, it is altogether possible that at that depth we were within a few feet of a large body of petroleum. Had it been struck while the flow of gas was in the unconquered condition, the result would have been disastrous, as there might have been no possible means of checking the flow. The flow of gas was so great that a cannon ball could not have been dropped down the pipe.

"The 'tar sands' seem to have been encountered at about the expected depth, and it appears likely that the limestone will be met with before 800 feet is reached.

"Owing to the impossibility of making further progress at the time at this place, I determined to allow the gas free escape, and it is quite likely that by next spring we shall be able to control it, and deepen the bore. The 4⅝ inch casing is in good shape, being perfectly free. the last thing I did being to raise it 5 feet to give the gas better vent.

"The fact that these petroleum-bearing sands are encountered at this depth so far away from the outcrop lower down the river, to my mind favours a belief in the existence of an oil field of great extent."

RECORD OF STRATA PASSED THROUGH IN THE PELICAN RIVER BORING.

1-86	ft.	Sand and gravel.
86-101	"	Dark-bluish shale, very soft.
101-105	"	Soft sandstone.
105-185	"	Dark-bluish shale, very soft.
		At 185 feet struck slightly saline water. There was a distinct change in the shale at 185 feet, it changing to a reddish-brown colour.
185-225	"	Reddish-brown shale. Rather hard.
225-234	"	Sandstone.
		At 225 feet struck water which flowed over the top of the bore.
234-245	"	Sandstone and brown shale.

Report on boring operations—*Cont.*

245-253 ft. Hard gray cemented shale.
At 253 feet struck more water and gas.
253-280 " A light greenish-gray shale that settles very quickly about the drill, making it difficult to extract it after boring about two feet.
280-290 " Soft greenish-gray shale, cement-like.
290-308 " Brown shale, with strata of gray shale.
308-310 " Brown shale.
310-311 " Hard sandstone. More gas and water.
311-328 " Brown shale and sandstone in alternate strata.
328-340 " Sandstone.
340-353 " Brown shale.
353-365 " Hard sand-rock, with layers of softer rock. At about 355 feet struck maltha or oil of a very heavy specific gravity. This flowed in small clots on top of the water from the well, and several barrels of it ran away into the river. There was a good deal of gas with this heavy petroleum.
365-410 " Sandstone, rather hard.
By this time the flow of petroleum had nearly ceased. I concluded that the water which came from below, being icy cold, had chilled it where it came into the bore, and had thickened it so as to choke the vein.
410-427 " Brown shale.
427-450 " Hard brown shale.
450-465 " Sandstone. More water and gas.
465-481 " Gray shale.
481-498 " Gray shale, caving rather badly.
498-503 " Gray shale, very sticky.
503-526 " Gray shale, very sticky and like the cemented gray shale we had before.
526-532 " Ironstone.
532-538 " Gray shale.
538-553 " Gray shale, cement-like.
553-556 " Sandstone.
556-558 " Very hard, probably ironstone.
558-563 " Very hard sandstone.
563-573 " Brown shale.
573-590 " Gray shale, streaks of sandstone.
590-620 " Gray shale, brown shale and sandstone in alternating strata; the cuttings from the sand pump carrying distinct traces of maltha.
620-625 " Gray shale.
Struck a strong flow of gas at 625 feet. Gas remarkably pure and free from odour. Considerable maltha coming away with the water.
625-643 " Very hard sandstone.
643-648 " Soft gray shale.
648-652 " Hard sandstone.
652-665 " Soft gray sandy shale.
665-675 " Ironstone.
675-684 " Soft gray shale.

Report on boring operations—*Cont.*

684-685 ft. Hard sandstone.
685-703 " Soft dark-gray shale.
703-713 " Hard sandstone.
713-718 " Soft gray sandy shale.
718-723 " Hard sandstone.
723-733 " Sandstone.
733-743 " Soft gray shale.
743-758 " " " with streaks of soft sandstone.

Struck gas and some oil at 750 feet. Quite a strong flow of gas at this point. Heavy oil similar to that obtained before, but of a higher specific gravity came out with the cuttings in the sand-pump. The heavy oil seems mixed all through the sandstone and shale at this depth, and it looks as though the tar-sands had been entered at about 740 feet.

The water was shut off by the casing at 740 feet and the hole is perfectly dry with the exception of the water we put in to drill with. This shows that there is no water in these lower sandstones, which is of great importance and value.

758-781 " Soft dark-gray shale, and soft sandstone.

The shale and sandstone here show very little perceptible difference, the heavy oil having consolidated them into a homogeneous mass.

At 773 feet a heavier flow of gas was struck. It made a roaring noise coming out of the bore, and had quite a pronounced petroleum odour. Increased quantities of petroleum in the cuttings at these depths.

781-800 " Alternate strata of soft gray shale and soft sandstone.

These also completely saturated with heavy petroleum. Increased quantities of petroleum observed in the sand-pump. The gas increasing in volume all the time. It has a distinct petroleum odour, but, unlike the gas met with in the Petrolia oil field, it is free from sulphur and does not inflame the eyes.

800-820 " The same as foregoing.

At 820 feet a tremendous flow of gas was struck, which blew every drop of water out of the bore. The roar of the gas could be heard for three miles or more. Soon it had completely dried the hole, and was blowing a cloud of dust 50 feet in the air.

Small nodules of iron-pyrites, about the size of a wall-nut, were blown out of the hole with incredible velocity. They came out like bullets from a rifle. We could not see them going, but could hear them crack on the top of the derrick. It was impossible to do anything with the bore that day, so we were forced to let it stand just as it was. There was danger that the men would be killed if struck by these missiles.

The next day a long stick was put on the tools, so that the men could turn them without getting too close to the

bore. In this way we succeeded in penetrating through 18 inches of a conglomerate mass of these iron-pyrites nodules embedded in heavy petroleum. As we drilled through this the gas threw out the nodules with clots of oil. Report on boring operations—*Cont.*

820-821 ft. 6 in. Conglomerate mass of iron-pyrites nodules embedded in oil.

At 821 feet 6 inches a very hard stratum of slate was encountered, which we penetrated about 3 inches. We could get no water down the well on account of the strong flow of gas, so we could make no further progress with the drill in this hard cutting. The danger to the men was so great that they refused to work longer over the bore. We then put the 4⅝-inch casing down to the very bottom, hoping to shut off the gas, but it failed to do so.

The casing in this bore-hole is as follows:—

Casing	(wooden),	15 inches	—	16	feet.	
"	(iron)	8⅝	"	63	"	7 inches.
"	"	7⅝	"	222	"	
"	"	6⅝	"	395	"	
"	"	5⅝	"	747	"	
"	"	4⅝	"	820	"	

"Just about the time the boring at the Pelican was suspended one of my men came over from Victoria, by way of Lac la Biche, bringing me intelligence that work had stopped owing to difficulties about the casing, and that the well was only 600 feet deep. I instructed the gang that had been working at the Pelican bore to proceed to Victoria without delay, and pushed on ahead myself, arriving there several days before them. Upon my arrival I found that the driller had not been carrying out my orders, and owing to this he severed his connection with the work.

"There had also been a great flood on the Saskatchewan, carrying away some of the casing clamps and a few other things.

"The bore had been located about 200 feet to the north of the mouth of Egg Creek, on the flat land about 8 feet above high-water mark. They had not been troubled much by caving in the bore-hole down to a depth of 560 feet, but beyond that it caved very badly. I found the well cased down to 560 feet with 6⅝-inch casing. The driller had not used the under-reamer, and the casing was stuck at that point.

"I pulled the 6⅝ inch casing out, meaning to put down the 7⅝-inch, but there was an obstruction on the inside of the 8⅝-inch casing and it would not go. I then put down the 6⅝-inch again and used the patent under-reamer ahead of it until we got to a depth of 700 feet. Here the

Report on boring operations—*Cont.*

pressure on the casing from the caving material became so great that it could not safely be driven any further.

"This fact will convey a good idea of how the formation here encountered caved. At 560 feet there was no caving, and from there to 700 feet, a distance of only 140 feet, was sufficient to jam this string of casing so tight that it could not be driven any further.

"At Athabasca Landing each string of casing could be driven from 600 to 1000 feet.

"As the 6⅝-inch casing would have to be drawn up from the bore and larger casing put down, so that the 6⅝-inch casing could be carried to a much greater depth; and as this could not be done in the time remaining to work in during the autumn, and as consultation with the Department seemed necessary to decide upon the best course to pursue about the larger casing, I determined to close down the work at that time, the 20th of October.

"The work at Victoria would have been more successful could I have been there myself during the summer. But as the Department hoped for some results this season from the Pelican River boring, the depth at which oil should be obtained being much less, I remained there."

RECORD OF STRATA PASSED THROUGH IN THE BORING AT VICTORIA.

1- 10	feet.	Sand.
10- 20	"	Light-gray shale, with traces of sand.
20- 30	"	Gray sandy shale.
30- 50	"	Light-gray sandy shale.
50-100	"	" shale. No sand.
100-110	"	Gray shale, darker in colour.
110-120	"	" lighter.
120-130	"	" brownish colour.
130-131	"	Ironstone strata.
131-140	"	Light-gray shale.
140-180	"	" brownish-gray shale; quite hard. At 156 feet struck a small vein of gas.
180-260	"	Dark-brownish shale, with streaks of ironstone.
260-270	"	Dark-brown shale. Strata of sandstone.
270-280	"	Gray shale. Ironstone stratum.
280-290	"	" with a 3-foot stratum of ironstone.
290-300	"	Brownish-gray shale; hard.
300-310	"	Gray shale; hard.
310-340	"	Dark-gray shale; softer.
340-350	"	" " harder.
350-390	"	Brownish-gray shale; hard.
390-410	"	Light-gray shale; hard; 2 feet ironstone.
410-420	"	Brown shale.
420-470	"	Brownish-gray shale.

Report on boring operations—*Cont.*

470-480	feet.	Very hard gray shale.
480-500	"	Light brownish-gray shale.
500-508	"	Ironstone stratum.
508-520	"	Light brownish-gray shale.
520-530	"	Gray shale, losing brown tone.
530-535	"	Ironstone stratum.
535-540	"	Light-gray shale; hard.
540-550	"	Gray shale, with stratum of ironstone.
550-554	"	Bluish-gray shale
554-560	"	Dark bluish-gray shale.
560-570	"	" " with ironstone stratum and fragments of iron-pyrites.
570-620	"	Gray shale; very soft.
620-630	"	" " with 3 feet stratum of sandstone or ironstone.
630-705	"	Bluish-gray shale; very soft and caving very badly. At 495 feet struck a vein of water slightly saline, which flowed over the top of the bore. Considerable gas with it.

The casing at present in this bore-hole is as follows:—

Casing (iron), $9\frac{5}{8}$-inch—31 feet 8 inches.
" " $8\frac{5}{8}$ " 170 "
" " $6\frac{5}{8}$ " 700 "

BRITISH COLUMBIA.

Work by Mr. McConnell.

The winter months of 1897 were spent by Mr. R. G. McConnell in working up the geological and topographical data collected during the previous year for publication.

Upon the work as completed during the summer, chiefly in the West Kootenay District, Mr. McConnell reports as follows:—

"I left Ottawa for Nelson on the 8th of June, and commenced field-work near Salmo, on the line of the Nelson and Fort Sheppard Railway, on the 19th of June. We remained in the field until the 12th of October. The season, as a whole, was favourable for mountain work. The early summer was wet, but the usual mid-summer smoke was not so dense as in previous years and did not cause much delay.

"Mr. Jas. McEvoy, of the Geological Survey staff, had charge of the topographical work, and Mr. R. W. Brock, also of this office, assisted in both the geological and topographical work. Mr. W. W. Leach was engaged at Nelson as topographical assistant. The staff was thus larger than in previous years; and taking into consideration the mountainous character of the country and the difficulty attending the transport of supplies, we were able to cover a comparatively large area.

British Columbia—*Cont.*

Districts examined.

"We were occupied principally in the south-eastern portion of the map-sheet in the unmapped region between the Salmon River and Kootenay Lake and River, and south of Midge Creek; but work was also carried on east of Kootenay Lake, on the north fork of the Salmon, in the group of mountains between the Salmon, Beaver and Pend d'Oreille rivers, on the Slocan River, on Ten-mile Creek, Slocan Lake and on the Nelson and Fort Sheppard Railway. An effort was in fact made to collect sufficient data for a general geological and topographical map embracing the region in which the principal mining camps of West Kootenay are situated. The material on hand is now being compiled and drafted.

Topographical features.

"The principal topographical feature of the country examined is its persistently mountainous character. The whole region, with the exception of the valleys of the Kootenay and Salmon, being simply a succession of high mountain ranges, separated by narrow, steep-sided valleys that have been carved out by the torrential streams draining the district. The principal streams engaged in this work between the Salmon and Kootenay, north of the International boundary, are Lost Creek, Sheep Creek, Hidden Creek, Porcupine Creek and Wild Horse Creek, flowing westward into the Salmon; and Boundary Creek, Summit Creek, Shaw Creek, Cultus Creek and Midge Creek, flowing eastward into Kootenay Lake and River. These streams head in a high range of quartzite and granite peaks and ridges that extend from the boundary north to Ymir Mountain. From the summit range transverse ridges, gradually decreasing in height, but often swelling into high peaks, extend outwards to the main valleys.

"East of the summit range, a prominent group of mountains, with peaks occasionally exceeding 8000 feet in height, occurs near Kootenay Lake, between Cultus and Summit creeks. They are built of granite, and owe their superior elevation to the greater resistance offered to denudation by this rock than by the surrounding softer schists.

"In the area between the Beaver, Pend d'Oreille and Salmon rivers the streams have not cut so deeply, and the mountains are round-topped and have a more uniform elevation.

Forest.

"The valleys and the slopes of the mountains up to an elevation of about 7500 feet, are or have been, wooded more or less densely with spruce, pine, cedar, hemlock, etc., but, as in other parts of the district, the trees have been destroyed over large areas by forest fires. A list of the forest trees is given in last year's summary.

"The geology of the district is extremely complicated, and has only been deciphered so far in a general way. It will be unnecessary to

more than mention its salient features here, as it will form the subject of a report which is now being prepared. British Columbia *Cont.*

"The four main groups of rocks are the granites, the dark eruptives and associated fragmental rocks, a schistose series of exceptional thickness which includes greenish, grayish and dark schists and slates, crystalline limestones, dolomites, quartzites and conglomerates, and the basal Shuswap series consisting here as elsewhere of mica-schists, mica-gneisses, crystalline limestones, dolomites and quartzites. It is probable that the schists and associated rocks are all of Cambrian age, the dark volcanics, so far as known, belong mostly to the Carboniferous and the granites are chiefly of post-Triassic age. Principal geological divisions.

"The dark volcanic rocks cover most of the area between the Beaver, Pend d'Oreille and Salmon rivers, except the south-west corner, which is occupied by schists that extend northwards along the main and north fork of the Salmon until cut off by the granites near Toad Mountain. They are replaced, east of the Salmon, by slates and schists that have been referred to the Nisconlith, a much older series. The rocks of this group include porphyrites of several kinds, monzonites, diabases, gabbros, breccias, tuffs, agglomerates and dark fine-grained slaty ash-rocks. Volcanic group.

"Grayish medium and coarse-grained and porphyritic granites, similar to those described in previous progress reports and belonging to the same period of eruption, occur everywhere in dykes and areas of various sizes throughout the district examined. Several areas were outlined on Boundary Creek, west of Kootenay Lake between Cultus and Summit creeks, east of the Salmon on Wild Horse, Hidden and Porcupine creeks; and a number of smaller bosses occur cutting the quartzites and schists which form the summit range between the Salmon and the Kootenay. Granites.

"Besides the ordinary gray granites of the district, an older granite, somewhat similar in appearance, occurs in a few places along Kootenay Lake, cutting the Shuswap and Cambrian schists; and a younger reddish granitic rock has a wide distribution, but except on Granite Mountain does not occur in large continuous areas.

"The great igneous activity which has characterized the district in the past, is shown by the fact that igneous rocks belonging to six distinct invasions are easily distinguished in the region examined during the season, and it is probable that with more detailed work in the field and with the microscope, the list would be increased. The oldest eruptive rock detected is a diorite, which is found intercalated in and cutting the schists of the Shuswap series. The diorite is followed in order by the older granites, the porphyrites and altered rocks so largely Igneous rocks.

British Columbia—*Cont.*

developed in the south-western part of the field, the ordinary gray granites, the younger granites and associated syenite-porphyry dykes, and, lastly, by a system of basic dykes belonging to the basaltic group. Besides the massive rocks just enumerated, a large proportion of the Shuswap and Cambrian schists represent igneous rocks which have been crushed and altered into their present conditions.

Schists.

"Between the Salmon River and Kootenay Lake and River, the rocks are mostly schists, cut by numerous granitic intrusions. The schists have a general north-and-south strike, and dip steadily eastward. Sections were examined on Sheep and Lost creeks flowing into the Salmon, and on Summit Creek which flows eastward into the Kootenay. The sections are interrupted in many places owing to the absence of exposures, but are sufficient to show a division of the rocks into three great groups each many thousand feet in thickness.

Nisconlith slates.

"From Salmon River eastward, for several miles, the rocks consist mostly of hard lead-coloured slates, usually somewhat siliceous and showing as a rule on cross sections numerous fine lines due to a separation of the laminæ by thin quartz films. The slates are always more or less altered and in places pass into micaceous schists. They include bands of greenish schists, quartzites, and grayish and whitish crystalline limestones. The slates have an average dip to the east of 50 degrees. They are succeeded and overlain on the east by a complex set of rocks consisting of alternating bands of greenish, grayish and dark schists, grayish and white quartzites, usually rather heavily bedded, fine and coarse hard conglomerates with a matrix of quartzite or schist, yellowish granular dolomites and massive green diabases. These rocks resemble

Selkirk series

the Selkirk series as described by Dr. Dawson. They are overlain by a great volume of quartzose mica-schists ranging from quartzites holding a few grains of mica arranged parallel to the bedding to well developed lustrous mica-schists. The quartzites occur in thin regular beds usually from one to three inches in thickness, separated by narrow schistose bands which are often crumpled. Crystals of kyanite were found by Mr. Brock in the ridge south of Summit Creek scattered through a band of coarse biotite-mica-schist included in this series. The schists last described extend eastward to Kootenay Lake. They dip to the east and apparently overlie the rocks referred to the Selkirk series, but show greater alteration. This may be due, however, to the vicinity of the granite masses on Boundary Creek and on Summit Creek.

"The three groups of schistose rocks briefly described above, are everywhere broken through by granite intrusions, and towards the north are cut off by the great central granite mass of the district.

"East of Kootenay Lake, Lockhart Creek, La France Creek, Crawford Creek and others were examined for varying distances from the lake. On Lockhart Creek the section shows dark slaty rocks and green schists near the lake, and underlying these the conglomerates, quartzites and schists of the Selkirk series. The position of the group is the reverse here of what it is in Lost Creek where the slates underlie the quartzite-conglomerate beds and it is probable that the whole series is overturned. British Columbia—Cont. Schists east of Kootenay Lake.

"On Crawford Creek, the section commences with the gray gneisses, mica-schists, quartzites and crystalline limestone of the Shuswap series, cut by a network of granite, pegmatite and diorite dykes. The Shuswap series is succeeded and apparently overlain toward the east by the greenish and grayish schists, quartzites and conglomerates of the Selkirk series. The Nisconlith slates, which, when the section is complete, separate the Selkirk from the older Shuswap series, were not here recognized. Shuswap series.

"The gneisses and associated crystalline rocks of the Shuswap occupy the basin and lower slopes of the valley of Kootenay Lake from its northern end to a point a few miles below Crawford Bay. They dip to the west and are apparently overlain on the west and underlain on the east by younger rocks. The conditions prevailing lead to the inference that the whole series has been thrown into a great anticline overthrown to the east. It is also probable that the folding was accompanied by considerable faulting, as the beds on the east and west of the lake do not correspond very closely. The schists have a close resemblance, but the quartzites and conglomerates so abundant east of the lake are only sparingly represented to the west. Structure of beds.

"The region examined during the past season does not include any of the larger mining camps of the district, but it is nearly everywhere more or less metalliferous, and mining claims have been staked off by the score on all the principal creeks, and on some of these claims a considerable amount of development work has been done. We were unable to devote much attention to the examination of these, as our time was fully occupied in collecting data for the completion of a general map of the region.

"The band of dark slaty rocks east of the Salmon River, that has been referred to the Nisconlith, is traversed by a number of leads, some of considerable promise. The Ymir claim, north of Wild Horse Creek, is situated in these slates, about half a mile east of their contact with the basic eruptive series. The Ymir lead cuts the slates in a direction S. 65° W. and dips to the north-west at an angle of 60 to 70°. The principal workings at the time of my visit consisted of a Ore deposits.

British Columbia—*Cont.* Ymir mine.

cross-cut 70 feet in length, a shaft at the end of the cross-cut 103 feet deep, and drifts 60 feet to the north-east and 105 feet to the south-west along the vein, at the bottom of the shaft. The shaft follows an ore-body varying from 10 to 20 feet in thickness, and a cross-cut of the vein on the south-west drift, 50 feet from the foot of shaft, cut nearly 30 feet of ledge matter, of which 18 feet was stated to be payable ore, carrying values of $20 or over, principally in gold. The ores consist of galena and iron-pyrites, with some blende and the gangue is mainly quartz.

Dundee mine.

"The Dundee mine, on Bear Creek, a short distance south of the Wild Horse, was examined by Mr. Leach. The vein occurs at the junction of the slate with a granite boss, and is traceable on the surface for 500 feet. The strike is almost parallel with that of the rock and it dips to the north-west at an angle of 75°. The workings consist of an incline 100 feet deep, following the foot-wall of the lead. The vein has a width of 12 feet on the surface and increases in width with depth, as at the bottom of the incline a cross-cut of 16 feet did not reach the hanging wall. The ore consists of galena and iron-pyrites, and is stated to average $23 to the ton in silver, gold and lead. A good wagon road has been built to the Dundee mine from the town of Ymir on the Nelson and Fort Sheppard Railway, and another is in course of construction from the same place to the Ymir mine. South of Wild Horse Creek a number of claims have been located along the same band of slates on Porcupine, Sheep and Lost creeks, and some development work has been done, but I was unable to afford time to examine them.

Porto Rico claim.

"West of the main Salmon, near the head of a branch of Baratt Creek, is the Porto Rico claim. It consists of a quartz vein averaging about 2 feet in width and traceable for 700 feet, carrying pyrites, pyrrhotite, chalcopyrite and mispickel. Assays from this lead are reported to have run very high in gold, but the average value of the ore was not ascertained. It is situated west of the Nisconlith slates in the basic eruptive series.

Copper camp.

"West of the summit, between Salmon and Kootenay rivers, and close to the International boundary, is situated what is known as Copper camp. A number of claims have been located here along the bands of dolomite included in the Selkirk series. The leads consist of quartz veins like the North Star, and more or less silicified bands in the dolomite, like those of the Hanna and B. C. claims. No large ore-bodies have so far been opened up, and very little development work was being done at the time of my visit. The B. C. has a width of about

2 feet, and has the same strike and dip as the dolomite band in which it is inclosed. The ore consists of gray copper (tennantite) and galena, distributed irregularly through the vein. The pay-ore, free from gangue, is stated to run $260 in copper, silver and gold. British Columbia—*Cont.*

"In the eastern part of the district numerous claims have been located on Goat, La France, Lockhart, Crawford and other creeks flowing into Kootenay Lake, but I had no opportunity to examine them."

Mr. McEvoy was engaged in the early part of the year in laying down the geological boundaries on the remaining unfinished portions of the Shuswap sheet from the information gained during the previous summer, and also in the construction of a map of the country in the vicinity of Rossland, B.C., from surveys made during the latter part of the same summer. Work by Mr. J. McEvoy.

During the past season he was employed in making a topographical survey in the West Kootenay district on which he reports as follows:

"Leaving Ottawa on the 10th of June, 1897, I proceeded to Nelson, B.C., according to instructions and joined Mr. McConnell. The area surveyed extends from near Nelson southward to the International boundary line and from Kootenay Lake on the east to Pend d'Oreille River and Beaver Creek on the west.

"In carrying out the survey of this area two principal methods were employed. 1. Panoramic sketches with transit bearings chiefly from suitable mountain tops, by means of which a system of triangles was extended from fixed points to the north and west so as to establish the main frame-work of a map. 2. Odometer traverses of roads and trails with barometric heights (to be afterwards corrected) for the purpose of getting better details for the valleys and streams. In many cases the odometer was impracticable and paced surveys were made instead. Methods of survey.

"Mr. R. W. Brock and Mr. W. W. Leach who were assistants to Mr. McConnell rendered valuable aid in this work.

"In the high mountainous region between Salmon River and Kootenay Lake, which is for the most part without either trail or track, travel was difficult and correspondingly slow. This was especially so toward the centre of the range where the angular quartzite ridges are impassable in many places and necessitate long detours.

"About the end of August Mr. Leach was given charge of a separate party and from that time until the close of the season continued operations independently. His surveys covered the valleys of the North Fork of Salmon River and Beaver Creek.

British Columbia—*Cont.*

"Circumstances being favourable, on the 1st of September I went to Slocan Lake and ascended Ten-mile Creek into the Kokanee Mountains. In these mountains which form the very centre of the region, with summits reaching 9500 feet above sea level, and from which streams radiate in all directions, a considerable area remained unmapped. A couple of weeks were spent in getting sufficient information to fill up the blanks.

Kokanee Mountains.

"Returning to Nelson I made a short trip, accompanied by Mr. Brock, to the Pend d'Oreille River and through the mountains to the north between it and the Nelson and Fort Sheppard Railway.

Vernon to Lower Arrow Lake.

"After this I joined Mr. McConnell at Nelson and from there went to Vernon. Here a few days were spent examining the rocks in the neighbourhood. We then procured pack-horses and travelled up the White Valley road to McIntyre's at the head of Cherry Creek. From there I made an exploratory survey via Kettle River and Fire Valley to Lower Arrow Lake.

"Mr. Leach in the meantime was working in the mountains to the east of the Slocan River. Returning once more to Nelson, I met Mr. Leach at the appointed time and we visited Copper Mountain south of Nelson. The next day a heavy snowfall covered the mountains and rendered further work impracticable. I returned to Ottawa on the 19th of October."

MANITOBA.

Work by Mr. J. B. Tyrrell

During the early months of 1897, Mr. Tyrrell was at first engaged in correcting the proofs of his report on the country between Athabasca Lake and Churchill River, and in arranging and labelling the rocks and fossils collected during the preceding summer. Thin sections were made of such of the rocks as needed fuller examination, and these were microscopically examined. A report was also written on the country explored during the summer of 1896, lying north of Lake Winnipeg and the Lower Saskatchewan River, west of the upper portion of Nelson River; and to accompany this report a map was drawn on the scale of two geographical miles to one inch, showing all the surveys made in the district examined. The greater part of the winter was, however, devoted to the preparation of a report on the region explored in 1893 and 1894, embracing the Doobaunt and Kazan rivers, and the country in their vicinity and to the west of Hudson Bay. The temporary loss of the specimens collected in 1893, with the considerable portions of the winters of that and the following year occupied in

the field, had necessarily delayed the completion of the report, which is now, however, ready for issue. Manitoba—*Cont.*

Mr. Tyrrell had also been asked to act as one of the secretaries of the geographical section of the British Association, and in that capacity attended the meeting of the Association in Toronto, when he read a paper on the Glaciation of North Central Canada, and another on the Physical Geography of the Barren Lands of Canada. Immediately at the close of this meeting he left for Northern Manitoba. Of his work there he reports as follows :—

"At Winnipeg I had the good fortune to secure the services of Roderick Thomas, one of the men who had been with me for the three previous summers, thence I went to St. Laurent, where a boat and two additional men were engaged and we at once sailed northward to Lake St. Martin, where a close examination was made of the outcrops of trappean rock on Sugar Island, and on the low hill on the east side of the Narrows. These rocks are particularly interesting as they have evidently formed relatively high hills on the original floor of the Palæozoic sea, and, together with some hills of granite, now rise as low rounded elevations in the midst of a region of undisturbed Palæozoic limestone. Lake St. Martin.

"The flat-lying limestone on the east side of the Narrows of Lake St. Martin was closely examined, and was found to be of Trenton age, while a couple of miles further east an escarpment rises to a height of about 100 feet above the lake. On the face of this escarpment are several well developed gravel beaches, marking old shore-lines of Lake Agassiz. The underlying rock was found to be a heavy-bedded, white, porous limestone of Niagara age. Rocks of Trenton age. Rocks of Niagara age.

"Eastward from the summit of the escarpment a dry plain, covered with a thin coating of soil and overgrown with small Banksian pines extends for many miles. Dry plain.

"This escarpment was examined at two different places, the journeys being made to it on foot through deep mossy swamps, after which we returned up Fairford River to Lake Manitoba, and thence, past Duck Islands, which were sketched in with approximate accuracy, to St. Laurent. During this journey a stop was made at a hill on the east side of the Narrows of Lake Manitoba, where thick-bedded white limestones of middle Devonian age are brought to the surface by a low anticline. Some holes had been sunk on this hill to test the character of the rock as a building stone. Some of the beds could be easily cut and would yield fine large blocks, of regular even grain. A free-working stone of this character should command a good market in Manitoba for building purposes.

Manitoba—*Cont.*

Country east of Shoal Lake.

"After leaving the boat at St. Laurent, a journey was undertaken with buck-board and carts into the country between Shoal Lake and Lake Winnipeg. Passing south of Shoal Lake, we followed its eastern shore as far north as Monar, and thence turned eastward to Dennis Lake, passing through a country partly wooded with small poplar, with occasional tracts of dry open prairie. Under these prairie tracts the soil was usually very thin, and was underlain by porous white limestone of Niagara age.

Dennis Lake.

"Dennis Lake lies at an elevation of about 900 feet, and from it the water is said to drain south-eastward into Netley Creek. From Dennis Lake we returned westward across the same dry limestone plateau to the north end of Shoal Lake, where we were joined by Mr. Stephens, Land Inspector for the Canadian Pacific Railway. Together we turned north-eastward on an old Indian hunting trail, and again crossing the dry limestone plateau, visited Pijiki Lake, in Tp. 21, Range 2 W., which is said to be the source of one of the branches of Fisher River. East of Pijiki Lake is a wet and swampy country which would be very difficult to penetrate except over the snow and ice in winter.

Pijiki Lake.

"From Pijiki Lake we returned to St. Laurent, leaving Mr. Stephens at the north end of Shoal Lake. Here, taking fresh horses, we drove northward into the country around the head-waters of Swan Creek. Near Oak Point, Upper Devonian limestone was found a short distance beneath the surface, and again at Clarkleigh Mr. Clark reports that red shales, doubtless the base of the Upper Devonian, were met with in the bottom of his well. At the south end of Swan Lake similar Devonian limestone was again seen.

Swan Creek.

Birch Lake.

"After a very tedious journey, in which the horses were often wading for long distances up to their bellies in water, Birch Lake, in Tp. 23, Range 5 W., was reached, but no exposures of the underlying rock were seen, and the country was so wet that it was impossible to penetrate further into it with horses. Boulders of Devonian limestone were, however, absent around Birch Lake, showing that the rocks of that age did not come to the surface, to any extent at least, north and east of that lake, while boulders of Niagara limestone were very abundant. On the return journey southward, Upper Devonian limestone, similar to that of Manitoba Island, was found just beneath the surface at Lundyville.

Stonewall.

"At St. Laurent, fresh horses were again hired and we drove across the country to Stonewall, where the rocks in the quarries were examined, and a collection of fossils was made, among them *Pentamerus*

decussatus, determining the age of the beds as the base of the Niagara. Thence we drove northward past Pleasant Home, finding rock in place in a few places, and ascertaining the thickness of the drift from the many wells in the vicinity. Manitoba—*Cont.*

"We then again returned to St. Laurent, and on November 4th the party was paid off for the season, and I proceeded to Winnipeg.

"The extent of country underlain by the various formations from the Devonian down to the base of the Niagara, had now been fairly well ascertained, but, in order to complete the section of the Palæozoic rocks of the Winnipeg basin, it remained to connect the Hudson River shales of Stony Mountain with the Niagara rocks of Stonewall.

"From Winnipeg I examined the rocks of Little Stony Mountain, where the upper band of limestones, as well as the lower red shales were found to be of Hudson River age. After a brief examination of the rocks at Stony Mountain I again went to Stonewall, and by the examination of some wells that had been blasted into the rock, was able to complete the section from the white Niagara limestone down to the red shales of the Hudson River. Hudson River rocks.

"From Stony Mountain I accompanied J. A. Macdonell, Esq., M.P., the provincial engineer, on a tour of inspection of the extensive drainage works undertaken by the Provincial Government to drain the great marsh that lies north and east of that place. This marsh is produced by numerous springs that rise along its western side, near the foot of a gentle slope descending from the higher level to the west, one of these springs being said to have a flow of about 2,500,000 gallons a day. These springs rise from the underlying limestone and shales of the Hudson River formation, on a northern continuation of the artesian basin that extends as far south as Winnipeg. St. Andrews marsh.

"The source from which the water comes to supply these springs, and the many artesian wells in the vicinity of Winnipeg has hitherto been unknown, but the explorations of the earlier part of the season show that the water is derived from the porous rocks that underlie the dry plateau extending north-northwestward from Dennis Lake to Lake St. Martin. The rain falling on that area, immediately runs down into the porous rock, and thence flows outwards at the lower level in numerous springs, or is stored up beneath the overlying covering of impervious till, ready to be drawn off when this till is penetrated by wells or borings. Source of artesian water.

"On my return to Winnipeg, Mr. Macdonell kindly placed his excellent drainage plans and contour maps at my disposal, and two days were spent tracing and making notes from these. After completing this I returned to Ottawa, arriving there on November 20th.

Manitoba—*Cont.*

"Much kind assistance was received in the above work, not only from Mr. J. A. Macdonnell, M.P., but also from Messrs. A. G. Hepworth and R. Blackwood, of St. Laurent, and John Dunn, of Stonewall."

ONTARIO.

Work by Mr. W. McInnes.

The winter of 1897 was spent by Mr. W. McInnes in office work, plotting and compiling the surveys of the previous season, and preparing for publication corrected editions of the Shebandowan and Seine River geological maps. A geological report on the district was partly written and will be ready for publication shortly.

Mr. McInnes left Ottawa on the 16th of June, accompanied by Mr. Aurélien Boyer, B.A.Sc., of Montreal, who had been appointed as his assistant for the season. A few days were spent in completing the log-survey of Wabigoon Lake, made last year. On the 23rd of June, Mr. Wm. Lawson, B.A., of Toronto, joined the party, and for the remainder of the season was engaged in independent surveys, for which his long experience in similar work in the district had made him well fitted.

Region covered.

The following report is given by Mr. McInnes of his field-work in that part of the district of Rainy River known as the Manitou region, and extending thence westward to the Lake of the Woods :—

"Starting from Regina Bay, Lake of the Woods, surveys were made of the lakes lying between Whitefish Bay and Lawrence Lake, and between that lake and Eagle and Manitou lakes, Mr. Lawson taking a different route from that followed by the rest of the party. Crow Lake.

Crow Lake, the largest of the series, has a length of about fifteen miles, and varies in width from four to two and one-half miles. It is a comparatively shallow lake, with clear, cold water, and studded with numerous rocky islands. The shore-line is irregularly and deeply indented, the shape of the bays being largely influenced by the direction of the schistosity of the Keewatin rocks in which the lake occurs. The comparatively small extent of its drainage-basin is a feature perhaps worth noting to illustrate the greatness of the precipitation in the region, as compared with the evaporation. The total area of the drainage-basin is roughly about one hundred and seventy-five square miles, and the lake itself has an area of about fifty-eight square miles, while the volume of water discharged at the outlet is considerable.

Geological notes.

"The more northerly of the two routes followed, led through Flint, Stephen, Cameron, Pine and Rowan lakes; the other through Cedar, Crow, Otter and Brooks lakes. On both routes Keewatin rocks only

were seen, with the exception of an isolated area of intrusive granite, about two miles by one mile, lying just south of Stephen Lake, and of a few very limited exposures of a similarly intrusive granite on some of the islands in Crow Lake. A local area of gabbro on the south shore of Rowan Lake may also be intrusive in the Keewatin. The prevailing rocks on the northern route, as far east as Cameron Lake, are of the quartz-porphyry and felsite type. Along Crow Lake and easterly and north-easterly to Rowan and Brooks lakes, agglomerates in broad and continuous belts and basic intrusives, with their derived schists, are the prevailing rocks. Ontario—*Cont.*

"Following the series of lakes which flow into Lawrence Lake from the north by way of Hector Lake, the most interesting point established by Mr. Lawson was the sudden termination of the broad band of Keewatin which we have just been considering. This belt, measured north-westerly across the strike from Lawrence Lake, has a width of nine miles, and followed north-easterly along the strike it entirely pinches out within seven miles. The route from Lawrence Lake to the Manitou, by way of Picture Narrows and Calder Lake, showed only obscurely-foliated, biotite-granite-gneisses of the ordinary Laurentian type to within about two miles of Manitou Lake, where the edge of the Keewatin belt in which the Manitou Lakes lie is reached. Mr. Lawson surveyed with boat-log and metallic tape a route from Deer Lake to the Canadian Pacific Railway at Eagle Lake by way of Poplar, Fisher and Mink lakes, and defined more closely the arm of Keewatin already known to connect the Eagle Lake area with that of Whitefish Lake. Routes from Lawrence Lake.

"Three routes were then surveyed between Upper Manitou or Anjikoming and Eagle Lake. The distance between these two lakes on a direct line is only eight miles. As a canoe-route to the Upper Manitou, however, none of these routes is so easy as the old one by way of Little Wabigoon Lake. They all lie in the biotite-gneisses after the narrow rim of Keewatin bordering the Manitou is crossed. Anjikoming to Eagle Lake

"An exploration and survey was next made of Little Wabigoon River and two of its main branches, and of Clearwater and Snake lakes and the routes leading thence to Small-trout, Manitou and Peak lakes. A number of lakes of fair size were surveyed on these routes. The largest of these is Wapageise Lake, lying to the south of Snake Lake, and emptying into the Big Turtle River at Jones Lake. It consists of a main body about three and a half miles long by three broad, and a long bay extending southerly for six and a half miles. The main body of the lake lies in the diorite and green schist division of the Keewatin, with a small area of intrusive granite at the extreme Lakes east of the Manitou route.

Ontario—*Cont.*

eastern end. The long southerly arm lies wholly in the biotite-gneisses, part of the Laurentian area of Big Turtle River. The northern boundary of this gneiss area proved somewhat intricate, and was traced out in considerable detail. The route to Peak Lake, by way of Saganaga Lake, kept to the north of this boundary and altogether within the Keewatin and for the most part in the division embracing the massive diorite and green schists.

Blueberry Lake.

"Blueberry Lake, which lies to the north of Snake and Clearwater lakes, on Niven's 5th meridian-line, was surveyed and found to lie entirely within the eastern biotite-granite area, the western edge of which is less than a mile beyond the western shore of the lake. The Keewatin here, as far as could be seen from the limited number of exposures, is represented by its quartz-porphyry and crystalline-felsite division. Prospecting was being very actively carried on along and in the vicinity of this contact during the early autumn, and the discovery of some good gold-bearing veins was claimed. A peculiarity of some of these veins is the occurrence, as part of the vein-matter, of a deep purple fluorite. Prospectors stated that they had panned gold from the lacustrine clays which cover large areas of the Wabigoon country, and to this was due probably the local name 'The new Klondike' given to the region. I was not able, however, personally to verify this reported occurrence of gold in the clays.

Region north of the C.P.R.

"North of the railway a survey was made of Sandy Lake and of a number of smaller lakes in its vicinity, Mr. Boyer doing the instrumental work with a micrometer telescope and prismatic compass. The whole region immediately north of the track is largely drift-covered and a good idea of its general character is obtained by a traverse of the Hudson's Bay Company's portage-road to Sandy Lake. This road, measured by metallic tape, was found to be eight and a quarter miles long. The country over which it passes is remarkably flat for the first three or four miles and is covered by the white, silty clays so common about Wabigoon Lake, on which is situated the Ontario Government farm at Dryden. The remainder of the road is occupied by low gravelly and bouldery ridges, probably originally morainic, with intervening lower grounds covered by the clays. The country-rock crops out only at a few points.

Sandy Lake.

"Sandy Lake has a comparatively regular outline and is an open body of water with but few islands and these near the shores. This absence of shelter has given the lake a bad name for canoe navigation in uncertain weather. In depth the lake seems to be very uniform, averaging about sixty feet. The eastern boundary of the great Lauren-

tian area of Lac Seul was found to lie from two to three miles to the west of the lake and to trend about north-east. The Keewatin rocks exposed about the lake are mainly diorites, often sheared to green schists and over considerable areas altered to fine, biotite-gneisses not unlike the Coutchiching gneisses of Rainy Lake. These extremely altered portions surround a central, apparently intrusive area of biotite-granite. Other, smaller, isolated areas of granite were defined on some of the neighbouring lakes. Keewatin schists, generally highly altered, were found all along the southern area of Minnitaki Lake as far as the survey was carried. Ontario—*Cont.*

"According to instructions, operations were transferred on the 21st of September to the Lake of the Woods, for the purpose of making certain additions to the topography and geology of that region prior to the issue of a new addition of the geological map. A survey by micrometer telescope was made of the shore of the lake lying between Niven's 7th meridian-line and his base-line which strikes the lake-shore north of Yellow Girl Point. Gibi (Chipai) Lake, Adams and Black rivers and some lakes lying in the Western Peninsula were surveyed, and necessary revision of the geology at these points and on Whitefish and Long bays was made. Work on Lake of the Woods.

"The striking diabase dyke previously traced by Dr. A. C. Lawson across several islands and well known to the Indians under the name Pingwabik (ash-rock or fire-rock) was noted by Mr. Boyer to cross Picture and Timber islands, giving it an actually traced length of seven miles, and making it quite probable that it is also continuous with that traced by Lawson across the small islands about four miles further north. Diabase dyke.

"A revision of the geological boundaries in the townships of Jaffray and Haycock was made, and the boundaries of the Keewatin belt, which extends north-easterly through these townships, rendered accessible by the opening up of that section by roads, and by its denudation of forest by fire, were fixed with greater exactness. The belt was found to have a greater width than that given to it on the old map, its eastern boundary lying nearly a mile to the east of the position assigned it on that map. Jaffray and Haycock.

"The people of the district have settled down to the development of their mining properties in a much more business-like way than ever before, and the results promise to justify their confidence in the future of the region as a gold-producer. Capital and energy are still being wasted here and there through the district, in developing properties of too low a grade for remunerative working, through the lingering Mining development.

Ontario—*Cont.*

belief, once so general among prospectors, that the gold contents of a vein must necessarily increase with depth. This often prompted them to sink blindly on prospects, which a few careful assays made as the work progressed, would have soon shown not to warrant further expenditure. This recklessness is not now, however, general. Experience has taught the miner here, as elsewhere, that to succeed he must adopt the methods applicable to any other business enterprise and see before him a reasonable expectation of return before sinking money in the acquisition and development of untested properties.

Mines on Lake of the Woods.

"Some of the mines on the Lake of the Woods have been showing very good results, notably the Sultana, which has installed, during the summer, a new and very complete stamp-mill with a No. 3 Gates crusher, 30 stamps and 6 vanners. The mining machinery has also been replaced by new and recent patterns, so that the output should be largely increased. The Regina too has been working regularly during the summer and the capacity of the mill has been increased.

Shoal Lake.

"On Shoal Lake, the mine on the Mikado property has made several 'clean-ups' with results which are satisfactory in the amount of gold recovered from the battery and plates. Neighbouring properties have been carrying on the work of development, but have not yet installed mills. At Camp Bay, the work of development has been pushed forward with vigour, and a considerable amount of ore has been sacked and brought to the lake-shore for shipment. At Gibi or Chipai Lake, a number of properties have been located, and the owners claim

Chipai Lake.

good prospects. These locations are situated on the tongue of Keewatin, extending north-easterly into the gneiss east of Witch Bay. They are thus near the same contact-line in the neighbourhood of which all the properties on the eastern side of the lake lie. North of the railway line, the Scramble has been carrying on the work of sinking and general development; a good wagon-road less than six miles in length has been constructed between the mine and Rat Portage making the property very easily accessible. More or less work has been done on innumerable other properties about the shores and on the islands of the lake.

Locations on Manitou Lakes.

"In the Manitou region, prospecting has been carried forward actively during the season. Many properties have been located and considerable development work has been done on some of them, notably on Anjikoming or Upper Manitou, Mosher Bay, and on one or two properties on the western side of the lake. All the properties in the Manitou region are comparatively near the contact between the gneisses and the schists, but in this case that must necessarily be so if they lie in the Keewatin at all, owing to the narrowness of the belt.

"The building of a wagon-road about seven miles in length from the head of steamboat navigation on Grassy River Lake directly to the north end of Upper Manitou Lake, has made the transportation of supplies, machinery, etc., into this region a much easier problem. Before the building of this road, the old Manitou canoe-route was followed and the part of that route cut off by this road included five portages, a mile and a quarter in total length, and a stretch of very small and bad brook travel, nearly two miles in length. A dam on the outlet of Wabigoon Lake at Dryden, makes the Grassy River navigable for small steamboats, three of which were plying on the route during the summer. At the Manitou end of the road, another steamboat was built, and a dam at the lower end of the lake opens the whole of the Manitou water-stretches to its passage. With easy means of access and abundance of wood and water, this region affords good facilities for the economical development of its leads. Ontario—*Cont.* Communication.

"Up to the present, but little work has been done in the country lying to the north of the railway in this vicinity. A few properties have been taken up and some development work done near Sandy Lake and on Minnitaki. On the latter lake the Harvey property has been partially developed by sinking, with what result I do not know.

"Taking the region as a whole, very fair progress is being made in its exploitation and development though little close or systematic prospecting has been done excepting that carried on by the Ontario Gold Concessions Syndicate (Limited) on their reserves and by the Regina and perhaps a few other mining companies on their locations. The 'Engledue' Syndicate has prospected its properties pretty thoroughly during the summer without the announcement, however, of any important discoveries. Whether payable leads are discovered on these concessions or not, it must be felt that to count upon such discovery within certain defined limits in untried ground is a very severe test to apply to a district in which, as far as we know, the occurrence of the gold is conditional upon a system of fissuring. General progress of region.

"Both Mr. Lawson and Mr. Boyer did very satisfactory work during the whole season, Mr. Lawson working independently. His individual part of the work has been indicated in some cases in the foregoing notes, but in others, for convenience, the work of the two parties has been treated together."

From the first of the year until the commencement of field operations in June, Mr. A. E. Barlow was engaged in plotting the various surveys made during the previous seasons and likewise in studying the Work by Mr. Barlow and Dr. Adams.

Ontario—*Cont.*

results obtained and their bearing on the complex problems of Archæan geology, which it is hoped the critical examination of the Haliburton region now being carried on by Dr. Adams and Mr. Barlow will do much towards solving. A large number of thin sections were, in this connection, examined under the microscope and the details of structure and mineralogical composition carefully noted. Some time was also employed in permanently labelling the large suite of specimens obtained illustrative of the geology of this region. Subsequent to the preparation of the last Summary Report, in which the main facts so far observed were somewhat fully outlined, a paper based on the same facts was presented by Messrs. Adams and Barlow at the winter meeting of the Geological Society of America. The general features previously given will not therefore need to be repeated in the present report.

Dr. Adams.

Dr. Adams left for the field on June 6th and returned in time to be present at the British Association meeting in Toronto. His time was spent in making a very careful and detailed study of one of the most complicated and at the same time crucial portions of the map-sheet. This is comprised in the townships of Anstruther, Chandos, Cardiff, Wollaston and parts of Monmouth and Cavendish. As these townships embrace a large number of lakes, which afford a ready means of access to most parts of the area as well as excellent exposures, the work was carried on largely by canoe.

Mr. Barlow.

Mr. Barlow was detained in Ottawa by office work until June 21st. Coe Hill, at the north-western terminus of the Central Ontario Railway, was made the headquarters of the survey during the month of June, but as the work progressed westward by Dr. Adams and northeastward by Mr. Barlow it was found necessary to frequently change the central camp.

Assistants.

Mr. Barlow was assisted by Mr. Joseph Keele, of the School of Practical Science, Toronto, and by Mr. G. C. Mackenzie, of Brantford. Mr. Keele's attention was directed principally to the prosecution of some of the topographical surveys and also to photography, and Mr. Barlow speaks of his services in terms of commendation.

In the subjoined report, the observations of Dr. Adams and Mr. Barlow are combined, and a notice of some length is accorded to the corundum-bearing rocks of the district because of their probable economic importance.

"The district embraced by Dr. Adams's examinations has represented in it all three of the divisions which were formerly recognized in this part of Ontario, namely, the Fundamental gneiss, the Grenville series

and the Hastings series, and it was selected for especially detailed study as offering a field where the relations of these divisions could be most readily and certainly worked out. The Fundamental gneiss is very extensively developed in the township of Anstruther, which lies on one of the great batholitic masses, referred to in the Summary Report of last year as rising through the limestone rocks of the Grenville series and being wrapped around by them. It underlies almost the whole township, and as the structure was followed out in detail on the numerous lakes in the southern half of the township, a wholly unexpected but remarkably perfect subordinate batholitic structure was discovered within the large batholitic mass itself, the strike of the gneiss running in great circles and sweeps through the mass and bending back upon itself in closed curves. The lakes are all excavated in or etched out of this gneiss, their outlines closely following the curves of the gneissic structure. The centre of one circle, which is especially well seen, lies about a mile to the north of Serpentine Lake, near the middle of the township on concession XVIII. Two bands of limestone were noticed which had been caught up in these curves: one on Eagle Lake, in the southern part of the township, and the other, which is much larger, in its northern portion, to the south-west of Eel Lake.

Ontario—*Cont.*

Fundamental gneiss.

"The mass of this gneiss is undoubtedly of igneous origin. From Anstruther it extends around the south-eastern portion of the township of Monmouth and into the northern part of Cardiff where, however, it presents rather the character of an intrusive granite, possibly owing to its having here been more completely softened, and it can be observed cutting through and across the limestone series in many places. Great masses of amphibolite moreover come in, of which the relations have not as yet been fully determined. In the south-east corner of Anstruther, the great batholitic series of the Fundamental gneiss abuts against a series of well-foliated and banded limestones, amphibolites of various kinds and fine-grained rusty-weathering gneisses, the two being brought together by a fault. This occurs immediately to the east of Crab Lake where the strike suddenly changes from N. 75° E. to N. 15° E.,* the easterly or limestone series, having the latter strike, passing out of Anstruther into the adjacent township of Chandos, all the northern portion of which township is underlain by the last-mentioned series. As developed in northern Chandos, this series consists of limestones interstratified with several distinct varieties of amphibolite, the most abundant being thinly foliated, and characterized by the development in it of radiating bunches of slender prisms of dark-coloured

Igneous origin of Fundamental gneiss.

* Bearings throughout this report are referred to the true meridian unless otherwise stated.

Ontario – *Cont.*

hornblende lying in the planes of the foliation. This 'feather' amphibolite is continuous over very large tracts of country and is associated with great intrusions (?) of a massive black gabbro-like rock which is well seen at Macdonald Rapids on the North River in the XVIIIth concession of Chandos, the rapids being caused by one of these great masses which is encountered by the stream at this point. In this series the batholitic structure is also excellently developed, the most perfect example being a batholite of which the central portion is occupied by Duck Lake, which sheet of water is situated about the middle of the township on concession XI. About the shores of this lake an impure limestone is found, the attitude of which is nearly horizontal. This occupies an approximately circular area with a width of about one mile. The limestone is surrounded by a zone of a heavy, more or less distinctly foliated amphibolite, averaging about a mile in width, which forms a cliff about the lake and dips away from it on all sides. This in its turn is succeeded by a zone of limestone and 'feather' amphibolite, also presenting the same quaquaversal dips, the strike of both series circling completely around the lake.

"The southern part of Chandos and the adjacent parts of Wollaston, are largely occupied by a great mass of granite which breaks through and eats into the series above mentioned, holding inclusions of it and sending off apophyses into it in all directions. This is excellently seen along the shores of South Bay of Loon Lake in Chandos, as well as about Gilmour Bay, an extension of the same lake, and along the Wellington road in the first range of the township. It extends down into Methuen on the south.

Conclusions formed from season's investigations.

"The investigations of last summer bear out the conclusions of former work, in showing that the Fundamental gneiss consists of granitoid-gneissic rocks in the form of great batholitic masses, the limestones, etc., of the Grenville series sagging down between and wrapping around the batholites as great mantles. These gneissic rocks, in parts of the area, have become more completely molten and have developed into truly intrusive granites which no longer merely arch up the overlying strata but break through and cut across them.

"The relation of the limestone, classed as Grenville series, to the stratified rocks referred to the Hastings series, cannot as yet be considered definitely settled, but important evidence bearing upon the question has been obtained by the discovery in several widely separated localities in the area examined this summer, of considerable

Conglomerate near The Ridge post-office.

exposures of conglomerate. The first of these localities is south of Eagle Lake on the road to The Ridge post-office, on lot 12, con. III. of Wollaston. Here the conglomerate appears by the roadside, the

matrix in some places being composed of silicified mineral but elsewhere of limestone. The pebbles are for the most part amphibolite and diorite, but many of them consist of quartz or quartzite and gneiss or granite. Where the matrix of the conglomerate is not limestone, they are often much flattened in the direction of the strike, as is usually the case in conglomerates found in districts which have been submitted to great pressure. Some of the pebbles, however, when the matrix is limestone, still preserve their original and nearly spherical form. Ontario—*Cont.*

"Another locality where conglomerate was found is on lot 18 of range I. of Cardiff. Here, in the heavily wooded country to the east of the southern extremity of Pine Lake, forming part of a highly inclined series of amphibolites with interstratified limestones and quartzites, a band of conglomerate nine feet thick is well exposed on the summit and side of a cliff. The matrix of this conglomerate is fine in grain and slightly calcareous and the pebbles, as in the case already cited, are often considerably flattened. The relative proportions of the different kinds of rocks forming the pebbles was ascertained in several places, and it was found that from 75 to 79 per cent of these consisted of a fine-grained pink granite, the remainder being chiefly composed of amphibolite and crystalline limestone. A careful study of their character will be made so soon as thin sections of them have been prepared, but judging from their macroscopic character, it seems highly probable that the granite pebbles have been derived from a mass of this rock which occurs about the southern end of Pine Lake and the other pebbles from exposures in that vicinity. Conglomerate in Cardiff.

"Two other exposures of conglomerate were noticed, one on the north side of the Bancroft and Bronson road a little over a mile east of Bancroft, and the other on the Carlow and Combermere road about five miles south of Combermere. The pebbles in both instances were rather similar to those described above, distinctly rounded and embedded in crystalline limestone matrix. Conglomerate near Carlow.

"Mr. Barlow's work was directed chiefly to surveys and geological examinations in the north-eastern part of the sheet, covering the townships of Wollaston, Faraday, Dungannon, Mayo, Raglan, Carlow, Herschell, McClure, Wicklow, Bangor, Radcliffe and parts of Ashby, Brudenell, Lyndoch, Sherwood and Hagarty. The relations of various members of the Fundamental gneiss were closely examined and the conclusion arrived at that both basic and acidic members are differentiated portions of a single magma. Abundant evidence was obtained that the nepheline-syenite which was at first thought to be a separate Work by Mr. Barlow.

Ontario—*Cont.*

and later intrusion must really be included with the gneissic rocks classified usually as Laurentian.

"A considerable portion of the time was spent in tracing out the corundum deposits and an account of their mode of occurrence is included in the present report.

Note on the discovery of corundum.

"The presence of corundum in the northern part of the county of Hastings and thus within the confines of the Haliburton map-sheet (No. 118) was really made known as the result of a visit made in October, 1896, by Mr. W. F. Ferrier, of the Geological Survey of Canada. In the Summary Report for the year* Mr. Ferrier relates the history of the discovery and the circumstances which led to his trip to that region. It is now, however, stated on undoubted authority that this was not the first intimation of the occurrence of corundum in the township of Carlow. Some six years previously, or about the year 1890, Mr. Woods, now a resident of Kingston, Ontario, an amateur geologist and mineralogist, was travelling through this district and was shown crystals obtained from the Carlow locality by Mr. Armstrong of Armstrong's Mills (New Carlow, P.O.), and he, after examination, pronounced them 'emery stone.' The value of the find, however, does not appear to have been appreciated by the original discoverers as nothing further was heard of it until after Mr. Ferrier's return from Hastings, although one of Mr. Armstrong's sons personally conducted him to the spot where the crystals occurred. Notwithstanding it is thus evident that although the nature of the mineral was known some years before Mr. Ferrier's visit, there can be no reasonable doubt that the true value and extent of the deposit would have remained practically unknown but for his description and report of its mode of occurrence.

Corundum mistaken for apatite.

"On the announcement of Mr. Ferrier's observations, the attention of Messrs. Robillard and Fitzgerald was directed to certain crystals which they knew to occur in the north-eastern part of the township of Raglan about five miles to the east of the Carlow locality. These had been supposed to be apatite or 'phosphate' and the gentlemen named above had been on the point of applying for the mining rights of the land on which the mineral was known to occur, when the somewhat sudden depreciation in the value of phosphate happened. Mr. Ferrier's description and the knowledge that these crystals were approximately on the same range of hills, confirmed the belief that the supposed apatite was in reality corundum, especially, as it coincided with the opinion of a so-called expert expressed some years before, although at the time no great reliance was placed

*See Summary Report, Geol. Surv. Can., 1896, p. 116 *et seq.*

on the accuracy of his determination. Immediately on Mr. Ferrier's return to Ottawa (23rd of Oct., 1896), the Director of the Survey communicated to the Ontario Bureau of Mines the results of this visit to the township of Carlow, and in consequence, the lands, which belonged to the Crown, were withdrawn from sale by the Ontario Government. Following shortly on this discovery, and doubtless as a result of it, came the news that Mr. George Bennett had found corundum at a so-called mica mine on lot 14 con. IX. of the township of Methuen in Peterborough county, about forty-five miles to the south-west of the Carlow occurrence. Ontario—*Cont.*

"During the past summer repeated reports of alleged 'finds' of corundum were circulated from time to time and a personal examination was made of a large number of these which invariably arose from mistaking some species of grayish felspar, usually albite, for corundum. Mr. Ferrier's prediction that the Carlow locality is not an 'isolated occurrence, but that other deposits will be found in the Hastings district,' has since, however, been amply verified by the detailed examinations carried on during the past summer both by the Geological Survey of Canada and the Ontario Bureau of Mines. During last August and September, Prof. W. G. Miller, of the Kingston School of Mines, who was conducting a prospectors class in Central Ontario, undertook an exploration of this stretch of country at the instance of the Ontario Bureau of Mines with the object of securing as much additional information as possible in regard to the distribution and association of the corundum. In many cases the work was carried on in co-operation by Mr. Barlow and Prof. Miller, so that much more satisfactory result were achieved than could have been accomplished by a single party. Prof. Miller has already written an interim report in the Sixth Annual Report of the Bureau of Mines, which has just appeared,* and as a result 'the mineral rights in those lands over which the corundum belt has been found to extend have been withdrawn from sale pending the completion of the final report.' Mr. Ferrier's prediction verified. Work by Prof. Miller.

"The name corundum embraces those varieties of oxide of aluminum having dull colours; the colours generally being light-bluish, greenish, grayish or brownish. The granular corundum of a blackish or grayish-black colour, when intimately mixed with magnetite or hæmatite, is usually referred to as emery. The mineral found in Hastings county is essentially pure. The susceptibility of corundum to alteration, and the difficulty of getting rid of the scaly decomposition products seem to be the chief hindrances to a more profitable, Nature and character of corundum. Alteration of corundum.

* Sixth Report Bureau of Mines, Ontario 1896, pp. 64-66.

Ontario—*Cont.*

nd therefore more general mining and use of the mineral. A variety of aluminous minerals result from its decomposition, the most abundant alteration product noticed being a pearly-white hydrous muscovite, evidently closely allied to damourite or margarite, and every gradation in alteration may be noticed at the different localities, from the incipient stages in which the comparatively unaltered crystals are coated with thin films or scales of this mineral, to that in which the whole individual has been converted into the magnesian mica. The circumstances under which such alteration takes place seem at present difficult of explanation, for often, even when embedded completely in comparatively fresh and unaltered rock, where the surrounding constituents have undergone little or no perceptible change, the corundum individuals may be seen, either wholly or in part, replaced by the objectionable mica. On the other hand, it was frequently noticed that crystals which had evidently been subjected for a considerable time to the action of the weather, show little or no sign of decomposition. Throughout the region examined, however, the corundum is, as a rule, comparatively fresh and unaltered, and it is confidently believed that the deposits will, if properly handled, furnish sufficient material of such uniform hardness and purity that it can be successfully treated for the removal of impurities by the use of machinery like that employed for this purpose in Georgia.

Comparison with Georgia corundum.

"In the State of Georgia, where corundum has been successfully mined since the year 1880, three varieties are commonly distinguished, and it is probable that in the Hastings area, these subdivisions will, in a rough way, hold good. 1. Sand corundum, 2. Block corundum, 3. Crystal corundum. The sand corundum is either coarsely or finely granular, usually found embedded in a gangue of decomposed felspar.

Block corundum.

The block corundum includes the massive corundum, with nearly rectangular parting or pseudo-cleavage. This type is of rather frequent occurrence, and at the Raglan locality a large irregularly oval mass was found by Mr. Henry Robillard, which measured 10 x 7 x 7 inches, and weighed 24 pounds. This large, and as yet unique specimen, was divided into two pieces by the finder, one being given to Capt. W. E. James, of Combermere, while the other went to Mr. James Best, of Bird Creek. Last summer, however, these gentlemen kindly presented the specimens to the Geological Survey, and they have now been placed side by side in the museum.

Crystal corundum.

Crystal corundum is, however, by far the most common type met with in the Hastings district, and, as might be expected, it passes into block corundum on the one hand, by an increase in size, which is almost invariably accompanied by a decrease in perfection of crystallographic outline, and, on the other

hand, to sand or granular corundum, when the individuals are so closely packed together that mutual interference prevents the assumption of regular crystalline forms. The crystals when normally developed are usually six-sided prisms which are sometimes terminated by a six-sided pyramid, and not infrequently by the basal plane. Ontario—*Coat.*

"Many of the crystals found here have a tolerably sharp and perfect outline, frequently showing a tapering to either extremity, thus producing the very characteristic barrel-shaped outline. The pyramidal and prismatic faces are very often more or less deeply striated or grooved horizontally. The basal planes or truncated ends of the crystals are frequently striated in three directions, forming equilateral triangles corresponding with the less perfect rhombohedral partings or pseudo-cleavages. When the crystals are large they are usually rough and imperfect. The corundum is in many instances somewhat brittle, breaking with an uneven or conchoidal fracture, but when in large and compact masses it is exceedingly tough. The hardness is 9 or second only to that of the diamond, but as might be expected from its liability to alteration this quality is somewhat variable and the chief purpose of all the manipulation it undergoes is to secure uniformity of hardness in the finished material. The lustre is in general vitreous, but in the translucent light-greenish variety noticed in Brudenell township the lustre is somewhat pearly. In a great many instances the surfaces revealed by the basal parting showed a distinct bronze-like metallic lustre, resembling very much in this particular that of the cleavage-planes of bronzite. The colour is in general brownish or grayish. Some of the crystals noticed in Brudenell were greenish, yellowish to almost colourless, while very occasional fragments and individuals have a distinct rose-red colour. Frequently, especially in the larger individuals, the colour is not uniform, but patches of gray, brown and green blend into each other. Crystallization of corundum.

"Although a certain tract or area was mapped out in which it was definitely ascertained that corundum was present, while the rocks in the district on either side seemed altogether barren of the mineral, and although the trend of this belt agrees in a rude way with the general strike of the containing gneissic rocks, still it was found that the mineral occupied no very definite position in any particular zone or band, but that it occurred somewhat sporadically developed in the various plutonic rocks of the region, whose chief point of resemblance consisted in their community of origin. The occurrence of the mineral in this connection affords additional evidence, if such were needed, of the identity of the magma from which the larger proportion of these granitic or gneissic rocks have crystallized. At many of the rock-ex- Occurrence of corundum.

Ontario—*Cont.*

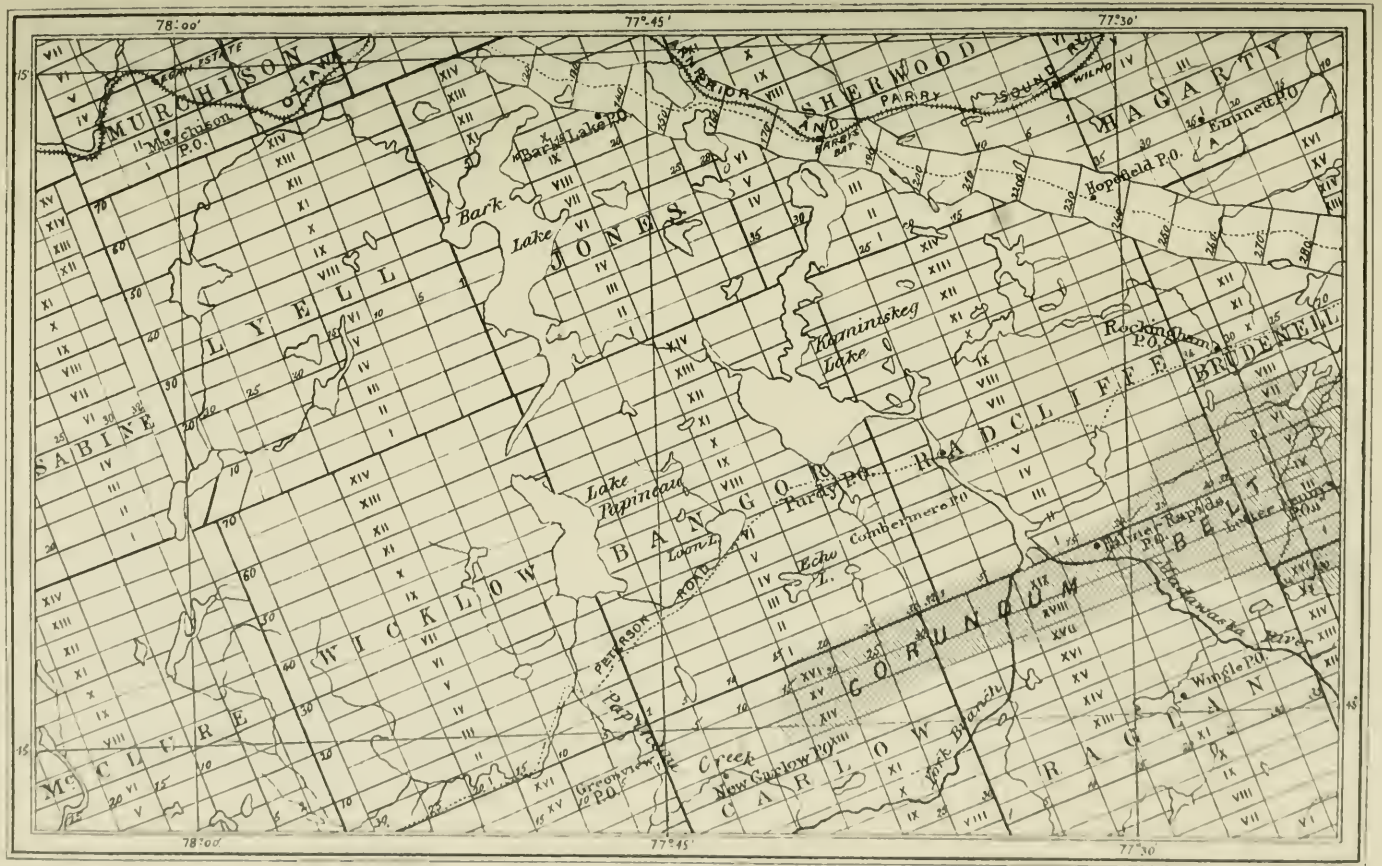
posures visited in the township of Brudenell, the corundum was frequently noticed completely embedded in and surrounded by the iron ore; in fact this association was the most common and noteworthy one. It is therefore apparent that the corundum was one of the first constituents to crystallize out from the molten magma, while at the same time sufficient material remained in the more acid residual portions to form the large and important occurrences seen in the pegmatite dykes which marked the final stage in the process of solidification. The foliated texture of many of the rocks with which the corundum is associated, show the same irregularity in their minor structural details so usual in other areas where similar rocks are exposed, while maintaining approximately the same general strike and inclination, or dip, over the whole extent of territory examined.

Limits of corundum belt.

"The limit of what may for convenience be called the 'corundum-bearing belt' extends on the west from lot 14, in the XIVth concession of the township of Carlow, where it was originally found, north-eastward as far as lot 25, in the VIth concession of the township of Brudenell. Mr. Barlow did not explore the territory further to the east, as the last-named locality corresponded very closely with the eastern limit of the map-sheet on which he is at present working in conjunction with Dr. Adams. The assumption at present seems very reasonable that corundum will be found, if careful and systematic prospecting is undertaken, in the northern portion of Lyndoch, the southern part of Brudenell and the middle concessions of Sebastopol. To the west of the Carlow occurrence, no corundum has been found on the hills forming the north-western part of the township of Carlow and the north-eastern portion of Monteagle township. The deep valley of Papineau Creek intervenes and seems to limit the occurrence in this direction, although very similar rocks prevail in this area.

Width of the belt.

"In width, the corundum belt is rather variable. In the township of Carlow corundum has been found in a large number of places over the hill which forms the north-eastern part of the township east of lot 14. It occurs at intervals at places from the XIIIth concession to the XVIth concession, thus showing a breadth of over two miles. In the township of Raglan, the mineral has been found in a large number of places on the high ridge which runs across the XVIIIth and XIXth concessions as far as the York River, a branch of the Madawaska. Prof. Miller and his assistants proved the existence of the mineral on many of the lots in the XVIIth, XVIIIth and XIXth concessions of Raglan, between the York River and the Madawaska, and likewise on a number of lots in the XVIIIth and XIXth concessions to the east of the Madawaska. In Raglan, therefore, the belt is very nearly two



Autographed by C. O. Senécal

Geologically surveyed by A. E. Barlow

PLAN SHEWING CORUNDUM BELT IN HASTINGS AND RENFREW COUNTIES ONT. 639

Scale 5 miles to 1 inch

miles wide, but further east corundum has been found on lot 32, concession II. of Radcliffe; lot 34, concession V.; lot 25, concession VI.; and lot 32, concession VII., of Brudenell township. Much of the country is either drift-covered or densely overgrown with a hardwood bush, so that prospecting is exceedingly tedious and difficult, but here and there small exposures of rock occur and these were carefully examined for the mineral. Boulders containing the mineral in the drift material, often formed excellent guides in prospecting, as in most cases it was ascertained that they had travelled no great distance from their original source. Mr. Joseph Keele, assistant to Mr. Barlow, was handed specimens of corundum said to come from the township of Lyndoch, on the road to Letter Kenny P.O., about a mile north of Quadville. Near the boundaries between the townships of Raglan, Radcliffe and Brudenell, therefore, the band of rocks in which corundum has been proved to occur is over three miles in width; and, if the Lyndoch occurrence mentioned above is authentic, the whole belt will be fully five miles wide at this place. Ontario Cont.

"On lot 14, con. XIV. of the township of Carlow, a range of very high prominent hills ends somewhat abruptly in a steep cliff or precipice composed chiefly of coarse flesh-red pegmatite, cutting a dark reddish or brownish gneissic rock, which on examination under the microscope proves to be a hornblende-granite-gneiss. To the north-east this hill rises gradually for a considerable distance. At first it trends to the north-east but then bends around more to the east, following very closely the direction of the concession lines through the north-eastern part of Carlow and the township of Raglan, terminating rather steeply at the large marsh (Campbell's marsh) through which the lower portion of the York River meanders before its junction with the Madawaska. To the east, although maintaining approximately the same elevation, this range of hills does not appear in such marked contrast to the topography immediately surrounding, as the whole country is rougher and more mountainous. Carlow.

"In Carlow township, the older plutonic rock cut by the pegmatites carrying the corundum, is composed of orthoclase, plagioclase, biotite and hornblende. Quartz is present, but by no means an abundant constituent. Sphene is very abundant, of a dark-brownish colour and marked pleochroism. Apatite is also present and zircon in occasional small crystals. The felspar is much stained with red and brown iron oxide, and shows the undulous extinction due to squeezing. This gneiss has a strike of north-east with a dip to the south-east at an angle varying from 15° to 30°. The foliation is very distinct, and further to Associated rocks.

Ontario—*Cont.*

the east shows a bending around in strike corresponding to the change in direction of the hill.

"The corundum is, as has been said, by no means uniformly distributed through the mass, and large portions of the rock are completely barren of this mineral, while certain portions on the other hand contain a very high percentage, constituting as much as a quarter to a third, or even more in some cases of the whole rock.

Raglan.

"In the township of Raglan, on concessions XVIII. and XIX., granite and granite-gneisses prevail, with which is associated a small quantity of nepheline-syenite and nepheline-syenite-gneiss. This peculiar and somewhat uncommon rock occurs in several small patches and areas on lot 2, concession XVIII. of Raglan, but was not noticed elsewhere on the hill. This nepheline-syenite is composed chiefly of a flesh-red or salmon-pink elæotite or nepheline, which is generally the most abundant constituent; a light-gray, almost white, albite and a small quantity of dark-coloured biotite. The nepheline, where exposed to the action of the atmosphere, shows the characteristic weathering, occurring in irregular sunken areas with all the inequalities rounded off and leaving the white plagioclase in marked relief. The strike of the foliation is about N. 80° E., with a dip at a small angle to the south, and is somewhat uniform over the whole of the hill. The corundum was noticed in a large number of places, often in sharp well-defined crystals, but usually in large irregular individuals or masses and aggregates. All the exposures visited were on the southern slope of the hill, chiefly on lots 2, 3 and 4. On lot 2 the corundum was noticed in the ordinary red felspathic gneiss as well as in the nepheline-syenite. A small cliff was seen composed of the latter species of rock, containing embedded crystals, whose major axes were lying at right angles to the foliation. On lots 3 and 4 the rock is the ordinary red felspathic gneiss closely allied in character to syenite, being poor in quartz, cut by pegmatite, which is likewise comparatively poor in silica. The coarser crystals and fragments are present as usual in the pegmatite phases of the rock, and one case was noticed where a promising exposure really formed a mere shell or covering, which was removed by the first blast, revealing the comparatively barren gneiss beneath. The whole of this hill had, previously to our visit, been rather carefully prospected by Mr. Henry Robillard, the original discoverer of this locality, but if it should be decided to work the place a careful and systematic examination would have to be made of the whole ridge.

Brudenell.

"On lot 33, concession VII., of the township of Brudenell, corundum crystals may be noticed thickly disseminated through a well foliated

nepheline-syenite-gneiss which as well as the ordinary red felspathic gneiss crosses the road running southward from the village of Rockingham to the German settlement towards the Madawaska. The two varieties of rocks are interfoliated and have a north-west and south-east strike. The corundum was noticed at intervals in rather small crystals but more thickly and evenly distributed than usual, for a distance of about an eighth of a mile across the strike of the foliation, although they are not so abundant in the ordinary felspathic gneiss and are altogether absent from many of the interfoliated bands. On lot 34, concession V. of Brudenell, the corundum occurs in large irregular crystals and masses embedded chiefly in the nepheline-syenite, and these are present in considerable quantities in the ordinary red syenite rock. At one place, a rather sharp contact was seen between these two rocks, the larger crystals being developed in the nepheline-syenite close to the line of junction. The rocks occur on a lot belonging to Mr. Frederick Black. The strike is here about north-west and south-east. The corundum is generally of a brownish colour, but some of the small crystals in a light-gray albite-gneiss are light-greenish, yellowish and grayish to almost white or colourless. The fields to the south-west of the exposures are covered with a great many boulders most of which are seen to contain corundum. The nepheline-syenite is composed of a very beautiful salmon-pink nepheline, gray albite and small spots or areas of deep-blue sodalite. The crystals of corundum are sometimes decomposed to the pearly magnesian mica already mentioned, the combination of all these constituents making a very striking and beautiful rock.

Ontario—*Cont.*

"At present the chief obstacles presenting themselves to the successful and profitable mining of this mineral, is the exceeding irregularity of the deposits and their wide separation from one another. Careful search may get rid of much of the latter objection, as the prospecting so far undertaken, though done very carefully, has been by no means exhaustive and the richness of some of the masses already encountered seems to show that the average yield of considerable bodies of rock will be satisfactory.

Obstacles to successful mining.

"In the event of treating the mineral on the spot, there are several good water-powers in close proximity to the various localities where corundum is now known to exist. In Carlow the water power now operating Armstrong's saw-mill on Papineau Creek is only about three miles from the corundum cliff. In Raglan a good water-power is already utilized by a small roofless saw-mill on a stream which flows through the valley immediately south of the hill on which the mineral occurs. Palmer's Rapids on the Madawaska would furnish good and

Water powers.

Ontario—*Cont.*

sufficient power for the treatment of corundum found in the surrounding country. All of these water-powers have already been considerably improved and would probably only need some minor alterations to make them immediately available.

Accessibility of deposits.

"The corundum deposits are rather readily accessible, the chief means of communication being by means of the York and Madawaska rivers and Kaminiskeg Lake as far as Barry's Bay, an important station on the Ottawa, Arnprior and Parry Sound Railway, about 108 miles west of Ottawa. A small steamer with scow attached now runs from Havergal (Campbell's Farm) on the York River to Combermere and Barry's Bay, passing the foot of the hill on which the Raglan deposits occur. Wagon roads approach the other deposits very closely and although most of them are exceedingly rough they could be considerably improved at a comparatively small outlay. Labour and supplies are cheap and abundant.

"The following notes may be of assistance to prospectors working in the district:—

Hints to prospectors.

"The great hardness of the unaltered corundum, the sharp edges of which will readily scratch the hardest steel, is perhaps its most valuable distinguishing characteristic. Its greater weight in contrast to any of the associated materials is also of value in recognizing this material, and the barrel-shaped outlines of many of the crystals is likewise very characteristic.

"The presence at the surface of a relatively greater abundance of the pearly or light-coloured mica, which so frequently results from the alteration of corundum, is in many cases a valuable indication of the probable proximity of the unaltered material. The rocks in which corundum has been found are relatively much poorer in quartz than the prevailing gneissic rocks of Laurentian areas. The presence of nepheline-syenite may also be considered as a promising indication locally, and a quartzless pegmatite, or one nearly so, seems to be especially favourable to the development of corundum.

"Frequently, especially on those glaciated rock-surfaces from which the covering of soil has been but lately removed, the corundum crystals and fragments stand out in bold relief and form very conspicuous objects. Many of the deposits were also found by following up boulders containing the mineral to the places of their origin, in a N.N.E. direction, as indicated by the glacial striation, which runs about S. 25° W."

Ontario—*Cont.*

The winter of 1896-97 was devoted by Dr. R. W. Ells to the plotting and compilation of the surveys pertaining to map-sheet No. 119, and to the arrangement of the notes of the late Mr Giroux, in connection with the mapping of the adjacent sheet, No. 120.

Work by Dr. Ells, Nova Scotia.

The month of June was spent by Dr. Ells with Mr. Fletcher and Dr. Ami in Nova Scotia, in the examination of some points connected with the conglomerates and associated Carboniferous rocks which flank the Cobequid Mountains, the relations of which are somewhat obscure. Some time was also devoted to the investigation of the rocks between Truro and Pictou, as well as to the examination of the Horton and Wolfville section. It was thought desirable that Dr. Ells should be associated with the above-mentioned gentlemen in this work because of his previous experience in the same field.

The greater part of the season was, however, employed by Dr. Ells in the continuation of the work upon sheets 119 and 120 of the Ontario series, known respectively as the Perth and Ottawa City sheets. The results are outlined by Dr. Ells as follows :—

Upper Madawasca River.

"Upon my return to Ottawa on July 1st, I proceeded almost directly to Barry's Bay, on the Ottawa, Arnprior and Parry Sound Railway, in order to make an examination of the upper portion of the Madawaska River. This stream was examined from Bark Lake east to the High Falls, at which point our surveys of the river ended in 1896. Thence the river was ascended to Mackey's Creek, by which a portage-route for canoes extends across to the Mississippi River near the village of Ardoch. This route crosses the Snow road by a portage between Brulé and Buckshot lakes, the latter of which discharges into the Mississippi. An examination was also made of a number of lakes in this vicinity in order to fix the limit between the Hastings limestones and the granite-gneiss of the Upper Madawaska district.

"The months of August and September were devoted to the completion of the surveys necessary for the compilation of map-sheet No. 119. In this work the wheel odometer was employed to a large extent, though details were filled in frequently by pacing. The surveys of the area embraced in this sheet have now been nearly completed and the map is ready for compilation, except for the survey of certain base-lines required for the purposes of ensuring geographical accuracy. In the surveys of the eastern portion of this sheet Mr. Wilson, of this office did a large amount of excellent work, principally in connection with the tracing out of the Potsdam and Calciferous formations.

Work by Mr. Wilson.

South of the lower Ottawa.

"In connection with Mr. James White, surveys were also made in the district south of the Ottawa River, in the southern portion of map-sheet

Ontario—*Cont.*

121, and along the line between this sheet and the one to the south, 120, which had been partially surveyed by the late Mr. N. J. Giroux. The latter part of the season was devoted to the survey of the district more immediately adjacent to the city of Ottawa, where a somewhat complicated piece of structure is presented, owing to the presence of numerous faults which traverse this district.

Calciferous and Potsdam of Lanark and Carleton counties.

"The rock-formations in the area examined include crystalline schists and limestones of the Hastings series as well as the granites and gneisses connected with these. In the eastern areas the Palæozoic formations are well developed, the principal being the Potsdam sandstone and the calciferous limestone which are particularly well exposed in the south-eastern part of Lanark county and the southern portion of the county of Carleton. The beds of these formations are in a nearly horizontal position, though in places they are inclined at angles of ten to fifteen degrees. They constitute the lowest members of the Ottawa Palæozoic basin and rest directly upon the gneiss and limestone of the Archæan. In the townships of Huntley and Nepean, as also in Ramsay, the Calciferous passes regularly up into the Chazy and on into the Black River and Trenton. There is usually a gradual passage upward from the Potsdam sandstone into the Calciferous limestone, and in places these transition beds are from thirty to fifty feet thick. This portion frequently contains an abundance of fossils, as in the township of Goulburn, though they are not often easily obtained in a good state of preservation.

Transition

Fault near Fallowfield.

"In Carleton county, on the road from Bell's Corners to Richmond, a sharp line of fault is seen about a mile to the north of Fallowfield on lot 28, range V., township of Nepean, by which the Trenton is brought in contact with the Potsdam sandstone. The Trenton beds are here highly fossiliferous and to the east of Fallowfield they pass down into the Chazy.

Faults in Gloucester.

"In the township of Gloucester, a well-defined break is also seen on the Russell road, about lot 17, ranges IV. and V., Gloucester. Here the Utica shales are in contact with the Calciferous limestones. This fault extends a considerable distance to the east, and also appears near the Rideau River about one mile above the Hog's Back. It is seen near the road up the east side of the Rideau on lots 2 and 3, range II., Gloucester township, where the contact is between the Chazy and Calciferous. The location of these faults is rendered uncertain at many points by the great covering of clay and sand which is widely spread over much of this area. The Utica basin does not reach the Rideau, but apparently is terminated by a fault which divides it

from the Trenton and Black River about the road leading south near the line between ranges II. and III., Gloucester. Ontario—Cont.

"The recent examination of certain areas south of the Ottawa River has fixed several of the boundaries of the Palæozoic formations more accurately. The Trenton and Black River have a considerable development south of the river, resting upon the Chazy. The Trenton extends south of the village of Cumberland from lot 1, almost to the village of Navan, which is a short distance east of the boundary of Carleton county. Here the formation passes up into the Utica about half a mile north of the latter village. Westward the line between the Utica and Trenton continues to Robillard P.O., on the Montreal road, the contact with the Trenton being about two miles and a half south of the Rideau River. This contact can also be seen along the road to the south of the Roman Catholic cemetery, about 250 yards east of the Montreal road, and the eastern limit of the Utica is seen in New Edinburgh, near Charles street, about 100 yards from the road to Rockliffe. The Utica occupies the flat country to the south of the Ottawa and east of Billings bridge, and the area along the road south of the latter place, extending to Hawthorn Corner, where the black shales are overlain by, or pass upward into, the gray sandy shales of the Lorraine (Hudson River) formation. Delimitation of the Utica near Ottawa.

"To the east of Carleton county, the Utica has been traced for a long distance. It has been conclusively shown that the formation extends in an unbroken area from the vicinity of Ottawa city for more than fifty miles east, or nearly to Vankleek Hill, with a breadth in places of nearly twelve miles. To the south-east of Ottawa, the Lorraine shales come in and extend in the direction of the Mer Bleu or great peat bog, which they apparently underlie, as the Utica shales again appear along the road which crosses southerly not far beyond the eastern limit of the bog. In the extreme south-west portion of Cumberland and the corner of Russell adjacent, a considerable area of reddish shales occurs, the location of which is easily recognized by the presence of bright red soil. The red shales are rarely seen at the surface, as they decompose readily, but the ledges were noted in several excavations, while the debris from wells also showed the presence of these rocks. They appear to have a thickness of at least fifty feet, though in the wells the bottom of the formation was not apparently reached. These are supposed to represent the Medina formation, and they are apparently newer than the Lorraine shales which appear both to the north-west and to the south. Medina and shales of Russell.

"In the crystalline rocks, the relations of the diorites and granites to the crystalline limestones and associated gneiss have been worked

Ontario—*Cont.*

Relations of Hastings limestone to those of Grenville.

out as carefully as the broken nature of much of the district would permit. The peculiar striped limestone or marble so characteristic of the Hastings series has been traced south-eastward beyond the Rideau Lakes into the township of South Elmsley. The strike of these rocks varies from N. 50° E. to N. 10° E.; and this course would carry the rocks of the series directly across the Ottawa River into the area occupied by the Grenville series. The passage of the striped limestones into the white marbles of the Grenville area is frequently noticed and the trend of the strike of the rocks to the south of the Ottawa, where they are overlain by the Palæozoic formations of the Ottawa basin, appears to follow the same courses as seen in the several members exposed along the upper Ottawa, in that the course gradually changes from an easterly direction to a northerly one. In this respect the conclusions already stated as to the apparent relations and equivalency of the Grenville and Hastings series have been maintained by the most recent observations.

Corundum deposits.

"One of the most important facts arrived at in the work of the past season, is the extension of the corundum-bearing rocks eastward from the county of Hastings, where they were first discovered, into the county of Renfrew. The characters of the rocks comprising the belt were recognized as similar in both areas several years ago; and during the present season the extension of the mineral-bearing portion was traced from the original location in Hastings county eastward across the Madawaska, by Mr. Barlow and his assistant. The mineral has now been found as far east as the western portion of Lyndoch and Brudenell townships. Drift blocks of the nepheline were also found along the south side of Clear Lake in the township of Sebastopol, as also along the Opeongo road in that township, so that the mineral may now be looked for in the country to the north of, or in the vicinity of Clear Lake in the direction of Eganville. The nepheline-syenite was observed along the road which passes from the Opeongo road, east of this lake, to Eganville.

Nepheline-syenite.

Pyrrhotite of Dalhousie.

"Nothing further has yet been done in the utilization of the iron deposits of the district along the Kingston and Pembroke Railway. A deposit of pyrrhotite was examined in the township of Dalhousie near the road leading north from Watson's Corners towards Poland, on the east half of lot 18, range III., Dalhousie. The deposit appears to be extensive, occurring with a dark-gray fine-grained diorite which cuts a rusty gray gneiss. An assay of this ore made in the laboratory of the survey showed it to contain neither gold nor silver, but 0·165 per cent of nickel. In the vicinity, quartz veins also occur cutting the diorite, and these are reported to be gold-bearing.

"Prospecting work for gold has been prosecuted on the area to the south of Joe's Lake, noted in the Summary Report of last year. The shaft has since then been sunk to a reported depth of about seventy feet, and the ore contains mispickel, copper and some gold. No direct returns have yet been made to this office from this area, and the work so far done has apparently been development only. Ontario—*Cont.* Gold mine near Joe's Lake.

"In the Calciferous and Black River formations many quarries of excellent building stone have been opened and are in places somewhat extensively worked for local use. A new outlier of the Black River was discovered in the low tract to the west of Clear Lake, in the township of Sebastopol, and the Palæozoic formations seen around the south-west corner of the lake, comprising the Trenton and Utica, appear to extend westward and to underlie a depression which continues as far as the road from Brudenell Corners to Killaloe. From the character of the drift and soil on the road leading up the mountain from Castile post-office, it is very probable that the Utica outlier of the south side of Clear Lake also extends in this direction for several miles, overlying the Trenton and Black River formations. It is probably from this Black River outlier, west of Clear Lake, that the large masses observed along the north slope, as well as along the top of the mountain, on the Opeongo road, have been derived. The direction of the ice movement in this district was a few degrees west of south. Black River and Utica outliers of Sebastopol.

"It is still quite possible that gas or oil may be found in commercially important quantities in the Trenton rocks in this part of Canada, and in this connection it is worth noting, as already explained, that these rocks are well developed in the vicinity of Ottawa city and along the south side of the Ottawa River, over a very extensive area. In that part of this area where the Trenton is overlain by Utica and Lorraine shales, constituting an impermeable capping, the conditions would of course, be more favourable than elsewhere. Several trial borings in the area to the north of the Canada Atlantic Railway, have shown that gas can be found, although the quantity so far met with has been inconsiderable. The conditions and formations here observed are very similar to those which occur along the eastern side of the St. Lawrence below Montreal, where boring operations for gas have been carried on in a desolutory manner for some years, with fair indications of ultimate success.* The covering of the red Medina shales in the eastern St. Lawrence basin appears, however, to be much heavier than in the Ottawa basin. No results of value were obtained in an attempt Conditions for gas and oil near Ottawa. Bore hole at Ottawa

*See Summary Report, Geol. Surv. Can., 1887, p. 33 A.

Ontario—*Concluded.*

made some years ago in the vicinity of Ottawa, when a depth of 1005 feet was attained, but the faulted character of the rocks at the place chosen rendered it a particularly unsatisfactory one for the purpose.*

Peat bogs.

"The extent and importance of the deposits of peat in the vicinity of Ottawa have been pointed out in former reports, and in view of the new applications of this material, not only for moss litter but as a disinfecting agent, its value will doubtless soon be recognized. The facilities for the production of prepared peat in the vicinity of this city are very great, and the proximity of the peat deposits to the two principal lines of railway, which skirt the principal area on either side, would greatly facilitate its being placed on the market.

"The season's work extended from June 1st to October 7th."

QUEBEC.

(With adjacent parts of Ontario.)

Work by Mr. R. Chalmers.

Subsequent to the date of the last Summary Report, Mr. R. Chalmers was engaged for some time in writing a report on the surface geology of south-eastern Quebec, including the gold-bearing deposits of the 'Eastern Townships,' and in laying down the work on a map to accompany it. A paper on the gold-bearing rocks was also prepared by Mr. Chalmers, and read at the meeting of the Federated Canadian Mining Institute, held in Montreal in February, 1897, and another paper on The Pre-glacial Decay of Rocks in Eastern Canada, was completed, and presented at the Toronto meeting of the British Association for the Advancement of Science, in August. Both the above communications were based largely upon the observations made by Mr. Chalmers in the course of his field-work.

On the 31st of May, Mr. Chalmers left Ottawa to resume his work in the field, returning on the 6th of November. It will probably be possible during the present winter to complete a general report for publication, including the work of two seasons, giving a connected account of the gold-bearing deposits and their associated facts.

The following is a preliminary report by Mr. Chalmers on the work accomplished during the past summer :—

Field-work during the season of 1897.

"The field-work assigned me during the season just closed was, briefly, the further investigation of some points in connection with the gold-bearing alluviums of south-eastern Quebec, with observations on

*See Annual Report, Geol. Surv. Can., vol. V. (N.S.) p. 22 q.

the surface geology of the St. Lawrence Valley generally, including the Quebec—
glaciation, the Pleistocene changes of level, etc., the two last being
regarded as of sufficient importance to warrant more systematic and
detailed exploration and study than have hitherto been accorded them.
To carry out this investigation properly it seemed necessary to make
an examination of the whole St. Lawrence Valley from the Gulf to the
Great Lakes. A portion of this work has been accomplished, although,
owing to the extent and varied character of the region, not in as great
detail as seems desirable. Sufficient has been done, however, to show
in a general way at least, the character of the superficial deposits, and
throw some light on a number of the problems pertaining to their
origin. The great Pleistocene marine plain of the St. Lawrence—un-
equalled in North America as a field for the study of the deposits of
this age and their fossil contents—was explored and traced out to its
furthest limits in as many localities as time and circumstances would
permit. The Pleistocene shore-lines which border it and rise in ter-
races, three or more in number, were levelled by aneroid from the
seaboard as far west as Lake Ontario, and also, with some interrup-
tions, along the Ottawa and Mattawa valleys to Lake Nipissing. In
addition to these investigations some time was spent in endeavouring
to work out the relations of the marine and lacustrine deposits, al-
though with indifferent success. Discussion regarding these and other
matters will have to be reserved for a detailed report.

"The information obtained respecting gold mining and develop-
ment work connected therewith in the 'Eastern Townships,' during
the past season will first receive attention.

"*Gold Mining.*—Gold mining operations in the Chaudière Valley, Gold mining in the Chaudiere Valley.
and in the 'Eastern Townships' generally, have been somewhat restricted
during the past season, owing to causes unnecessary to relate. In the
first-mentioned district an advance has, however, been made and new
methods of operating the alluvial mines there have been inaugurated.
Two new companies have been formed—one called the Gilbert-Beauce
Mining Company, whose object is to re-open and work the gold mines
of the Gilbert River Valley; another, known as the Central Quebec
Gold Fields Company, to explore the gravels of Rivière du Loup Valley.
To carry on the work more advantageously in the Gilbert Valley, a
scheme of draining the mines by an open-cut or trench has been adopted,
the slope of the valley being sufficient to allow this to be done, an
opening of twenty or thirty feet in depth affording an outlet to the
drainage of that portion of the old pre-glacial channel above lot 15,
DeLery. At the time of my last visit (November 4) this open cut or
trench had been carried up stream to a point where it was from sixteen

Quebec—*Cont.*

to eighteen feet below the surface and tunnelling was in progress. The bottom of the pre-glacial river-channel, it was expected, would be reached at a depth of twenty feet, when sluicing for gold would commence. If this scheme is successful, the whole of the Gilbert River Valley above the point mentioned can be drained into this trench by gravitation.

Meule Creek.

"On Meule Creek, a branch of Mill River, Mr. Coupal has been washing for gold during the whole season, and is reported to be meeting with fair success.

Rivière du Loup.

"The Central Quebec Gold Fields Company, organized to work the auriferous gravels of Rivière du Loup, with Mr. Louis Gendreau, of Jersey Mills as manager, has sunk several shafts some two or three miles above the mouth of the river to a depth of sixty feet, reaching the pre-glacial gravels. Water came in so rapidly, however, that work had to be suspended until pumps were put down. Mr. Gendreau informs me that he found gold in the gravels near these shafts and nuggets of an ounce weight or more.

Dudswell.

"At Dudswell work has been in progress under the Rodrigue Mining Company during the whole season. In order to obtain a greater supply of water for sluicing it was found necessary to raise the dam formerly constructed near the source of Kingsley Brook. Further prospecting along this stream revealed the fact that gold exists in the gravels all along its channel nearly to the source. Gold has also been found in the bed of a small stream to the west of Willard's or Maynard's Brook. The facts at hand render it evident now that all the streams which flow off Dudswell Mountain contain gold in small quantities, and that the source of the precious metal is probably at or near the summit.

Sherbrooke.

"Reports having reached the office of the Geological Survey that gold was found in the rocks (Pre-Cambrian) of the Stoke Mountain range at Sherbrooke, an examination of the locality was made. Pits had been opened by blasting along the summit of a low ridge, and a number of the specimens obtained therefrom had been forwarded for assay to this office. In the autumn these were assayed for gold in the laboratory of the survey; but the results were negative.

"No further information is available respecting the Ditton gold mines. At Massawippi Lake nothing has been done during the past season.

Shore-lines of the St. Lawrence Valley.

"*Pleistocene Shore-lines of the St. Lawrence Valley.*—In the investigations regarding the height of the shore-lines, the St. Lawrence Valley was traversed from Orleans Island westward to Lake Ontario and to Lake Nipissing. Longitudinally, the valley may be said to rise from the estuary and gulf westward, its bottom preserving nearly

the same gradient throughout till it enters the Lake Ontario basin. The lateral valley of the Ottawa also exhibits the same contours from its confluence with the St. Lawrence to Chalk River, west of Pembroke. From this point upwards the latter ascends more rapidly; but the river itself flows in a comparatively deep and narrow valley on the north side to Mattawa and beyond. This higher, broken, or undulating and wider valley of the Ottawa continues along the Mattawa River also till it joins the Nipissing Lake basin. Quebec—*Cont.*

"Transversely, the St. Lawrence Valley also ascends from the river northward and southward to well-defined limits, though apparently forming a level plain. Along its margins the shore-lines or terraces extend, abutting against higher slopes, usually in a series of three or more, the lower distinct, the higher often interrupted. These, like the bottom of the St. Lawrence Valley itself, have an ascending gradient westward, *i.e.*, up the valley. The gradient of the shore-lines rises more rapidly than that of the bottom of the plain, however; but neither is exactly uniform, as local uplifts or deformations occur here and there, or what may be termed a 'bulging up' of the surface. These when near the border of the marine plain seem to have affected the shore-lines, some of the local deformations apparently extending beyond the limits of the valley and its marginal terraces. The upward grade of the shore-lines westward is greatest on the north side of the Ottawa, increasing towards the region immediately north of the Great Lakes, although, from the lower end of Orleans Island, or rather from Cap Tourmente on the north, and St. Thomas on the south, westward to Montreal Island, they are of nearly equal height on both sides of the valley. The general or regional upheaval, however, has been on the whole tolerably uniform. Contours of the valley.

"The method pursued in tracing out the Pleistocene shore-lines was to proceed from the known marine fossiliferous beds outwards, towards the margin of the plain, and to follow those which extend along the slopes and face the open valley. This work had been in progress during 1895 and 1896* on the south side of the St. Lawrence from Métis as far west as Richmond or Shefford, in Quebec, the elevation of the highest being about as follows:—At Gaspé, 230 feet, at Ste. Flavie, 345 feet, at Trois Pistoles, 375 feet, at St. Anselme, 555 feet, at Ste. Henedine, 750 feet, and in the vicinity of Danville and Richmond, 895 feet. To the west of this, the shore-lines seemed on first examination to decrease in height, but a more careful exploration during the past season showed that this supposed descent towards Lake Method of work. Heights of shore-lines on south side of St. Lawrence.

* Summary Report 1895, p. 96 A.; Summary Report 1896, pp. 81-82 A.

Quebec—*Cont.*

Champlain, if any, is but slight. North-west of the Pinnacle in Sutton Mountain, and within a mile or two of the International boundary, the elevation of the highest shore-line was found to be about 885 feet.

Beaches in northern New York.

"In the autumn a cursory examination of the evidences of the post-glacial uplift was made along the northern slope of the Adirondacks as far west as the Iroquois beach. This is a beach which has been traced along the south side of Lake Ontario by Mr. G. K. Gilbert, and found to ascend from a height of 385 feet at Lewiston, N.Y., to 730 feet near Watertown. Thence it was taken up by Dr. J. W. Spencer and followed eastward to Fine and beyond, at the latter place reaching a height of 972 feet.*

"Ascending from the marine plain at Valleyfield, in Quebec, to Malone, N.Y., the slope was found to rise with a comparatively even surface to an elevation of 1100 or 1200 feet, and the superficial materials occupying it to be fine, stratified sand with gravel in places, forming ancient deltas and spits, and stratified clay beneath, resting on boulder-clay, the whole apparently identical in character and composition with the deposits upon the low-lying tracts. The slope faces the great St. Lawrence valley, and the streams have cut narrow, steep-sided, trench-like water-ways into the deposits, showing that they have been eroded recently, that is since the uplift took place. Westward from Cherubusco and Chateauguay stations (Lake Champlain and Ogdensburg Railway), as far as Lake Ontario and Watertown, N.Y., similar deposits were seen to occupy the district, evidencing submergence and deposition of sediments under water with subsequent uplift.

Differential uplifts.

"The inference deducible from the observed facts along the northern base of the Adirondack Mountains, is that a greater uplift may have taken place there than to the north-east of the International boundary, and perhaps even greater than to the west. A similar local uplift above the normal gradient, though much less in range, occurs in the height of the shore-lines between Ste. Julie and Richmond in Quebec. But that the north-eastern part of the Iroquois beach, at least, as levelled by Gilbert and Spencer, belongs to the same system of shore-lines as that which occurs east of Lake Champlain valley there seems now little reason to doubt.

Relation to Warren beach.

"To the west of the Adirondack Mountains, however, the shore-line or beach which seems to approach nearest to the height of the uppermost marine shore-line of south-eastern Quebec, is that named the Warren

* Bull. Geol. Soc. Am., vol. III., pp. 488-495.

beach. It has been traced from Skaneateles Lake, west of Syracuse, along the southern side of Lake Ontario and Lake Erie, its elevation being from 860 to 890 feet.* Quebec—Cont.

" On the north side of the St. Lawrence and Ottawa rivers, the shore-lines were traced from Cap Tourmente or Ste. Anne de Beaupré, where the height is 540 feet, along the ascending grade westward to Lake Nipissing. The upper border of the marine sediments can, in many places, be followed more closely and to better advantage on this side of the St. Lawrence ; but it often runs in among the hills, forming a very irregular line. Generally, however, the border of the Pleistocene marine region is coterminous with that of the lake area of the Laurentides, the marine sediments having filled up all the smaller lake basins to the limit of submergence. North of Quebec city the highest shore-line is 560 feet; at the St. Maurice River, 670 feet ; at Lake Maskinongé, 865 feet; at St. Jérôme, about 900 feet; at Lachute, 975 feet, and at Kingsmere Mountain, north of the city of Ottawa, about 965 feet. Between these two last points, there seems to be a part of the country which has not been raised to the same extent as that to the east and to the west of it, as no shore-lines have been observed at a greater height than about 825 feet. Lower shore-lines well preserved, occur, however, at two or three levels, and it may be that the higher exists there also, but owing to the fact that the slopes are usually covered by forest detailed examination was impracticable. Shore-lines on the north side of the St. Lawrence and Ottawa rivers.

" On the north side of the Ottawa River, just above Allumette Island, sand and gravel terraces and benches were found at different levels up to a height of about 800 feet. The Ottawa for forty-five or fifty miles here, viz., from Allumette Rapids to Joachim Rapids is lake-like, and in places is said to be 200 feet deep or more. If the depth stated is correct then the bottom of the river in this part of its course lies as low as it does above the Chaudière Falls at the city of Ottawa, or lower. This fact, together with the general appearance of the valley at Calumet and Allumette islands, and from there to Joachim Rapids, would indicate that there may have been a sag or reduced uplift along this part of the river valley at least. Beyond Joachim Rapids the uplift seems to have been much greater as far as the divide north of Lake Nipissing. The Ottawa above Fort William, and the Mattawa also, run along the north side of the valley and have trenched their courses considerably below its level. Terraces and benches are therefore, rare on the north bank. On the south side, however, we find heavy beds of fine stratified sand underlain by stratified clay, the Sand deposits.

* Bull. Geol. Soc. Am., vol. VIII, pp. 269-286. Geol. Magazine, December, 1897. Science, vol. XI, 1888.

Quebec—*Cont.*

whole resting on boulder-clay, which, in places, protrudes in hummocks through the overlying series. Deposits of this kind are abundant from Madawaska River westward, and on the lower grounds contain Pleistocene marine fossils. They are especially noticeable along the Ottawa, Arnprior and Parry Sound Railway, between Killaloe and Barry's Bay, constituting sand-hills rising from 1000 to 1100 feet or more above sea-level. Denuded sand beds of the same series occur to the south of Deux Rivières, Canadian Pacific Railway, where they reach about the same elevation. The latter have been described by Mr. F. B. Taylor* but appear to be Saxicava sand beds, probably marking the upper limit of the Pleistocene submergence in this part of the Ottawa Valley.

Stratified deposits at Mattawa.

"At Mattawa, a fine, blue, stratified clay or silty clay, slightly calcareous, was found in sinking wells in the terrace to the west of the Canadian Pacific railway station, between the track and the river. The owner informed me that in one of the wells he passed through the following beds:—(1) Four or five feet of gravel and sand, and (2) sixteen feet of the clay or silt above described, without reaching its bottom. Concluding that he was not likely to find water there, he sank another well nearer the railway track and hill-side, passing through (1) gravel and sand, five or six feet; (2) clay, the same as described, about six feet; (3) sand and gravel, reaching water.

"These deposits show that at the close of the ice age, or during the Leda clay period, if the upper gravels and sands correspond with the Saxicava sands, quiet, deep waters existed in the basin where the Mattawa now joins the Ottawa River.

Beaches at North Bay.

"High-level beaches and terraces (1100 to 1200 feet), described by Mr. F. B. Taylor,† occur north of North Bay. Whether these beaches are marine, as first supposed by him, or not, is, for the present, left an open question. But the great sand and silt beds spread over the region up to a height even greater than that of the beaches, and to which the name of 'Algoma Sands' was applied by the early Canadian geologists, demand further investigation than has yet been given them.‡

Boulders of the Ottawa valley.

"*Boulders.*—The Ottawa valley is remarkable for the great quantities of boulders, as well as for the deposits of sand and gravel, which it contains. Some curious accumulations of these boulders were noted, *e.g.* at Rigaud Mountain,‖ at Hull opposite the city of Ottawa, and at Mattawa

* American Geologist, vol. XVIII., p. 114.

† Bull. Geol. Soc. Am., vol. V., 1893. Am. Geologist, vols. XIV. and XVIII., 1894 and 1896. ‡ Geology of Canada, 1863, pp. 907-908.

‖ Geology of Canada, 1863, p. 896.

and other places, which evince the great denudation to which the materials of this valley have been subjected during, and at the close, of the Saxicava sand period, as the land rose from beneath the Pleistocene sea, as well as in the interval between that period and the present. Many of them have, doubtless, been transported by floating ice during the submergence of the region about the close of the glacial period and afterwards. Those at Rigaud Mountain seem to have accumulated in their present situation on the shore of the river from the sifting out of the finer materials at the time that the Ottawa debouched into the sea, when it was at or near this elevation. At Hull, the boulders are partly imbedded in a deposit of sand and gravel, probably the equivalent of the Saxicava sand, as beneath it, Leda clay, containing fragments of marine shells, was found by Mr. W. J. Wilson, of this Survey, and the writer. The Leda clay rests upon boulder-clay. At Mattawa the succession is the same, but no fossils have yet been detected in the clays there. Quebec—*Cont.*

"The boulders of the Ottawa Valley seem, therefore, to have been brought to the surface by the denudation of the beds of which they formed a part, as the valley emerged from beneath the Pleistocene sea, and these beds became subjected to erosion by the Ottawa River. The upper portion of the series of deposits now found in the valley may be partly marine and partly fluviatile. Whether the upper Great Lakes once found outlet by the Mattawa-Ottawa Valley, is a question which cannot be entered into here. Origin of the boulder beds.

"Along the Canadian Pacific Railway to the east of Toronto, viz., at Myrtle, Burketon and Pontypool, sand and gravel plains, consisting of water-laid materials, occur at a height of 1100 or 1200 feet. The sands are fine and clean, and form terraces filling in the inequalities of the boulder-clay surface beneath. No barrier exists between these plains and Lake Ontario. Terraces and plains near Toronto.

"*Waterfalls.*—A remarkable feature of the St. Lawrence Valley is the number and beauty of the waterfalls in the tributary rivers, both on the north and south sides. These waterfalls appear, in many instances, to have been caused by dislocations of the rocks due to faulting, or orogenic, or regional differential uplifts. Examples of dislocations of this kind can be seen in the valleys of the Chaudière and St. Francis rivers in south-eastern Quebec, also on the north side of the St. Lawrence in the St. Maurice Valley at Grand Mère, and along other rivers. In very few instances could the origin of these waterfalls be traced to diversions of the rivers from in-filling of the pre-glacial channels by boulder-clay and sediments. None of the tributaries of the Probable origin of waterfalls.

Quebec—*Cont.*

St. Lawrence, rising in or traversing the pre-Cambrian rocks on either side of the valley, have succeeded in reducing their channels to the base-level of erosion since the last differential upheaval of the region.

General upheaval of the region.

"*Extent of upheaval.*—The foregoing facts indicate that the general upheaval of the St. Lawrence basin in the Pleistocene period was differential throughout, increasing to the westward; but that portions of the region were besides raised higher than others locally, the uplift being somewhat unequal. The greatest upheaval seems to have been immediately to the north-east and north of the Great Lakes, and the maximum heights there will probably be found to be represented by a number of axes, or uplifted belts, not always trending in the same direction, but conforming more or less to the longer axes of these great bodies of water. It is probable that these uplifted areas, too, almost necessarily implying correlative subsidence in the same region, have a close relation to the lake-basins as regards their origin. Upward and downward complimentary movements of greater or less amount and complexity, with faulting and displacements, doubtless occurred. And it seems, therefore, not unreasonable to assume that it was at this stage of the Pleistocene that the lake-basins referred to attained their present form and dimensions and sank so far below the level of the surrounding country. The period at which this great upheaval of the region took place, appears to have been that of the deposition of the Saxicava sands, or rather during the latter part of that period. Had the Great Lakes existed in their present form and at their present depth from an earlier date, it is difficult to see why the deposition of boulder-clay, from glacial action, and subsequent sedimentation, when the thick beds of clay, sand and gravel found in the region were laid down, should not have partially filled in and raised the deep-lying portions of their basins to a higher level than they now have.

Agreement between ice-movements and post-glacial attitude of the region.

"Before leaving this subject, it may be remarked that the foregoing view respecting the changes of level to the north-east of the Great Lakes is in agreement with the facts regarding ice-movements in this region during the latter part of the glacial period.

Leda clay and Saxicava sand.

"Some time was spent in examining the Leda clay and Saxicava sand along the canals now being constructed and deepened, between Soulanges and Cardinal, on the north side of the St. Lawrence River, and the deposits from Brockville to Kingston were also critically examined. The excavations along the Trent Valley canal were visited, also the upper part of the Rideau canal.

"Within the Lake Ontario basin the clays were found to contain great numbers of limestone nodules or concretions, but no marine fossils have yet been detected in them. Quebec—Cont.

"*Glacial Striation*.—The glaciation of the St. Lawrence Valley was studied in considerable detail, and a large body of facts relating to that subject was collected. Previous observations on the south side of the St. Lawrence River had shown that three systems of striation by land ice were produced upon that slope during the glacial period, and one in the bottom of the valley by floating ice. *First*, a northerly ice-flow from the axial divide of the Notre Dame and Green Mountain range down to the bottom of the valley. East of the Chaudière River this ice flowed to the east of north, west of St. Francis River west of north.* *Second*, following this was an invasion of that region by the earlier Laurentide glacier, which spread over the slope up to an elevation of 1800 or 2000 feet, distributing Laurentian boulders upon it. *Third*, on the retirement of the Laurentide ice, local sheets moved down the slopes in different directions, as they were influenced by the contours. *Fourth*, floating ice striæ, produced by ice moving generally up the valley. These are, of course, found only within the limits of the valley and below the highest Pleistocene shore-lines. Striation. On south side of the St. Lawrence.

"On the north side of the St. Lawrence Valley, and on the Laurentian plateau, the oldest striation seems to have been that produced by the earlier Laurentide glacier referred to, the striæ of which were observed everywhere from the summit of the hills to the bottom of the valley. In many parts of the region this system is very much defaced—in some places entirely obliterated—from weathering and the action of later ice. Its general course is from S. 10° W. to S. 15° E.; but it often veers from S. 25° W. to S. 45° E., and has still more divergent courses in river-valleys. This system corresponds, for the most part, with that observed on the northern slope of the first range of mountains on the south side of the St. Lawrence River, (sometimes called the Sutton Mountain range,) that attributed to the earlier Laurentide glacier. The ice producing it did not cross the St. Lawrence River below the city of Quebec, but from the portion which occupied the St. Lawrence Valley tongues or lobes diverged eastward in different places—one flowing down the valley of St. Charles River and along the depression between Orleans Island and the north bank of the St. Lawrence, overriding the eastern portion of the island diagonally, but leaving the western and southern part unglaciated. Another swung round out of the Chaudière Valley among the ridges on the west side of that river and On north side of the St. Lawrence. Earlier Laurentide glacier.

* All these courses of striæ are referred to the true meridian.

Quebec—*Cont.*

flowed across the district drained by the Etchemin River, while a third crossed the divide above the head-waters of the north-west branch of the St. John, moving eastwardly towards the upper valley of that river. Other lobes or tongues entered New England by the valleys and passes along the International boundary, especially by Norton Mills, Hall Stream, Memphremagog Lake and Lake Champlain. The striæ of this older glacier are distinct in the latter basin, and have been also observed in the vicinity of Ogdensburg and other places in northern New York. In the Lake Ontario basin, the movements of this glacier, although in many places effaced, have been traced as far west as my examinations extend, *viz.*, to Tweed station and Peterborough, and in the Ottawa Valley to Lake Nipissing. The striation of this system does not seem to be as heavy as that produced by the later ice.

Later Laurentide glacier.

"*Later Laurentide Glacier.*—Succeeding this system of ice movements there was a second, which has left the most distinct striation met with in the region, especially on the north side of the St. Lawrence River and the Great Lakes. The general course of this ice-flow was between S. 30° W. and S. 65° W., and the striæ produced by it have been found superposed on those of the earlier Laurentide glacier in a number of places. From the fact that this system of striation occurs over a large area and with such a persistent trend, it would seem as if it must have been produced by a separate body of ice. It has been found as far east as the hilly country at Bonhomme Mountain, west of Quebec city, and along the St. Lawrence and Lake Ontario valleys as far as my examination extended, and was also traced throughout the Ottawa and Mattawa valleys to lake Nipissing. From the observations of others, it is known to be the dominant system along the north and north-east sides of the Great Lakes. Is this south-west striation due to land or floating ice? As seen in the St. Lawrence Valley from Montreal to Kingston, it certainly seems to have been produced by the latter agent, as it follows the course of the valley for the most part, and the exposures exhibiting the striæ are often scratched as if by means of a body touching the more prominent parts only, and not by one moving slowly over and accommodating itself to all the inequalities of the rock-surface On the other hand, the height at which the striæ are sometimes found above sea-level, especially west of Quebec city, along the Upper Ottawa and in the region of the Great Lakes, together with their persistent south-west trend over a large area, especially west of Montreal and St. Jérôme, seem opposed to this view. Without coming to any conclusion at present in regard to this system of striation, I lean to the opinion that it has been produced by both agencies—in the St. Lawrence Valley

proper, by floating ice; on the higher grounds, by land ice—the region to the south-west, as far as the Great Lakes, having apparently been lower relatively to the Laurentian area to the north at that stage of the Pleistocene than at present. Whether at any time during the interval between the maxima of these two glacier systems (assuming the last to have been partly land ice), there was a withdrawal of glacial conditions in Eastern Canada and an interglacial epoch, or whether the second really followed the first consecutively, the south-westerly flow having been caused by a subsidence of the region north of the Great Lakes after the first glaciation, are questions requiring further detailed work to enable me to decide. Provisionally, however, the ice producing this system will be referred to as the second or later Laurentide glacier, as it seems to have had its source also in the highlands to the north of the St. Lawrence. Quebec—*Cont.*

"Striæ produced, to all appearance, by this second system, were noted on the south side of the St. Lawrence Valley at Ste. Julie, Arthabaska, Danville, Shefford and Brome mountains, Sweetsburg and Pigeon Hill; also in numerous places between the Upper St. Lawrence and the base of the Adirondack Mountains.

"There seems, however, to be another set of striæ in the St. Lawrence Valley, which leaves no doubt as to its having been produced by floating ice at the close of the glacial period when the region stood at a lower level. This may be a part of the second system or later Laurentide striation described above, although it was observed to cross those of the latter, as well as the striæ of the earlier system in some places. It is evidently due to the very latest ice which existed in the region, and is a continuation westward of those striæ along the Lower St. Lawrence described in reports and publications by Sir J. Wm. Dawson and the writer, the production of which is attributed to floating ice. The striæ of this system were observed at Lévis, Mount Royal (Montreal), St. Jérôme, Soulanges Canal, Valleyfield, Ogdensburg, N.Y., the Thousand Islands at Kingston, Perth and other places. The course is generally between south-west and west; but is often very irregular. Floating ice.

"Many other irregular courses of striæ were noted, some doubtless produced by land ice, others by floating ice. They belong, apparently for the most part, to the closing stage of the glacial period.

"The stossing on the north-east brow of Mount Royal, Montreal, described by Sir J. Wm. Dawson* was found to be a common feature on all the isolated trap hills of the St. Lawrence Valley, Montarville or Crag-and-tail form of trap hills in St. Lawrence Valley.

* The Canadian Ice Age, p. 43.

Quebec—*Cont.*

Belœil Mountain, Mount St. Hilaire, Rougemont, Yamaska, and Johnson mountains, and Shefford and Brome mountains are all more or less abrupt and stossed on the north-east sides and have a crag-and-tail form on the south-west, with terraces and shore-lines. On the south-west side of Shefford Mountain ancient dunes and spits occur at a height of 865 to 883 feet. It is evident that there must have been strong currents flowing up the St. Lawrence Valley during the period of submergence, carrying drift ice which impinged heavily against these hills.

Soils of the region.

"*Agricultural character.*—The soils of the region everywhere bear an intimate relation to the underlying or subjacent rocks. In their present condition these soils are the result of a long series of degradation processes,—subaerial, glacial, marine, lacustrine and fluviatile—acting upon the rocks of the country, and the clays, sands, gravels, boulders, etc., entering into their composition, have often been transported considerable distances from their parent sources. An assortment of the materials constituting the soils has taken place in many districts by the agencies mentioned, the result of which has been to give those of some tracts a greater degree of fertility than pertains to others, nevertheless, their character in this respect is largely dependent upon the nature of the rocks from which they have been originally derived. Upon the great marine plain of the St. Lawrence Valley and the lower grounds of the region of the Great Lakes, where the superficial deposits are, perhaps more closely related to the limestones and slates of Palæozoic age underlying them, some of the best lands in Canada for general agricultural purposes are to be found. The principal portions of these in Quebec and Ontario are cleared and have been under cultivation for many years. Although more thickly settled than most other parts of the country, they, nevertheless, seem capable of supporting a larger agricultural population than at present subsists upon them."

HUDSON STRAIT.

Explorations in Hudson Strait.

As already explained, it was decided to take advantage of the despatch of the steamer *Diana* to Hudson Strait and Bay by the Department of Marine and Fisheries, to geologically examine and explore as much as possible of both shores of Hudson Strait. This work was entrusted to Dr. R. Bell and Mr. A. P. Low, the north coast being assigned to the first named gentleman. Dr. Bell being in Europe on leave of absence from February 1st to May 1st, the duty of looking

after the building of two small yachts and other preparations for this work devolved upon Mr. Low, as elsewhere noted. Hudson Strait—*Cont.*

Dr. Bell reports as follows upon the exploration carried out by him during the summer :— Work by Dr. R. Bell.

"On the 19th of May I left Ottawa and arrived the next day at Halifax, from which place it had been arranged that the sealing steamer *Diana* was to convey Mr. A. P. Low and myself with our parties to Hudson Strait and to bring us back as far as St. John's, Newfoundland, at the close of the season which we might find suitable for field-work. The small yachts built for the work had already arrived at the wharf of the Department of Marine and Fisheries in Halifax. I engaged four men as sailors, one of whom was to be responsible for sailing the yacht and another was to act as cook in addition to his other duties. I had no assistant. The yachts, together with a small jolly-boat for each, were hoisted upon the deck of the *Diana* and we sailed from Halifax on the 3rd of June.

"Passing by the west coast of Newfoundland and through the Strait of Belle Isle, we met with considerable delay in the field-ice off the coast of Labrador, nearly abreast of Hamilton Inlet. On our entering Hudson Strait on the 22nd of June we found it entirely clear of ice. On proceeding up the northern side of the strait we were, however, again detained by ice close to Big Island, but the *Diana* completed her first run into Hudson Bay on the 12th of July. Outward voyage.

"It had been intended that I should explore as much as possible of the northern shore from the vicinity of King's Cape eastward, and that the *Diana* should pick me up to return home at some place of which the position had been already determined, because in the absence of any chart of the coast this precaution was necessary to avoid any mistake about the meeting place. To carry out this programme, it was decided that I should be landed from the ship near King's Cape, which is at the junction of the north shore of Hudson strait with the east side of Fox Basin, whence I was to work eastward to Ashe Inlet on Big Island. But on attempting to make the land in this vicinity on the 13th of July, the floe-ice was found to be moving about so rapidly, in consequence of currents, that the attempt was abandoned and we proceeded to King George's Sound on the south side, where Mr. Low and his party were placed on board their yacht. To explore the north shore.

"The best course which now remained for me was to begin work at Ashe Inlet and to proceed as far as possible to the north-westward, returning to the same place to meet the *Diana* at a date to be agreed upon, which was fixed for the 10th of September. Accordingly the

Hudson Strait—*Cont.*

Land at Ashe Inlet.

Diana brought me to Ashe Inlet on the 19th July, and my yacht was launched there on the 20th. The following day the wind blew too strongly for us to get out of the inlet and the time was spent in fixing its position relatively to other geographical features of Big Island, as a commencement of a track-survey of the coast. On the 22nd we made a start to windward, intending to pass up on the outside of Big Island. Before leaving the inlet, early in the morning, we fortunately found an Eskimo who had some knowledge of the English language and was acquainted with the south coast and the southern interior of Baffin Land, and I engaged him to go with us as guide and interpreter for the whole of our journey. He had slept near our anchorage and had nothing with him but a gun.

Eskimo guide.

"The hull of our yacht was made of one inch white-pine boards. She was, therefore incapable of contending with the ice, and our safety lay in avoiding it altogether. We had not gone many miles up the outer coast of Big Island, when we met an ice-pack laying in our course as far ahead as the eye could reach. Our Eskimo guide now advised us to try the passage between the island and the mainland, and accordingly we turned back and attempted to get round the south-eastern extremity, but on account of the wind failing us altogether we were able to make only about six miles to the south-eastward of Ashe Inlet. Here we discovered a much better harbour than Ashe Inlet, and I named it after Reeves, our sailing master. It is about a quarter of a mile in diameter, has two deep narrow entrances, a good bottom for holding and a depth of from five to fourteen fathoms at low water. The next day we rounded the south-eastern extremity of Big Island, which is about thirty miles long, but owing to a strong north-west wind we were obliged to anchor for the night among some small islands lying north-east of this point. It was fortunate that we took this route, as we found the family and relatives of our guide camped on the lower end of the island, and he was now able to make arrangements with them for his absence till September. He had not previously told us anything about his people.

Take inside passage.

Reeves Harbour.

"At this season of the year there was continuous daylight in Hudson Strait during the whole twenty-four hours, and we sailed at two o'clock the following morning (24th) and made a track-survey of the inner side of Big Island as well as of a part of the main shore opposite. Two good harbours were discovered on this side of the island towards the northern end, and two more on the coast of the mainland in this vicinity.

Four harbours discovered.

"In proceeding north-westward up the coast from Big Island the shore began to be fringed with innumerable rocky islands thickly

clustered together. The breadth of the belt or archipelago increased as we advanced, until we approached the long inlet or fiord called Tcharkbach, where our exploration ended. Here the islands became less numerous. The maximum breadth of the archipelago is about midway between Big Island and this inlet, and is about twenty-five miles. The islands vary in size from ten miles in length down to mere rocks. The spaces between the large ones are filled up with smaller islands having a great variety of dimensions and forms. As a rule, the largest and highest islands lie towards the mainland, while the outermost ones are smaller and lower. In sailing among these islands it was only when near the outer edge that we could see a clear horizon to the southward.

Hudson Strait—*Cont.*

Archipelago, 25 miles wide.

"The whole coast is rugged and for the most part mountainous. The innermost islands interlock with the bays and points of the mainland in such a manner that it is impossible to know without the aid of a guide whether one has reached the main shore or not. On ascending the higher hills or mountains of the outer ranges on the mainland, long channels of the sea can be seen running inland in different directions among the hills, which so closely resemble those among the adjacent large mountainous islands that only a person already acquainted with the geography could trace the coast-line of the mainland. The larger islands are equally hilly and rugged and the channels between them are usually not wide. Viewed from the top of a distant hill, so that the intervening channels cannot be seen, the eye fails to detect any difference between the general appearance of the islands and the mainland. The conditions may be best described if we imagine a rough mountainous country, rising as a whole gradually to the northward, to have been half submerged. The outer islands, which are also the smallest and most scattered, represent the more completely sunken hills, while as we proceed inward the progressingly larger and larger ones represent the less and less submerged areas and ranges, until, at last, we find only narrow channels of the sea running into the solid land. Besides these narrow and sometimes tortuous channels, numerous wide and tolerably straight fiords run inland. These generally have high hills on either side of them.

Mountainous coast.

Many channels.

The islands.

"On leaving Big Island, it soon became evident that it would be impossible to make an instrumental survey of any considerable part of such a coast as this in the limited time that would be at my disposal, and that this time would be most advantageously spent in making the best track-survey possible under the circumstances, especially as it was necessary to devote a portion of the time to geological observation. I therefore determined to keep an accurate record of all the courses we

Character of survey.

Hudson Strait—*Cont.*

followed among the islands or up the fiords, under the guidance of our Eskimo pilot, and also as good an estimate as possible of the length of each course, plotting them on diagrams as we went along. On these diagrams the relative positions of all the surrounding points, bays, islands, hills, etc., were also marked by the aid of many cross-bearings and estimated distances. Observations for the latitude and the variation of the compass were taken every day and I also obtained numerous sights for longitude.

Astronomical observations.

Good harbours.

"The coast abounded in good harbours, and careful sketch-plans with soundings were made of all those that we visited. The heights of numerous hills, which I climbed, were ascertained by barometer. A sufficient number of photographs for illustration were obtained; collections of rock specimens and of plants and insects were made and notes were recorded on all subjects that might be of interest in regard to this little-known region, whether from personal observations or or from information supplied by the natives.

Observations and collections.

Weather.

"From the time of our leaving Ashe Inlet, on the 21st of July, until we returned to it again on the 1st of September, the weather was mostly fine and bright, although cold upon the water, but we suffered much delay from calms. The main obstacle to our progress, however, was the field-ice, which appeared to have come into the strait from the eastward during the winter or early spring, and to have insinuated itself into every channel and fiord. When not tightly packed, it was constantly moving hither and thither under the influence of the rapid and changeful currents generated by the high tides of the strait.

Calms and field-ice.

Tides of Hudson Strait.

"The height of the mean tide at Big Island was ascertained by Mr. Ashe to be 30 feet, and the time of high-water at full and new moon to be 9h. 32m. Further west we could not determine the time of high or low water, which was irregular on account, apparently, of the effect of the reflux from Hudson Bay upon the in-coming or out-going tide of the strait; while the local conditions, such as the directions, divisions, depths and widths of the channels still further complicated the problem. In trying to navigate our frail yacht in the open spaces, the heavy ice would set down upon us or run together and threaten to crush our little vessel in the most unexpected manner. Our undertaking was, therefore, constantly accompanied by great danger and anxiety, and it was only by constant vigilance night and day that we were fortunate enough to escape any harm during the entire trip.

Amadjuak Fiord.

"When we had reached a point a little beyond the entrance of Amadjuak Fiord, we found the ice closely packed among the islands all around us. But the next morning the wind or tide had opened a lane

up the fiord itself and I explored it to its extremity. The ice outside still remained packed, and in order to utilize the time most profitably, I determined to make an exploration into the interior of the country. Two seamen were left in charge of the yacht with instructions to make lines of soundings in the fiord, and with the other two and the Eskimo guide, I started on a journey northward towards Amadjuak Lake, one of the bays of which was supposed to be at no great distance from this part of the coast. It proved, however, to be upwards of fifty miles inland. This journey occupied seven days, and the results will be described further on. When we returned to the head of the fiord, the sea was found to be open and we immediately set sail to continue the westward exploration of the coast.

Hudson Strait—*Cont.*

Journey inland.

"On the 22nd of August we had reached Tcharkbach Inlet, and in case of being detained by calms or head winds on our return journey, I judged it prudent to turn back from this place in order to be sure of being able to keep our appointment to meet the *Diana* at Ashe Inlet on the 10th of September. In returning I followed a course which lay outside of that of the westward journey, so as to make a second line of track-survey among the island belt and of the outside of Big Island. We had good weather and anchored again in Ashe Inlet on the 1st of September. In order to fill up the time with advantage till the 10th, I ran across to the main north shore opposite the island and explored it topographically and geologically nearly to Icy Cove. I then returned to Asle Inlet before the 10th, but owing to stormy weather, the *Diana* was not able to enter until the 12th. It only required two or three hours to transfer our outfit and surplus stores to the steamer and to dismantle the yacht and make her ready to tow across the strait to Fort Chimo, where I proposed to leave her, as it was not considered advisable to risk taking her to St. John's, Newfoundland, on the deck of the *Diana*. On the following morning we reached the northern extremity of Akpatok Island in Ungava Bay, and after coasting along the eastern side of the island we anchored close to the shore about half-way to the southern extremity. This afforded me an opportunity of landing in order to take photographs, examine the rocks, collect fossils and ascertain the heights of some of the cliffs and hills by the barometer. This was, so far as I am aware, the first landing of a white man upon this island. Its position and general form and direction are erroneously represented upon the latest charts. The hypothetical 'Green Island' of the charts corresponds with the northern part of Akpatok Island as determined by the observations of Captain Whiteley, and it is probable that this, seen from the northward, was mistaken for a different island.

Turn back from Tcharkbach Inlet.

Rejoin the *Diana*.

Land on Akpatok Island.

Hudson Strait—*Cont.*
Fort Chimo.

"At Fort Chimo, Mr. Low and his party were taken on board and the *Diana* sailed for St. John's on the 17th and reached that place on the 22nd of September. Leaving her at this port we reached Halifax by steamer, and there I paid off my men, disposed of some surplus provisions and reached Ottawa on the 11th of October.

Geology.

"*Geology.*—The rocks of the whole northern shore of Hudson Strait from Big Island and the coast of the mainland opposite as far north-west as Tcharkbach Fiord, belong to the Laurentian system. They consist of a variety of gneisses associated with numerous bands of crystalline limestones and light-coloured felspar rock, often of great thickness. These limestone and felspar bands are generally associated with gneissoid schists, full of graphite, fissile when weathered and stained brown, yellow and red by the decomposition of disseminated iron-pyrites. Small garnets are common in most of the gneisses. The strike is usually straight, with uniform dip, and it is parallel to the general trend of the coast, which is about north-west (astronomically.) The prevailing dip is to the north-east at angles which approximate to 45°, but sometimes the inclination is nearly vertical and occasionally it becomes almost horizontal.

Crystalline limestones and felspar rocks.

"The most notable feature of these rocks is the abundance and persistence of the crystalline limestone and felspar bands and their associated rocks. On this account and for other reasons the series may be considered as belonging to the higher part of the Laurentian system. Whatever theories may be suggested to account for the origin of similar crystalline limestones in other Laurentian districts, there is little doubt that in this region they are bedded or stratified rocks. On the mainland, nearly opposite the Spicer Islands, there is one band of these rocks which must be about 5000 feet thick, and other bands nearly as wide were observed on other parts of the coast.

Origin of crystalline limestones.

Extent of crystalline limestones.

"The south-western border of the limestone-bearing belt, appears to correspond with a north-westerly line passing through Big Island, the outer side of which shows no limestone. Between this island and Amadjuak Fiord, the light-coloured limestones are seen in the bare mountains in great abundance as far inland as the eye can reach, and in this section of Baffin Land the limstone-bearing belt may have a width of forty miles or more. On my journey northward from the head of the Amadjuak Fiord, which is at a distance of about twelve miles inside of the general line of the mainland coast, the limestones become scarce after passing over the first ten miles, and in the second half of this traverse they are not seen at all.

"These limestones are generally coarsely crystalline and they usually vary in colour from gray or light-gray to pure white, but sometimes they are reddish or flesh- and salmon-coloured. The Red Islands near the Spicer group are formed of coarsely crystalline limestone of this colour. The limestone and felspar are often mingled in the same band, and the two rocks have generally a rude parallelism to one another in a variety of irregular fashions. Hudson Strait Coast. The Red Islands.

"In addition to the gneiss, gneissic schists and limestone-felspar bands, I observed a few bands of quartz-rocks, some veins or dykes and small patches of coarse granite, an occasional bed of black hornblende-rock, pyroxenite on an island off Amadjuak Fiord. At the extremity of Fair Ness, some of the islets and points consist of a black-looking rock, of which the weathered surface resembles the form of a cauliflower on a great scale. The rough water and rushing tide prevented us from landing to examine this rock. Various rocks.

"The economic minerals of the rocks above described, consist of the felspars and limestones, together with mica and graphite. The Eskimos of Big Island had shown me, both last summer and on previous visits, good specimens of the last two minerals, and had stated that they had brought them from one place on the main north shore opposite the island, but when I proposed to visit the locality last September, they said the owners of the discovery were absent, and nothing would induce them to point out the occurrence. A diligent search by myself and men in the vicinity indicated failed to reveal either mineral. Some specimens of vein-stones were collected at different places, to be assayed for gold. Economic minerals.

"In the valleys on the way from Amadjuak Fiord to Lake Mingo fragments of unaltered gray limestone were observed, sparingly at first, but becoming more numerous as we went inland, and towards the lake they began to be noticed upon the hills as well. On a mountain near Lake Mingo, one of these fragments contained two specimens of a species of *Pentamerus*, which is closely allied to *P. decusatus*, if not identical with that form. These limestone fragments are like the rock of Mansfield Island, which, from the fossils I collected there in 1884, appears to be of the age of the Niagara formation. Fragments fossiliferous limestone.

"The country between Lakes Mingo and Amadjuak, and on the south and east sides of the latter, is low and generally level, but by the aid of a powerful binocular, in looking from a height I could detect hummocks of the crystalline rocks rising here and there all over these plains.

Hudson Strait—*Cont.*

Levels of lakes.

"Our barometric observations seem to show that Lake Mingo may be only about 300 feet above the sea, and from my guide's description of the short river which discharges it into Amadjuak, I should judge that the latter is only slightly lower. Mount Mingo, overlooking both lakes, rises to a height of 666 feet above the lake of the same name. Fragments of the unaltered gray limestone are abundant on the shores of this lake, and from the description given by my Eskimo guide, who had walked over the ground in summer, I would judge that the Niagara limestone may occur in its north-western part, and also on the south and west sides of Lake Nettilling to the northward of it, this name meaning 'flat-floor.'

Flat country.

Trenton limestone.

"I have found fragments of limestone containing Trenton or Galena formation fossils on the floe-ice towards the north side of Hudson Strait (see report for 1884), and it is stated that Messrs. Power and Shaw, during the past summer, examined the Silurian limestones at the head of Frobisher Bay which had been previously discovered by Hall. In this connection I may mention that small icebergs are known to drift from this bay up the north side of Hudson Strait as far as I went, and some of the floe-ice which accompanies them probably comes out of the same bay.

Rocks of Akpatok Island.

"As stated above, the *Diana* coasted along the eastern side of Akpatok Island, Ungava Bay, when on our way from Ashe Inlet to Fort Chimo. The portion of the island which I saw (from the northern end to the middle of the east side) consists of unaltered gray limestone in horizontal beds, and it presents a perpendicular wall 400 or 500 feet high all along. This sea-wall is clean-cut and the beds appear thick and solid, but wherever their edges have been long exposed to the weather or in the hill-sides and ravines of the interior, they split up into thinner layers. Some fragments observed in one place had the appearance of lithographic stone.

"I was enabled to land opposite the place where the *Diana* anchored, as already mentioned, about the middle of the eastern side and I improved the opportunity to collect fossils which, however, were not abundant. Those obtained indicate the Hudson River formation. Just above the landing place, I ascertained, by the barometer, the height of a hill to be 700 feet, and I estimated others to the southward and a short distance inland to be 200 feet higher, so that this formation must here have a thickness of 900 feet above the sea-level, and there is possibly a great additional thickness of Cambro-Silurian rocks beneath the sea-level.

Hudson River formation.

Glaciation.

"On the north side of Hudson Strait, the evidence of glacial action is everywhere conspicuous, and, except on the higher levels, the effects

of former submergence may be observed in many places. The glacial striæ are best seen in the valleys, but they are also common on the hill-tops. The general course of the ice-movement has been from the interior towards the strait, with a tendency to turn eastward on approaching the latter. Ancient shore-lines were noted at various levels up to about 600 feet above the sea. Shells of a few common species of marine mollusks occur in stony clays in several places, the highest noted being about 200 feet above sea-level. Hudson Strait—*Cont.* Ancient shore-lines.

"The effects of the action of land ice in former times, may be observed in the form of moraines of different kinds, and heaps and even small hills of boulders without any admixture of fine material, besides the boulders and broken fragments of rocks which are scattered everywhere over the valleys and hills or perched on their sides. Ridges and large mounds of coarse gravel, taking a variety of forms, were met with in some of the valleys between the strait and Amadjuak Lake. Occasional deposits of coarse sand were also seen in the bottoms or on the sides of valleys in this part of the country. Nothing that could be called soil was observed in any part of the region examined. Moraines and boulders.

"I collected about 200 trimmed rock-specimens, about 90 fossils on Akpatok Island, 460 specimens, (embracing upwards of 100 species) of land plants, already determined by Professor Macoun, 60 specimens of Lepidoptera which have been submitted to Dr. James Fletcher, a fine walrus skull and some other bones, besides geological specimens in addition to the above, and a few objects of ethnological interest. A considerable number of photographs were also taken to illustrate physical and geological features of the country examined." Various collections.

During the early part of the past winter, Mr. Low was engaged in mapping the surveys made by him during the previous summer, in order that they might be added to the north-west sheet of the Labrador map. Later, he was occupied in writing a report on the explorations of 1896 in the northern part of the Labrador Peninsula between Hudson and Ungava bays. In March he was sent to Nova Scotia to arrange for the building of two suitable small yachts to be used during the coming summer in the exploration of the shores of Hudson Strait. The dimensions of the yachts decided upon as best suited for the work were, 35 feet in length, 10 feet beam and a draught of about 3 feet; with accommodation below deck for five men. They were built at Mahone Bay, and proved entirely suitable for the work. Work by Mr A. P. Low.

Hudson Strait—*Cont.*

On his return to Ottawa, he was kept busy attending to the details necessary for the fitting out of his own and Dr. Bell's parties (in the absence of the last-named gentleman) until the time arrived for his departure to join the steamer at Halifax.

On his summer's work Mr. Low reports as follows:—

Leave for Hudson Strait.

"I left Ottawa for Halifax on the 14th May, to take over the yachts from the builders and to purchase supplies and outfit for Dr. Bell's and my own party. Everything was shipped on board the *Diana*, the sealing steamer chartered by the Dominion Government, and we left Halifax on June 3rd, carrying the two yachts with their attendant small boats on deck.

Members of party.

"My party consisted of Mr. G. A. Young, who again performed the duties of assistant in a highly satisfactorily and efficient manner, a sailor and carpenter, and a cook. It was proposed to add an Eskimo interpreter to the crew, but owing to the quantity of ice met with along the Atlantic coast of Labrador, it was found impossible to get near any of the places where such a man could be engaged, and in consequence the crew was completed by the loan of a sailor from the *Diana*, through the kindness of Commander Wakeham. On account of obstruction, due chiefly to ice, we were not landed from the *Diana* until July 16th, in a bay called Douglas Harbour, situated on the south side of Hudson Strait, about 150 miles from its western end. The yacht having been got overboard and the outfit and provisions stowed away, the *Diana* left us, with instructions to meet her at Fort Chimo on September 15th. Douglas Harbour is about sixteen miles long and is divided nearly half-way up, into two narrow arms. The surrounding country is high, rough and barren, without any trees, the only vegetation being dwarfed arctic mosses, and flowering plants which were in full bloom at the time and partly covered the hillsides with a gorgeous display of colour. We remained six days in this bay, thoroughly exploring it, and also making excursions inland from the head of the south-west arm. The interior country is exceedingly desolate when viewed from the top of the higher hills, some 1500 feet above sea-level. It has the characteristic outline of the glaciated Laurentian region, low rounded hills formed into long broken ridges, with small narrow lakes dotting the valleys between. The vegetation is not sufficient to mask and soften the surface, and in every direction the bare rock is seen, strewn over with innumerable blocks and boulders of all sizes. The lack of trees and the presence of numerous patches of snow and ice in the valleys with a northern aspect, enhance the desolation of the view. The winds blowing off the

Douglas Harbour.

Character of the country.

highlands into the narrow reaches of the bay were always strong and gusty, sweeping down in squalls that often tore the surface of the water into miniature waterspouts. This, together with the amount of floating ice in the bay, caused considerable delay and occasional danger in the navigation of the yacht. Hudson Strait—*Cont.*

"Leaving the bay with a strong gale, we explored the coast twenty five miles eastward, to the next large inlet called Fisher Bay, which lies immediately south of Prince of Wales Island. About a dozen families of Eskimos were found camped near its mouth, where they were engaged harpooning white porpoises and seals for their winter supply of oil. These people were dressed wholly in hairy skin clothing, without any shirts or other garments bought from the shop at Fort Chimo, where they send picked men, with dog teams, in the spring, to trade their year's hunt for tobacco, powder and shot. They were supplied with guns, and some had rifles, but the rest of their outfits were of native manufacture. Every man had a kyack, the frame of which was made from wood hauled several hundred miles from the southward for that purpose. Their encampment consisted of five seal-skin tents, set up on a rocky hill-side covered with boulders. Most of them were located on an ancient beach, made up of rounded boulders from four to eight inches in diameter, directly on which the deer-skin beddings were spread, making a somewhat hard and lumpy bed. All were anxious to trade, but had nothing to exchange except a few seal-skins and some oil, having already disposed of their furs at Fort Chimo. As we could not use any of these articles, we presented each individual with a piece of tobacco for allowing us to take their photographs. Tobacco is a most highly prized article, as they all offered to exchange any and all their possessions, including clothing, boats or hunting implements for it, and did not appear to greatly want anything else that we possessed. It is used for smoking, chewing and snuffing by men, women and children; mothers passing their pipes to small infants carried in the hoods of their coats, and it was amusing to see the youngsters set up a howl when the mothers took their own turn at the pipe. These people, like the other Eskimos met along the coast, are rather above than under the average height of Europeans, but appear much shorter owing to the clumsy, hair-covered clothing worn by them. Fisher Bay. Eskimo.

"Having examined Fisher Bay and found a good sheltered anchorage for ships behind its islands, we left next day and proceeding south-east along the coast entered Wakeham Bay, ten miles farther on, and sailed up it twenty miles, to its head. This bay varies from half a mile to five miles in width, and penetrates into the same high, barren country. Returning the next day to near its mouth, we found the Wakeham Bay.

Hudson Strait—*Cont.*

entrance blocked with ice that was driving into the bay with a north-east wind, then blowing. Finding it impossible to get the boat through this barrier, we anchored in a small bay on the south side near the outlet, where the currents kept the water comparatively free from ice.

Detention by ice.

The wind continued from the same direction for several days, all the time forcing a steady stream of ice into the bay, so that by the third day it was completely full and we were forced to ground the yacht at high-water in order to escape being crushed by the heavy ice, often more than twenty feet thick. On the fourth day, the wind died out at even-ing, and taking advantage of a narrow belt of partly open water along shore, we towed the yacht out of the bay into a small cove facing the strait, about four miles away. The yacht had several narrow escapes from crushing between large 'pans' moving about with the strong cur-rents and eddies, and her sides were badly scarred by contact with the ice. In our new harbour, we were again forced on the beach and remained ice-bound for three days longer, until a steady wind from the westward opened the ice along the coast and permitted us to sail, through narrow lanes of water, twenty miles eastward, to Cape Prince of Wales. Rounding the cape, we anchored in Stupart Bay, where the house, used as an observation station in 1884-86, was found in a good state of preservation, but quite unfit for future use owing to its filthy state, the natives having used it as a store-house for oil.

Character of the coast.

"The coast from Douglas Harbour to the vicinity of Cape Prince of Wales, is high and rocky with few islands and with deep water close in shore, so that there is little danger in approaching it with large vessels, while excellent shelter and anchorages are to be found in all three of the large bays explored. As Cape Prince of Wales is approached, the land becomes lower and the highest hills do not rise more than 500 feet above sea-level. The water at the same time becomes shoaler, and small islands render the approach to the coast dangerous. At Stupart Bay we had our last experience with floating ice on the 2nd of August. After that date very little ice was seen, none of it being near the course followed by the yacht.

Coast south of Stupart Bay.

"From Cape Prince of Wales, the general trend of the coast is south for upwards of twenty-five miles; the shores are comparatively low and the country behind seldom reaches an elevation of 500 feet. The coast is indented with a number of shallow irregular bays, the two largest being called Whitley and Joy bays. Both are dotted with islands at low-tide, and are largely obstructed by reefs and bouldery shoals; while a wide margin of boulder-strewn, muddy flats, extends outwards from high-water mark. This is a dangerous coast for vessels, owing to the hidden obstructions and the strong currents caused by the tides, which

have a rise and fall of more than 30 feet. The general direction of the coast next changes to nearly east; and with a rise in the coast and country in rear, the water again becomes deep. These conditions continue for fifty miles, to Diana Bay; the intervening shore-line being indented by many bays, none of which afford shelter from a north or north-east wind. Diana Bay is about fifteen miles wide, but appears from seaward to be two bays, owing to the large island lying in its mouth. It is nearly twenty miles long and towards its extremity the water is shallow with a number of rocky islands and shoals. The general level of the country falls from over 1000 feet to less than 200 feet on the east side of the bay, where a flat point from five to ten miles wide only separates it from the entrance to Ungava Bay. Hudson Strait—*Cont.*

"We finished the exploration of Diana Bay and arrived at Cape Hope's Advance, or Prince Henry Foreland, on August 10th. From here the trend of the coast is southward, forming the west shore of Ungava Bay. A wide fringe of rocky islands extends along the shore for thirty miles from the cape; the water between them being so shallow that they are practically joined to the mainland and to one another when the tide is low. Outside the islands the water continues shallow for a considerable distance, and the bottom is lumpy, rendering approach dangerous. The coast is low and is broken into numerous wide, shallow bays, that at low-water show great expanses of boulder-strewn flats. The country behind is nearly flat, being broken only by a few rocky ridges none of which are over 300 feet high. Coast south of Cape Hope's Advance.

"For the next forty-five miles, to the mouth of Payne River, similar conditions prevail, except that the islands are fewer and there is consequently less shelter for small craft. We encountered considerable difficulty and some danger in coasting along this shore, owing to the great rise and fall of the tides and the strong currents caused by this. As an example, it may be stated that one night we anchored in 42 feet of water between some small islands, and after an exciting time, caused by the yacht swaying and jerking at her anchor chain, we grounded for a short time on a mass of boulders in a tidal current running six or seven miles an hour. On another occasion, we were forced by stress of weather into a small rocky cove at the head of a wide bay, where we beached the yacht near high-water mark and remained for two days. The appearance of the bay at low tide was astonishing, the water retreated about three miles, leaving an uneven bottom of mud and reefs covered with innumerable boulders, some of which were the size of a small house. At high-tide the bay became a mass of foaming breakers.

Hudson Strait—*Cont.*
Payne River.

"The mouth of the Payne River is situated exactly on the 60th parallel of north latitude. The bay into which it empties is about twelve miles, proper, wide and is full of shoals and islands. The mouth of the river is about twelve miles up the bay, where it is over two miles wide. From its mouth it gradually narrows, so that it is only a mile across eighteen miles up, where a reef, connecting a small island with both shores, causes a heavy shallow rapid up and down stream with the rise or fall of the tide, and we had a critical experience in passing with the yacht. Above the rapid the river is deep and navigable for about twelve miles to where it is blocked by a ridge of boulders stretching obliquely from shore to shore. At low-tide there is a fall of eight feet at this place, the water passing down by a number of small channels between the boulders. The volume of fresh water discharged was estimated to be about equal to that of the Gatineau River at Ottawa. The Eskimos met with on the river informed us that it divides into three branches a few miles further up and that one of the branches flows out of Payne Lake some miles to the westward of the upper rapid. There are no direct falls on the river as far as the lake, but the current is often very swift, with a number of rapids. This is the only important river flowing in along the coast between Douglas Harbour and its mouth. The numerous other streams seen entering into the heads of the several bays were all small, and none of them could be more than thirty miles in length. This would lead to the conclusion that the land along the coast is higher than the interior, and that the main drainage is away from the northern coast toward the southern interior, and thence east and west into Ungava and Mosquito bays. This inference is borne out by the statements of the natives, who report that the country to the west and south of Payne River is a comparatively low plain, where the barren-ground caribou feed during the summer.

Character of the interior.

"The Eskimos were on their way to the caribou grounds in order to procure skins for their winter clothing and bedding. They stated that in September, the caribou would be found crossing the river in great bands on their way southward, and that, as usual, they would kill all they required by spearing the animals in the water from the kyacks. A quantity of large trout were seen at the upper rapid but they would not take either bait or the fly. Some were obtained from the Eskimos near the mouth of the river, where they were caught in nets, and they

Fisheries.

proved to be the same as those taken at Fort Chimo, being not the ordinary southern sea-trout, but a larger arctic species, or Hearne's salmon, which is found abundantly in all the northern rivers. The natives informed me that both trout and the Atlantic salmon were usually

plentiful in Payne River, but none of the latter were caught in the nets while we were on the river. Hudson Strait Coast.

"It may be mentioned that the salmon fishery in the rivers of Ungava Bay was almost a total failure in 1897, the catch at the different Hudson's Bay posts being less than a quarter of the average catch. Ice in Ungava Bay and clear calm weather during the time the fish were passing into the rivers were the only reasons given for this failure. Failure of the salmon fishery

"We left the mouth of Payne River on August 19th and continued southward along the coast. The danger of shoal water over an uneven bottom, gradually forced us away from the mainland, so that for forty miles we could not get within four miles of the shore and only landed on the outer islands. For this reason we could not explore Hope's Advance Bay, which is shown on the maps as a great inlet free from islands, extending westward more than sixty miles, with a breadth varying from ten to twenty miles. Looking for some such conditions we passed the bay without knowing it, as its entrance is blocked with large islands and none of the channels between them are more than three or four miles wide. From information obtained from the natives, Hope's Advance would appear to be about ten miles wide and not more than thirty miles long, while the water at its mouth is so shallow that no large vessel could enter it without great danger, especially as the tide sets in and out through the shallow channels at an astonishing rate. Hope's Advance Bay.

"About fifty miles south of Payne River and to the southward of Hope's Advance, the land becomes higher and is thrown into sharp ridges with steep slopes to the westward. Innumerable islands of all sizes so mask the shore for twenty miles from Hope's Advance, to the mouth of Leaf River, that it is impossible to distinguish the mainland. According to the statements of the captain of the Hudson's Bay Company's yawl, who makes an annual trip to Leaf River for the porpoise fishery, the river is reached through a narrow channel between steep rocky cliffs, connecting the head of a long bay with Leaf Lake. The lake is a large body of salt water, some ten miles wide, that stretches from twenty to thirty miles both south-east and north-west from the entrance. The river flows into the lake almost directly opposite the outlet and is about equal in volume to Payne River. From the entrance to Leaf Lake to the mouth of the Koksoak River, a distance of about fifty miles, only a few islands occur along a more regular shore, that rises slowly inland to a general elevation of between 200 and 300 feet. The navigation along this coast is not difficult, as the water deepens gradually to six or eight fathoms within a mile of the beach : the only drawback is the absence of any convenient Leaf River.

Hudson Strait—*Cont.*

harbour for small craft. We reached the mouth of the Koksoak on the morning of August 24th, and ascended it thirty miles to Fort Chimo on the rising tide in the evening. The Hudson's Bay Company's steamship *Erik* was found anchored opposite the fort, having arrived from Churchill on the 20th, the earliest arrival on record.

Fort Chimo.

"We remained at Fort Chimo, making a few necessary repairs to the yacht, until the 27th, when we left to continue the exploration as far as George River, in the south-east corner of Ungava Bay, about 100 miles east of the mouth of the Koksoak. Before leaving, arrangements were made with Captain Gray, of the *Erik*, on our return, to transport the yacht and equipment to Nachvak, in order that it might be available for future use. Our course was due east from the mouth of the Koksoak for about twenty miles, past the mouth of False River, a long, shallow bay that has been taken for the entrance to the Koksoak by several vessels. We then turned south along the western side of a mass of shoals and rocky islands that extend nearly twenty miles outward from the mouth of Whale River, and ascended that river about eight miles to the small Hudson's Bay post situated there. The river, as far as the post, is about a mile wide, but it soon becomes much smaller, and beyond tide-water it is only a medium-sized stream, not comparable in length or volume with the Koksoak or George rivers.

Whale River.

Character of coast between Whale and George rivers.

"We left Whale River by its eastern channel, which is only navigable at high-tide, and continued along the coast in a north-east direction sixty miles, to the mouth of George River. Three large bays were passed on the way, each having a small river flowing in at its head. Along this portion of the coast, low rocky hills extend inland from high-water mark, and soon rise into the irregular uplands that are nearly 1000 feet above sea-level. Between high- and low-water marks there is usually a wide interval of mud, covered with boulders, and the large bays are practically dry at low water. Except in the vicinity of George River, few islands are found, and consequently there are no harbours where shelter can be obtained without grounding the boat.

George River.

"The George River is nearly eight miles wide at its mouth, but it soon narrows to about three miles, and twelve miles up it is about a mile and a half wide. From here to the Hudson's Bay post, some twelve miles further, it varies from one to two miles in width. According to information obtained at the post, a short distance above, it narrows to less than a mile, becomes swift and shallow and is broken by a rapid at the head of tide some ten miles above the post. Above tide-water the stream is less than half a mile wide and is very shallow, with a constant swift current for a long distance to a large lake,

which it passes through. Its head-waters are in a number of large lakes situated to the north of Michikamau and the Hamilton River, in the centre of Labrador. Hudson Strait—*Cont.*

"Having finished the exploration to George River, we returned to Fort Chimo, reaching there on the 4th of September. We immediately stripped the yacht for shipment on the *Erik*, which sailed on the 8th. We then awaited the arrival of the *Diana*, on the 16th, and left Fort Chimo on the 18th. After a pleasant and uneventful trip we were landed at St. John's, Newfoundland, on the 25th. Taking advantage of a freight steamer calling at Halifax we left St. John's on the 27th, landed at Halifax on the 30th and reached Ottawa on October the 2nd. Return journey.

"Among the results of the expedition may be mentioned the exploration and survey of 650 miles of coast, most of which was practically unknown, while the remainder had been only roughly charted by passing ships. The rocks along the coast were examined in many places, and, although work in detail could not be undertaken, sufficient information was obtained to show that only the older formations are present, and it is thought that a study of the large collection of rock specimens brought home will show that the only formations represented in this portion of Labrador are the Laurentian and the so-called Cambrian, the former consisting chiefly of various granites and granite-gneisses, the latter of a more or less altered series of bedded schists and gneisses associated with basic eruptive rocks. These schistose rocks are often penetrated by numerous quartz veins, and their proximity to large masses of igneous rock are conditions favourable for the occurrence of gold. Specimens from a number of promising looking veins were brought home and are now awaiting examination. Along with the schists are large beds of impure iron ore which appear to correspond to the enormous deposits of bedded iron ore already found in the less altered Cambrian rocks of the Koksoak and Hamilton rivers. The schists and gneisses are usually highly garnetiferous and in many localities dark-red garnet crystals upwards of an inch in diameter were observed. About three-fourths of the coast explored appeared to be occupied by the granite and granite-gneisses, the remainder being schists and their associated basic eruptive rocks. Geological information.

"The glacial phenomena observed point to a total covering of the country by an ice-cap that flowed outwards to the sea, most of the glacial striæ having a direction transverse to the general trend of the coast where they occur. The land along the coast has risen about 400 feet since the time of glaciation, that being the elevation above the present sea-level of the highest terraces and beaches fronting seaward. Glacial phenomena.

Hudson Strait—*Cont.*

The upward movement of the coast in modern times has been very little, if any; as no evidence of such motion was noted.

Collection of plants.

"A large and nearly complete collection of lichens, mosses and flowering plants was made by Mr. Young, and although little new material was secured, the range of many species was extended. During delays caused by ice and wind, dredging operations were carried on to a depth of twenty fathoms, and an interesting collection of arctic sea life was obtained and brought home for determination.

"The usual meteorological observations were taken three times daily, together with the surface temperature of the sea, and notes were also made on the condition and nature of the ice-pack while it lasted. Photographs were taken of all interesting objects, giving a good idea of the general scenery and of the rocks, and also affording a pictorial census of the Eskimo living on the coast from Douglas Harbour to Fort Chimo, together with their houses, boats and other effects."

NEW BRUNSWICK.

Work by Prof. L. W. Bailey.

Professor L. W. Bailey, having completed the geological examination of south-western Nova Scotia in 1896, so far as to admit the writing of a general report on the area (now in the press), was last summer requested to undertake a general re-examination and review of the minerals of economic value in the province of New Brunswick. His completed report on this subject will undoubtedly form a useful handbook of the mineral resources of the province, in regard to which frequent inquiries are received. Professor Bailey's account of the work accomplished with preliminary notes on certain minerals, is as follows:—

Plan of operations.

"In accordance with your letter of instructions, dated the 26th of May, 1897, the purpose of my investigations in New Brunswick was to obtain the most recent and trustworthy information respecting mineral developments of economic value throughout the province, with the object of compiling a general account of such resources for the public information.

"With a view to the above result, examination having first been made of the data in the possession of the Mining Branch of the Department of Crown Lands in Fredericton, and correspondence sought with parties interested in mineral development, personal visits were made to all localities throughout the province which seemed to afford any promise of useful information. These localities include the Newcastle coal-field; the granite quarries of Hampstead, Weldford,

Bocabec and St. George; the freestone and grindstone quarries of Hopewell (Albert county), Newcastle (Northumberland county), Stonehaven and New Bandon (Gloucester county); the gypsum deposits of Hillsborough (Albert county) and Tobique River (Victoria county); the bituminous shale and albertite deposits of Albert and Westmoreland counties; the manganese deposits of Tattagouche River (Gloucester county), Markhamville and Jordan Mountain (King's county), and Shepody Mountain and Dawson Settlement (Albert county); the iron ores of Jacksontown (Carleton county) and Lepreau (Charlotte county); the nickeliferous pyrrhotites of St. Stephen and La Tete (Charlotte county); the copper-bearing rocks of Grand Manan, Adams Island, Simpson's Island, Magaguadavic River, Beaver Harbour and La Tete (Charlotte county), and those of Alma, Point Wolf, etc., (Albert county); the antimony deposits of Prince William (York county), and the limestones and graphites of St. John. New Brunswick (cont'd.

"A canoe exploration, of a fortnight's duration, was made of the Serpentine River, a branch of the Tobique River, where discoveries of gold had been reported. Serpentine River.

"Information was also sought and obtained as to a variety of substances which, though not of the nature of ore or rock-deposits, as ordinarily understood, possess a commercial importance. These include brines and other mineral waters, petroleum, peat, infusorial earth and other siliceous deposits, clays and sands.

"In the majority of instances the substances and localities above enumerated have been long known, and little that is new is to be gathered concerning them. The difficulty of so doing is further enhanced by the fact that while in but few instances the several deposits have been sufficiently exploited to enable one to form any just conception of their extent and value, even those which have been more fully opened and which, like the Albert Mines and manganese beds of Markhamville, gave for a time remunerative returns, have apparently become exhausted, and having been abandoned, afford now no opportunities for further study. To so great a degree, indeed, does this condition of things prevail that, excepting the operations in building and ornamental stones, in coal and gypsum, one locality only (that of Dawson settlement, in Albert county) can be named where anything like systematic mineral development is now in progress. Minerals now actually worked.

"That the above statement should be, in view of the great variety of useful minerals represented and the geological conditions, equally varied, under which they are found, is not a little remarkable, and can only be accounted for on the supposition that the agencies con- Causes deterrent to mineral development.

New Brunswick—*Cont.*

trolling such conditions have failed to produce here their usual results,—results, too, which find abundant illustration in the neighbouring provinces of Quebec and Nova Scotia,—or that our knowledge upon the subject is still very incomplete. That the latter belief is the more probable (and that with no discredit to the officers of the Geological Survey) will be readily understood, when it is remembered that a large part of the province, and nearly the whole of the portion likely to be most productive of useful minerals, is still covered with unbroken forest, while it has not been the work of the geological surveyors to undertake systematic prospecting. Until this is done, it is impossible to form any just conception of what the mineral resources of the province really are, and plans are now under consideration by the provincial government, by which it is hoped that such knowledge may be obtained.

Influence of new processes and methods.

"It is also important to observe, in this connection, that recently introduced processes of manufacture or the application of products in new directions, may at any time give value to substances previously considered as worthless, or nearly so. The following examples, based on recent information, afford good illustrations of this:—

Iron.

"*Iron.*—The hæmatite deposits of Carleton county have been long known and were at one time the basis of somewhat extensive operations, the manganiferous ore proving to be especially well adapted for the manufacture of steel, thus anticipating the subsequent employment of spiegeleisen for a like purpose. It carried, however, also a considerable proportion of phosphorus, and this, together with the increasing scarcity of fuel, was the main cause of its abandonment. By the introduction of improved methods of working (especially the basic process of Thomas and Gilchrist), the presence of phosphorus is now of far less importance, and ores previously regarded as worthless on account of its presence, are becoming available. It is doubtful whether, under existing circumstances, the Woodstock ores could be worked with profit, but, the above facts being taken into consideration, they at least deserve to be ranked among possible reserves.

Manganese.

"*Manganese.*—The ores of this metal are another admirable illustration of the increased value given to comparatively useless materials as the result of new methods and directions of application. While the deposits of manganese formerly mined somewhat extensively at Markhamville, and which from their purity and large oxygen-content were so highly esteemed for chemical purposes, have apparently become exhausted, a low-grade ore, in the form of wad or bog-manganese, which a few years ago would have been regarded as worthless, or nearly

so, and which is still worthless for the uses referred to, now promises to become the basis of a comparatively new and important industry, viz., the manufacture of ferro-manganese, an alloy largely employed, if not essential, in the economic manufacture of steel. The deposits which it is proposed to employ in this way are situated in Dawson settlement, in Albert county, where they cover an area of about seventeen acres, with a thickness varying from a few inches to thirty-five feet. The material is a fine, jet-black powder, quite free from pebbles or other foreign matter, and carrying about 45 per cent of manganese, with a little iron and silica, and only a trace of phosphorus. The average value of the ore is about $13 or $14 per ton (while that of Markhamville ranged, in its higher grades, from $70 to $80 per ton), but would not possess even this value except through the operation of a special process whereby the incoherent powder is cemented and compressed into solid briquettes, capable of ready transportation and of direct addition to the iron of the Bessemer furnace. A large plant has been erected for the production of these briquettes, which are loaded directly on a short branch railway connecting with the Harvey and Salisbury Railway, by which and by the Intercolonial Railway, they are to be forwarded to Bridgeville, N.S., to be there used in connection with the plant of the Pictou Charcoal Iron Company, both plants being now the under control of the Mineral Products Company of New Brunswick. The cost of the plant at Dawson settlement, including the branch railway of about one mile and a half, is said to have been about $30,000. New Brunswick—*Cont*

"*Pyrites and Pyrrhotite.*—Deposits of these minerals, usually regarded as of but little value, have for some years been known to occur in the vicinity of St. Stephen in Charlotte county, and at times have aroused considerable interest on account of the fact of their yielding nickel, in this as well as in other respects bearing a somewhat close resemblance to the deposits of these minerals found at Sudbury, in Ontario. It is not yet known that the percentage of nickel in the St. Stephen deposits will in any part average as high as those of the locality last-named, or even sufficiently high to admit of profitable extraction (a point which is now under examination). Apart from this question, however, one cannot pass over the extensive tract occupied by the pyrrhotite and pyrite deposits, of which the thickness is still unknown, without being impressed with the possibility of their useful application in other directions, and especially for the production of sulphuric acid, in connection with the wood-pulp industry now being so rapidly developed in New Brunswick. Iron pyrites.

New Brunswick—*Cont*

Gypsum.

"*Gypsum.*—This comparatively cheap and abundant material affords still another illustration of varied adaptability and a possible largely increased production resulting therefrom. While still extensively quarried both for use in the raw state as 'land-plaster' and, after calcination, as plaster of Paris, it is said that new processes are being introduced whereby ground plaster may become, on a more extensive scale than formerly, the basis of the manufacture of artificial stone.

Gold.

"With further reference to this subject of possible future developments of mineral resources, the facts relating to the occurrence of gold in New Brunswick deserve some attention. For many years finds of this metal have been reported, and there seems to be no good reasons to doubt that some at least of these are authentic. Indeed, so impressed have some parties been with the belief that certain tracts, especially those bordering upon the Serpentine River, in Victoria county, are auriferous, that they have incurred the expense of transporting and erecting a small stamp-mill into that remote and comparatively inacessible locality. My visit to the region, made by your desire, tended strongly to confirm the justice of this belief. It is true that I was unable to find any free gold, but the character of the rocks, consisting of glossy slates and schists, together with the nature of the quartz veins by which these were found to be abundantly intersected, and, finally, the evidences of mineralization afforded by an abundance of pyrite and mispickel, were all features favourable to a belief in its occurrence. Should that belief, for the testing of which appropriate samples were selected, be confirmed, it will be important to notice that the same belt of rocks, with evidently the same characters, has a wide distribution in northern New Brunswick, as also that it is the tract in which the larger part of the reported discoveries of gold have been made. At present the greater portion of it is densely forest-clad, and thus removed from ordinary observation.

Coal.

"The question of coal supply in New Brunswick is also one in regard to which the interest lies quite as much in the possibilities of the future as in the present development. As to the latter, the mines at Grand Lake, Queen's county, continue to be the only producers, and here little or no change is to be noted either in the extent of the output or in the conditions of occurrence. The facts and conclusions as to the Newcastle coal-field fully given in the Report of Progress for 1872, remain unaltered, and no observations have been made which tend to indicate that other and larger seams occur here than those which have been so long worked near the surface.

"It also remains true of the New Brunswick coal-field as a whole that, with large area and nearly horizontal beds, it has probably but

little thickness, and therefore affords but little prospect of containing many or large deposits of coal. But this conclusion, however probable, is by no means beyond question, more especially as regards that portion of the field lying between Grand Lake and the shore of Northumberland Strait. It is definitely known that the Carboniferous rocks of the province rest upon a floor of older rocks, which has been both extensively folded and eroded prior to the deposition of the coal-bearing strata. Thus the latter must undoubtedly be at many points thicker than at others, with of course the possibility of carrying proportionate quantities of coal. This question can only be finally settled by means of systematic borings throughout a considerable area; and one cannot help thinking that if, instead of using the diamond-drill, owned by the provincial government, within a few rods of a prominent ridge of Pre-Carboniferous rocks, as was done during the past summer, without result, in the vicinity of Moncton, this had been employed in the direction above indicated, the results, even if negative, would have been far more conclusive and satisfactory.

New Brunswick—*Cont.*

Boring operations proposed.

"Of other mineral products, it is only necessary to say in this brief summary that the operations in building and ornamental stones continue to be fairly active, although, as in the case of the lime industry at St. John, the output would be many times increased were it not for the depressing influence of adverse tariffs. While the granite industry still continues at St. George, and smaller quarries of so-called 'black granite' have been opened at several points, the operations in freestone and grindstones, formerly so extensively carried on at the head of the Bay of Fundy, have there almost ceased, the principal centres of this work at present being the vicinity of Newcastle, Northumberland county, and the shores of Bay Chaleur.

Building stones.

"Veins of pyrolusite (manganese oxide) were observed in the vicinity of Tattagouche Falls, in Gloucester county, at points not previously reported, affording some ground for the belief that much larger deposits of this mineral may yet be found in that vicinity.

Other metallic minerals.

"Veins of magnetic iron ore, from a fourth of an inch to eight inches in thickness, were observed in the vicinity of Lepreau River, St. John county, and small veins of galena and copper-pyrites at several points along the coasts of St. John and Charlotte counties, but none large enough to give much promise of successful working.

Peat bogs.

"The subject of peat bogs and their applications is one of considerable economic interest. Those of New Brunswick have been studied by Mr. R. Chambers* and also for several summers by Prof. W. F. Ganong,

* See especially Annual Report, Geol. Surv. Can. (N.S.), Vol. VII., Part M.

New Brunswick—*Cont.*

of Northampton, Mass. An account of the attempts made to work these for moss-litter and other purposes, upon an extensive scale, will be contained in my final report of which a summary only is here given.

"In the same report an effort will be made to include, as to all the minerals and mineral localities alluded to above, as full particulars, historical and otherwise, as is possible to obtain.

"Specimens from numerous localities have been collected, and will be sent to the Survey office for examination."

NOVA SCOTIA.

Work by Mr. H. Fletcher.

Mr. Hugh Fletcher was engaged during the winter of 1896-1897 in plotting his surveys and in revising those made and plotted by his assistant, Mr. M. H. McLeod, and with other work connected with the preparation of several sheets of the geological map of Nova Scotia. Vertical sections were also drawn of the rocks of Chignecto Bay, from Shulie to Spicer Cove, and of the upper divisions of Sir W. Logan's section for comparison with them. Sections were also prepared of the rocks along Sutherland River and of those between McGregor Mountain and Deacon's Cove, on the East River of Pictou, with a view to defining the relations of the beds in these places, with the information now available, and of ascertaining the points upon which additional facts are required.

Of the field-work carried out during the past summer, Mr. Fletcher writes as follows:—

Examinations made with Dr. Ells and Dr. Ami.

"Leaving Ottawa on June 1st, 1897, with Dr. Ells and Dr. Ami, I spent several days with these gentlemen on the shores of Chignecto Bay, and in various parts of Pictou and Colchester counties, in the examination of certain crucial points in the geology of parts of the district comprised in the 'Cumberland' sheet, previously published on the scale of four miles to the inch, and in collecting further evidence respecting the age of the New Glasgow conglomerate and the rocks immediately overlying it, as well as those of Riversdale, which lie beneath the red rocks of Union, upon which in turn rest unconformably Lower Carboniferous limestone and gypsum.

"Dr. Ells and I examined also the rocks of Greenville, Wentworth, the Florida Road, Swallow settlement, Waugh River, River John, Scotsburn and the Big Island of Merigomish, in regard to the stratigraphical position of some of which considerable difference of opinion has been entertained. The coarse rocks of Big Island, between Savage Point and the overlying coal, are precisely like those of King Head, Begg

Brook and the Drummond Railway, near the north fault, containing large trunks of trees, cordaites and obscure ferns, while the coal of Little Harbour, Smelt Brook, Deacon's Cove and Abercrombie, appears to be, in these several places, separated from the top of the New Glasgow conglomerate by about the same thickness of strata. Several months have been spent by Dr. Ami during the last three seasons in collecting fossils from these strata, and his report on them may perhaps throw more light on their relations. Nova Scotia—Cont. Fossils.

"In August I again visited McAra Brook, in company with Mr. H. S. Poole and Dr. Ami, where we discovered and collected fossils from several new beds containing fish remains, among others abounding in carbonized plants; as laid down in the section subsequently measured along the banks of the brook, both above and below the shore-road. In October, with Mr. Lee Russell, of the Truro Normal School, I further examined parts of the shore of Chignecto Bay.

"The remainder of the season was spent in the district to be covered by the Springhill and Joggins map-sheets, many interesting facts being observed, the bearings of some of which are not yet entirely clear. The observations in the immediate neighbourhood of the coal mines are too disconnected to be of value before all the surveys shall have been plotted; and the relations of the coal measures to the underlying and overlying rocks are so imperfectly ascertained, and the questions involved of so great economic importance, that they must be further studied in the various sections before they can be presented. Cumberland County.

"The explorations of Mr. James Baird seem to have proved the coal measures to exist parallel with a band of conglomerate, traced by the late Mr. McOuat, ninety-five chains east of the old Economy road to a fault recognized both by Mr. McOuat and Mr. Scott Barlow. It seems probable that, as in Cape Breton, certain bands may be traced out by superficial indications, so as to indicate the geological structure in the absence of definite outcrops or of pits. Much has been already done in this way by Mr. G. W. McCarthy, of Springhill, and bands of conglomerate, of concretionary limestone, gypsum and massive sandstone have been followed by him with great skill. As a fire last spring destroyed the notes of Mr. McCarthy's surveys and the company's maps, together with many valuable records of pits, bore-holes, etc., Mr. J. R. Cowans, manager, kindly allowed him to accompany me and point out features of interest in the coal-field. Wherever such distinctive beds of the kind mentioned above were observed, an attempt was made to follow them, aided in many cases by the prospecting pits so numerous in this field; the Coal measures. Beds traced by Mr. McCarthy at Springhill mines.

Nova Scotia—*Cont.*

records of which, if they had been properly preserved, would probably serve to clear up every point that is now obscure in the geology. The

Relation of conglomerates to coal-seams.

particular importance of tracing the two conglomerates of Polly Brook and Rattling Brook cannot be overestimated, for on their position depends the relation of the coal-seams to the rocks of Athol, Southampton and the country to the westward, and the extent and depth of the basin of the Springhill coal measures. Even if it should be found that all the rocks where they lie near the old hills are conglomeratic, while on Logan's section, between Shulie and Minudie, they consist entirely of relatively fine sediments, this is a difficulty not perhaps insuperable, but requiring close study. The thickness of strata on opposite sides of the syncline near Athol—assuming that the fault separating the gypsum of Stewart Meadow from the upper red beds of Little Forks River and the Stony Half-mile either does not pass here, or is unconformably overlapped—may give the relative positions of the strata and show whether the gray sandstone and conglomerate of Rattling Brook are not the massive sandstone of the Stony Half-mile.

"The workings at the mines from the Aberdeen slope (which suggests the existence of a great fault by its steep dips and the proximity of the Carboniferous limestone) to the southerly-dipping coals of the Herritt road, have proved the direction of the coal-seams hereabout, but in other parts of the field this is not so plain, and more surveys, aided perhaps by a few shallow pits, may still be required. It is hoped that a study of the fossils so abundant in this field may serve to determine the relations of the different sections that have been measured.

Section at Chignecto Bay.

"A careful examination was made of all the brooks and roads of the district above referred to. This included a re-examination of Atkinson Brook, Shulie and Hebert rivers and most of the streams east of Chignecto Bay, where it was desirable to ascertain the dip more precisely, as well as the differences of strata and possible unconformities and faults, which could only be detected by careful tracing from point to point, owing to the similarity of the rocks and the absence of distinctive fossils. I am at present inclined to think that all the rocks of this section represent Logan's Joggins section only as far as the upper part of Division 3, and are not to be placed in the lower part of that section, although previously so mapped on the Cumberland sheet. If the three breaks already known to interrupt the continuity of the strata between the top of Logan's section and the old rocks of the Cobequids may be considered as of trivial importance, the above-mentioned supposition must hold. These breaks or faults, as already mentioned, occur at Sand Cove, at Sand River, and at

Spicer Cove. They did not appear to me to bring in any new rocks, but only to displace slightly the conglomerate, gray sandstone and red shale of the upper series, but this view requires verification. The Sand Cove fault is no doubt that seen on Shulie River, about a third of a mile above the shore-road, as its bearing deduced from the dip carries it directly to that point. Nova Scotia—Coal.

"Wherever the rocks are well exposed near the Cobequid Hills, it has been found that there is no such great thickness of red conglomerate as at Waugh River and New Glasgow, notwithstanding the great horizontal extent of such rocks produced by the low dip at Glasgow Mountain and towards the east branch of Apple River. They are succeeded by gray conglomerate and flaggy, coherent sandstone, like the rocks assumed by McOuat (Report of Progress, 1872-73, p. 169), to rest upon the coal measures. Next above these come fine gray sandstones and flags, like those of Shulie River, above the old Sand River road. The absence of coarse conglomerate towards the head of Shulie River, is remarkable; the gray and green flags overlying seem to take their place either by a fault or unconformity. Logan's Division 1 extends to the vicinity of Ragged Reef. The rocks generally have a low dip, and perhaps encroach by overlap upon the underlying strata. Carboniferous rocks near Cobequid Hills.

"On the farm of Mr. Amos Blenkhorn, on the east side of the road between Maccan and Nappan, a considerable quantity of copper ore has been taken from a slope sunk on a belt of gray sandstone, carrying trunks and leaves of carbonized trees, and charged with pyrite and gray copper ore, with barite in breaks and small veins, a little coal in gashes and veins and traces of chalcopyrite. In addition to large aggregations of the ore, much is scattered through the sandstone. The rocks, which dip steeply south, are probably Lower Carboniferous, like those of Downing Cove. From Nappan Station they extend, as shown on Dr. Ells' map, towards the Salem road, where a limestone holding manganese has been largely quarried at Mr. Fred Shipley's, occupying a broad belt near his house. From several of the openings manganese ore has been extracted which is said to have nearly paid the cost of working. The limestone is concretionary, yielding no fossils, and produces good lime, a kiln capable of burning three hundred bushels at a charge being operated by Mr. Shipley. Copper. Manganese

"On November 16th I visited Sydney, and spent some time at and near the coal mines, collecting details of the most recent workings and explorations, preparatory to the revision of the map-sheets of this coal-field. Cape Breton.

Nova Scotia—*Cont.*

Discovery of coal at Cochran Lake.

"At the western end of the Cow Bay basin, Mr. Moseley has continued his borings of last year, and has satisfied himself, as did Mr. Charles Archibald at the east end, that no seams of greater thickness than three feet immediately underlie the McAulay seam, and its extension to the westward as the Neville seam. He has also put down two bore-holes and sunk a trial shaft further west on the Ferguson road, about a mile south of Cochran Lake. In the shaft I measured five feet six inches of clean coal of good quality. Immediately overlying this was a black streak, probably representing the upper bench of the bore-holes, but not well-defined owing to the want of a solid roof. The section of the bore-holes, as given by Mr. Moseley, is as follows :—

No. 1.

	Ft.	In.	Feet.	Inches.
Surface			13	0
Gray sandstone and argillaceous shale			15	2
Top coal	0	9		
Shale	0	4		
Coal	5	5		
Mixture	0	0½	8	2
Coal	0	3½		
Coal and clay	0	11		
Coal	0	4		
Rock, principally shale			31	0

No. 2.

	Ft.	In.	Feet.	Inches.
Surface			12	3
Sandstone and shale			38	6
Top coal	0	11		
Clay	0	2½		
Coal	5	0½	7	7
Clay	0	7		
Coal	0	10		
Underclay			1	7

"No. 2 lies one hundred feet north of No. 1 towards the dip. The shaft is fifty feet to the rise of No. 1, and the coal was reached at a depth of about twenty-four feet from the surface.

"Explorations are still being made on Mira Road, and a slope is being sunk on the two foot nine inch coal in the hope that it may improve in thickness*.

Dr. White's report on petroleum in Cape Breton.

"Dr. I. C. White, of Morgantown, West Virginia, has made, on behalf of gentlemen interested in that district, an examination of the supposed oil producing territory of Lake Ainslie, referred to in the report for 1882-84, page 90 H, and has expressed himself as satisfied that, although there is petroleum in a thick stratum of sand-rock on the western shore of Lake Ainslie, the area of the field is so limited and the dip of the strata so high that there is hardly a chance of its being obtained there in large enough quantities to pay for development.

"Dr. White adversely criticises the borings previously carried on at Lake Ainslie, pointing out that in one place there are six holes in an area of not much more than half an acre—two of them only thirty or

* By a mistake in last Summary Report, p. 95, line 13, the top coal of the Tracy mine was said to be two feet seven inches, instead of three feet seven inches.

forty feet apart—when of course a single well would have been quite enough to test that amount of territory. From one of the wells a small quantity of heavy, black petroleum was obtained by lowering into it a bunch of rags at the end of a pole, and from another, natural gas was escaping in small quantities and could be lighted with a match, but in the others there was no sign either of oil or gas. More than a dozen wells in all were found, eight or ten on the western shore of the lake and three on the eastern. Dr. White made a journey of about 125 miles around Lake Ainslie and through the valleys of the Margaree, Middle and Baddeck rivers, but did not find there a field level enough and extensive enough to pay for development, even assuming that it contained oil. Sand-rock having the characteristic odour of petroleum was found in several places, but its contents had long before disappeared, and in some cases a substance supposed to be oil proved to be nothing more than a film or stain of iron. Dr. White's conclusion is that, in the parts of the island visited, there is no geological evidence of the existence of petroleum in quantities large enough to make it commercially valuable. On the contrary, all the geological evidence goes to negative the supposition." Nova Scotia—*Cont.*

The first two months of the winter of 1896-97 was devoted by Mr. E. R. Faribault to the plotting of surveys made during the previous summer and to the revising of those made by assistants, but the greater part of the winter was spent completing the compilation of the Lawrencetown and Stewiacke map-sheets and in continuing the compilation of the Preston, Middle Musquodoboit and Halifax sheets. The Ship Harbour, Moose River, Upper Musquodoboit and Eastville sheets were also prepared for the engraver, and structural sections made for the two first-named sheets. Some time was also occupied correcting proofs from the engraver of the Fifteen-mile Stream, Ship Harbour and Moose River sheets which are now published, and progress was made in compiling a report on the gold-fields of the eastern part of the province. Work by Mr. E. R. Faribault. Map-sheets in course of compilation.

On the field-work accomplished in 1897, Mr. Faribault reports as follows :— Field-work.

"In compliance with your letter of instructions, I left Ottawa on the 5th of June, to continue the mapping and study of the structural geology of the gold-bearing rocks of the Atlantic coast of Nova Scotia, devoting much of my time to a review of the gold-fields of the eastern part of the province, already surveyed, with the object of producing a general report on these fields during the winter.

Nova Scotia—*Cont.*

Lunenburg county.

"Mr. Archibald Cameron was engaged the whole of the season with preliminary work in the south-west part of Lunenburg county, surveying with the odometer and prismatic compass the roads to be used as tie-lines in the compilation of the Lunenburg and Vogler's Cove map-sheet. He also completed the topography and made preliminary geological surveys of the Mahone Bay sheet, as well as the north-east portion of the Lunenburg sheet lying to the north-east of La Have River. He has now completed the plotting of his summer's work.

Gold-districts surveyed in Guysborough and Halifax counties.

"My own time in the field was principally devoted, assisted by Mr. J. McG. Cruickshank, to the study of the structural geology of the principal gold districts lying east of the Musquodoboit River included in the county of Guysborough and the eastern part of the county of Halifax. Special detailed surveys were made and plans partly completed of the gold-districts of Isaac's Harbour, Upper Seal Harbour, Forest Hill, Cochran Hill, Goldenville, Salmon River, Fifteen-mile Stream, Killag, Caribou, Moose River and Mooseland. It was found most difficult in some districts to get the necessary informations regarding abandoned mines, some of which have not been in operation for over twenty-five years, and the time at my disposal did not permit me to prepare as complete and accurate plans of these districts as the importance of some of them should require. No mining plans have been kept by the different companies operating the older districts from time to time for the last thirty-five years, or if plans have been kept they are now lost or in possession of private individuals. Such plans would be most valuable in affording the data necessary to work up the geological structure, and they would be very useful to companies re-opening old abandoned workings, as well as to capitalists and mining engineers seeking information. It is most desirable and important that some steps be taken by the proper authorities to have this want remedied. I must say, however, that I have been the recipient of much courtesy at all the mining centres, and I have to thank more especially many old miners for valuable information regarding the nature of the ore-deposits of these abandoned mines and the extent to which they have been worked.

Upper Seal Harbour gold-district.

"*Upper Seal Harbour Gold District.*—Thirteen days were spent making a survey of this new district, discovered at the time we located the anticline in the spring of 1892, and a plan on the scale of 500 feet to an inch has been prepared, giving the geological structure of the anticlinal fold from Country Harbour to the head-waters of Seal Harbour streams, a distance of 28,200 feet.

This anticline has a general course of N. 60 W. (*mag.*),* with a pitch to the east of 10 at the west end, increasing to 32° at the east end, the strata on both sides of the axis having about the same inclination to the north and south, the angle of dip averaging 50 near the apex and increasing to 80 some distance off. Three main parallel faults have been discovered and located this summer, cutting the fold diagonally at angles varying from 40 to 50, with horizontal displacements varying from 500 to 1100 feet and running about N. 15 W. (*mag.*). As the gold-bearing veins are here confined to the crown of the anticlinal fold, where they bulge out to large size, and as the greater part of the district is covered with heavy drift and woods, the exact location of these faults becomes most important in tracing out the auriferous belt; and I may say that several hundred areas were taken up by local prospectors last season on finding out the extent of the displacements of these faults. Nova Scotia—Cont. Faults.

"The eastern fault lies west of Dolliver Mountain gold mine, passing in the vicinity of the north branch of Davidson Brook, with a displacement of 500 feet to the north on the east side, shoving the anticlinal fold from area 772 to area 869 on the east side.

"The middle fault lies 600 feet west of the mouth of Isaac's Harbour River and follows the general course of the Northwest Branch Brook to the head of the harbour, down which it runs passing between Hurricane Island and the eastern shore. The anticlinal fold is cut off on the east side of this fault on area 906, block 6, and shoved to the south-east some 1100 feet, in the vicinity of the discharge of the Branch Brook into Isaac's Harbour.

"The western fault runs parallel to the other two, along the valley of the south branch of Smelt Brook of Country Harbour, and is well seen at the Porcupine Rock, but, on account of heavy drift, the anticline could not be located on either side in the vicinity of the fault. The fold is, however, well exposed further west on the shore of Country Harbour, on areas 780 and 781 of block 10, giving a horizontal shove of some 500 feet.

"The only mine in operation in the district, at the time of my visit, was the Richardson gold mine, working an auriferous quartz vein that follows a belt of slate lying between two heavy beds of quartzite, curving to the eastward around the anticlinal fold, which dips to the north at an angle of 70°, to the south at an angle of 50, and with a pitch of 21° along the axis. The belt on the north dip has a width of 7 feet, and has been worked 150 feet on the incline; on the south, Richardson gold mine.

* The magnetic variation in this part of Nova Scotia is about 23° E.

Nova Scotia—*Cont.*

the width is 8 feet, and it was worked to a depth of 200 feet, while on the apex, the belt increases to a thickness of 25 feet, half of which is quartz, and has been worked on the incline to a depth of 400 feet. The slate, as well as the quartz, contains milling gold, but it also holds an important amount of auriferous sulphides, which, from analysis made by Mr. F. H. Mason, of Halifax, contain a good percentage of gold that is not free-milling, and should be saved by suitable concentrators.

Development work.

"A great deal of exploratory work has been done in the last few years to the east and west of the Richardson property, along a distance of some five miles, on both sides of the anticlinal axis; notably, on the Dolliver Mountain property where some twelve veins showing gold have been opened, and also on the McMillan, the Samuel Grant, the O. J. Griffin, the H. Richard and the East Gold Brook areas, where some rich drift has been found. Large belts of low-grade ore, similar to that of the Richardson vein, certainly occur along this fold, but they will only be found on the apex of the fold, where more prospecting should be done: and this could be accomplished most readily and at least cost by sinking perpendicular shafts along the axis.

Belts of low-grade ore.

Isaac's Harbour gold-district.

Faults.

"*Isaac's Harbour Gold District.*—The three faults above described as affecting the Upper Seal Harbour belt, have been traced across this belt lying two miles further south. The middle fault and the western fault run down the harbour and pass between Hurricane Island and the eastern shore, and converge at Dung Cove, giving a horizontal throw of some 1500 feet to the north on the east side of the harbour. The Mulgrave belt should thus be the continuation of the Hurricane Island belt, where an anticlinal and synclinal fold only 12 feet wide is developing on the western side of the harbour, into the Burke mine anticline and North Star mine syncline which are here 100 feet apart. This explains why the Mulgrave belt can not be traced on its natural course on the western side of the harbour, and it gives also the theoretical reason for the occurrence of an auriferous belt apparently remote from an anticlinal fold.

Importance of faults in future development

"The Hattie belt, now operated by the Griffin Gold Mining Company, on the south side of the Isaac's Harbour anticline, is likewise shoved by the same fault some 1500 feet to the south on the west side of Dung Cove at Red Head, where rich drift has been found.

"The eastern fault described above appears to pass a few hundred feet west of the Skunk Den mine, apparently cutting the Mulgrave leads between areas 13 and 14, but the extent of this fault here could not be exactly made out. It may have a displacement of 500 feet, like that two miles further north.

"The knowledge of the location and displacements of these faults should assist in tracing out rich veins beyond them and encourage the prospecting of new areas. Nova Scotia—*Cont.*

"*Country Harbour Gold District.*—No work was being done here at the time of our visit. More evidence was gathered, however, confirming the views expressed before regarding the structure of the district. The quartz veins, so extensively worked here for some years with large returns, are situated along a very sharp anticlinal fold which is a part of the Cochran Hill and Forest Hill anticline swung into a north-and-south direction by the Country Harbour fault, which has caused a horizontal displacement of over one mile to the south-east on the north-east side of the fault. Country Harbour gold-district.

"*Forest Hill Gold District.*—One week was devoted to making a plan on the scale of 500 feet to an inch of this newly discovered district, where a belt of gold-bearing rocks occurs between two axes of granite, from which numerous dykes and veins are sent into the adjoining rocks which are altered into andalusite, staurolite and garnetiferous schists. The belt is plicated into an anticlinal fold which has a north-west course, gradually curving to the west and south-west and most probably joining the Country Harbour anticline. On the McConnell property the anticline has a pitch to the east of 3°. The Mudstock, McConnell, Mason and Phœnix companies are working a group of some ten veins 1000 feet south of the granite on the south side of this fold, which has an overturned dip to the north varying from 90° to 70°. The Salmon River and Ophir leads, which have so far been the most productive, are the nearest to the anticline, being respectively 100 and 500 feet distant from it; and, judging from the present developments, it appears that the outcrops of the pay-streaks on the different leads are situated along an imaginary line crossing diagonally the course of the leads, and running N. 73° W. (*mag.*) from the McConnell mill. I would thus suggest cross-cutting north from a shaft on the Salmon River lead in the vicinity of the O'Connell mill, where the anticline is well exposed twenty feet north of the mill, to develop leads on the line of the pay-streak which do not crop at the surface. Forest Hill gold-district. Pay-streaks

"Auriferous quartz veins have also been prospected on three different properties one mile further west, on the south side of Mile Lake, where granite spurs from the mass lying immediately to the north cut the stratified rocks and interbedded veins in all directions, creating disturbances which render prospecting very difficult. This district is the most interesting place yet visited in the province for studying the relation of the granite to the sedimentary rocks. Granite cutting quartz veins.

Nova Scotia—*Cont.*

Cochran Hill gold-district.

"*Cochran Hill Gold District.*—A hurried survey of this district has been made and partly plotted on the scale of 300 feet to one inch. The axis of the anticline, not located here before, was determined at the crusher, on area 533, block 77, and traced eastward, where gold-bearing drift was discovered last season, a fact which ought to encourage prospecting along its course, which is S. 79° E. (*mag.*) This anticline is a very sharp fold overturned to the south, the dip on the north side being to the north at an angle increasing from 60° to 70°, as we recede from the axis, while the south leg has an inverted dip to the north increasing from 75° to 85°, as we approach the axis. The pitch is to the west, at a very low angle.

"At the time of my visit a large belt of leads, called the Mitchell belt, which had been worked from time to time with more or less success, was being re-opened. This belt is 250 feet south of the anticline, 100 feet wide, and composed of several veins of low-grade ore from two to fifteen inches wide.

Goldenville gold-district.

"*Goldenville Gold District.*—One month was devoted last season to this most important district, in making a detailed survey of over 125 auriferous quartz veins which have been worked from time to time. A plan, on the scale of 200 feet to an inch, was plotted in the field, showing the size and cropping of the veins, as far as they can be traced on the surface, the extent to which they have been worked in depth, and the faults and disturbances affecting them.

Pay-streaks following anticlines of minor undulations.

"These veins occur on both sides of a main anticlinal fold, which has a general westerly pitch varying from 0° to 30°, with a perpendicular dip on the south side, and a north dip of 43°. In studying the structure of this anticline more closely, we find that gentle undulations leave the main fold in a north-westerly direction, and that the enlargements and pay-streaks of the veins are found along well-defined lines, having the same north-westerly directions and corresponding to the anticlines of these undulations, while the synclines correspond to a narrowing or disappearance of the veins and to lower grade or barren ore. Three well-defined transverse undulations have been traced on the north side of the saddle, the most easterly of which leaves the main Cobourg shaft near the anticline and runs N. 65° W. (*mag.*) to the shafts on the Gold Hill belt, then curving slightly to the north, it runs N. 57° W. (*mag.*) to the shafts on the Gladstone, developing enlargements and rich streaks on the veins it crosses. Important pay-streaks have been worked along this line on the Cobourg lead to a depth of 200 feet on the incline; on the Gold Hill 75 feet; Bung, 280 feet; Wellington, 750 feet; Dewar, 400 feet; Cameron Whin, 100 feet; Blue, 300 feet;

Wellington line of pay-streaks.

McKenzie, 150 feet; Zwicker Big, 300 feet; Gladstone, 140 feet; McClure, 300 feet; Harrison, 300 feet; Dougald Cameron, 60 feet; Dan McKenzie, 90 feet, and on the Wheel lead, 75 feet. Nova Scotia—*Cont.*

"The second undulation leaves the Mayflower belt on the anticline, and runs N. 50° W. (*mag.*) to and beyond the Little Hayden lead, creating enlargements and pay-streaks on the veins crossed. The most important are those worked on the Mayflower, Roothog, John R, to a depth of 90 feet, Murray, Serpent, Bailey 130 feet, Old Hayden 90 feet, Jumbo 180 feet, and on the Little Hayden worked to a depth of 350 feet. A swamp lying north-west of the Little Hayden has, no doubt, prevented prospecting further north-west on this undulation, but there is every reason to believe that rich streaks occur there. Hayden line of pay-streaks.

"The veins crossing the space between the two most easterly undulations have been found of no value, and prospecting done to the west of the Hayden undulation has proved that the veins pinch out and are completely wanting for a space of 700 feet, at the west of which the western undulation begins. Barren ground.

"Only a few veins have so far been opened on the western undulation, passing about the McRae vein, but good streaks may yet be discovered on some of the veins crossing this line. McRae line of pay-streaks.

"On the south side of the Goldenville anticline, the interbedded auriferous veins are perpendicular and run straight, except on the saddle where they curve to the north-west and the angle of dip decreases gradually. Here again, as a general rule, the richest streaks have been found where the strata and the inclosed veins begin to curve around the main anticline. One well-defined line of pay-streaks leaves the anticlinal axis at the Mayflower belt and runs S. 35° E. (*mag.*) developing the rich streaks worked on the Palmerston and the Meridian big belts to depths of 100 feet. Palmerston line of pay-streaks.

"The above general conclusions are sufficient to prove that the mode of occurrence of the veins depends entirely on the structure of the folds and the lateral pressures to which they owe their origin. If, therefore, the structure of a gold district can be ascertained and mapped out it becomes quite simple to locate the lines of pay-streaks and to trace them to great depths, as is done in Bendigo, Australia, where mining operations have been pushed down, at six different mines, to depths of over 3000 feet, by means of perpendicular shafts on the top of anticlinal folds. Importance of structural geology in deep mining.

"Enormous lateral pressure has induced, at the east end of the district, small cross-faults, the two largest giving a horizontal displacement Faults.

Nova Scotia—*Cont.*

of 40 and 42 feet respectively on the south side of the fold, of later origin than the auriferous veins.

Mining operations.

"The district, once a centre of much activity and from which over $2,000,000 worth of gold has been extracted, has been little worked for the last fifteen years, but within a year or two abandoned properties have been re-opened and worked with very satisfactory results, so that it is safe to say this district is destined in the near future to resume its position as an important gold producing centre.

"At the time of our visit, operations were being prosecuted with renewed energy on the Cobourg, the Springfield, the New Glasgow, the Stuart-Hardman and the Sutherland properties. The return from the four first-named properties for the month of August was 397 ounces of gold from 1245 tons of quartz.

Salmon River gold-district.

"*Salmon River Gold District.*—A few days were spent in a survey of this district, but the plotting of the field-notes is not yet completed. The surface of the district is largely covered with drift and only a few out-crops could be seen, outside the Dufferin mine, at the east end of the district, where some veins have been opened. Large plans and sections of the extensive underground workings of the Dufferin mine have been made by the company. By the courtesy of Mr. R. G. Leckie, manager of the company, these plans have been placed at the disposal of the Geological Survey and will be of great value in affording the data necessary to work out the structure of this important district.

Large veins on anticlines to great depths.

"The quartz veins worked at the Dufferin mine are situated on the apex of a very sharp anticlinal fold. At the main shaft the apex has a westerly and easterly pitch, which has caused a sliding and an uplift of the strata, developing large auriferous quartz veins on the crown of the saddle. These latter occur one under another in the same manner as some of those in Victoria, Australia, to which allusion has already been made. No work was done here last summer, but I was informed that the company contemplates the erection of a suitable plant and will sink a deep perpendicular shaft on the crown of the saddle to work the large ore-bodies converging at this point.

Fifteen-mile Stream gold-district.

"*Fifteen-mile Stream Gold District.*—Ten days were spent in a survey of this district and a plan on the scale of 300 feet to an inch was completed in the field. The north anticline of the Moose River mine passes through this district and is here composed of three minor anti-

Three anticlines.

clinal folds. The two most northerly folds are only 130 feet apart at the east end of the district, on the New Egerton property, and have a pitch to the east at an angle of 30°. The northernmost is well exposed at the west end of the district, on the east shore of Sheet Harbour

River, 100 feet south of the Free Claim lead, where the pitch is to the west at an angle of 18°, but the middle fold could not be located here as the bed-rock does not crop out immediately south of the Free Claim mine. The east and west pitches of the north anticline meet and form a dome a short distance west of the Hudson property, where good ground is most likely to be found. Nova Scotia—Cont.

"The southern anticline is well exposed at the west end of the district on area 905, block 2, 750 feet south of the Free Claim lead, also on the Sheet Harbour portage-road on area 858, block 4. Further east, it passes about 50 feet north of the Halliday lead, beyond which, it is thrown to the north, about 150 feet, by a fault, and passes north of the McCuaig lead and south of the Hudson and White leads, prospected here on the eastern pitch of the anticline. No veins have, so far, been operated on this fold, but some very rich drift, derived, no doubt, from its axis, has been found 600 feet to the south of it on areas 706 and 713, block 6, and at other places, and considerable prospecting has been done through a great thickness of drift to find the auriferous veins. No doubt systematic prospecting along this anticlinal fold will bring to light rich veins. Southern undeveloped anticline promising.

"Mining operations have, so far, been confined to the quartz veins lying along the two northern anticlines. The New Egerton Gold Mining Company has lately taken possession of the principal properties which had been worked from time to time by different companies, and they are now operating on a large scale the important belts of low-grade ore known as the Mother Seigel, and the Nonpareil, on the synclinal fold, immediately south of the middle anticline, at the eastern end of the district. The returns for the first nine months of 1897 are, 8269 tons of quartz passed through a 40-stamp mill, giving 2557 ounces of free gold, or an average of 6·19 dwt. per ton, and last September, 1000 tons gave 445 ounces, or an average of 8·90 dwt. per ton. Mining operations.

"This district is one of the most promising for new discoveries, and is likely eventually to become one of the most important mining centres in the province. But on account of its isolated position, with only one bad road of thirty miles for ingress, it has not been given all the attention it deserves. District very promising.

"*Killag Gold District.*—A few days were employed surveying this comparatively new district, a plan of which was plotted on the scale of 300 feet to an inch. The anticline passing through this district is the continuation of the Goldenville fold from the east, and of the Gold Lake fold from the west. It has a course of S. 79° E. (*mag.*), but instead Killag gold-district.

Nova Scotia—*Cont.*

of having a westerly pitch as in the two latter districts, its axis has a pitch to the east at an angle of 15°. The measures on the south side have a due east-and-west (*mag.*) course and perpendicular dip, while on the north side the measures have a general course of S. 55° E. (*mag.*) and dip to the north at an angle averaging 35°.

Much rich ground undeveloped.

"Only a few veins have so far been worked in this district, but very rich drift has been found for some distance along the course of the axis, indicating that more will yet be discovered. The veins are much larger and more numerous on the apex of the fold than at a distance from it, and more prospecting should be done along this line and operations carried down to greater depths on the saddle.

Operations.

"At the time of my visit, the H. S. McKay property was being operated on two different leads, one on the north dip and the other on the south, with good results. Prospecting was being done on the Mott-Stuart property, on some areas where very rich quartz was found, and two leads dipping to the north have been discovered showing gold quite freely.

Caribou gold-district.

"*Caribou Gold District.*—Twelve days were devoted to surveying this district, a plan of which was plotted on the scale of 500 feet to an inch. The anticlinal fold passing through this district is the continuation of the Cochran Hill and Cameron Dam anticline, which has brought up the upper measures of the lower quartzite group of the gold-bearing series on an elliptical dome, 2900 feet broad and four miles long, surrounded and overlain by the upper slate group. This dome has its centre on areas 328 and 329, block 2, where many quartz veins have been segregated in slate belts interbedded with quartzite beds, dipping away from the centre at low angles along the axis of the fold, increasing gradually to 65° on the north dip and to 70° on the south dip. The course of the fold from the centre of the dome is N. 79° E. and S. 76° W. (*mag.*)

Fissure veins operated.

"Besides the many interbedded veins which have been operated from time to time for some years, four important large fissure-veins, cutting the strata at small angles, have also been worked extensively with good returns. One of these cuts the quartzite and slate group and the other three cut the slate group near its base. Two of the latter are at present worked.

Promising belt on dome of anticline.

"More attention should be paid to the large belt of flat veins lying close together on the centre of the dome, on areas 328 and 329, block 2, on the property of the Caribou Gold Mining Company; for the structure of the fold shows that they probably overlie a succession

of similar veins, all of which could be worked most economically by a perpendicular shaft sunk on the apex. Nova Scotia—Cont.

"*Moose River Gold District.*—Twelve days were spent in this district and a plan on the scale of 200 feet to an inch was plotted in the field. The Fifteen-mile Stream and the Beaver Dam anticlines converge as they approach this district from the east, and are here only 450 feet apart, with two minor plications between them. The folds have a general east-and-west course. The most northerly, which is the more important, has a north dip increasing gradually from 35° to 80° and its axis has a pitch to the west at an angle of 10°. The measures on the south side of the south fold dip south at an angle averaging 60°, and the axis has a pitch to the east at an angle of 15°, and the minor intervening plications lie at an angle seldom higher than 45°. The immense strain and pressure accompanying the meeting of these folds have greatly disturbed the measures and have caused many flexures and faults which complicate very much the structure of the district. The main lines of faulting have a general course varying from N. 10° E. to N. 25° E. (*mag.*), with displacements from a few feet up to 165 feet. Moose River gold district. Several broad folds.

"With the exception of one or two small, true, fissure veins of but little importance, cutting the strata at small angles, all the veins worked in this district are of the interbedded class. The most important are those worked on the north dip and on the crown of the northern anticline, by the Touquoy and the Moose River Gold Mining companies. Some veins have also been worked on the south anticline and on the two smaller plications lying between these two main folds.

"A belt of slate, over 100 feet wide, plicated by these folds, contains a large percentage of auriferous quartz occurring in corrugated veinlets and filling fissures generally following the stratification. A large quantity of this slate has been mined on the Moose River property by open quarries, and a considerable percentage of the slate as well as quartz has been crushed and is said to have given satisfactory returns. This large belt of slate could be mined at a very low cost, and if certain parts of it were sampled separately, tested and found to contain enough gold to cover expenses of mining, it would become a great source of revenue, as the belt is repeated by these plications and gives a considerable width, and can be traced for some distance east and west. Belts of slate of a similar nature that occur in other districts seem worthy of consideration. Important belt of slate.

"The discovery, last summer, of a 100-ounce pocket on the Britannia lead, newly opened on the south dip of one of the middle plica- 100-ounce pocket.

Nova Scotia—*Cont.*

tions, on the Touquoy property, has created more interest in the district, and, as a result, prospecting has been begun on the east and west ends of the district, where much good ground is yet undeveloped.

Mooseland gold-district.

"*Mooseland Gold District.*—One week was occupied in surveying and plotting this district and a plan on the scale of 200 feet to an inch is in progress. All the leads worked occur on the south leg of a very sharp fold, dipping 75° on both the south and north sides, the axis of which runs from the centre of a dome east, magnetic, and N. 81° W. (*mag.*), and has a pitch of 10° to the east and 5° to the west.

Faults.

"Several lines of faulting have caused important displacements at the east end of the district. The westernmost of these runs S. 35° E. (*mag.*) along the edge of a flat on the west side of the Tangier River and gives a horizontal displacement of 560 feet to the north on the east side, the anticline situated 48 feet north of the Irving lead being the same as that immediately south of the Bismarck lead.

"On the east side of the Tangier River, another main fault, running parallel with the first, passes through the west Otter Pond and follows its brook to the south, while northward it follows the river along Grassy Lake. The Bismarck lead anticline is shoved 1500 feet to the north on the east side of this fault, to a ridge 150 feet north of the west Otter Pond, and 50 or 100 feet north of the Brown lead opened here. The pitch of the anticline, which is to the east on the Bismarck lead, is changed to the west on the east side of the fault where the veins will curve westward around the fold. Small faults exist no doubt between this fault and the Bismarck lead, and one was located at the east end of the workings on this lead, but a great thickness of drift east of the river prevents the determination of the others.

Undeveloped ground.

"The location of the anticline to the east of these faults opens up an important new field for the prospector; and the block of country situated between the two main faults and lying to the south of the Bismarck lead anticline, is certainly very valuable, as it contains the continuation of the Irving and other rich leads worked years ago on the old Musgrave property.

Large belt of quartz.

"The very large belt of four veins, giving fifteen feet of quartz in the space of 35 feet, and exposed for 1850 feet along the apex of the anticline north of the Irving lead, contains some sulphides and it should be properly tested for gold by means of perpendicular shafts along the eastern pitch of the apex. The same may be said of the continuation of this belt on and under the Bismarck lead fold, the

latter lead having been found quite rich on the eastern pitch of the apex where it reaches the thickness of fourteen feet."

CHEMISTRY AND MINERALOGY.

Chemistry and mineralogy.

Reporting on the work done in these branches of the Survey's operations Dr. Hoffmann says:—"The work carried out in the chemical laboratory during the past year has been conducted upon the same lines as those heretofore followed. It having been almost exclusively confined to the examination and analysis of such minerals, ores, etc., as were considered likely to prove of economic importance. Briefly stated, it embraced:—

Analyses and assays.

"1. Analyses of fuels—including peat, lignite, lignitic coal, coal and anthracite—from the provinces of Nova Scotia and New Brunswick, the North-west Territory, and the province of British Columbia.

"2. Analyses of natural waters—with the object of ascertaining their suitability for domestic or manufacturing purposes, or possible therapeutic value—from springs in the provinces of Nova Scotia, Quebec, and British Columbia; also of the waters of the Bow, Elbow, Highwood, and Sheep rivers, and of Fish Creek, in the district of Alberta, North-west Territory.

"3. Analyses of limestones and dolomites, from various localities,—in continuation of the series of analyses of such stones already carried out, in connection with an enquiry into their individual merits for structural purposes, for the manufacture of lime, or of hydraulic cement, or for metallurgical purposes, etc.

"4. Analyses of iron ores—including magnetites, hæmatites, and bog-iron ores—from various parts of the Dominion.

"5. Analyses, in regard to nickel content, of certain ores from the province of British Columbia.

"6. Assays, for gold and silver, of ores from the provinces of Nova Scotia, New Brunswick, Quebec, and Ontario, also from Hudson Strait, the North-west Territory, and the province of British Columbia.

"7. Analyses of several highly interesting and for the most part, from an economic point of view, important minerals.

"8. Miscellaneous examinations, such as the partial analysis or testing, as the case might be, of samples of copper ore, iron ochre, graphite, carbonaceous shale, clays, marls, iron sands, and other material not included under the above headings.

Mineral specimens examined.

"The number of mineral specimens received during the period in question, for identification or the obtaining of information in regard to their economic value, was greatly in excess of that of any previous year—amounting to not less than nine hundred and eighty-five. Of these, a large number were brought by visitors, to whom the desired information was communicated at the time of their calling, or failing that—owing to a more than mere cursory examination being necessary or when a partial or even complete analysis was considered desirable—it was subsequently conveyed to them by letter. The number of letters personally written—almost exclusively of the nature of reports and embodying the results of the examination, analysis, or assay, as the case might be, of mineral specimens—amounted to three hundred and thirty-five. The number of those received to one hundred and seventy-two.

Work by assistants.

"Messrs. R. A. A. Johnston and F. G. Wait, assistants in the laboratory, have, as a result of the interest taken by them in their work, and their great assiduity, rendered excellent service. Of these, the former has, in addition to the carrying out of a very large number of gold and silver assays, also made numerous analyses of important minerals, and likewise conducted a very great variety of miscellaneous examinations, whilst the latter has made analyses of a great many natural waters, of some iron and manganese ores, also of some rocks, and in addition carried out some miscellaneous examinations.

"In the work connected with the mineralogical section of the museum, I have had the hearty co-operation and assistance of Mr. R. L. Broadbent. Apart from the general museum work, including the labelling and cataloguing of all newly received specimens, and the maintenance of the collection generally in an orderly condition, he has replaced in the collections illustrating the distribution of iron, copper, lead, antimony, and other ores—close upon a thousand manuscript, by printed labels; and also labelled and catalogued the contents of four recently added new cases, consisting of one hundred and eighty-three specimens of gold and silver ores, collected by Mr. R. G. McConnell, from various mines and claims in the Trail Creek, Nelson, Toad Mountain, Slocan, and Ainsworth mining districts, in West Kootenay, British Columbia.

"Some of the specimens contained in the cases have been replaced by more characteristic ones, and others, to the number of one hundred and twenty-four, added—including the following:—

(A.) *Collected by members of the staff or others engaged in field-work in connection with the Survey:—*

Bailey, L. W.:—

a. Magnetite and specular iron ore from Lepreau, Charlotte County, N.B.

b. Limestone from L'Etang, Charlotte County, N. B.
c. Umber from Letite, Charlotte County, N. B.
d. Pyrite from Red Head, St. John County, N.B.
e. Copper ore from Adams Island and Simpson Island, Charlotte County, N.B.
f. Copper ore from Alma, Albert County, N.B.
g. Dolomite with galena from Frenchman's Creek, Lancaster, St. John County, N.B.
h. Pyrolusite from Quaco, St. John County, N.B.
i. Bog manganese (wad) from Dawson Settlement, Albert County, N.B.
j. Stibnite from Prince William, York County, N.B.
k. Nickeliferous pyrrhotite from St. Stephen, Charlotte County, N.B.
l. Clay from near Deadman Harbour, Charlotte County, N.B.
m. Serpentine from the Narrows of the St. John River, St. John County, N.B
n. Felsite (polished) from Chamcook Mountain, Charlotte County, N.B.
o. "Black Granite" from Bocabec, Charlotte County, N.B.
p. Grindstone, nile-green scythestones, etc., from Stonehaven, Gloucester County, N.B.
q. Specular iron ore from Cranberry Head, St. John County, N.B.
r. Pyrolusite from Tête-à-gauche, Gloucester County, N.B.

Barlow, A. E.:—

a. Sodalite, nephelite, cancrinite and zircon from the Township of Dungannon, Hastings County, O.
b. Auriferous rock from the Crystal gold mine, Wahnapitae Lake, District of Nipissing, O.

Cole, A. A.:—

Columnar graphite from lot 21, range VII., Buckingham, Ottawa County, Q.

Faribault, E. R.:—

a. Iron ochre from East Chester, Lunenburg County, N.S.
b. Stibnite from West Gore, Hants County, N.S.

Ferrier, W. F.:—

a. Quartz crystals from lot 1, con. IX., Madoc, Hastings County, O.
b. Stilpnomelane (var. chalcodite) from lot 12, con. V., Madoc, Hastings County, O.
c. Erythrite from the Cross mine, Madoc Village, Hastings County, O.

Contributions to museum—*Cont.*

d. Limonite (var. bog iron ore) and hæmatite from lot 9, con. XIV., Huntingdon, Hastings County, O.

e. Corundum from lot 14, con. XIV., Carlow, Hastings County, O.

f. Corundum (blue) from lot—, con. IX., Methuen, Peterborough County, O.

g. Corundum from lot 4, con. XVIII., and lot 1, con. XIX., Raglan, Renfrew County, O.

h. Muscovite from the Township of Methuen, Peterborough County, O.

i. Pyroxene crystals from lot 3, con. IV., Herschel, Hastings County, O.

j. Nephelite, sodalite, cancrinite, zircon, apatite, and biotite from the Township of Dungannon, Hastings County, O.

k. Bismuthinite from lot 34, con. IV., Tudor, Hastings County, O.

McConnell, R. G.:—

Collection of gold and silver ores from the following mines and claims in the Trail Creek, Nelson, Toad Mountain, Slocan and Ainsworth mining districts, West Kootenay, B.C.:—

a. Trail Creek mining district—

Jumbo mine.	Sovereign claim.
Josie mine.	Monte Cristo claim.
Cliff mine.	Deer Park claim.
War Eagle mine.	Union claim.
Crown Point mine.	Nickel Plate mine.
Red Mountain mine.	Commander claim.
Homestake claim.	R. E. Lee claim.
Lily May claim.	April Fool claim.
Sheep Creek Star claim.	Mayflower claim.
Gold Star claim.	Deadwood group.
Le Roi mine.	Iron Horse mine.
Iron Colt claim.	Kootenay-Columbia mine.
Gold Hill claim.	Coxey claim.
Great Western claim.	Heather Bell claim.
Iota claim.	Iron Chief claim.
Apache claim.	Waterloo mine.
Black Hawk claim.	Aaron's Isle claim.
Gladiator claim.	O. K. mine, Sheep Creek.

b. Nelson mining district—

Mersey claim.	Queen Victoria claim.
Elise mine.	Maud S. claim.
Homestake claim.	Arnold claim.
Ben Hassan claim.	Canadian King claim.

North Fork of the Salmon River.

Contributions to museum—*Cont.*

c. Toad Mountain mining district—

Whitewater mine.	Dandy mine.
Grizzly Bear claim.	Silver King mine.
Iroquois claim.	Golden Dale claim.
Starlight claim.	Golden King claim.

d. Slocan mining district—

Arlington mine.	Mollie Hughes' claim.
Dayton claim.	Rambler mine.
Nancy Hanks claim.	Proctor's claim.
Carbonate mine.	Best mine.
Enterprise mine.	Idaho mine.
Utica claim.	Ohio claim.
Reco mine.	Phœnix claim.
Slocan Star mine.	Mountain Chief mine.
Granite Mountain claim.	Evening Star claim.
Antelope mine.	Two Friends mine.
Tamarack claim.	Ruth mine.
Fisher Maiden mine.	Last Chance mine.
Kalispell claim.	Alpha mine.
Texas mine.	Freddie Lee mine.
Currie mine.	Cumberland mine.
Ivanhoe mine.	Daisy claim.
Noble Five mine.	Alameda claim.
Lucky Jim mine.	Noonday mine.
Monitor mine.	Deadman mine.
Beaver mine.	London group.
Alamo mine.	Bluebird mine.
Goodenough mine.	Wellington mine.
Silver Bell mine.	Eureka mine.
Miner Boy claim.	Reid & Robinson claims.
L. H. claim.	Springer Creek.
North Fork of Carpenter Creek.	

e. Ainsworth mining district—

King Solomon claim.	Lady of the Lake claim.
Skyline mine.	No. 1 mine.
Blue Bell mine.	Woodberry Creek. (Can. Pac. Co.)

McEvoy, J.:—

Molybdenite and andradite from three miles south-west of Grand Prairie, Yale district, B.C.

Contributions to museum—*Cont.*

(B.)—Received as Presentations :—

Anderson, J. H., Petpeswick Harbour, N.S. :—

Auriferous quartz from the Anderson mine, Lake Catcha gold-district, East Chezzetcook, Halifax County, N.S.

Bache, R. P., Bound Brook, New Jersey U. S. :—

Disseminated graphite from lot 26, range VI., Buckingham, Ottawa County, Q.

Barnum, S., Madoc, Hastings County, O. :—

Sphalerite from lot 1, con. XI., Marmora, Hastings County, O.

Baumgarten, Mrs. H., Ottawa, per W. J. Wilson :—

Quartz crystal and muscovite from mica mine near Lac du Pied des Monts, 18 miles from Murray Bay, Charlevoix County, Q.

Best, James, Bird Creek, Hastings County, O., per A. E. Barlow :—

Corundum crystal from lot 4, con. XVIII., Raglan, Renfrew County, O.

Blue, A., Director of the Ontario Mining Bureau, Toronto, O. :—

Corundum (blue) from lot 14, con. IX., Methuen, Peterborough County, O.

Bostock, H., M.P., Monte Creek Ranch, Ducks, B.C. :—

Obsidian from creek near Martin's, South Thompson River, B.C.

Chambers, R. E., M. E., Bridgeville, N.S., per Dr. H. M. Ami :—

Limonite from the East Branch of East River, Pictou County, N.S.

Claxton, F. J. :—

Amygdaloidal trap with native copper, from about two miles from the line of railway of the Union Collieries Company, and about thirteen miles inland from Union Bay, Vancouver Island, B.C.

Coe, A., Madoc, Hastings County, O., per W. F. Ferrier :—

a. Calcite crystals on hæmatite from lot 9, con. XIV, Madoc, Hastings County, O.

b. Chalcopyrite from lot 25, con. VII, Madoc, Hastings County, O.

Danville Asbestus and Slate Company, Danville Q., per E. D. Ingall :—

a. Crude asbestus, No. 1, from the Jeffrey mine, lot 9, range III. Shipton, Richmond County, Q.

b. Crude asbestus, No. 2.

c. Teased asbestus, No. 1.

d. Teased asbestus, No. 2.
e. " Grade C.
f. " " D.
g. " " E.
h. " Asbestic " sand.
i. Three samples of " Asbestic " plastering.

De Beck, G. W., Vancouver, B.C. :—

Auriferous quartz from Takush Harbour, Smith's Inlet, N. of Vancouver Island, B.C. :—

Domville, Lieut.-Col. J., M.P., Rothsay, N.B. :—

Chalcopyrite and bornite from Mineral Vale, Elgin, Albert County, N.B.

Ferrier, W. F., Geological Survey Dept., Ottawa :—

a. Meteorite (pallasite) from Brenham Township, Kiowa County, Kansas, U.S.

b. Anhydrite from lot 4, con. III. North Burgess, Lanark County, O.

c. Whartonite (of Dr. Emmens) from lot 2, con. II, Blezard, District of Nipissing, O.

Fitzgerald, J., Greenview, Hastings County, O., per W. F. Ferrier :—

Corundum (crystal) from lot 4, con. XVIII, Raglan, Renfrew County, O.

Gray, W. M. E., London, England :—

Collection of gold ores from West Australia :—

a. Dark-gray mica schist, carrying iron-pyrites, from the Ivanhoe mine, Hannans.

b. Gray schistose rock, carrying native gold, from Lake View, Hannans.

c. Slightly weathered quartzite, carrying native gold, from Hoffman, fourteen miles north of Niagara.

d. White subtranslucent quartz carrying native gold from Mount Malcolm Proprietary, Mount Margaret district.

e. Weathered sandstone carrying native gold from Cashman's Reward, Forty-two-mile district.

f. An association of white quartz and white kaolin from Cashman's Reward (surface stone), Forty-two-mile district.

g. Banded, white, greenish-gray and grayish-black steatite, carrying native gold from Devon Hill End, Broad Arrow district.

Contributions to museum—*Cont.*

Haley, Allen, M. P., Windsor, N.S. :—

Filiform native silver from No. 1 mine, Ainsworth mining district, West Kootenay, B.C.

Hardman, J. E., C. E., Montreal, Q. :—

Coal from near the junction of Keremeos road with the road from Penticton to Osoyoos, B.C.

Harris, J. M., Sandon, B.C., per Dr. G. M. Dawson :—

Silver ores from the Mollie Gibson lead, Reco mine, and the Arlington mine, Slocan mining district, West Kootenay, B.C.

James, Capt. W. E., Combermere, O., per W. F. Ferrier :—

Corundum (crystal) from lot 4, con. XVIII., Raglan, Renfrew County O.

Jones & Stark, Messrs., Wellington and Nanaimo, B.C., per W. F. Ferrier :—

Molybdenite from the Marguerite, Evangeline and Josephine claims, north side of Mount Buttle, about five miles north of Cowichan Lake, Vancouver Island, B.C.

Lanigan, R., Calumet, Q. :—

Porcelain-ware manufactured from kaolin found on lot 5, range VI., Amherst, Ottawa County, Q.

Low & Blenkhorn. Messrs, Nappan, N. S., per Hugh Fletcher :—

Chalcocite from the farm of Amos Blenkhorn, on the road between Nappan and Maccan, Cumberland County, N.S.

McArthur, D. H., Calabogie, O.

Tremolite (var. asbestus) from lot 22, con. IV., Blythfield, Renfrew County, O.

McAllister, W. B., Ottawa, Q., per W. F. Ferrier :—

Quartz crystals from lot 23, range XIII., Eardley, Ottawa County, Q.

McKenzie, H. R., C. E., Sydney, N.S. :—

Soapstone from Landing Cove, north shore of Gabarus Bay, near Louisbourg, Cape Breton County, N.S.

McLellan, A., 117 Metcalfe St., Ottawa :—

Tremolite (var. asbestus) from lot 22, con. IV., Blythfield, Renfrew County, O.

Moffatt, C. P., North Sydney, N.S. :—

Chalcopyrite from George River, Cape Breton County, N.S.

Newby, Frank, Ottawa, O. :— Contribution to museum—Cont.

Tremolite (var. asbestus) from near Calabogie, Renfrew County, O.

North American Graphite Company, Ottawa, O., per H. P. H. Brumell, Manager :—

a. Disseminated graphite from lot 28, range VI., Buckingham, Ottawa County, Q.

b. Vein graphite from the same locality as the preceding.

c. Prepared graphite, for crucible making—Grades L.B., L.C., L.D. and L.G.

d. Prepared graphite, for lubricating—Grades L.B., L.C., L.D., L.L., S.A. and S.A.X.

e. Prepared graphite, for packing—Grades L.D., L.F. and L.M.

f. Prepared graphite, for stove polish and pencils—Grade S.A. and S.A.X.

g. Prepared graphite, for paints—Grade S.A., S.B., P.A., P.C. (gray), P.D. and P.E.

h. Prepared graphite, for electrotyping—Grades E.A., L.L., S.A. and S.A.X.

i. Prepared graphite, for graphite greases—Grades S.A., S.A.X., S.B. and L.L.

Northumberland Stone Company, Shediac, N.B. per Foster Pickard Manager :—

Sandstone (6 in. cube, dressed) from Buctouche, Kent County, N.B.

Obalski, J., Mining Inspector, province of Quebec, Quebec, Q., per C. W. Willmott :—

Grossularite from P. P. Hall's chromite mine, block A, Coleraine, near Black Lake, Megantic County, Q.

Ogilvie, Wm., Ottawa, O.:—

a. Coal from Coal Creek, Yukon River, N.W.T.

b. Mineral resin, Yukon River, N.W.T.

c. Collection of rocks from the Yukon district, N.W.T.

Reed, Dr. J., Reedsdale, Megantic County, Q.

Bornite from Harvey Hill, Leeds, Megantic County, Q.

Soues, F., Clinton, B. C.:—

a. Auriferous quartz from the Golden Eagle, Golden Cache, and Excelsior claims, Cayoosh Creek, Lillooet district, B.C.

Contributions to museum--*Cont.*

b. Auriferous quartz from the Ida May and Forty Thieves claims, Head Waters of the South Fork of Bridge River, Lillooet district, B.C.

Struthers, Dr. R. B., Sudbury, O., per Dr. H. M. Ami :—

Anthraxolite from lot 9, con. VI, Fairbank, district of Algoma, O.

Sutherland, Hugh, Winnipeg, Man.:—

Silver ore from the Silver Nugget mine, Eight-mile Creek, Slocan Lake, West Kootenay, B.C.

Taylor, J. W., Ottawa, O.:—

Microcline from the Township of Templeton, Ottawa County, Q.

Waterman, W. J., Vancouver, B.C.:—

Radiated quartz from Valdez Island, Seymour Narrows, B.C.

West, Howard :—

Calcite from Wilson Creek, Slocan Lake, West Kootenay, B.C.

Wheeler, A. O., Ottawa, O.:—

Marl from the Fraser River Valley, near Mission City, B.C.

Wells and Redpath, Messrs., Kamloops, B.C.:—

Asbestus from the south side of Tulameen River, nearly opposite Bear Creek, Yale district, B.C.

Educational collections supplied.

" Mr. C. W. Willimott has, for the most part, been engaged in making up collections of minerals and rocks for distribution to various Canadian educational institutions. The following is a list of those to which such collections have been sent :—

1. Collegiate Institute, Seaforth, O.	Consisting of	120	specimens.
2. High School, Calgary, N.W.T.	"	120	"
3. Public School, Hopewell Cape, N.B.	"	80	"
4. Union Mine School, Comox, V.I., B.C.	"	80	"
5. West Kent School, Charlottetown, P.E.I.	"	120	"
6. High School, Orillia, O.	"	120	"
7. High School, Summerside, P.E.I.	"	120	"
8. Provincial Normal School, Winnipeg, Man.	"	120	"
9. High School, Oxford, N.S.	"	120	"
10. Granby College, Granby, Q.	"	120	"
11. Public School, Parrsborough, N.S.	"	80	"
12. County Academy, Shelburne, N.S.	"	40	"
13. Public School, Andover, N.B.	"	80	"
14. St. Vincent's School, St. John, N.B.	"	80	"
15. Joggins Mine School, Joggins Mines, N.S.	"	80	"
16. Queen's County Academy, Liverpool, N.S.	"	120	"
17. Mont Ste. Marie Convent, Montreal, Q.	"	80	"
18. B. C. School of Mines, Vancouver, B.C.	"	120	"

Educational collections supplied—*Cont.*

19. Cong. des Sœurs de Ste. Croix et des Sept Douleurs, Montreal, Q	Consisting of	80	specimens.
20. High School, Williamstown, O	"	120	"
21. High School, St. Stephen, N.B.	"	40	"
22. Polytechnic School of Laval University, Montreal, Q	"	64	"
23. Sacred Heart Academy, London, O	"	80	"
24. Grammar School, Bathurst, N.B	"	120	"
25. Convent Jesus Marie, St. Joseph de Lévis, Q	"	80	"
26. High School, Stellarton, N.S	"	120	"
27. High School, Great Village, N.S	"	80	"
28. Collegiate Institute, Kingston, O	"	120	"
29. High School, Bridgewater, N.S.	"	120	"
30. Superior School, Upper Maugerville, N.B.	"	80	"
31. McGill College, Montreal, Q	"	8	"
32. University of New Brunswick, Fredericton, N.B.	"	8	"
33. University of Toronto, Toronto, O	"	8	"
34. Queen's University, Kingston, O	"	8	"
35. University of Laval, Quebec, Q	"	8	"
36. School of Mining and Agriculture, Kingston, O	"	8	"
37. Grammar School, Richibucto, N.B.	"	120	"
38. Grand Harbour School, Grand Manan, N.B.	"	80	"
39. Public Library, St. Catharines, O	"	120	"
40. Laval Business College, St. Vincent de Paul, Q	"	120	"
41. Huron Street Public School, Toronto, O	"	80	"
42. Demill Ladies' College, St. Catharines, O	"	80	"
43. Imperial Institute, London, Eng	"	12	"
44. Morin College, Quebec, Q	"	40	"
45. Public School, Riverside, N.B.	"	80	"
46. High School, Tracadie, N.B.	"	120	"
47. Hants Border School, Hantsport, N.S.	"	80	"
48. Convent du Sacré Cœur, Ottawa, O	"	80	"
49. High School, Waterford, N.B.	"	120	"
50. High School, St. Catharines, O	"	120	"
51. The Academy, Yarmouth, N.S.	"	120	"
52. Salem School, Salem, N.S.	"	80	"
53. High School, Mitchell, O	"	120	"
54. High School, Markham, O	"	120	"
55. Havergal Ladies' College, Toronto, O	"	120	"
56. District No. 1 School, "The Range," N.B.	"	80	"
57. Public School, Jarvis, O	"	80	"
58. Public School, Brandon, Man.	"	80	"

"Making a total of 5,164 specimens thus distributed. In addition, specimens of various mineral substances have been supplied by request to several institutions and firms.

Collections made by Mr. Willimott.

"In the early part of the summer Mr. Willimott visited, with the object of procuring further material for the making up of collections and simultaneously, cabinet specimens for the museum—the townships of Hull, Wakefield, Masham, Wright, Maniwaki and Egan, in Wright county, and those of Aldfield, Cawood and Alleyn, in Pontiac county, in the province of Quebec; as likewise the townships of Cameron,

Collections made by Mr. Willimott—*Cont.*

Papineau and Calvin, in the district of Nipissing, and those of Griffith, Lyndoch, Raglan and Sebastopol, in Renfrew county, in the province of Ontario.

"In the prosecution of this work he procured, amongst other specimens :—

	Specimens.	Weight.
Albite	24	
Apatite, crystals	150	
Amazon stone	150	
Asbestus	7	
Barite		400 pounds.
Calcite		150 "
Chrysotile	2	
Chalcedony	2	
Corundum	200	
Fluorite	30	
Gneiss		700 "
Graphic granite	2	
Graphite	2	
Grossularite	130	
Hornblende, crystallized		150 "
Limestone, crystalline		300 "
Mica	8	
Mica, crystals	50	
Microcline	3	
Molybdenite, from Aldfield, Hull and Egan	66	
Molybdenite, from Alleyn		100 "
Mountain cork	70	
Pyroxene	30	
Quartz, crystals	130	
Quartz, massive		200 "
Serpentine		450 "
Tourmaline, crystallized	235	
Tremolite		400 "
Wollastonite	100	

"Amongst the minerals collected by Mr. Willimott for the museum, collection, was one which proves on examination to be a rare and interesting species not previously found in Canada. This will be referred to in full in my forthcoming report. Mr. Willimott also made some useful notes in regard to the occurrence of some of the above-mentioned minerals—more especially touching that of the molybdenite.

"In addition to the above minerals, Mr. Willimott has received for making up collections the following from Mr. W. F. Ferrier :—

	Specimens.	Weight.
Andradite	16	
Nephelite, with albite	50	
Corundum, in matrix		100 pounds.
Pyroxene, crystals	200	
Quartz, crystals	380	

LITHOLOGY.

Mr. W. F. Ferrier reports as follows on the lithological work of the year :— Lithology.

"The usual routine work has been carried on during the past year. It has comprised the examination and reporting on numerous miscellaneous minerals and rocks, including interesting series of rock specimens from the cinnabar deposits near Kamloops Lake, British Columbia, and some of the Seine River gneisses collected by Mr. McInnes.

"In the museum, temporary labels have now been placed in all the upright cases of the stratigraphical collection of rocks. A camera for taking micro-photographs with the new Fuess microscope lately acquired, has enabled a number of interesting photographs illustrating the structure of various rocks to be obtained, some of which will be published in forthcoming reports. Museum.

"On the 27th of June I left Ottawa to continue my observations on the corundum deposits of Hastings and Peterborough counties, O., and also to examine the nepheline-syenite localities in the former county for rare minerals. During a portion of the time I made my head-quarters at the camp of Mr. Barlow of this Survey, whose work lay in the vicinity. Field-work.

"The nepheline-syenites of Dungannon township were carefully examined, and fine specimens of sodalite, nepheline, cancrinite, biotite, apatite, hastingsite, etc , were secured. Besides these minerals some rare and interesting species not previously observed were collected and will shortly be described. Minerals collected.

"From Dungannon I went with Mr. Barlow to the pyroxene locality in the township of Herschel, and collected some hundreds of exceedingly fine and perfect crystals. I then went south to Madoc, collecting blende, quartz crystals, hæmatite, erythrite and calcite in the neighbourhood, and drove to the corundum locality in the township of Methuen, Peterborough county.

"The corundum here, as in Hastings, occurs in a coarse pegmatite, distributed rather sparsely throughout the mass and intimately associated with muscovite, in which it is frequently completely embedded. Some of it is of a rich sapphire blue colour, but no material fit for cutting was found. No good crystals were seen, the corundum occurring in irregular rounded masses, having a most curious corroded surface, greatly resembling the rounded and corroded quartz crystals that occur in the bornite at the Harvey Hill mines in the Eastern Townships of Quebec. Corundum.

Lithology—*Cont.*

"I returned to Madoc and went north again to the township of Carlow, where the original corundum locality, near Armstrong's mills, was visited, fine crystals collected and several photographs taken by Mr. Barlow. From Carlow I proceeded to the corundum locality on the farm of Henry Robillard, lots 1 and 2, concession XIX., and 3 and 4, concession XVIII., Raglan township. The occurrence of the corundum here appears to be of much the same character as in Carlow, but some interesting and new facts were observed.

"In the same hill we found syenite, granite and nepheline-syenite occurring in such relations as to leave no doubt in my opinion that we have there a magnificent example of magmatic differentiation of rock types. The corundum occurs impartially distributed throughout the whole of these three types of rock. This particular locality will be fully described in Dr. Adams's and Mr. Barlow's report on the region.

"Spinel, of a bright green colour, in beautifully fresh and well formed octahedrons, was found lining cavities in the corundum; and many other interesting minerals were observed.

"I returned to Ottawa on the 17th of July, and, availing myself of your permission, attended the August meeting of the British Association for the Advancement of Science in Toronto, where I read a paper jointly with Mr. Barlow."

MINING AND MINERAL STATISTICS.

Mineral statistics.

Of the work under his charge, Mr. E. D. Ingall reports as follows:—

"The work of the Section of Mineral Statistics and Mines has been prosecuted throughout the year on much the same lines as heretofore.

"The preparation of the preliminary summary statement of the mineral production of the Dominion for 1896 was completed by the 13th of February of the current year. This is the earliest date yet accomplished, and the pamphlet containing this tabulated statement, together with the explanatory matter, was distributed shortly afterwards.

"On 26th of June, a pamphlet was completed giving in tabular form the production of the various mineral industries of Canada from 1886 to 1896, inclusive. This statement was compiled from the summary tables of mineral production found in the annual reports of the section, revised in accordance with the latest information available and brought to a uniform basis of presentment. This was accompanied by explan-

atory matter relating to the growth and change of the various industries during the eleven-year period covered. Mineral statistics—*Cont.*

"As much of the detailed information for the detailed statistical report is not available for some months after the close of the year dealt with, it has been found impossible, with present facilities, to complete it and put it through the press till late in the year following that to which it refers. The full report for 1896 is, however, printed and distributed to our exchanges. A commencement has been made toward revising the statistical data for past years contained in this report, with regard to which important information has of late come to hand which was not available in previous years.

"The collection of samples from borings made throughout the Dominion and of records of the same, has, through the kindness of operators, been augmented, and progress has been made in the collection of plans, photographs and other records of mines and mineral deposits. Samples from borings.

"The widespread interest of late aroused in mining matters and in the mineral resources of the Dominion has greatly stimulated inquiry on these points, and the Section has, of course, had to do its share of the largely increased work of the Department due to this cause.

"Of late years, for various reasons, but little time has been available for the personal study by the officers of the Section of the various mineral industries of the country. Thus the technical information available for the report is either fragmentary and somewhat doubtful or obtained indirectly from various sources of varying reliability. An effort was, however, made during the summer to use the little time available, and visits were made to the iron deposit and quarries at Arnprior and to the galena deposits near Galetta in that vicinity. Visits to mines.

"With a view to increasing our knowledge of the graphite industry of Ottawa county, Quebec, I made several trips to the mines in Buckingham township to determine the best lines of procedure to this end. This work was carried out by Mr. A. A. Cole, B.A.Sc., who was occupied several weeks in making the necessary surveys and examinations. As a result of his work detailed plans are now available, showing the distribution of the worked deposits and the extent and relations of the workings, together with notes on their immediate geological surroundings and various other points. It is intended to incorporate these results in the next report and to give thus, not only the statistical data, but also the technical details necessary to a complete description of this industry.

Mineral statistics—*Cont.*

"During the year Mr. A. A. Cole has acted as technical assistant, and in July the staff of the Section was brought to its former strength by the appointment of Mr. J. McLeish, B.A., *vice* Mr. L. L. Brophy, who resigned on March 31st."

PALÆONTOLOGY AND ZOOLOGY.

Palæontology and Zoology.

Mr. Whiteaves submits the following statement of the palæontological and zoological work done in 1897, either by himself personally or under his immediate supervision.

Publications.

"The third part of the third volume of 'Palæozoic Fossils' referred to in the Summary Report of this Department for 1896, was published in April, 1897. It consists of 114 pages, large octavo, and is illustrated by seven full-page lithographic plates and fifteen woodcuts. During its preparation, the authorities of the United States National Museum kindly lent to the writer, for study and comparison, all the fossils in their collection from the Galena-Trenton formation of the Red River valley in Canada. These fossils were identified early in the spring and returned, named, on April 30th.

"A collection of fossils from the Cretaceous rocks of North-west Bay, Vancouver Island, and other localities in British Columbia, has been examined and the species determined, for Mr. Walter Harvey, of Shoal Bay, Thurlow Island, B.C., who has presented many fine and rare specimens to the Museum.

"A paper entitled 'Description of a new genus and species of Cystideans from the Trenton limestone at Ottawa,' was published, with three illustrations, in the number of the 'Canadian Record of Science' issued in June. The genus is of special interest to biologists on account of its close affinity to the Blastoids. Two papers descriptive of other remarkable fossils in the Survey collection were read at the meeting of the British Association for the Advancement of Science in Toronto. One of these is entitled 'Note on a fish tooth from the Upper Arisaig series of Nova Scotia,' and the other 'On some remains of a Sepia-like Cuttle-fish from the Cretaceous rocks of the South Saskatchewan.'

"While attending the meeting of the Royal Society of Canada at Halifax in June, and that of the British Association in August, several public and private palæontological and zoological collections were examined, and a number of specimens of interest secured for the museum of the Survey.

"The second part of the first volume of 'Contributions to anadian Palæontology' published in 1889, contains an illustrated paper (advance sheets of which were distributed in 1887 and 1888) entitled 'On some fossils from the Hamilton formation of Ontario,' with a list of the species at present known from that formation and province. Since this paper was published, many additional species have been discovered in these rocks by local collectors, and specimens of most of them have been presented to the museum of the Survey, or acquired for it. It has, therefore, been decided to devote the fifth and concluding part of the volume to an illustrated paper consisting of a revision of this local fauna, inclusive and descriptive of the most recent additions thereto. With this object in view and before commencing the manuscript of this paper, a visit was paid to Thedford in May, and the large and important collections of the fossils of that neighbourhood recently made by the Rev. Hector Currie, Mr. G. Kernahan and Mr. N. J. Kearney were carefully examined. At Toronto, Mr. B. E. Walker's collection of the fossils of the Thedford region was also critically examined. Numerous specimens from each of these collections have been borrowed for a further and more exhaustive study, and Mr. Charles Schuchert has most kindly lent the writer 284 specimens of 44 species of fossils, and a list of all the species that he collected at Thedford and Bartlett's Mills, in 1895, for the United States National Museum. Many of the species lent by Mr. Schuchert have not previously been found in Canada, and a few are, apparently, new to science. A preliminary study of the whole of this material has been made and the manuscript of the part of the paper referring to the corals, echinodermata, brachiopoda and pelecypoda, or about one-third of the whole, has been written. It is hoped that the whole of the manuscript, with the plates, will be ready for publication, and the volume finished, next spring.

Palæontology and Zoology—Cont.

Hamilton formation, Ontario.

"Since the lamented death of Professor E. D. Cope, in April, the vertebrate fossils from the Belly River and Laramie rocks of Alberta, which had been entrusted to him for study and description, have been returned from Philadelphia. A few of the more fragile of these specimens were somewhat broken in transit, but these have been skilfully mended by Mr. T. C. Weston, who has also mounted several of them, especially two unique skulls of a Dinosaur (*Lælaps incrassatus*, Cope), for exhibition in the museum.

Cretaceous vertebrate fossils.

"In addition to the series of vertebrate fossils from the Red Deer River collected by Mr. Lambe, and the bones and teeth of Mastodons from two localities in Ontario collected by Dr. Ami, which are referred to in their reports, several interesting collections of fossils have been acquired during the past year, either by donation or purchase, and in

Palæontology and Zoology—*Cont.*

most cases as the result of correspondence or of personal interviews with the collectors.

Additions in zoology.

"The additions to the zoological collections in the museum have been quite as numerous as in previous years, as will be seen in the list of contributions to the museum, in which they are fully particularized. The skins of the adult male northern fur-seal and two pups, and of the northern sea-lion and cub, from the Pribyloff Islands, which were referred to in last year's Summary Report as having been received from Mr. James M. Macoun, have been mounted at the Ward Natural Science Establishment at Rochester, N.Y. The group of the three fur-seals makes a striking and attractive exhibit, but the sea-lion is unfortunately too large to be brought into the museum.

"The official correspondence has been about as usual (a little more than 200 letters). The duties of Acting Director have been performed for about five weeks, during the Director's absence in British Columbia.

Work by Dr. H. M. Ami.

"Dr. Ami has continued the work of determining palæontological collections, principally from the eastern provinces of the Dominion, besides giving some time to the preparation and display of specimens in the museum.

"Lists of fossils from numerous localities in the Ottawa palæozoic basin and in the valley of the St. Lawrence, between Brockville and Montreal, have been prepared and added to those referred to on page 126 of the Summary Report for 1896, all of which are to accompany the reports by Dr. Ells on the areas comprised in Ottawa City, Perth and Pembroke sheets (Nos. 119, 120, 122 of Quebec and Ontario). These lists were prepared from collections made by Dr. Ells and the late Mr. N. J. Giroux in 1896. Dr. Ami also assisted Dr. Ells in ascertaining the precise geological horizons of certain much faulted and disturbed fossiliferous limestones in the vicinity of Ottawa.

"He has also continued the work of determining a large number of fossils collected by Mr. Hugh Fletcher, Mr. T. C. Weston, Mr. J. A. Robert, and by himself, last season, in Colchester, Pictou and Antigonish counties. With a view to ascertaining the exact age of the sedimentary formations of that part of Nova Scotia, the report and geological maps of which areas are being prepared for publication by Mr. Fletcher, the greater portion of the specimens have been examined and preliminary lists of the species prepared.

Field-work in Nova Scotia.

"On the first of June Dr. Ami received instructions to proceed to Nova Scotia to continue the work of the two previous seasons and 'obtain local series or lists of fossils from as many places as possible in

the so-called Devonian belt of the southern parts of Pictou and Colchester counties;' likewise 'to visit such parts of the province to the west as might be found desirable in the course of Mr. Fletcher's mapping work, with possible reference to the taxonomic position of the New Glasgow conglomerates or their equivalents,' etc. From the 1st of June to the 10th of August he visited numerous localities in the Middle and West River valleys of Pictou county, along the valleys of the Salmon and Black rivers and Calvary Brook, in the numerous cuttings afforded by the railway from Union station to West River station. Special attention was paid to the highly fossiliferous shales of Avonport, Horton and Trenholm Brook, in order to ascertain the relations which the Horton series of Sir Wm. Dawson bears to the fossiliferous rocks of Riverdale and other localities of so-called Devonian age. From these Horton beds a large and interesting collection of fossils was obtained. Palæontology and Zoology — *Cont.* Pictou county

"In Antigonish county, he also spent some time obtaining material both from the undoubted Silurian formations of the Arisaig shore and from the supposed Devonian series of McAra's Brook. From several localities in this brook better material was obtained than on any previous occasion. It is hoped that this will serve to fix more definitely the age of these rocks and to enable the proper geological colouring to be given to the maps of this part of the province, now awaiting publication. Antigonish county.

"Big Island Merigomish, and King Head were visited with a view of ascertaining the exact age of the coal-seam cropping out north of the lobster factory, but the palæontological evidence obtained in these places was very meagre and unsatisfactory.

"The Cumberland coal basin and the relations of the Millstone Grit and the productive Coal Measures and of the Upper Carboniferous or Permo-Carboniferous, to one another, occupied a considerable portion of his time. Collections of fossils were made at Spicer's Cove, West Cove, Pudsey's Point, Sand River Cove, Shulie, Joggins and Fish Cove, in the Joggins Mines district, as well as at Leamington, in South Brook, Dixon's Mills and Salt Springs mines, in the Springhill mines region. The shales of Spicer's Cove contain a flora apparently akin to that of rocks which are referred by Dr. Ells to the Millstone Grit. This flora, however, has a decided resemblance to that of the Coal Measures. In no part of the district did he find types which are indicative of Permian age. Cumberland county.

"In this work Dr. Ami was ably assisted by Mr. Lee Russell, of the Provincial Normal School, Truro, N.S., and by Mr. M. H. McLeod—

Palæontology and Zoology—*Cont.*

Mr. Hugh Fletcher's assistant. He desires to convey thanks also to Prof. Coldwell, Prof. Tufts, and to Mr. Harold Tufts, all of Wolfville, N.S., for assistance furnished whilst in their neighbourhood.

"He has prepared preliminary lists of the fossils from these localities which will help to determine the exact palæontological and stratigraphical relations of the various members of the disturbed and doubtful series of rock formations of the counties of eastern Nova Scotia. When in Halifax, Montreal and St. John, N.B., Dr. Ami obtained access to the palæontological collections from Nova Scotia in the museums of those places, and secured lists of fossils which help to throw further light upon this difficult problem. In connection with the work a standard section should be made, and he suggests that a careful examination might be undertaken of the exact sequence of the fossils in Sir Wm. Logan's great section of Carboniferous strata at the Joggins shore. Also a series of collections of fossils should be made from Folley, Economy, Parrsboro', Five Islands, Shubenacadie, Tenycape and Walton, in Nova Scotia, and from St. John, Mispec, Albert county and other localities in New Brunswick.

"In connection with the work in Nova Scotia the following points may be noted:—

Notes on the work done.

"(1) No fossils were obtained in the New Glasgow conglomerate of Pictou county.

"(2) In the rocks overlying the New Glasgow conglomerate along the eastern bank of the East River, between New Glasgow and Trenton, in Rear Brook quarry, and along the left bank of Smelt Brook above the bridge at the Trenton steel works, certain black Carboniferous and highly fossiliferous shales occur, associated with soft, gray, and more or less fine-grained sandy shales and sandstones also fossiliferous. The evidence afforded by the fossil flora and fauna of this series points to the Carboniferous rather than to the Permian age of the rocks in question. No typical Permian forms have yet been obtained from these beds, but land plants and aquatic animals collected indicate the Carboniferous Period.

"(3) The nearest approach to Permian is found in the strata of Cape John and vicinity, where large branches of the genus *Walchia* and fronds of *Pecopteris* occur. These have a Permian facies, but the genera mentioned might occur in Upper Carboniferous rocks. The term Permo-Carboniferous, already used by the Survey, seems quite applicable to the shales and sandstones of Cape John and other localities.

"(4) The fossiliferous sandstones and shales of the Union and Riversdale regions in Colchester and Pictou counties, are seen to lie

unconformably beneath the fossiliferous marine limestones, sandstones and shales of Lower Carboniferous age. They hold plants and animals which in their broad general characters resemble those of the eastern American Carboniferous—if we leave out of consideration the types which occur in the 'fern-ledges' of Lancaster county in New Brunswick, described and regarded as Devonian. The fossils which show this affinity to types of Carboniferous age include, besides the presence of a protolimuloid crustacean closely allied to *Prestwichia* and erect trees of doubtful affinities, such genera as: *Calamites*, *Asterophyllites*, *Alethopteris*, *Sphenopteris*, *Cyclopteris*, *Cordaites*, *Spirorbis*, *Naiadites*, *(Anthracomya)*, *Lepidodendron*, *Leaia*, *Carbonia*, *Estheria*, *etc.* All these have been found in the Riversdale and Union rocks, and the following species are common to these rocks and those of Lancaster county, New Brunswick: *Cyclopteris (Aneimites) Acadica*, *Lepidodendron corrugatum*, *Stigmaria ficoides*, var., *Cordaites Robbii*, (sometimes with numerous specimens of *Spirorbis* covering the surface of the leaves), besides closely related forms belonging to the genera *Calamites*, *Asterophyllites*, *Alethopteris* and *Sphenopteris*. From this it would appear that the strata of Union and Riversdale may be regarded as equivalent to those in Lancaster county, which have been described and held to be of Devonian age. Palæontology and Zoology—*Cont.*

"Some Ostracods from the rocks above referred to have been sent to Prof. T. Rupert Jones, and fragments of crustacea and fishes to Dr. Henry Woodward and Mr. A. Smith Woodward, of the British Museum; who have furnished important information in regard to them.

"In the museum, a large number of boxes containing local series and lists of fossils has been placed in the drawers below the cases, and a catalogue of these has been prepared. Two cases of fossils from the Manitoba Devonian areas have been arranged during the year. To the collection containing duplicate specimens for educational and distribution purposes, material has been added from time to time. Additions of species to the museum collection have been recorded and entered in a catalogue of Canadian fossils in course of preparation. Work in the museum.

"Dr. Ami also reports that he has kept the records and additions to the ethnological collection and has spent some time in obtaining exact information regarding the objects of Indian manufacture recently obtained from the Department of Indian Affairs.

"On the 21st of August he was instructed to proceed to Leamington, in Essex county, Ont., and to Marburg, in Norfolk county, Ont., to investigate recent discoveries of elephantine remains at these places. Mastodon remains in Ontario.

Palæontology and Zoology—*Cont.*

Nearly six weeks were spent in this work. He made notes on the mode of occurrence of the remains, and on the characters of the deposits in which they were found, and obtained, not only numerous bones and teeth, with portions of the skulls, of two or more specimens of Mastodon, but also specimens of fossil wood and molluscan fossils occurring with the remains, which throw some light on the climatic conditions of the period when these animals existed in Ontario. As far as is known the exact mode of occurrence of Mastodon remains in Western Ontario has not been previously noted.

Cambro-Silurian outliers.

"In connection with the geology of the district comprised in sheet No. 131, Ontario, Lake Nipissing sheet, he has examined a small but important collection of fossils from Mattawa, which appears to represent the most westerly outlier of Ordovician strata in the Ottawa Valley. The list of fossils from this locality will appear in Mr. Barlow's report on the geology of that region. In order to more effectively complete the study of the fossil fauna of the Lake Temiscaming outlier, sheet No. 138 of the Ontario series, a box of fossil remains obtained by officers of the Geological Survey during Sir Wm. Logan's administration, was examined and a list of the species therein prepared to be incorporated in the report on the fossils of the district.

"Collections of fossils for educational institutions in Canada are in course of preparation, and seventy-five specimens of fossil Brachiopoda from the Island of Anticosti have been forwarded to Prof. James Hall, of Albany, N.Y., in exchange for specimens received.

Report on museums.

"By request of the Director, and with his assistance, Dr. Ami has prepared a 'Report upon the state of the principal museums in Canada and Newfoundland.' This report, which was read before The General Conference Committee of the British Association for the Advancement of Science during its meeting in August last at Toronto, has subsequently been printed *in extenso*. It is essentially a digest of the contents of thirty-one museums in Canada, together with notes on fifty private collections.

"On several occasions he has been called upon to examine and report upon materials obtained in the course of boring operations in the Palæozoic rocks of various localities in Ontario, with special reference to the occurrence of gas, oil or salt in the strata penetrated. These reports were handed to the Director from time to time.

Report by Prof. Lapworth.

"Prof. Charles Lapworth, of Mason Science College, England, the well-known authority on graptolites, has completed the task of identifying a large number of specimens sent him since 1885, and has sent a MS. report on the graptolites from many localities in Canada, from

the Atlantic to the Pacific. The specimens upon which this report is based were returned in the spring. Palæontology and Zoology—*Cont.*

"The following papers were prepared by Dr. Ami during the past year, in addition to his report on Canadian museums:—

"'Notes on some of the fossil organic remains in the geological formations and outliers of the Ottawa Palæozoic Basin.' Royal Soc. Can., 2nd series, vol. II., sec. IV., pp. 151-158. 'Synopsis of the Geology of Montreal,' being part of British Medical Association Souvenir Guide. 'Contribution to the Palæontology of the Post-Pliocene Deposits of the Ottawa Valley.' Ottawa Naturalist, vol. XI., No. 1, pp. 20-26.

"Mr. L. M. Lambe completed the revision of the Palæozoic tabulate corals of Canada, to which reference was made in the Summary Report of 1896, and the manuscript was prepared for the printer at the end of February. The drawings thought necessary for the proper illustration of the structural details of the corals were made by Mr. Lambe, and have been reproduced, forming in all five octavo plates. Late in February, in continuation of his study of Canadian Palæozoic corals, work on the *Rugosa* was begun and continued until the middle of July. There are now known in Canada about twenty-four genera and over one hundred species of corals of this group. Work by Mr. L. M. Lambe.

"In July, Mr. Lambe was directed to proceed to the North-west Territories, with the double object of inspecting and reporting upon the experimental borings in progress there and of collecting further fossil remains from the Laramie and Belly River formations in the vicinity of Red Deer River. In compliance with these instructions, Mr. Lambe left Ottawa on July 23rd for Red Deer, Alberta, from which place it was proposed to descend the river by boat and thus reach some of the best exposures of these formations. Red Deer was reached on July 29th, and, with two men engaged there, a start was made on the morning of July 31st. Collections made in the North-west.

"Progress down the river was rendered comparatively easy, as there was a fair amount of water in the stream, and the current was moderately strong. The mouth of the Red Deer River, where it debouches into the south branch of the Saskatchewan River, was reached on August 31st. Continuing down the South Saskatchewan River, Saskatchewan Landing, distant about three hundred and eighty-five miles from Red Deer by water, was reached on September 3rd. Here the fossils collected, aggregating in all over eleven hundred pounds in weight, were packed in boxes and transported by wagon south by the Battleford trail to Swift Current, a distance of twenty-seven miles, whence they

Palæontology and Zoology—*Cont.*

were shipped to Ottawa by rail. It was found later, on being unpacked, that none of the fossils, nearly all of which were fragile and some of considerable weight and size, had suffered from their long journey.

"The Red Deer River, below Red Deer, is swift, with an average fall of about five feet to the mile, and for about forty miles below the village is practically a succession of short rapids. From Tail Creek to the Rosebud River, the current averages a little over two miles an hour. In the lower part of the river the current is about one and three-quarters mile an hour. Between Dead Lodge Cañon and the mouth, progress was often much impeded by the prevalence of sand-bars, over which the boat, now weighed down by its load of specimens and drawing about eleven inches of water, had to be constantly dragged. On the South Saskatchewan River, using two pairs of oars and assisted by a favourable wind, as much as forty miles was made in one day.

"All the rocks exposed on either side of the river, as far as a point a couple of miles below Willow Creek, belong to the Laramie formation and consist, for the most part, of sandstones and clay-shales. Beyond this the Pierre rocks underlying the Laramie, make their appearance in the bottom of the valley, and are continuous for a distance of about thirty-three miles, to a point three or four miles below Bull Pound Creek, where those of the Belly River series underlying the Pierre are met with.

"The primary object of the expedition being the collecting of reptilian remains, especially those of dinosaurs, that were known to occur in the rocks of the Laramie and Belly River formations, special search was made for bones in all the rock-exposures seen as the course of the river was followed downward. The intervals between camps varied much, and depended entirely on the richness of the beds in fossil remains. When it was found desirable, a stay of two or three days was made at one locality, or the camp was then removed across the river, or only a mile or two down stream.

"On leaving Swift Current, Mr. Lambe proceeded to Edmonton and thence to Victoria, Alberta, in connection with the boring operations there in progress under contract with the government.

"Ottawa was reached on October 2nd.

Dinosaurian remains.

"It would be premature to offer any descriptive account of the fossil organic remains collected, more especially as it is hoped that further collections may be made, which will elucidate the relations of the dinosaurian bones, of which the greater part of the material consists. The eventual comparison of the remains from the Laramie and Belly

River formations—two clearly defined series between which the marine Pierre formation is interposed—will undoubtedly afford matter of much interest."

The following is a list of specimens collected by or received from officers of the Survey, during the year 1897 :— Contributions to museum.

Dr. R. Bell :—

Walrus skull, from Baffin Land.
Ninety fossils from Akpatok Island.
Six objects of Eskimo manufacture.
Forty-six birds' eggs from Hudson Bay.

Professor Macoun :—

Thirty-four sets of birds' eggs from Alberta, collected by W. Spreadborough.

James Macoun :—

Nest and eggs of the Lapland Longspur and Gray-necked Finch, and eggs of five other species of birds, from St. Paul's Island, Behring Sea.

J. B. Tyrrell :—

432 fossils from the Cambro-Silurian and Devonian rocks of northern Manitoba, and fifty specimens of *Anodonta Simpsoniana* and *Unio luteolus* from Lake Manitoba.
Stone knife obtained from José Mercredi, Fond du Lac, Lake Athabasca, in 1892.
Two fragments of pottery from Ile à la Crosse, Churchill River, collected in 1892.
Four spear heads from Cree Lake, Stone and Churchill rivers, collected in 1892.

A. P. Low :—

Two specimens of the Ivory Gull, shot in the ice off Sandwich Bay, Labrador, June 12, 1897.

L. M. Lambe :—

A series of reptilian and plant remains from the Belly River and Laramie formations of the Red Deer River, Alberta.
Two stone mauls of Indian manufacture from the Red Deer River.

W. McInnes :—

A few obscure fossils (loose) from the Lake of the Woods and Eagle Lake, O.

Contributions to museum—*Cont.*

Dr. H. M. Ami :—

About 2,000 fossils from Pictou, Colchester and Cumberland counties, N. S.

400 specimens of fossil plants, fish remains, *etc.*, from Avonport, Horton Beach and Trenholm Brook, King's County, N.S.

Portions of the skeleton of two specimens of the Mastodon from Essex and Norfolk counties, O.

336 chipped flints, 144 arrow-heads, four adzes, three whetstones and two gouges, of Indian manufacture, from the township of Woodhouse, Norfolk county, O.

Dr. Ami, L. M. Lambe and W. J. Wilson :—

A number of Pleistocene fossils from Besserer's Grove, near Ottawa.

The additions to the palæontological, zoological and ethnological collection during the year, from other sources, are as follows :—

By presentation :—

(A.—*Palæontology*).

Colonel C. C. Grant, Hamilton, O. :—

Numerous fossils from the Medina, Clinton and Niagara formations, near Hamilton.

B. E. Lyster :—

Several fossil plants from the Tertiary rocks at Vancouver, B.C.

J. B. Hobson :—

Portion of a bone from the Cariboo Hydraulic mine, B.C.

Thomas Armstrong, Harwood Plains, O. :—

Specimen of *Columnaria Halli*, Nicholson, from the Black River limestone of March township, Carleton County, O.

Rev. Hector Currie, Thedford, O. :—

Twenty-five fossils from the Hamilton formation at Thedford and Bartletts Mills.

G. Kernahan, Thedford, O. :—

Fifty fossils from the same formation and localities.

R. Macintosh, Thedford, O. :—

Five fossils from the Hamilton shales at Thedford.

Colonel F. Ruttan, Winnipeg (per J. B. Tyrrell) :—

Five fossils from the Hudson River formation at Little Stony Mountain, Manitoba.

Contributions to museum—*Cont.*

W. H. Robson, Lethbridge, Alberta (per J. B. Tyrrell) :—

100 fossils from the Hudson River formation at Stony Mountain, Man., from the Silurian rocks at Stonewall, Man., and from the Cretaceous rocks of Alberta.

W. Townley, Stony Mountain, Manitoba (per J. B. Tyrrell) :—

Seven fossils from the Hudson River formation at Stony Mountain.

John Gunn, Stonewall, Manitoba (per J. B. Tyrrell) :—

Specimen of a supposed new species of *Gyroceras* from the Silurian rocks at Stonewall.

Donald Gunn, Stonewall, Manitoba (per J. B. Tyrrell) :—

Specimen of an *Orthoceras* from Stonewall.

Frank Newby, Ottawa :—

Three fossils from the Guelph formation at Elora.

W. G. Otto, Vars, Russell County, O.:—

Specimen of an *Orthoceras* in a slab of limestone dug up at Vars.

Rev. W. Patterson, M.A., Leamington, O.:—

Eight fossils from the Corniferous limestone of Essex County, O.

Victor W. Lyon, Jeffersonville, Indiana, U.S.A. :—

One hundred and eighty-seven specimens of seventy-two species of fossils from the Devonian formation, and nine specimens of three species from the Niagara formation, of Clarke County, Indiana.

S. W. Wilkins, Ottawa :—

Six species of fossils from the Cretaceous rocks of the Belly River district.

(B.—*Zoology*).

Sir William Henry Flower, K.C.B., &c., Director Nat. Hist. Dep., British Museum :—

Skull of Bull Gaur (*Bos gaurus*) from India.
Skull of Indian Buffalo (*Bos bubalus*).

Prof. D'Arcy W. Thompson, Univ. Coll., Dundee, Scotland :—

One egg of the Great Black-backed Gull, two eggs of the Glaucous Gull, one egg of the Kittiwake, and one egg of the Dovekie, all from Disco, Greenland ; and one egg of the Kittiwake from Davis Strait.

Contributions to museum—*Cont.*

Rev. C. J. Young, Lansdowne, O. :—

Specimen of Brunnichs Murre, shot on the St. Lawrence at Rockport, O.

Three eggs of Cooper's Hawk, three of the Florida Gallinule, and three of the Red-winged Blackbird, all taken in eastern Ontario.

T. J. Egan, Halifax, N.S.:—

Two specimens of the Black Rat *(Mus rattus)* caught near Halifax.

Two specimens of the Red Phalarope *(Crymophilus fulicarius)*.

Dr. C. F. Newcombe, Victoria, B.C.:—

Ten specimens of three species of marine shells from British Columbia, not previously represented in the museum.

Walter Harvey, Thurlow, B.C.:—

Four specimens of a rare marine mollusc (*Volutharpa ampullacea*) from Shoal Bay, B.C.

J. H. Fleming, Toronto :—

Egg of the Black-footed Penguin (*Spheniscus demersus*).

Set of four eggs of the Chickadee (*Parus atricapillus*) from the Parry Sound district.

F. A. Saunders, Ottawa :—

Skins of 220 Canadian birds and of five Canadian mammals.

R. H. Hunter, Ottawa :—

Two eggs of the Night Hawk found on the roof of a house in Gilmour St.

W. B. Dawson, Ottawa :—

Small land shells from St. Paul Island, Gulf of St. Lawrence.

W. T. Lawless, Ottawa :—

Adult female Murre (*Uria troile*) caught in the ice at Kettle Island, Ottawa River, Dec. 12, 1897.

John Giles, Mimico, O.:—

Curious variety of the House Sparrow, shot at Mimico.

Dr. James Fletcher, Ottawa :—

Specimen of a sponge (*Clathria delicata*, Lambe) from Squirrel Creek, Prince Edward Island.

G. B. Boucher, Fort Chimo, Labrador (per A. P. Low) :—

Three eggs of the Gyr Falcon and three of the Semipalmated Plover.

G. R. White, Ottawa :—

Seven mounted photographs of the nest and eggs of Canadian birds, in their natural surroundings.

(*C.—Ethnology*).

From the Department of Indian Affairs :—

A collection of objects of Indian manufacture from the coast of British Columbia and the North-west Territories.

Commander Wakeham, Ottawa :—

Harpoon, spear, duck dart, waterproof skin and two floats, from the shores of Hudson Strait.

W. H. Porter, Fort Erie, O. :—

Nineteen specimens of arrow-heads, spear-heads, and other stone implements from Fort Erie.

Malcolm McKinnon, Thedford, O.:—

Three flint arrow-heads from Thedford.

T. C. Weston, Ottawa :—

Paint bag from an Indian grave in the N. W. T.

C. N. Challand (per Dr. H. M. Ami) :—

Spear head from lot 15, concession V., township of Woodhouse, Norfolk County.

Christopher Nelson, Marburg, O. (per Dr. H. M. Ami) :—

Stone amulet or ornament from lot 3, concession V., township of Walpole, county of Haldimand.

Frank McCall, Simcoe, O. (per Dr. H. M. Ami) :—

Five arrow and spear-heads from lot 1, concession V., township of Woodhouse, county of Norfolk.

By purchase :—

(A.—*Palæontology*).

Tusks and other remains of a Mastodon found by Mr. Challand at Marburg, Norfolk County, O.

Twenty-three rare species of fossils from the Cretaceous rocks at Hornby, Denman and Vancouver islands, B.C.

Three rare and almost unique crinoids, and one portion of a ventromedian plate of a *Coccosteus*-like fish, from the Hamilton formation of Ontario.

Contributions to museum—*Cont.*

Numerous specimens of fossil plants and fresh water shells, mostly Unionidæ, from the interglacial deposits near Toronto.

About 200 specimens of the rarer fossils of the limestones and shales of the Lévis formation at St. Joseph de Lévis, Q.

(B.—*Zoology*).

Specimen of the Golden Eagle, shot near Woodbridge, York County, O, in November, 1897.

Ruff and Reeve, shot on Toronto Island by Mr. H. Humphrey, in May, 1877.

Set of (two) eggs of the Bald Eagle, taken at Sheet Harbour, near Halifax, N.S.

Two eggs of the Osprey, taken at Porter's Lake, near Halifax.

Two eggs of the Great Black-backed Gull, from Grand Lake, N.S.

Two eggs of the Raven, from Truro, N.S.

Set of (four) eggs of the Black-throated Green Warbler, from Miller's Woods, near Halifax.

A small collection of rare recent shells.

Set of (two) eggs of the Bald Eagle, taken in the north-east point of Raza Island, at the entrance of Toba Inlet, B.C., in May, 1897.

Sets of eggs of ten species of birds and a single egg of Leach's Petrel, all from Nova Scotia.

Specimen of the Lesser Snow Goose, from Portage la Prairie, Manitoba.

Set of (three) eggs of the Duck Hawk, two eggs of Richardson's Merlin, one egg of the Prairie Falcon, and two eggs of the Long-billed Curlew, all from Alberta.

Sepiostaires of three recent species of *Sepia*, for comparison with remains of Sepiadæ from the Cretaceous rocks of the South Saskatchewan.

(C.—*Ethnology*).

Large baked clay pot of Indian manufacture, found in the township of Eardley, Q.

Natural History.

Professor J. Macoun makes the following report on the work done by him or under his immediate control, during the year 1897 :—

Work during winter.

" Between the date of my last report and my departure for the field on June 1st, I was, owing to my assistant being engaged on other

work, able to do little more than attend to the routine work of my office and classify and arrange the natural history collections made during the previous season. Natural history collections.

"During the past eight years I have not only been collecting and studying the flora of western Canada, but have been investigating the fauna as well. A part of the results of my botanical work has already been published, and the large collections of botanical specimens made have been mounted and placed in the herbarium, so that this is now very rich in western plants, and when the time comes for the publication of a flora of the western provinces, we have all the necessary material on hand.

"During the seasons of 1894, 1895 and 1896, I worked up, in the field, the natural history of the prairie region between Winnipeg and the foot-hills of the Rocky Mountains. In 1889, 1890 and 1891, I studied the fauna and flora of the Rocky Mountains, and of that part of British Columbia lying along the line of the Canadian Pacific Railway. In 1893, I worked on Vancouver Island. The only portion of the southern part of western Canada thus remaining unvisited, was the region between the prairie and the summit of the Rocky Mountains and this section you authorized me to examine last summer. Explorations of previous years.

"In all the years mentioned above, I have had Mr. William Spreadborough for my field assistant. Besides having unrivalled powers of observation, he is an accomplished taxidermist, and these qualifications have enabled him to render valuable assistance in systematically working up both the fauna and flora of the regions we have visited together. Having in view from the first the advisability of writing a complete catalogue of Canadian birds, I thought it wise to have collections and observations made early in the spring, so that something might be learned of their migration-routes. This scheme has been carried out by Mr. Spreadborough. He was stationed in the spring of 1892 at Indian Head, in 1895 at Moosejaw, in 1894 at Medicine Hat, in 1897 at Edmonton, in 1891 at Banff, in 1890 at Revelstoke, in 1889 at Hastings, B.C., and in 1893 at Victoria, Vancouver Island. It will thus be seen that the range in longitude of the western birds ought now to be pretty well known. The summers being generally spent in moving through the districts in the vicinity of the above stations, a complete knowledge of the birds that breed in the region in question has also been obtained. Collections of eggs and skins were also made every year. Assistance in field-work.

"It has now become possible to prepare a catalogue of the birds of the whole Dominion, that will include notes on their migration, Catalogue of birds.

Natural history—*Cont.*

summer haunts, nests, eggs and other interesting matters. The first part of this catalogue is now almost ready.

"Large collections of the smaller mammals have been made, and a catalogue of the species, giving their approximate ranges, could now be produced, but owing to the diversity in local forms, years must elapse before an exhaustive enumeration can be made. We know definitely, however, the range of the greater number, and from the material now in hand, a preliminary report might be prepared at any time.

"Besides plants, birds and mammals, collections have also been made of the reptilian fauna, and so far as was possible of the smaller fishes.

Field-work.

"Having your instructions to complete my examination of the foot-hill country south of Calgary, Alberta, I left Ottawa for Calgary on June 1st, last, and was able to commence work on the 6th of that month. Taking Calgary as a base, I began a list of the plants occurring there and made collections of all the species in flower at that time. When this was done, I was asked to examine into certain cases of cattle poisoning that had occurred at Jumping Pound and other points, causing great alarm among the ranchers. I reached Jumping Pound on June 11th, and on the afternoon of the same day went to look at some of the dead cattle and discover if possible the cause of death. There had been eighteen deaths at that date. After an examination of the flora, I found there was only one plant that could cause death by poisoning. This was a tall-growing larkspur (*Delphinium scopulorum*), which is common in all the foot-hill country from the Highwood River to the Arctic Circle. So that there could be no doubt about the matter, I took a rancher with me and followed the cattle-tracks into the woods, where we found dead cattle and the remains of partially eaten plants. The contents of the stomachs showed the stringy outside bark of the stems of larkspur. With these facts before me, I suggested to those interested that they should keep their cattle out of the woods in the early spring. No trouble is to be feared after the middle of June, when grass becomes plentiful.

Poisoned cattle.

Work on Elbow River.

"On July 19th, I returned to Calgary, intending to go south to Macleod, and was there joined by Mr. Spreadborough, who had been at Edmonton since early in April, making observations on birds and collecting their skins and those of small mammals. When I reached Calgary, part of the town was under water, in consequence of the phenomenally heavy rains which had occurred. All the bridges between Calgary and Macleod were carried away, and there seemed little chance

of our being able to go south for some weeks. On considering the work to be done, I saw that could I reach the head of the Elbow River I would do just as well as if I went to the source of Highwood River, so I joined the party of Mr. A. O. Wheeler, a Dominion land surveyor, who was at that time going into the foot-hills with a large staff. Natural history *Cont.*

"From June 21st to July 24th, Mr. Spreadborough and I had our head-quarters in Mr. Wheeler's camp, and made excursions with pack-horses or on foot, as occasion demanded. On June 29th, we took pack-horses and ascended Bragg's Creek, the north branch of the Elbow River, to its source, and camped at an altitude of over 6000 feet. During the next five days we made excursions from our camp to numerous points up to 8000 feet, and made extensive collections. As we were camped only a little over 1000 feet below the timber-line, we were able to study the fauna and flora above the timber-line and to note the transitions due to altitude.

"Only three species of plants passed from the plains to the highest summits, and all three extend far beyond the Arctic Circle being at home on the shores of the Arctic Sea. These plants are: *Delphinium scopulorum* (Larkspur), *Anemone multifida* (cut-leaved anemone), and *Anemone hirsutissima* (prairie 'crocus'). Most of the 208 forms seen above 6000 feet were boreal or far northern species, but many of them were common in the marshes and thickets of the foot-hills. Dry situations, even if exposed to cold winds, produced prairie plants, just as bogs and marshes produce arctic plants in the eastern provinces. Character of flora.

"The bulk of the species were of northern origin, and the passage from the prairie to the mountain summits was like that to be met with if one had walked north from Edmonton to the Arctic Sea. A few real alpine species were, however, found on Moose Mountain above 7000 feet, such as *Arabis Lyallii*, *Claytonia megarrhiza*, *Aplopappus Brandegii Townsendia Parryi*, *Rhododendron albiflorum*, *Stenanthium occidentale*. All these seemed to be those characteristic of mountain regions further south, and are not found much further to the northward.

"We had good opportunities of studying the smaller mammals and found that they were quite local in their habits, but in all cases they liked to be near water. The only form of the prairie and foot-hill region that reached an altitude of 7000 feet was the pouched gopher or 'mole' as called by the residents of the country. This animal is universally distributed over the prairie region, but prefers the rich black earth on the sides of ravines in the south and on the borders of poplar Distribution of small mammals.

Natural history—*Cont.*

thickets to the north. A complete series of skins, taken at Edmonton, Moose Mountain at an altitude of 7000 feet, along the Milk River, Alberta, and at Indian Head, Assiniboia, show that we have but one form of this species. It was the same with the Spermophiles. No matter where Franklin's, Richardson's or the thirteen-striped species were seen, they never varied. It was not so with the squirrels and chipmunks. These varied as we left the plains, so that the higher we ascended the more distinct the forms became and the easier to differentiate.

"None of the prairie birds breed in the mountains, but such birds as the White-crowned Sparrow, the Pipet and the Gray-necked Finch were breeding above the timber-line, and on the extreme summits the White-tailed Ptarmigan seemed quite at home.

"Our mountain work was done between the first and second series of great rain storms, and on July 5th, in a terrible storm, we left our camp for the plain. When we saw the mountains again they were buried in snow which remained for a week. On the morning of the 7th, Mr. Spreadborough went up the Elbow River thirty-one miles, and camped above the mouth of the Fisher Branch, where he had the mountains all around him. I joined him on the 12th, having walked over the pack-trail from our lower camp. Many interesting things were picked up and additional facts regarding distribution were recorded. Four days were spent collecting and exploring above the timber-line here and many additions were made to our collections. As usual we found Parry's Marmot and the Little Pika on the very summit of the mountains and always dwelling in colonies.

Work at Crow Nest Pass.

"We returned to Calgary on July 19th, and after packing up our specimens started for Macleod on the 24th. One day was spent there, supplies were procured and a team was hired to take us to Crow Nest Lake, seventy-two miles off. As we were ahead of the railway parties, we found the road in very poor condition after the heavy rains of the preceding months. The water in the streams was still very high, but we made all the crossings safely and reached the lake on the 28th. Our tent was soon pitched and work commenced, and while I occupied myself chiefly with botany, Mr. Spreadborough attended to the fauna. In both branches of our work we found a marked change from the species seen at the source of the Elbow River. It would be apparent to the most casual observer that here the climatic conditions are different from those of the mountains further north. Our first trip was to the summit of the mountain north of Crow Nest Lake, and from this altitude we could

take in without difficulty all surrounding mountains and the district characterized by yourself as consisting of 'rough hills. It now became apparent to me why this region had such a peculiar flora. To the west, no mountains were visible, but far to the north up Michel Creek and Elk River snowy peaks were to be seen. To the south a large mountain rose from the lake, but later examination showed that it stood alone and was perfectly dry to its summit, which is 8600 feet above the sea. To the east, twelve miles off, was Turtle Mountain, and beyond was the open treeless prairie. Here, then, was the source of the continual winds at Macleod. Natural history Obs'

"The peculiarly western species found in Crow Nest Pass, and along the North and South Kootenay passes were now accounted for and the remarkable extension of such plants as *Balsamorhiza sagittata* and *Fritillaria pudica* and others far out on the south-western prairies was explained. Owing to the breaking up of the mountain ridges south of the Livingstone Range, the dry and warm winds from south-eastern British Columbia and Idaho have a clear sweep across the low summits and through the passes, giving both a climate and vegetation akin to that of a region much farther south. Western and south western plants.

"During our stay at Crow Nest Pass, we ascended the mountains in the vicinity and found them all barren at their summits and wind-swept. Indeed at the altitude of over 8000 feet on August 4th, the air was hot and the sun's rays almost unbearable, yet a mile away, facing the north, we saw quantities of snow and a small glacier. An excursion made to that place later, showed a long exposed slope to the west and north-west, and the snow on the northern exposures was the remains of the winter drifts formed by the constant winds from the west. During the five weeks we were in the pass we never saw clouds move from any point but the west. Often strong winds blew into the pass from other directions, but they did not reach nor affect the high clouds. With the dryness of the mountains, the flora took on a corresponding character, and all the new forms which were discovered belonged to the southern mountains, but were here not found at so high an altitude as further south. Amongst these were valuable medicinal plants such as *Osmorhiza occidentalis* and *Ferula dissoluta*. The mountains were so dry that the usual alpine cruciferous and saxifragaceous plants were altogether wanting.

"Later examinations showed that all the waters of the higher mountains here entered rents in the strata, those of the north side being discharged by a large stream issuing from the mountain-side and flowing almost directly into Crow Nest Lake. An excursion

Natural history—*Cont.*

was made on August 9th to the snow-field and glacier seen in the recesses of the high mountain to the south of the lake. After ascending the lake in a small boat, we climbed around the western shoulder of the mountain and ascended the stream that enters the head of the lake. Four hours of climbing showed the glacier lying before us on the south, and about a mile further on we found the greater part of the water issuing from a cave in the mountain-side about 2000 feet below the summit. Shortly after, we were surprised to see an opening right through the mountain to the south and west of the glacier. This opening was near the summit, and an arch of unknown thickness was formed by the rock over it.

Mountain south of Crow Nest Lake.

The Gap.

"After completing our examination of the region about Crow Nest Lake, we moved on August 11th twelve miles east to the 'Gap,' close to the sulphur spring under Turtle Mountain. Between that date and the 22nd, we climbed all the mountains round and penetrated into the hills, making collections of plants and trapping small mammals. Our work was completed by the 22nd, when we packed up and returned to Macleod. The day after we arrived there we went on to Calgary, where after our specimens had been arranged for shipment to Ottawa I dismissed my assistant and went up to Banff, there meeting the visiting members of the British Association. On September 2nd I started for Ottawa and arrived there on the 6th.

Results of heavy rains.

"The heavy rains of June and July amply fulfilled my forecast of 1895, the drought was broken, as all the lakes and ponds in the foot-hills were again filled with water, and on the line of the Crow Nest Pass Railway, ponds that the wagon-road had gone through in 1896 were found with six feet of water in 1897. I am informed that in October the ducks came back to the long deserted ponds and seemed to be as plentiful as they were ten years ago. Grass in the foot-hills and on the prairie was luxuriant.

Determination of plants.

"The increased interest that is now being taken in botany in every part of the Dominion is very encouraging, but at the same time it adds very largely to our duties, as scarcely a day passes that specimens do not arrive for determination. This consumes much of our time. In large parcels alone, we named, during the year, nearly 2000 species of plants. Of these 650 species came from the Department of Agriculture, British Columbia. The collections made by Mr. Low, Dr. Bell and myself last summer will be worked up by my assistant Mr. J. M. Macoun this winter, and this will occupy most of his time. My own time for the remainder of the winter will be required to complete my work on the birds of Canada.

"My work on the Hepaticæ and Lichens has progressed so far that another season in the eastern provinces, where these plants reach their greatest development, will enable me to complete Part VII. of the catalogue of Canadian plants. Natural history—*Cont.*

"Owing to the fact that I have had no regular office assistant during the past year, a smaller number of plants than usual has been mounted and placed in the herbarium. For the same reason, a comparatively small number of duplicates has been distributed and very few exchanges were made. Herbarium work.

"Three thousand three hundred and ninety-six sheets of specimens were mounted for the herbarium as follows:— Number of plants mounted.

Canadian	2,086
Foreign	472
Cryptogams	838
Total	3,396

"Two thousand seven hundred and thirty-four sheets of specimens were distributed, partly to public institutions, partly to private individuals in exchange for other specimens. Number distributed.

"The principal universities and other public institutions to which specimens were sent are:—

Harvard University	130
Missouri Botanic Gardens	120
United States National Museum	174
Botanical Museum, Copenhagen	288
Kew Gardens	180
Columbia College	198
Catholic University, Washington	308
University of Minnesota	113
British Museum	73
Botanical Museum, Stockholm	125
Agricultural College, Michigan	70

Dr. James Fletcher, F.R.S.C., Entomologist and Botanist to the Experimental Farm, has kindly continued his services as honorary curator of the entomological collections belonging to the Geological Survey, and reports as follows on these: Report by Dr. Fletcher.

"I have the honour to report that the entomological collections of the Geological Survey Department are in a good state of preservation. Few additions have been made during the past year. With the exception of two collections from Dr. Robert Bell—one of Coleoptera, made in 1887 at Temagami Lake; the other, a collection of Lepidoptera, made in Baffin Land and the islands north of Hudson Bay—no other insects have been collected by the officers of the Survey during

the past season. Among Dr. Bell's insects were a few of great rarity. Two specimens of *Chionobas Taygete* were particularly acceptable, as this species was not previously represented in the collection. The collection of insects for the Banff museum has been much increased in value through the energy of Mr. N. B. Sanson, the curator, who during the summer collected no less than thirty different species of diurnal Lepidoptera. Specimens of these are now being spread to be placed in this collection so that the species represented may be shown from actual specimens taken in the Rocky Mountain Park at Banff. A few specimens also have been kindly given for this collection by Mr. W. H. Danby, taken at Rossland, B.C., and Mr. C. De Blois Green, taken in the Okanagan Valley, B.C."

Maps.

Maps.

Mr. James White, geographer and chief draughtsman, reports as follows on the mapping work and related subjects :—

"During the past year Mr. C. O. Senécal has compiled portions of the West Kootenay, Manitou and Sydney Coal-field sheets and has autographed maps Nos. 619 and 621. Mr. L. N. Richard has traced Sheets 126 and 129, Ontario, and 50, 56, 57 and 58, Nova Scotia, for the engraver, and has drawn a map of Western Nova Scotia for photo-lithography. Mr. W. J. Wilson has compiled and reduced material for the map of the Dominion. Mr. O. E. Prudhomme has also been employed on the Dominion map and in making reductions for the new edition of the Yukon sheets. Mr. J. F. E. Johnston has compiled and drawn the greater portion of Sheet 121, Ontario and Quebec. Mr. W. M. Ogilvie was employed on general draughting work from June 9th to August 19th, when he was detached for field-work as assistant to Mr. W. T. Jennings, C.E. He rejoined the staff 20th December. Mr. E. D. Bolton was employed on general draughting from January 18th to April 30th.

"During the year, nineteen new maps and a second edition of the 'Northern portion of the Lake of the Woods' map have been published. Twenty new maps and a second edition of the three Yukon sheets are now being engraved or photo-lithographed. The stones for the 'black' of sheets 42 to 48 of the Nova Scotia series have been engraved, but their publication has been delayed, pending the completion of the geological work. The unusual demand, owing to the gold discoveries, having exhausted the edition of the 'Northern portion of the Lake of the Woods' and 'Yukon' maps, a second edition of the former, revised and corrected to date, was issued in April last, and a similar edition of the Yukon maps is now in progress and will be ready shortly.

"Owing to the pressure of other work, the progress of the new map of the Dominion has been much delayed, but it will, probably, now be completed within a few months. Reductions for the northern portion of this map were supplied to the Department of Railways and Canals to assist in the correction of the new edition of the map of that department. Maps—*Cont.*

"As Mr. Giroux's illness and death had left his work in the townships of Hawkesbury and Lochiel incomplete, I made in September last, the surveys required for the portion included in Sheet 121, and also surveyed a few roads in the township of Loughborough, for the Frontenac map.

"An enumeration of the maps published during the past year, or in course of preparation, is appended herewith.

Maps Printed in 1897.

		Area in square miles.
620	British Columbia—Part of Trail Creek Mining Division—West Kootenay District.—Scale 1 mile to 1 inch	208
594	Athabasca and Peace River—Sheet I—Scale 10 miles to 1 inch	39,700
595	" " " —Sheet II— " "	39,700
596	" " " —Sheet III— " "	41,000
597	North-west Territories—Country between Lake Athabasca and Churchill River—Scale 25 miles to 1 inch	137,100
603	North-west Territories—Doobaunt and Kazan Rivers and North-west Coast of Hudson Bay—Scale 25 miles to 1 inch	250,000
619	North-west Territories—Map of Sledge Routes, 1893 and 1894, Fort Churchill to Nelson River—Scale 25 miles to 1 inch	25,400
621	North-west Territories—Diagram showing three positions successively occupied by the Centre of the Keewatin Glacier—Scale 100 miles to 1 inch	405,000
227	Western Ontario—Sheet 1—Northern part of the Lake of the Woods (2nd edition)—Scale 2 miles to 1 inch	3,456
570	Ontario—Sheet No. 125—French River Sheet—Scale 4 miles to 1 inch	3,456
606	Ontario—Sheet No. 131—Lake Nipissing Sheet—Scale 4 miles to 1 inch	3,456
599	Ontario and Quebec—Sheet No. 138—Lake Temiscaming Sheet—Scale 4 miles to 1 inch	3,456
590	Quebec—Portions of Joliette, Argenteuil, Terrebonne and Montcalm Counties—Scale 4 miles to 1 inch	3,350
585	Labrador Peninsula—South-west Sheet—Scale 25 miles to 1 inch	251,100
586	" " —South-east Sheet " " "	251,100
587	" " —North-west Sheet " " "	251,100
588	" " —North-east Sheet " " "	251,100
592	Nova Scotia—Sheet No. 40—Sheet Harbour Sheet—Scale 1 mile to 1 inch	216
607	Nova Scotia—Sheet No. 41—Fifteen-mile Stream Sheet—Scale 1 mile to 1 inch	216
611	Nova Scotia—Sheet 51 (and 52)—Ship Harbour Sheet—Scale 1 mile to 1 inch	

Maps—*Cont.*

Maps, Engraving or in Press.

		Area in square miles.
	Dominion of Canada, 2 sheets, each 28″ x 34″, including the Dominion from the Atlantic to the Pacific and from the International Boundary to Hudson Strait and Great Bear Lake.	
604	British Columbia—Shuswap Sheet—Scale 4 miles to 1 inch.	6,400
605	Ontario—Sheet No. 126—Manitoulin Island Sheet—Scale 4 miles to 1 inch	3,456
630	Ontario—Sheet No. 129—Missisauga Sheet—Scale 4 miles to 1 inch.	3,456
626	Ontario—Map showing the occurrences of Iron Ores and other minerals in portions of the Counties of Frontenac, Lanark, Leeds, and Renfrew—Scale 2 miles to 1 inch	1,700
631	Quebec—Lièvre River and Templeton Phosphate District—Sheet 1—Scale 40 chains to 1 inch	120
632	Quebec—Lièvre River and Templeton Phosphate District—Sheet 2—Scale 40 chains to 1 inch.	100
593	Nova Scotia—Sheet No. 42—Trafalgar Sheet—Scale 1 mile to 1 inch	216
598	Nova Scotia—Sheet No. 43—Stellarton Sheet—Scale 1 mile to 1 inch	216
600	Nova Scotia—Sheet No. 44—New Glasgow Sheet—Scale 1 mile to 1 inch	216
608	Nova Scotia—Sheet No. 45—Toney River Sheet—Scale 1 mile to 1 inch	216
609	Nova Scotia—Sheet No. 46—Pictou Sheet—Scale 1 mile to 1 inch.	216
610	Nova Scotia—Sheet No. 47—Westville Sheet—Scale 1 mile to 1 inch.	216
633	Nova Scotia—Sheet No. 48—Eastville Sheet—Scale 1 mile to 1 inch.	216
634	Nova Scotia—Sheet No. 49—Musquodoboit Sheet—Scale 1 mile to 1 inch	216
624	Nova Scotia—Sheet No. 50—Moose River Sheet—Scale 1 mile to 1 inch	216
635	Nova Scotia—Sheet No. 56—Shubenacadie Sheet—Scale 1 mile to 1 inch	216
636	Nova Scotia—Sheet No. 57—Truro Sheet—Scale 1 mile to 1 inch.	216
637	Nova Scotia—Sheet No. 58—Earltown Sheet—Scale 1 mile to 1 inch.	216

Maps, Compilation Completed.

	Manitoba—Lake Winnipeg Sheet—Scale 8 miles to 1 inch.	43,600
	Nova Scotia—Sheet No. 53—Lawrencetown Sheet—Scale 1 mile to 1 inch.	216
	Nova Scotia—Map of Western Nova Scotia—Scale 8 miles to 1 inch.	12,830
	Nova Scotia—Plans of Killag, Salmon River, Caribou, Goldenville and Oldham mining districts—Scale 500 feet to 1 inch.	

Maps, Compilation Incomplete.

	British Columbia—West Kootenay Sheet—Scale 4 miles to 1 inch.	6,400
	Western Ontario—Sheet No. 4—Manitou Sheet—Scale 4 miles to 1 inch.	3,456
	Quebec and Ontario—Sheet No. 121—Grenville Sheet—Scale 4 miles to 1 inch.	3,456
	Quebec—North-west Sheet of "Eastern Townships" Map—Scale 4 miles to 1 inch	7,200
	New Brunswick—Sheet 1 N.W.—Fredericton Sheet—Surface Geology—Scale 4 miles to 1 inch.	3,456
	New Brunswick—Sheet 2 S. W.—Andover Sheet—Surface Geology—Scale 4 miles to 1 inch	3,456
	Nova Scotia—Sheet No. 133—Cape Dauphin Sheet—Scale 1 mile to 1 inch	216
	" " —Sheet No. 134—Sydney Sheet—Scale 1 mile to 1 inch	216
	" " —Sheet No. 135—Glace Bay Sheet—Scale 1 mile to 1 inch	216
	" " —Sheets Nos. 59 to 65, 76, 82, 100 and 101—Scale 1 mile to 1 inch	2,376
	" " —Sheets 54, 55, 66, 67, 68, 69—Scale 1 mile to 1 inch.	1,296

Library.

Dr. Thorburn, librarian, reports that during the year ended December 31, 1897, there were distributed 9927 copies of the Survey publications, comprising reports, special reports and maps. Of these 7690 were distributed in Canada, the remainder, 2237, were sent as exchanges to other countries. Library and Publications.

In addition to the above, the sales of publications during the year were 5843, for which $981.82 has been received.

The number of publications received as exchange, was 2758, and the number purchased was eighty five volumes, besides thirty-three periodicals subscribed for.

The number of letters dealing with library matters sent out was 1551, and in addition there were 749 acknowledgments.

The number of letters received was 1168 besides 1228 acknowledgments.

The number of volumes bound during the year was 135. It is estimated that there are now in the library about 12,000 volumes besides a large number of pamphlets.

Note.—It may be stated that the books in the library can be consulted during office hours by those who wish to obtain information on scientific subjects.

Visitors to Museum.

The number of visitors registering during the year 1897 has been 32,357, being a slight increase over that for 1896, and the highest yet attained. Visitors to Museum.

Staff, Appropriation, Expenditure and Correspondence.

The strength of the staff at present employed is forty-nine. Staff.

In May last Mr. R. W. Brock was appointed to the vacancy in the technical class, caused by the death of Mr. N. J. Giroux.

Appropriation and expenditure.

The funds available for the work, including appropriation for boring in Alberta, and the expenditure of the department during the fiscal year ended 30th June, 1897, were :—

——	Grant.	Expenditure.
	$ cts.	$ cts.
Civil list appropriation	50,675 00	
Geological Survey appropriation	60,000 00	
Boring appropriation	7,000 00	
Civil list salaries		49,983 31
Exploration and survey		19,066 91
Wages of temporary employees		9,199 43
Boring operations		7,000 00
Printing and lithography		19,652 81
Purchase of books and instruments		1,176 08
" chemicals and chemical apparatus		212 39
" specimens		378 73
Stationery, mapping materials and Queen's Printer		1,445 52
Incidental and other expenses		1,879 14
Advances to explorers on account of 1897-98		16,250 00
		126,244 32
Less—Paid in 1895-96 on account of 1896-97		9,261 56
		116,982 76
Unexpended balance civil list appropriation		691 69
" Geological Survey appropriation		55
	117,675 00	117,675 00

The correspondence of the Department shows a total of 9160 letters sent, and 8803 received.

I have the honour to be, sir,

Your obedient servant,

GEORGE M. DAWSON,

Deputy Head and Director.