

GEOLOGICAL AND NATURAL HISTORY SURVEY OF CANADA
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SUMMARY REPORT
OF THE
OPERATIONS OF THE GEOLOGICAL SURVEY

FOR THE YEAR

1886.

BY
THE DIRECTOR.



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The present Summary Report is a reprint, with some additions and alterations of Part III of the Report of the Department of the Interior for 1886, in which the detailed reports and the maps now presented are referred to, together with others the publication of which it has been found desirable to defer, pending further study and surveys in the districts to which they relate.

Especial thanks are due from the Survey to Mr. Joseph Wrigley, Chief Commissioner of the Hudson's Bay Company, for letters to the officers at the various posts visited by the parties working in the region north of Lake Superior and around Hudson's Bay, and also to the officers themselves for their uniform kindness and valuable assistance in various ways.

On the 9th of February I left Ottawa for England, to superintend the unpacking and arrangement of the collections sent to illustrate the mineral, vegetable and animal resources of the Dominion, at the Colonial and Indian Exhibition. I arrived in London on the 22nd of February, and a few weeks later, was joined by my colleagues, Messrs. Macoun, Adams and Willimott.

In reference to some of the practical results which may be expected, or have already arisen from the work of the Exhibition, the following facts may be mentioned:—

Plumbago—Enquiries were constantly being made about this mineral by persons from various parts of the United Kingdom, as well as from the continent. They were referred to the various exhibitors, whose addresses were given them.

Mica—A number of similar enquiries were made.

Soapstone.—Two or three gentlemen who are very anxious to find localities from which they can get continuous supplies of good soapstone, were given samples from Canada, which gave such satisfaction that one gentleman ordered five tons to make further trials, and they have all promised to report on the qualities of the samples supplied them, and will state in what essential the stone is deficient. The precise article required by the trade will thus be ascertained, and a considerable business in this material will, in all probability, be developed.

Asbestos.—There was a fine exhibit of this mineral; much attention was attracted by it, and many enquiries were made concerning it. Several asbestos properties were sold as a result of the information given. These various refractory minerals attracted especial attention.

Chrome Iron Ore—Samples of several of the specimens exhibited were sent to large consumers for examination. It was found that some would sell for about £4 stg. a ton in Glasgow, while others which were not sufficiently rich to pay for exportation might be made so by a process of careful selection, or by the ore improving in depth. Now that the Eastern Townships have greatly increased railroad facilities, and that it is ascertained that this mineral will bring remunerative prices, it will doubtless ere long be largely exported.

The gold and silver ores of British Columbia, Ontario, Nova Scotia and Quebec also attracted much attention. As a result of the exhibition, several mines have been sold, and preparations are being made for working others. Reports from the Port Arthur district show that a direct impetus has been given to gold and silver mining in that district by the Exhibition.

In this connection another very valuable result of the Exhibition is that some firms in England have made arrangements to purchase and concentrate the tailings of the principal Nova Scotia gold mines, shipping the concentrate to England for treatment. This kind of work has heretofore been carried on almost entirely in Germany.

Iron Ores.—The Iron and Steel Institute made a careful examination of the various iron ores and coals of the colonies and India represented in the Exhibition and issued a report on their iron-making resources. Out of a total of 137 pages, no less than 69 were devoted to Canada, and much attention was in this way drawn to our iron ores, which were very highly spoken of. "It requires," the report says, "no great degree of prophetic instinct to see that before long, Canada,

India, New South Wales, New Zealand, and Queensland are destined to become in a greater or less degree friendly rivals with us in competing for their own and neighboring markets." After the reading of the report, the members of the Institute visited the Exhibition and examined the ores and fuels. The ores from British Columbia, which are in proximity to coal, were the especial objects of enquiry, and it is stated that large works for the production of iron and steel will shortly be erected in that province.

A mining engineer called and asked to see our samples of these ores, stating that he was about to leave for British Columbia to erect iron works, &c., to cost some three million dollars.

Manganese.—Many enquiries were made about this mineral, and the addresses of the producers in Canada were given.

Petroleum.—Experts who were found to be much prejudiced against Canadian oil say that the samples shown them were as good as could be desired and quite free from bad smell. The Exhibition will, no doubt, help to remove this prejudice.

Ochres.—Samples were sent by request to various large consumers who will examine them and report on the prices they would bring in the English market.

Slate.—Rockland slate and slate manufactures were very highly commended, and said to compare very favorably with the best qualities of Welsh and Scotch slate.

Rocks.—There were many enquiries about Canadian granites and marbles. The red granites and the grey Arnprior marbles were much admired; and it is expected that business will be done in New Brunswick granite.

Agates, &c.—Enquiries have also been made by several firms who manufacture agate goods, respecting the agates from Nova Scotia and Lake Superior. The addresses of persons who could supply them were given. The Huronian red jasper conglomerate also attracted much attention and enquiry.

Phosphate.—The attention directed to this mineral by the fine specimens exhibited—the only ones in the exhibition—has given an impetus to this industry, and resulted in the sale of several properties.

Reports, &c.—The special Descriptive Catalogue of the Economic Minerals of Canada, already referred to, was widely distributed at the

Exhibition. Detailed articles on the mineral wealth of the Dominion appeared in many of the principal papers and magazines. Lectures were given in the conference room on the natural resources of the Dominion, both mineral, vegetable and animal, while during the whole period of the Exhibition either Professor Macoun, Mr. Adams, Mr. Willimott or I was in attendance to answer the many enquiries which were daily being made respecting the climate, the geography, the geology and the natural productions of the country.

My best thanks are due to my colleagues above named for their hearty and zealous co-operation and valuable assistance in the work above referred to, and in arranging the large quantity of material which had to be dealt with, in such a manner as to make a successful and attractive display of the varied resources of the Dominion.

After the close of the Exhibition, on the 10th of November—except a few specimens that had to be returned to their respective owners—the whole of the minerals and some of the natural history specimens were packed up to be made over to the authorities who represent the interests of the proposed Imperial and Colonial Institute. The valuable collection of birds and other animals purchased, or supplied from the Museum collections were all carefully packed to be returned to Ottawa, where they will be properly cared for, and be available for future exhibitions.

During my absence in England in connection with the Colonial and Indian Exhibition from the 9th of February to the 22nd of December, Dr. G. M. Dawson has superintended the work of the survey as Acting Director, and his time was so fully occupied in attending to the shipment of the mineral exhibits, in work connected with the preparation of the special catalogue printed subsequently under my superintendence in London, in editing the annual volume of Survey Reports, in completing and publishing his own report on a portion of the Rocky Mountains, in making preliminary arrangements connected with the collection and compilation of mineral and mining statistics, and in the general routine and office duties, that he found it impossible to undertake any work in the field. I wish here to record my high appreciation of the very able and efficient manner in which Dr. Dawson has performed all the work above referred to.

Captain G. Geddes has during the present year put the collection of insects purchased from him in 1885 into a complete state of arrangement. Special acknowledgment is due in this connection to Mr. James Fletcher for his services in checking and verifying the nomenclature of the entire collection, an operation requiring much labor and time. An important addition has been made to the museum by the purchase of the ethnological collection of Mr. François Mercier, a

collection of representative character gathered by him in the course of a number of years' residence on the Yukon River. The Museum now contains a good typical collection of the arts and manufactures of the tribes of the west coast, from Vancouver Island to the Arctic Ocean.

The title of the detailed report of the Survey was in the last issue changed from that of "Report of Progress" to "Annual Report" and the present issue is the second volume of this new series. A certain number of copies of each report has been printed separately, and though involving more labor in regard to distribution, and some additional expense, the plan has already proved to have many advantages, particularly in enabling the public to obtain, at a nominal cost, the information respecting any particular district.

The requirements of the Survey in respect to increased museum and office accommodation become each year more pressing, and the cramped condition and limited accommodation afforded by the building at present occupied is now such as in some instances to seriously embarrass the work in progress. It is respectfully submitted that an office of such capacity is required as would enable the apportioning of a separate room to each officer entrusted with the work in a particular district, while the museum building should have a character more proportionate to the value of the collections and more creditable to the Dominion. Several plans have been suggested by which the requisite additional accommodation could be secured at a comparatively small outlay, and I venture to hope that the matter will shortly receive the favorable consideration of the Government, more especially as the risk in the present building of the total destruction of the collections by fire is very great.

It will be observed that during the past season the field work was in progress in eleven districts, and that in some of these, in addition to the work by the head of the party, independent work was simultaneously in progress by one or more assistants

BRITISH COLUMBIA AND NORTH WEST TERRITORY.

In British Columbia the exploration of the most important area in the Cariboo gold-bearing district was continued by Mr. A. Bowman, the Government of British Columbia contributing as before towards the expense of this work, which involves the mapping of a very rough district in addition to its geological exploration. It is anticipated that a map and report on this district will be ready for publication next spring. Mr. Bowman gives the following details respecting the work accomplished :—

British
Columbia.

"In continuation of the work of 1885 in Cariboo district, I left Victoria 23rd June, accompanied by Mr. James McEvoy as geographical assistant; procured pack animals, supplies, and four additional men at the 150 Mile House, all in Cariboo district; and on Saturday, the 3rd July, started into the field.

"Our equipment this year was suited to exploration in the mountainous parts away from the waggon road and trails ordinarily travelled.

"The field covered was, in general, the same as last year, viz.: the mining region embraced between latitude $52^{\circ} 40'$ and $53^{\circ} 40'$ N. and longitude 121° to 122° W. but the work differed somewhat in character as well as in method of execution. Last year the roads and trails were measured; a waggon was used as a base of supplies in connection with three or four pack animals, the centrally situated mountains were occupied as triangulation stations, and geological and mining features were subordinated to geography. This year I was also able to entrust most of the geographical work to Mr. McEvoy. Although our parties were equipped to move independently of each other, we generally worked together, or near each other, and my attention to the geographical work was only directed to its general progress and final completion in connection with my own investigations. From this must be excepted, however, those parts of the country visited exclusively by my party, and all the details of the geological work to be fitted into the map.

"The Goose Creek Mountains and the Selkirk Range, where there are no trails, were traversed with shoulder packs, relying on the rifle, to a considerable extent, for supplies. A micrometer measurement of the great Quesnel Lake was carried out with the aid of a large Chinese boat and an Indian canoe. Bear and Swamp River Mountains and the Dragon Creek Mountains were ascended with a single pack horse, relying on the axe in lieu of a trail for progress.

"The geographical work was completed by occupying with the transit all the necessary outlying stations, and by measuring with the steel tape two independent base lines approximately fifty miles apart, situated respectively on Snowshoe Plateau and at Quesnel Mouth, which will be used as the foundation of the whole of the work.

"In the geological work pursued by myself while thus completing the observations for our map, it was the distribution of the rocks and the mining features of the country that governed, not only my own movement, but the movements of both parties. A section was made from the limestone rocks of Beaver Lake through the gold bearing series to the northern Selkirk or Inner Cariboo watershed, between Mitchell's Lake and Canoe River, near Albreda Lake. Subsequently the cherty rocks of Bear River, which occupy a prominent position in

Cariboo, were intersected at various points and in different directions. Quartz ledges adjacent to the rich placers heretofore mined were everywhere noted, examined and sampled for assay.

"As results of the season's work I may mention the discovery of abundant evidence of the continuousness, permanence and richness of the quartz ledges of Cariboo, and of fossils in the gold bearing region, which determine the age and position of its rocks in the geological scale.

"The slates are of palæozoic age, and not improbably identical with those of Anderson River and Boston Bar on the lower Fraser, associated with the first gold mining in British Columbia, accordingly much older than the auriferous rocks in California, as determined. On the other hand I found near Quesnel Forks very good placer diggings, the gold of which is derived from rocks containing fossils of the 'Shasta Group' of the Cretaceous.

"The time occupied in field work was from June 23rd to November 6th, four months and a half." Mr. Bowmans detailed report and maps are now being prepared for publication.

In 1885 Mr. R. G. McConnell had been occupied in geologically exploring the Rocky Mountains to the north of the line of the Canadian Pacific Railway, and it became obvious as the result of this work and of that carried on by Dr. Dawson in other parts of the mountains, that a carefully examined section across the entire width of the range on some chosen line was necessary as a clue to its intricate structure. Mr. McConnell, who was instructed to undertake this examination, reports as follows on it:—

"The principal object of the season's work was to obtain a more detailed section across the main Rocky Mountain range than the hasty exploratory work heretofore done has afforded; as it was considered that the knowledge thus obtained would greatly facilitate operations in more remote regions where the shortness and uncertain character of the season, combined with the difficulties in travelling, due to trails encumbered with wind-fall and crossed every few miles by swift mountain streams, which even near their sources are often well-nigh impassable, render the prosecution of geological work both tedious and expensive. The country in the vicinity of the Canadian Pacific railway was selected as the best adapted to the purpose in view, as, besides its greater accessibility, it adds the further advantage of being more accurately surveyed than any other part of the range. Work was commenced on the 24th of May, at the Gap of the Bow River, and during the course of the summer, all the subordinate ranges lying between that point and Golden City were ascended and examined; involving altogether climbing to the extent of over 200,000 feet. In October the

North-west
Territory.

weather having become too severe for further work in the mountains, a short time was devoted to the examination of the Cretaceous rocks of the eastern foot-hills in the vicinity of the Bow River. In addition to the stratigraphical work accomplished, a number of sketches and cross bearings were taken from the summits of most of the mountains ascended, which will add considerably to our knowledge of the topography of the region, and a large suite of fossils was collected from the various formations represented in the range. The results of the exploration have not been worked up yet, and cannot therefore be given in detail, but the following general statements may not be uninteresting.

“The Rocky Mountains are mainly composed of strata ranging in age from Lower Cambrian to Lower Carboniferous. Along the line examined, this series has a minimum thickness of 20,000 feet, and is apparently conformable throughout, although in other parts of the range, distinct unconformities have been detected by Dr. Dawson and by Dr. Hector. That deposition was not continuous throughout the entire period is shown by the fact that in the eastern part of the range, the Silurian is scarcely represented, although it becomes of considerable importance on approaching the Columbia. East of the main divide, the Lower Carboniferous is overlain in places by beds of Lower Cretaceous age, and here again, although the two formations differ so widely in respect to age, one overlies the other without any perceptible break, and the separation of one from the other is rendered more difficult by the fact that the upper beds of the Carboniferous are lithologically almost precisely like those of the Cretaceous. Were it not for fossil evidence, one would naturally suppose that a single formation was being dealt with. This great series of conformable strata shows that prior to the last great upheaval which gave the range its present form, the region was subjected to little disturbance and no folding or crumpling of the rocks to any appreciable extent had occurred. This fact is also further evidenced by the prevalence of one dominant type of structure. From the axis of the range to the eastern edge, the beds nearly everywhere dip regularly and usually at high angles, in towards the centre. This uniformity in dip is produced by a series of great fractures, accompanied by displacements of many thousands of feet, which have had the effect of causing the same beds to be repeated at least seven times. These faults are of great length, and run in approximately parallel lines, and as soon as, or before, one dies out it is replaced by another, a few miles distant, which continues on in nearly the same direction. The range is bounded on the east by a dislocation of such magnitude that few occurrences of a similar character elsewhere can bear comparison with it; it has affected all

the formations between the Cambrian and the Middle Cretaceous. The Cambrian limestones have been thrust forward for miles along the line of this fault and now overlie in a nearly horizontal position. the black shales of the Cretaceous. West of the axis, only one fault has been clearly made out, but the beds have been so disturbed and altered by an intrusion of igneous rock near the line of section that the structure there becomes more difficult to unravel. All the evidence collected, however, goes to show that west of the axis overturned folds and not faults play the most important part. An interesting feature of this range, and one which places it in rather an anomalous position among mountain chains is the fact that along the watershed range, and for several miles on either side of it, the beds, although folded to some extent, are less disturbed than in any other part, and in no place examined has denudation yet uncovered a granitic axis."*

Mr. J. B. Tyrrell, assisted by Mr. D. B. Dowling, was occupied during the entire summer in completing the geological exploration and examination of the country between the Bow and the North Saskatchewan River, east of the 115th meridian. A report and map of this district will be prepared during the present winter. Mr. Tyrrell furnishes the following summary of the work accomplished:—

"Acompanied by Mr. D. B. Dowling, I left Ottawa on the 10th of May and proceeded at once to Calgary, where our horses had been left in the autumn of 1885. Having there obtained men and the necessary supplies, we started eastward to the Lord Lorne Crossing of the Red Deer River where our survey began.

"Following the trail on which Lord Lorne had travelled out in the summer of 1881, we crossed Bull Pound and Berry creeks and traversing a stretch of flat 'alkaline,' country reached Sounding Creek. We there left the trail and followed the creek in its winding course for one hundred and twenty miles, till it reaches Sounding Lake, lying in the middle of the Neutral Hills. Leaving this lake and crossing the hills in a westerly direction we reached Nose Creek, which we followed northward to its confluence with Battle River, a little above the crossing of the Fort Pitt and Sounding Lake trail. The next few weeks were spent in examining the valleys through which streams run into Battle River from the north, working from east to west in order to be able to reach Edmonton about the middle of July.

"During the time we were able to define with a fair degree of accuracy the northern extension of the low anticlinals, which had already been noted by Mr. McConnel, in the region to the south, as bringing

*For further information respecting the very interesting observations on the geological structure as well as concerning the mining development in the district above briefly referred to, Mr. McConnell's detailed report and section part D. of this volume, can now be consulted.—A.R.C.S.

the sandstones and clays of the Belly River series to the surface from under the shales of the Pierre group.

"At Edmonton a boat was secured and in it I made a traverse of the North Saskatchewan as far east as Fort Pitt, while Mr. Dowling went round by the north trail with the horses and waggons, at the same time making an odometer survey of the line of travel and of as much of the surrounding country as the time at his disposal would permit. Turning west from Fort Pitt we followed in succession the Vermilion River, and other streams flowing north into the Saskatchewan, till we again reached Edmonton, thus completing our preliminary examination of the district lying south of the North Saskatchewan and between the fourth principal meridian and the Edmonton-Calgary trail.

"Our attention was then turned to the country lying to the west of this trail. We proceeded overland to Rocky Mountain House where we constructed a boat, and sending the teams back as they had come, I descended the river to Edmonton, making a geological examination of its banks, and a track-survey of those parts which had not yet been surveyed. Afterwards we went south-west to Pigeon Lake, made an examination of Battle Lake and the upper portion of Battle River; thence west to Gull and Black Lakes, the Blind Man, Medicine and Wolf rivers, returning to Calgary the eighteenth of November, when our horses were sent out to be herded and our outfit left in store for the winter.

"During the course of the season, special attention was paid to the occurrence of the different coal seams throughout the district, they having been found to underlie a very much larger extent of country than could have been thought at all probable.

"The 'Big Coal Seam' on the North Saskatchewan, for instance, was found to be on the continuation of a coal horizon stretching north westward from Knee Hills Creek and the Red Deer River, underlying country which is at present completely grass-covered, and shows no external evidence of coal anywhere in the vicinity. Along the Red Deer River, this seam has been burnt in a number of places, and the ashes which were collected at the foot of the bank have been assayed by Prof. Chapman, of Toronto, who finds that they contain small quantities of both gold and silver.*

"Besides matters of strictly geological interest, the character of the different soils has been noted, as well as the character of the grass or the timber growing thereon, so that it will now be possible to bring out a map showing the limits of the prairie and of the wooded districts, with notes on the nature of the underlying soils. Careful barometric

* Subsequent assays made in the laboratory of the Survey gave in some cases a trace of gold, but no silver. See page 33 Part T. this volume.

readings have also been taken at numerous points throughout the area examined, in order to lay down on the map contour lines, sufficiently close to show at least the general slopes of the country.

“A number of fossil remains, of plants and animals, was collected during the season, while Mr. Dowling devoted time to the collection and preservation of objects of natural history, of which mention is made on a succeeding page.”

During the season, forty-three photographs were taken, illustrating the character of the country. Field work ended on the 18th of November, when the party reached Calgary.

ONTARIO AND HUDSON'S BAY.

Mr. A. C. Lawson, assisted by Mr. W. H. Smith, was engaged in the geological survey of the country to the east of the Lake of the Woods, the work being devoted principally to the mapping of the sheet which includes Rainy Lake and its vicinity, but covering also portions of adjacent territory, and in the measurement of certain connecting lines which were found necessary in order to complete the geological and topographical information.

Mr. Lawson left Ottawa for field work on the 15th of June and returned from the field on the 12th of October. As the work of another season will be required to complete the information for the Rainy Lake sheet, Mr. Lawson has prepared a synopsis of the geological results so far arrived at, in some detail, as follows:—

“The season's operations were begun at Wabigoon, where Mr. Smith was intrusted to carry a micrometer and compass survey from a fixed point on the Canadian Pacific railway through to Rainy Lake by way of the Manitou canoe route to connect with the system of township surveys on the Rainy River. The west side of the lake on this route was mapped in detail as far as the middle of Manitou Lake, from which point onwards both sides were embraced in the survey, being within the limits of the Rainy Lake sheet. Several weeks were next occupied by Mr. Smith in completing the survey of the north-western expanse of Rainy Lake from Couchiching northward to the Devil's Falls. In addition to the usual micrometer and compass survey, a transit line was run between the two latter points, a basis upon which to check the variation of the compass, which does not appear to be uniform throughout the district. This done, Mr. Smith next made a survey of an important chain of lakes extending from the bottom of Redgut Bay, Rainy Lake, to Lake Manitou, which it is believed has never hitherto been explored. During the last few weeks of the season, Mr. Smith was engaged in completing certain detached surveys near

the mouth of Rainy River and in the south part of the Lake of the Woods, which stress of weather or other adverse circumstances had interfered with the previous season; so that nearly all the topographical material requisite for the mapping of the Rainy River sheet is now on hand.

"After having at the beginning of the season provided Mr. Smith with men and equipment requisite for his survey of the Manitou route, I left him at Wabigoon and proceeded to Rat Portage. Here two or three days were spent in the usual preliminary arrangements, and in inquiring into the state of the mining industry of the district, after which I proceeded to make a topographical and geological survey of the canoe route which extends from Lake of the Woods to Rainy Lake *viâ* Crow Lake and Pipestone Lake. The route consists of a chain of large lakes which have never heretofore been mapped. The west side of Crow Lake had previously been traversed by the survey, so that work was begun in the neighborhood of Turtle Portage, and carried along the south side of Crow Lake, thence through Boulders, Sand-hill and Schist Lakes into Pipestone Lake, and then through Stone-dam, Loon, Jack-fish and Foot-print lakes to the north-west bay of Rainy Lake. The survey was made by means of a Massey's patent log, the portages being chained, and was checked at various points on previous surveys. The Huronian (Keewatin) series of the Lake of the Woods was traced eastward and southward of Crow Lake, and was found to have an extensive development in those directions to a point midway between that lake and Rainy Lake; and as similar rocks are found along the Manitou route, it would appear probable that they also occupy the intermediate country between the two routes, although that is a point which has yet to be investigated. On Stone-dam Lake the Keewatin rocks give way to granitoid gneisses. The gneisses continue through to Rainy Lake, and it was here observed that they exhibited a more decided tendency towards a differentiation than has hitherto been noticed throughout the region. The two types into which the gneiss here resolves itself are a rather massive syenite gneiss and a more distinctly laminated biotite gneiss. An attempt was made to trace out this differentiation, not only on the Pipestone route, but also on the western shores of Rainy Lake, by subjecting them to a more critical examination than had been given them at the time of their topographical survey during the previous season. This attempt met with some measure of success, and it was found that throughout the field there can be distinguished as regards mineralogical composition:—

1. (a) Hornblende syenite gneiss. } With little or no quartz.
- (b) Mica syenite gneiss. }
2. Quartzose biotite gneiss.

"Both these vary much in their texture, from coarse grained granitoid to regularly foliated gneisses. Often they are marked off from each other very distinctly, and when this is the case, the syenitic gneiss appears to occur between the quartzose biotite gneiss and the lowest member of the green schists of the Huronian (Keewatin series). At other times the quartzose biotite gneiss and the syenite gneiss are so confusedly intermixed that it is a hopeless task to attempt to separate them. Whether these two types of gneiss can be sufficiently separated to permit of a geological generalization, which would be of service in the elucidation of this great fundamental series of rocks, can only be ascertained after the field notes have been carefully plotted. The belt of Keewatin rocks which crosses the Kishcotena route between Lake Kishcotena and Lake Despair was studied in detail and traced in continuous connection with the area of the same rocks examined earlier in the summer on Crow Lake, and Pipestone Lake. Some three or four lakes, of which Kaktimiagamak Lake is the most important, were surveyed and added to the topography of this route. The geological features of the northern part of the Manitou route were mapped out by the aid of the topographical sheets supplied by Mr. Smith's survey. The section proved an extremely interesting one, revealing, among other things, an extensive fault, with which is probably associated the origin of the long, narrow, deep body of water known as Lake Manitou.

I returned to Rainy Lake by the Little Canoe route, making a log survey of the several lakes which form it, and mapping the geological features exposed on their shores. These four approximately parallel routes, the Kishcotena, the Pipestone, the Manitou and the Little Canoe, together with two others, the Little Gull Lake route and the Big Canoe River, which have yet to be surveyed and examined, afford as many parallel sections across the country by the aid of which, since they are always interlacing, it is hoped that the distribution of the different formations in this part of the field will be satisfactorily mapped.

"In the southern part of Rainy Lake some time was spent in working out the geological features of the islands and part of the south shore, as well as that portion of the north shore which required special investigation in the light of the previous season's work; and considerable additions were made to the topography. The most interesting fact brought to light is, that, whereas on the Lake of the Woods and in the northern part of the Rainy Lake district the hornblende-schists and the altered traps which constitute the base of the volcanic division of the Keewatin series are generally (though not always) in immediate contact with the granitoid gneisses, here there occurs-

between the green schists and altered traps, and the fundamental gneiss, an immense development of mica-schists with some fine-grained, evenly laminated, micaceous gneiss. The underlying granitoid gneiss bears the same intrusive relation to these mica-schists as it does to the basal hornblende-schists of the Lake of the Woods. The mica-schists appear to thin out towards the north and to expand in volume to the south into Minnesota. They constitute the floor upon which the green schists and altered traps have been deposited, and their intervention between the latter and the granitoid gneiss, to a thickness of between two and three miles or even more, is a striking and conclusive argument, so far as regards this region at least, against the theory which would make lithological character a function of age, and therefore an indication of the age of non-fossiliferous rocks.

“For the purpose of acquiring a knowledge of the geological features of the south-eastward continuation of the Rainy Lake formation, and at the same time of becoming familiar in a general way with the features of the country between Rainy Lake and Thunder Bay, the last few weeks of the season were devoted to an examination of the canoe route along the Canadian side of the Minnesota boundary, and the field work was brought to a close at Port Arthur.”

Mr. E. D. Ingall left Ottawa for his field of work in the Thunder Bay district on the 9th of June, returning to Ottawa on the 13th of November. He was assisted by Messrs. H. P. Brummel and J. H. Moore, and was engaged principally in continuing and completing his work previously carried out in connection with the Silver Mountain and Rabbit Mountain mining regions and adjacent territory. This work will be made the subject of a detailed report, accompanied by a map, as soon as the result can be elaborated. Mr. Ingall has prepared the following sketch of the mining developments of the district, which embodies the main results arrived at, in advance of the detailed report:—

“The new mining region to which attention is now especially directed lies west-south-west from the town of Port Arthur on Thunder Bay, Lake Superior, which place is the headquarters of the mining men and the explorers.

“The discoveries are situated along the northern fringe of a range of hills forming the southern boundary of the valleys of the Kaministiquia and Whitefish Rivers as far as the source of the latter, a distance of some 60 miles from Port Arthur.

“There are two chief centres of activity in this belt of country which is from four to six miles wide, namely, Rabbit Mountain and Silver Mountain. At these places numerous mining locations have been taken up. On some of the most promising a good deal of work

has been done toward testing, whilst on the rest, little or no developments have been made. In some cases it seems doubtful whether the purchasers were ever in the country, for many of the locations are situated in valleys where the rock must lie under a very considerable thickness of clay or even of swamp soil.

"Besides the veins that have been discovered and taken up around these two places, exploration and acquirement of locations has also gone on to a considerable extent around Whitefish Lake in the same series of rocks, and a few locations have been taken up on the supposed southern extension of the veins towards the international boundary at Pigeon River.

"The surface of the region presents a number of flat-topped hills, frequently roughly circular, separated by valleys about 200 to 300 feet deep. From the tops of the hills down, the rock is shown in cliffs varying in height from 30 to 150 feet, below which the debris fallen from above, slopes off at an angle of 45° for probably another 50 feet when it merges into the gentler slope of the clay and soil filling the valley.

"Geologically the rocks in which the veins occur belong to the Animikie Series which is presumed to be Lower Cambrian. The strip of country containing the discoveries is from two to four miles away from, and runs roughly parallel to the junction of these Animikie rocks with the granitic and other rocks to the north referred either to the Huronian, or to the Laurentian.

"The Animikie rocks of the Silver Mountain district are nearly horizontal and consist of diabase trap, black argillites and some ferruginous dolomites, chert and jasper. The diabase caps the tops of the hills and has a thickness of from 150 to 200 feet, but the hills being bevelled off all round the thickness of the rocks shown in the cliffs is only from 50 to 100 feet. Below the trap there are about 200 feet of argillites, whilst at Silver Mountain below this again are to be seen about 100 feet of the chert and jaspery beds. The depth to which these latter extend cannot be ascertained as the soil of the valleys covers up everything below this.

"The trap occurs also as intrusive sheets, and although it is most probable that dykes of this rock occur I have not as yet been able to identify any. If they exist in the Silver Mountain area they must have weathered away more easily than the other rocks and for this reason are always covered up. The reverse of this is found to be the case in the sections of these rocks shown along the coast of Lake Superior between Port Arthur and Pigeon River, where the dykes form points and even protrude as distinct walls on passing inland from the shore.

"The argillites are in places soft and black, whilst at others they are harder and siliceous, and again at others contain a small proportion of magnetite and small crystals of chiastolite.

"The lower silicious beds consist of a variety of rocks, black, white and green cherts and jaspers, the latter are found plentifully sprinkled with vermilion spots. Inter-stratified with these are irregular beds of dolomite, generally rusty colored from the presence of iron. These siliceous rocks all contain iron in varying amounts—sometimes as ferric oxide, sometimes as magnetic oxide; the latter occasionally forming such a large proportion of the rock as to constitute an iron ore. An analysis of such ore gave Mr. Hoffmann 53 per cent. of metallic iron and no titanitic acid.

"The principal veins of the Rabbit Mountain district are seen to cut through similar hills of black argillites, capped by the same kind of trap, but as I have only begun a detailed examination of this latter district I cannot yet say whether the section downward is the same in detail as at Silver Mountain.

"To the north of Whitefish Lake and west of Silver Mountain is an area consisting chiefly of the siliceous group in which several veins have been discovered, whilst a few which have been located on the south side of the lake cut the argillite group.

"These lodes are true fissures, as evidenced by the way they have faulted the 'country' rock, the vertical displacement varying in different cases from a few feet up to 70 or 80 feet in one case. The lodes vary in their size and definiteness in the different beds. In the trap they are generally wide and filled with a solid mass of gangue minerals, often having in the centre large cavities or 'vugs,' lined with coarsely crystallized calcite, whilst in the argillites they are composite, breaking up into a number of branches and stringers distributed through the 'country rock,' or else they form a regular brecciated vein with the gangue minerals crystallized around the enclosed portions of the argillites. The veins which have been discovered in the lower cherty beds are generally more solid and with more definite walls than those in the argillites, and contain less silver.

"At times great difficulty is experienced in following these veins in the argillites owing to the fact that in drifting or sinking they pass from a good solid vein to portions where the ground is all split up by numerous small stringers, distributed through a large thickness of 'country' rock, so that only one or two of them can be followed. This has sometimes led to the belief that the vein had 'pinched out,' and that the veins do not continue downward. This is, however, an erroneous belief, for such very shallow fissures would hardly have produced the amount of displacement of the rocks so frequently found,

and further, one would naturally expect much local splitting up and indefiniteness of the veins in such laminated rocks as these argillites. This idea is borne out by the appearance of the veins where they cut the upper trap. This being compact, they are there large and solid. I feel sure that where there is a vein showing evidence at other points of being a 'strong' one, if followed carefully through the distributed part, it will again come together and become solid, and this has been the case in more than one instance in the region.

"The gangue or veinstone in these lodes consists mostly of barite, calcite and fluorite (green and purple) with white and amethystine quartz. The relative proportion of these minerals varies considerably in different parts of the vein. The silver occurs in the form of argentite and native. The former is the most common, the latter, so far, seeming to be confined to the surface, or to some slight depth below it. The other metallic minerals are pyrite, blende and galena. The two latter vary in the amount of silver they carry, sometimes assaying none, sometimes yielding a considerable percentage.

"It seems to be the rule, so far, that where the vein is charged with silver, the blende and galena also carry it, although it is not visible in them, whilst, away from these places, they are as a rule either poor in silver or wholly free from it.

"The silver is usually concentrated in spots in the veins, these ore bodies being of greater or less extent and varying much in their richness, sometimes assaying even into the thousands of dollars per ton, and sometimes yielding \$100 down to \$10 or less per ton. Between the ore bodies there are barren stretches of greater or less extent where the vein carries either a small proportion of blende, pyrite and galena or often no metallic mineral at all. At those places where they cut the upper trap bed, the veins carry either no silver or very little.

"Although much exaggerated talk has been indulged in the locality to which one cannot subscribe, the occurrence of rich silver ores in the veins is a fact.

"I have personally visited some eight different properties where I have seen excellent ore in the veins in bodies of greater or less extent. In some cases, the quantity has been small but encouraging as an earnest of more extensive bodies yet to be discovered by underground development, whilst in others the extent of the ore has been such as to yield from \$5,000 to \$30,000 or perhaps more.

"The precious metal is fairly distributed in the veins. In one instance recently, I was present when some very rich ore was taken out which was full of argentite in the form of nuggets and sheet leaf, and 600 feet from this spot silver has since been found in another opening on the same vein.

" At another place, equally rich ore was discovered at a depth of 160 feet, a body of rich ore having been previously taken from the outcrop of the vein, and mill rock is now being taken out at a depth of 40 feet.

" In yet another instance very rich ore was taken out of the vein at one place and, although this did not prove extensive, further development disclosed some good ore near the first body, though sufficient work has not yet been done to judge of its extent. On the same vein, ore running about \$200 to the ton has been found a mile from the first discovery.

" The chief development work in the region has been made at the following points in the Silver Mountain district:—Silver Mountain east end, Silver Mountain west end, and Crown Point, whilst in the Rabbit Mountain district the chief work has been done on the Rabbit Mountain, the Beaver and the Porcupine veins. At all of these points ore of greater or less richness and extent has been obtained. At Rabbit Mountain a mill with a daily capacity of 15 tons, is now erected to treat the ore, and has been running since first August last, whilst at the Beaver mine a similar mill, but of larger capacity, is being built. None of the mines have as yet attained a depth of more than 200 feet below the overlying trap, and they are therefore all in the argillite. The reason of this is that nearly all the veins intersect hills or ridges some 200 feet high, and it has therefore been most natural to commence by driving tunnels into the sides of these hills.

" The opening up of the region has not been nearly so rapid as it ought to have been, owing to the many disadvantages under which it has labored, of which I propose to speak at length in my detailed report.

" For these reasons the district is not yet out of its trial stage, nor will be, until there are a few mines opened up to a much greater extent than those at present existent, and we must anxiously await the confirming results of developments in depth. The question must be solved in several cases as to whether these ore bodies occur at sufficiently frequent intervals in the veins to pay for going through the intermediate stretches of poor ground, but I see no reason at present for supposing they do not.

" The region will of course have its failures as all mining districts have, and many of the veins found will never develop into rich mines; but this does not prevent it from becoming an active mining region with many successful enterprises.

" Considering the difficulties under which prospectors labor and the comparatively small amount of prospecting and development yet accomplished, I think the results are very encouraging, and were the

locality under more favorable conditions there would be ten times the amount of activity now observable. The development of the district requires not only energy, but that this energy should be rightly directed, and that a liberal policy should be pursued by the owners of mines and by the Government controlling the land; the former when without the requisite means to develop the mines, should not drive away the capitalist by counting on large sums for the mere right to work.

“ Besides the possibilities of this section in the direction of silver mining there is a chance of its coming to the front as an iron producer, for the prevalence of magnetite and other forms of iron ore in the lower siliceous beds of the series raises the expectation that exploration may lead to the discovery of points where this ore occurs in sufficiently large and pure beds to be profitably worked.

“ The attention of explorers has just now been turned to the question by the successful working of the iron ores lately discovered at Vermilion Lake, in the United States. These mines are situated in Minnesota and are about 120 miles west-south-west from Silver Mountain. Such has been the success attendant upon their opening that within the last two years the little town of Tower, with 2,000 inhabitants, has sprung up in the middle of the wilderness, and some 60 miles of first class railroad, now operating, connects it with the nearest shipping point on Lake Superior, and in about two months this railroad will be completed through to Duluth. At the present lake terminus of Two Harbours a little village has sprung up and there are complete docks for shipping the ore.

“ The company working the mines has 1,150 men on its pay-roll at present, and is shipping 1,100 tons of ore per day, worth about \$5,700, or at the rate of about \$1,700,000 per annum.

“ It has been pointed out to explorers and to mining men, in the Port Arthur district, that the geological features there lead to the conclusion that the iron ore deposits of Tower will be found to continue to the North-east into Canadian territory, where similar green Huronian slates occur, in contact with the Animikie argillites.

“ Somewhat similar iron ore in the Huronian green schists has been described* near the Kaministiquia station, and thence eastward through the township of Oliver the indications of the occurrence of deposits of iron ore are very marked. Mr. Peter McKellar reports the discovery of a very large iron ore deposit near the Huronian Gold Mine, but this I have been unable to visit.”

Mr. E. Coste was engaged during the season of 1884 and the greater part of that of 1885, in the geological survey of sheet No 113,

* Geol. Survey Report for 1869, pp. 330.

Ontario, this sheet having been selected as that covering certain important mining districts. It includes parts of Hastings, Northumberland, Durham, Peterborough and Victoria counties.

The extremely untrustworthy character of much of the geographical and topographical information available for the part of the province in question, and the necessity of measuring and resurveying many lines in order to produce a map of sufficient accuracy for the proper delineation of the geological features, together with the geological complications which were discovered, continued to render the progress of this work much more tedious than had been anticipated. In view of these circumstances and the fact, which became evident in the course of the work, that the region immediately surrounding Madoc and Marmora required minute investigation and a very detailed survey, in order properly to establish and explain the nature and relations of the deposits of iron ore and of the auriferous mispickel and quartz veins, with the granitic and dioritic igneous masses—a relation noticed by Mr. Coste in 1884—it was considered advisable to give this particular investigation the first place in the work of the present year. Mr. Coste reports that with the assistance of Mr. J. White as topographer, a map of the Madoc and Marmora region, including an area of about 700 square miles, has now been completed on a large scale. In addition to this work, about seven weeks were spent on portions of the northern part of sheet 113 outside this particular area. The complicated outline of the edge of the Cambro-Silurian limestones on the Archæan rocks had previously been mapped across the sheet by Mr. Coste, but with the purpose of endeavoring to separate the Trenton and Black River groups of the Cambro-Silurian, Mr. H. M. Ami was requested to make a palæontological examination of these rocks, which he successfully accomplished and at the same time obtained a number of interesting sections illustrating their character. Between six and seven hundred specimens of fossils were collected in this district by Mr. Ami. Mr. Coste states that the north-east part of sheet 113 has proved to be “of extreme geological complication. Fifteen large igneous masses and numerous smaller ones are to be found there in an area of about 500 square miles. They have cut the Archæan or primitive rocks to pieces and have completely metamorphosed large areas of the rocks of that system, so much so, that I estimate these metamorphosed rocks (principally metamorphosed by injection) and the igneous masses, to occupy about half the area of the Archæan of that part of the country. This great complication has made numerous traverses absolutely necessary in the parts examined, and though I have reason to think that these eruptions are less numerous to the west in the other parts of the map occupied by the Archæan rocks, it is nevertheless certain that there also many traverses will be required.”

In consequence of these facts and the uncleared and sparsely settled character of the north-western part of sheet 113, it may perhaps be found advantageous to prepare this sheet with an accompanying report, for immediate publication, leaving the details of the intrusions probably yet to be discovered for future elaboration. Respecting the detailed map above referred to Mr. Coste writes as follows:—

“ Apart from the seven weeks already stated to have been spent by me this summer in the working out of sheet No. 113, the rest of my time, from the beginning of June until the middle of October was devoted to the detailed map of the Madoc and Marmora mining district, as well as the whole time, during that period, of my assistant, Mr. White, who was engaged in the topographical work. I am pleased to report that we have been able to complete the work, and that we have now a map of 40 by 40 inches on the scale of 20 chains to an inch, showing with a great many details the geographical, topographical and geological features. A complete transit and chain re-survey of the whole area under examination had to be undertaken, and was well and diligently performed by Mr. White, assisted by two men. As the work proceeded Mr. White, had to plot it in the field, to allow the geological lines to be accurately laid down, the old township maps available being of no service. Mr. White is now engaged in replotting and reducing the whole summer's work and the map to a scale of 40 chains to the inch. When geologically colored, this map will clearly prove the close proximity referred to of the iron ores and auriferous quartz veins to the igneous masses and dykes cutting the Archæan, thus giving the key for further discoveries of economic importance in the Archæan rocks which cover so large an extent of country in Canada; besides being a guide for the district itself not only to what has been done towards the development of these mineral resources, but also to what may be expected and to where new work and researches should be directed. It will further show at a glance the very uneven and undulating surface of the Archæan rocks at the time the Cambro-Silurian sea invaded the country, and the great amount of valley erosion effected since the time the sea receded.”

In December Mr. Coste spent about ten days in visiting some points in the province of Quebec from which additional particulars were required for the purpose of completing information in regard to mineral statistics, and as the compilation and preparation for publication of these statistics for the current year will now be a first charge on his time, the detailed report on the Madoc and Marmora region may not be ready for publication for some months, though it is anticipated that it will form a portion of the next annual volume.

Mr. Coste's field work was begun the 21st May, and concluded on the 16th of October.

Dr. Bell was requested as early as possible in the season to visit the Great Manitoulin Island with a view to examine and, if found necessary, correct the topographical and geological lines that had been laid down to be engraved for publication on the sheet map No. 126, on a scale of a quarter of an inch to a mile, and which had been prepared from the surveys made some years previously and would therefore, it was considered, probably require corrections and additions before being republished. Later in the season, Dr. Bell was to explore a portion of the region lying to the south of Hudson's Bay and west of the District of Keewatin.

On this work Dr Bell reports as follows:—

"In pursuance of these instructions I left Ottawa on the 12th of June and spent a short time on Manitoulin Island, where, being favored by fine weather, I got over a good deal of ground, but it was not found necessary to make any material change in the geological lines as they had been laid down. Two days were spent at Sault Ste. Marie where I hired six voyageurs for my northern exploration. On arriving a day later at Port Arthur, these men were sent immediately with Mr. John McMillan and Mr. Alfred P. Murray, who were to act as my assistants, to Wabigoon tank, on the Canadian Pacific Railway, which was selected as our starting point. Provisions and other supplies were purchased at Port Arthur the same day and forwarded to Wabigoon tank. I had ascertained by correspondence that it would be difficult to obtain bark canoes, which are almost essential for the kind of work which lay before us. In the course of a few days, however, I succeeded in obtaining four canoes large enough for carrying my party and all the supplies we required for the whole season. Smaller canoes were afterwards obtained from time to time as required.

"Before we could start on our canoe voyage, everything had to be transported over a 'tote road' from Wabigoon tank, a distance of eight miles, to Sandy Lake. Leaving this long portage on the 6th of July the general course of our route was north-eastward, or towards Cape Henrietta-Maria on Hudson's Bay.

"From Sandy Lake I proceeded to Lonely Lake by way of Minnetakie Lake and its outlet. My route then lay through Osaburg Lake (or Lake St. Joseph) and the upper part of the Albany River, from which I crossed the country northward to the Attawapishkat River and descended this stream to the sea. Coasting southward on the west side of James Bay, the Albany River was reached and ascended to The Forks, or junction of the Kenogamin River. Following the stream to its source we passed through Long Lake and descended the Black River to its intersection with the Canadian Pacific Railway.

“ Exploratory or track surveys were made of the route followed from the time we entered Long Lake till we reached The Forks of the Albany River, with the exception of the coast of James' Bay between the mouths of the Attawapishkat and Albany rivers. In making these approximate surveys, the distances were ascertained by a boat's log or by the time occupied in traversing them at a known speed, while the bearings were taken by compass. Observations for latitude were made almost every day, and the variation of the compass was also frequently ascertained, so that I have the means of checking my positions as given by the above method. Careful sketches were always made of the shores of lakes and rivers, the positions of islands, points, &c., being checked by frequent bearings. The total length of the exploratory surveys made during the season by myself and assistants cannot be stated until the work shall have been plotted. In the course of the journey, upwards of forty photographs were taken, which show the character of the natives, the scenery and the surface geology of the country traversed.

“ From the above general sketch of the route followed and of the methods employed, the following brief account of the work done will be the better understood. In passing through the eastern part of Lonely Lake, a track survey was made of our route as an addition to the approximate survey of this part of the lake made by myself in 1883; and from the head of Lonely Lake (simultaneously with the geological examination of the country) surveys of the same kind were continued as above stated. Leaving the eastern extremity of Lonely Lake, we ascended the small river which flows into it, and turning up one of its eastern branches, we reached the height of land near Osnaburgh Lake.

“ In passing through Osnaburgh Lake, we explored its principal bays and then descended the Albany to the outlet of Eabamet (or Labamet) Lake, on the north side. It was here that we turned northward and followed up a chain of lakes, discharging by small rapid streams from one into another until we gained the height of land separating these waters from those of the Attawapishkat River. From the head of this chain of lakes it had been our intention to follow a small river, which was reported to flow northward into a lake on the Attawapishkat River, but not succeeding in finding it, we descended a rapid stream with many portages, which followed a north-easterly course to its junction with this river. Two days before I reached the Attawapishkat, Messrs. McMillan and Murray with two men were sent back to do other work which will be referred to further on.

“ On arriving at the Attawapishkat, I left my stores and large canoe in charge of one man on an island (which I called Nolin's Island) at the junction of the rivers, and proceeded with the other men to

examine the upward course of the larger stream for some distance, previous to descending it to the sea. At about eleven miles above Nolin's Island we reached the lowermost lake of the Attawapishkat, which the Indians informed me bears the same name as the river. It lies diagonally across the course of the river, and has a length of about nine miles from south-west to north-east by four miles from south-east to north-west. Two miles above Attawapishkat Lake we entered a beautiful lake of much larger size, which having as yet no distinctive name I propose to call Lake Lansdowne, in honor of the Governor General of the Dominion. This lake proved to measure about thirteen miles from south-east to north-west by about ten miles from south-west to north-east, and it is the largest sheet of water connected with the river. It contains many large islands and is much indented with bays. The surrounding country is more or less undulating and hilly, and thus affords a pleasing contrast to the level, and monotonous character of nearly all the rest of the region explored during the season. The commencement of the upward continuation of the Attawapishkat River is found in the south-western bay of Lake Lansdowne. This part of the river is described by the Indians as being broad, having, for the most part, a sluggish current and expanding occasionally into small lakes.

"The Attawapishkat River proved to be somewhat smaller than the Albany, which is not far from the size of the Ottawa above the capital. It descends at an almost uniform rate all the way from Lake Lansdowne to the sea, a distance of several hundred miles, notwithstanding the fact that in the upper part of its course it traverses Laurentian and Huronian rocks, while the lower portion flows over unaltered flat-lying palæozoic limestones. In this distance we did not require to make a single portage and from the description of the river above the lake, it would appear to be navigable without portages almost to its source, which has probably an elevation of more than 1,000 feet above the sea. Where it flows over the limestone country it is broader and shallower than in the higher parts of its course.

"Along the upper part of the river, the banks were lower than further down, where the spring freshets fill up the bed of the stream to a height of from twenty to thirty feet, and even more, above the summer level, and the ice which comes down at these times, has swept the banks clear of all obstructions and given them an uniform appearance throughout, except where cliffs and islands of limestone occur.

"The shores and islands of Lake Lansdowne are well wooded with large spruce, tamarac, aspen and rough barked poplar, with fair sized cedar and white birch; and the same kinds of wood continue along the

banks of the river for many miles down, but the timber at a distance from the water is of smaller size. In the low, level country, not only along the lower part of this river, but on the west side of James Bay generally, the greater part of the area between the rivers appears to consist of open sphagnum plains, with some small spruce and tamarac trees, either in groves or scattered singly, while the immediate banks of the streams are well wooded. In places the better class of timber forms belts extending for some miles back from the rivers. The fossiliferous limestones of the west side of James' Bay extend for a considerable distance inland on the Attawapishkat River, but they can only be mapped when my approximate survey shall have been plotted. The sea coast between the Attawapishkat and Albany Rivers is very low and uniform in outline and without indentations. The water is so shallow that we could touch the bottom with our canoe paddles at from half-a-mile to one mile from the shore. In order to pass the bouldery reefs, which extend from the shore north of the Albany, we were obliged to go so far out from the land that the tops of the trees were barely visible at the highest places.

"A careful track-survey of the Albany was made from its mouth to The Forks, which, with that of the upper part also made during this season, when plotted, will enable me to map the whole course of this river, an actual survey of the intermediate portion having been made by myself in 1870. The Albany possesses additional importance from the fact of its constituting part of the northern boundary of the province of Ontario.

"From the mouth to The Forks the river passes through a low and very level country, and it is characterized by a wide shallow bed with ice-swept banks like those of the Attawapishkat, but of somewhat greater height. On the Albany the limestones do not form conspicuous cliffs and islands as on the latter stream. The numerous large islands in the Albany form one of the features of the river between The Forks and the sea. My supposition, based on former explorations, that the Devonian limestones extend from James' Bay nearly, if not quite, to The Forks, has been confirmed by the present year's examinations.

"The Kenogami River and Long Lake are described in my Reports for 1870 and 1871, but the Black River had not been previously examined geologically. The rocks in its valley were found to consist of crystalline schists and diorites, granite, syenite and gneiss.

"Before reaching the Attawapishkat River, as already stated, Messrs. McMillan and Murray with two men were sent back to perform other duty. They were instructed to make a track-survey between Eabanut Point and Abazotikitchewan Lake on the Albany, to

the latter of which my instrumental survey of 1871 had extended. They were then to proceed to make a geological examination of Cat River from Osnaburgh Lake to Cat Lake and to return home by way of Wabigoon. On my return here I found they had accomplished the above work, with the exception of the upper third of the Cat River. By using the map laid down from micrometer survey by Mr. Thomas Fawcett, D.L.S. (for the use of which we are indebted to Surveyor-General Deville) along with the track survey made by Mr. McMillan in connection with his geological notes, a considerable addition is made to our knowledge of the distribution of the rocks in the region which he traversed."

In Part G. of this volume further details are given with illustrations.

Mr. A. P. Low, accompanied by Mr. J. M. Macoun as assistant, left Ottawa on the 10th May, and proceeded to Selkirk, to await the departure of the first boat for the mouth of the Berens River, on Lake Winnipeg. This point was reached on the 28th of May.

Here, having purchased canoes, the season's work was commenced, and a micrometer survey was carried up the Berens River to the height of land, between the waters of Lake Winnipeg and those falling direct into Hudson's Bay.

This point was reached on the 17th of June, the distance along the route surveyed being 168 miles. From its mouth, the Berens River trends a few degrees south of east for 102 miles to Family Lake. Throughout this distance its course is broken by numerous small falls, entailing many short portages.

At Family Lake the river bends sharply to the north, and the survey line runs in a slightly north of east direction to the height of land, and passes through several small lakes in that distance.

The watershed was passed by a short portage, ending at two small lakes on a small stream at the head of the middle branch of the Severn River.

Following this stream in a north-east course, and on the way passing through several little lakes surrounded by broken, rocky and barren country, the party reached Deer Lake on the 19th of June. This lake is distant 22 miles from the height of land, and is very long and narrow, with several deep bays. Here the track survey which had been made by Mr. Cochrane in 1882 ended, and, having been unable to obtain an Indian guide beyond this point, much trouble was experienced in finding and following the river running out of the lake. Descending the outlet for 176 miles, another large lake was reached, the shores of which were covered with a fair growth of timber, and the soil in the vicinity of which appeared suitable for cultivation. This is called Favorable Lake.

Following the river running out of it for 100 miles, a large lake, called Sandy Lake, was entered. The country along the river was flat, and if not too swampy, would make good farming land.

From Sandy to Severn Lake the distance is 150 miles by the river, which runs through moderately good country. Here an Indian was met who acted as guide to the Hudson's Bay Company's post on Trout Lake, distant 55 miles, the intervening country being flat and swampy, with a small growth of black spruce and tamarac. Mr. Low was informed at Trout Lake that summer frosts were rare, and never damaged the crops of potatoes and roots grown there. No attempt has been made to grow grain. Leaving Trout Lake, the survey was carried down the Fawn River, the outlet of the lake, which falls into the Severn River 226 miles from the lake and sixty miles from Fort Severn, at its mouth, which was reached on the 6th of August, thus completing a line of micrometer survey from Lake Winnipeg to Hudson's Bay, 882 miles long.

From Severn, the party proceeded along the coast to York Factory. The shore between these points is very low and sandy, covered with a scant growth of grass and moss, the tree line being distant several miles from the sea.

The return journey was made from York in a small boat, by ascending the Hayes River route to Norway House, and thence down Lake Winnipeg, reaching Ottawa the 19th of October.

From Lake Winnipeg to Deer Lake the country passed through is rough and rocky, covered with a small growth of black spruce, aspen, poplar, banksian pine, tamarac and white birch.

From Deer Lake to Severn Lake the surface is much more even and the soil and timber better, the latter consisting of white, black and balsam spruce, aspen and balsam poplar, tamarac and birch, many trees exceeding eighteen inches in diameter three feet from the ground. This section of the country is fit for agricultural occupation, but great difficulty will be experienced in obtaining an outlet until a railway is built.

Between Severn and Trout Lakes, and for 100 miles down the Fawn River, the country is very flat and swampy, the timber being chiefly black spruce and tamarac of small size.

Beyond this, as far as the sea, the river cuts more deeply into the surface of the country, forming a valley, the banks of which are composed of sand and clay and vary in elevation from 50 to 200 feet. Beyond the valley the soil appears light and poor, and in many places swampy, sustaining a small growth of black spruce and poplar. The rocks met with are all Laurentian gneiss as far as Favorable Lake. Here, and along the route to Trout Lake, several bands of Huronian rocks

are seen together with the Laurentian. These bands are highly magnetic and contain large quantities of pyrite. Further details of this exploration are given in Part F. of this volume.

Mr. W. Ellis, in the following preliminary report of his work in the Eastern Townships, has included a number of details, bearing specially on the asbestos industry, which it seems important should be made immediately available.

"The work of the past season embraced the further examination of that portion of the Eastern Townships lying to the east of Lake Memphremagog, and of Richmond and Arthabaska, and extending thence to the Maine boundary, with the view of completing in greater detail the S.E. quarter of the map of a part of the province of Quebec known as the map of the Eastern Townships. For the purpose of better elucidating the somewhat complicated structure of this section, over 2,000 miles of roads were carefully surveyed. The settlements of the last dozen years have opened up a large tract of country which had been almost entirely inaccessible to previous explorers, and we were thus enabled the more readily to decipher and to map the outlines of the various geological formations. In this work I was ably assisted as in former years by Mr. N. J. Giroux.

"The latter part of the season was chiefly devoted to an examination of the principal mining areas, among which, on account of their great economic importance, special attention was directed to those where asbestos mining is now carried on.

"Highly important discoveries of graptolites at two points have necessarily led to a somewhat extensive re-arrangement of the several formations in the area in question, more particularly as regards the distribution of the Silurian (Upper Silurian) rocks. Thus, by reference to the Geological Map of Canada, 1866, it will be noticed that two very extensive areas of rocks which were then regarded as of this age are depicted, the one extending northerly from the vicinity of Lake Memphremagog into the township of Ham, with a breadth of some twenty miles or more, while the second, and of still larger area, embraced the greater part of the country lying east of a line N. E. from Lennoxville and extending to the boundary of Maine. During the season of 1885, the necessity for correcting the boundaries of this system was noted, but no precise palæontological data could at that time be found which would fix the horizon of a great part of these rocks more definitely. In July last, however, while examining closely the country about Lake Memphremagog, in company with Mr. H. M. Ami, considerable areas of black slates on both sides of the lake were found to be very rich in graptolites, the exact age of which has not yet been ascertained, but which are very like those found at various points on

the south side of the St. Lawrence, at and below Quebec, and which have been determined to be of Cambro-Silurian or Ordovician Trenton-Utica age.

“As regards the distribution of the Silurian (Upper Silurian) slates and limestones, it has been found that these rocks are, for the most part, confined to limited areas and patches which have escaped denudation, and now rest unconformably upon a great series of black slates and grey sandstones of presumed Cambro-Silurian age, but in which except as above referred to no fossils have been found. These patches occur principally at Lakes Memphremagog and Massawippi, Stoke Centre and North Stoke, Lakes Aylmer and St. Francis, and the Chaudière River, between the Famine River and the village of St. George, Beauce. Fossils (corals, &c.) which range from the Niagara to the base of the Devonian are found at many points throughout these rocks. Their unconformability upon the underlying slates, is however, well defined at several observed points. The relations of the crystalline schists and other associated rocks of the mineral bearing belt have also been again carefully studied by detailed surveys, and it is hoped that the additional facts which have been obtained during the past season, will, when plotted, assist in satisfactorily establishing their true position as regards the graptolitic black slates with which they appear to be conformably associated. This work will be done during the coming winter, when the final results will be duly presented.

“The various mountain masses, such as the Owl’s Head, Orford, Ham and Bull Mountains, north-west of Lake St. Francis, all apparently belong to one era, and form a disconnected chain of eruptive peaks which extend north-easterly for nearly 100 miles.* Their intrusive and eruptive character and comparatively recent age is clearly established by their action upon the black graptolitic slates which flank them and which are, in many cases, highly altered along the contact, the rock being in places changed to a true porcelain. Like these, also, they give off dykes into the surrounding slates and sandstones, with which are also intimately associated the great areas of serpentine, which have, during the last half-dozen years, come into marked prominence as being the country rock of the valuable mineral asbestos.

“The various mining industries carried on at several points are in some cases marked by a decided increase in the output. The new system of mining returns will, it is hoped, eventually furnish a great amount of valuable information, and it is highly gratifying to

* This is the belt of rocks which I have elsewhere described and mapped as the Volcanic Group, or the upper division of the so-called “Altered Quebec Group;” at the same time I stated that these rocks might be of lower palæozoic (Cambrian) or of pre-palæozoic age. It includes the serpentine belt, and the serpentines are undoubtedly altered igneous rocks, probably volcanic. I cannot concur in the view above expressed that these igneous rocks are comparatively recent. They are certainly older than the Levis formation, while the black graptolitic slates on the south-eastern side of them are certainly newer.—A. R. C. S.

find, in all cases, such a willingness on the part of mining men to assist in every way the collection of mineral statistics.

"The principal mining industries at present carried on in the section embraced in the season's work are:—

"The slate quarries of Rockland and Danville—the latter lately reopened—while the former, by marked improvement in plant, is also rapidly increasing its output.

"The copper mines of Capelton, also showing a marked increase in output.

"The asbestos or crysotile mines of Thetford, Coleraine and Wolfestown, and the gold mines of Ditton and the Chaudière.

"As regards the latter industry, it is to be regretted that no returns can, apparently, be procured as to the quantity of gold annually obtained from the Ditton gold field. The area being entirely in private hands, over which the local Government has no control, no royalties are paid, and no definite data can be had. There is no doubt, however, that a very large quantity of gold has been found in this section and that the prospects for profitable workings are excellent.

"In the Beauce district, work is being carried on in the Cumberland stream, a branch of the Famine, by Captain Richards; and on the St. André, near St. George, by the St. Onge Company. The returns from the former are very encouraging, but at the latter, considerable difficulty has been found in reaching the gravels of the old river channel, though gold is taken out in small quantity.

"The mining of asbestos is carried on at several points along the line of the Quebec Central railway, viz., at Thetford, Black Lake, Coleraine and Belmina. Some work has also been done near Coleraine station. Near Danville, four miles from the Grand Trunk railway, a mine of considerable extent has been operated for several years. As this industry has already grown to large proportions, and bids fair to become one of the most important in the Dominion, a brief description of the various asbestos properties, its mode of occurrence, and some facts bearing on the future of the industry may be of general interest.

"The various companies engaged in mining asbestos at Thetford are King Bros., the Boston Asbestos Packing Co., Johnston & Co., and Ward Bros.; while at Black Lake and Coleraine are situated the mines of the Anglo-Canadian Co., Frechette's, and the Lionais Martin or Scottish Canadian Company's property. These all lie along or near the line of the Quebec Central railway, which crosses the property at Thetford, while at Black Lake it is from a quarter to half a mile distant from the workings. At Belmina, which is about four miles from the railway at Coleraine station, a small force of men, from six to eight, have been engaged for several years merely on explo-

ratory work, on property owned by Mr. John Bell, of London, England. With a view of acquiring more definite information concerning this valuable mineral, a somewhat detailed examination of all these properties was made, in order to give advice and information, if required, to any persons interested in this industry.

"All the asbestos mines in the Eastern Townships are situated on portions of the great serpentine belts which extend in tolerably direct lines, though with many breaks, north-eastward from the Vermont boundary for some distance beyond the Chaudière River. Further east, these peculiar rocks present large areas in the Shickshock Mountain Range, which extends through the northern portion of the Gaspé Peninsula in rear of Ste. Anne des Monts, and further east on the lower part of the Dartmouth River. Though indications of asbestos are found at most points throughout the whole serpentine formation, the developments of it appear, in so far as yet known, to be greatest in the areas about Thetford and Black Lake and near Danville, though there is no apparent reason why it should not be found in paying quantity at other points, and it is possible that subsequent exploration will largely extend the area where profitable mining operations can be carried on.

"The serpentines, without going into any detailed account of their mode of formation, may be stated to be intimately associated with masses of dioritic or doleritic rocks, of certain varieties of which, rich in olivine or some allied mineral, the serpentine is in many cases doubtless an alteration product. The serpentines are also frequently associated with masses and dykes of whitish rocks, often composed entirely of quartz and felspar, but at times with an admixture of black mica, forming a granitoid rock. They occur generally not far from the axes of certain anticlinals which exist in the group of rocks designated the altered Quebec Group by Logan. (See foot note ante.) The asbestos (crysotile) traverses the serpentine in veins often irregular, and ranging from mere threads to a thickness of three and even in some cases six inches, in all of which the fibre of the vein is, unless affected by the dislocation of the containing rock, at right angles to the sides of the fissure. The rock is in many cases somewhat impure, from the admixture of grains or small irregular veins of chromic iron, which break the continuity of the fibre in the vein and require the mineral to be carefully "cobbed" in order to separate these impurities. The veins at or near the surface are also affected by the infiltration of water by which the asbestos is discolored and its value correspondingly reduced. This is especially noticeable in areas where the surface serpentine is shattered, either by the action of weather or other causes, and this discoloring ceases as the rock be-

comes solid. As a rule, the veins increase in value or quality of fibre as lower depths are reached. The veins are not, however, continuous. They frequently vary in size, and like all mineral veins, they are affected by faults or slides which often cut off, completely, a valuable working face. In such cases the slicken-sided character is very marked; sheets of impure or imperfect asbestos with long coarse woody fibre lying along the lines of fault. The veins have often the aspect of true segregation veins, and the containing walls often change their character for a distance of half an inch to three inches on each side of the vein. The theory of their formation is, however, as yet an open question.

“Asbestos mining was commenced at Thetford in the year 1878, by what is now known as the Boston Asbestos Packing Company. The demand at that time was exceedingly limited and considerable difficulty was at first experienced in finding a market. The output for that year did not exceed 50 tons, but its value was soon ascertained, and explorations on the serpentine belt at this place resulted in finding asbestos in workable quantity over a considerable area.

“The Thetford River appears to mark the western limit of the serpentine on these properties, the rocks on the other side of the stream being altered slate and sandstones. To the east of the railway which cuts directly across the area, the serpentine forms a knoll with an elevation of about 90 to 100 feet above the track. All the works are confined to this portion of the area and consist of open cuts in the face of the hills, nothing apparently having yet been done to ascertain the value of the area between the railway and the river.

“The quality of the asbestos at all the four mines at this place may be stated as excellent. The fibre is fine and readily worked, and the veins are, for the most part, especially in the lower cuts, comparatively free from chromic iron or other impurities, reaching a width of from three-quarters of an inch to four inches, though in some, notably the quarry of Johnston & Co., veins of five or six inches are observed. The fibre in these large veins is not, however, of such good quality, in so far as yet worked, as that found in those of less size, and veins of an inch and a half to three inches give as good material as can be wished. Numbers of such veins, yielding fibre which ranks as extra first quality are found in all the mines at this place. In some of the cuts these appear as a perfect interlacing network in the surrounding walls, and can be counted by the dozen. While all these properties may be said to be about equally productive, that of the Boston Company may be especially mentioned, both for the quantity of its output, which will probably equal that of the three others combined, as well as for the excellent way in which the property has been developed with a view

to successful future operations, by its experienced manager, Mr. Thomas Sheridan, and also as illustrating the remarkable improvement in the quality and increase in the quantity of the fibre as the depth increases; a feature clearly established at all the mines, not only in this vicinity, but also at Black Lake.

“The profitable mining of asbestos is at present, apparently, only limited by the demand. The quantity extracted since the commencement of operations here may be briefly stated thus;—

“Boston Asbestos Packing Company, opened 1878, output for 1886, 700 tons. Total output to end of 1886, 30,000 tons.

“King Bros., adjoining to north, for 1886, say 250 tons, total since 1881, 850 tons.

“Irving-Johnson Company for 1886, say 400 tons, opened since 1879, total 2,500 tons.

“Ross-Ward Bros., one quarry, three years only, say 400 tons.

“The cost of extraction varies in different localities and depends upon how much barren rock is encountered, which owing to the action of faults is greater in some cuts than others. It may, however, be safely put down at \$20 to \$25 per ton.

“The prices obtained for the asbestos at points of shipment on railways range from \$50 to \$55 per ton for second quality to \$80 or even \$100 for first, a considerable portion of that taken from the lower cuts realizing the latter figures. The markets are Great Britain, Germany, Belgium, the United States and Italy.

“The majority of the veins worked range from three-fourths of an inch to two inches and a half. The material is blasted out, carried to the dump, broken up and cobbled by boys and old men, who grade the asbestos, according to the color as well as the purity of the fibre, with due regard to its length. The wages paid for laborers in the quarry range from \$1 to \$1.10 per day, and for boys and cobblers, 50 cents.

“The comparison of the cost of extraction with the value of the raw material shows a very good margin for profit. The works at this place are, however, carried on, for the most part, during the six months of summer and autumn only, since it has not yet been found advantageous, in view of the limited market, to undergo the inconvenience and extra expense of continuing operations during the winter. As the market enlarges, however, the mode of working will doubtless adjust itself to the demand. The properties worked at Black Lake are situated on the west side of a steep ridge of serpentine which rises to a height of about 900 feet above the waters of the lake itself. The three areas are contiguous and from a quarter to half a mile east of the railway. The work is carried on by open cuts in the face of the hill, in all of which veins of excellent asbestos are disclosed, ranging in size

up to four inches. The fibre is, in most of these, somewhat discolored from the presence of water which penetrates the shattered serpentine, and, as a consequence, the greater portion of the output grades as second; but in most of the openings, the solid rock is now reached, and the quality of the asbestos is rapidly improving. These mines have not been in operation so long a time as those of Thetford, but the output, which is as follows, shows readily the growing importance of this locality:

"The output of the Anglo-Canadian (formerly Hopper's mine) for 1886 may be stated at 550 tons, and total output for the four years, 1,500 tons.

"The Frechette mine has been at work only one year, with an output of about 200 tons.

"The Lionais-Martin mine, now the Scottish Canadian Company, has done a large amount of exploratory work. Its estimated output for 1886 may be stated at 250 tons, with a total from the commencement of, say 700 tons.

"The cost of mining here varies but little from that at Thetford, and may be stated as averaging \$25 per ton.

"In the vicinity of Black Lake, several other areas occur, in which the exploratory work done, though not very extensive, shows indications that fully warrant the statement that a valuable and profitable output may be expected. These properties are known as the Reed and Hayden properties, and are situated on lots 27 and 28, range B, Coleraine. In various open cuts in the sides of the hills, numerous veins are disclosed, ranging upwards to a width of two inches and a half, with surface indications apparently in no way inferior to those of the adjoining properties now being worked at this place, or even on those at Thetford, not only as to number and size of veins, but also as to quality of fibre. These indications appear at many points on both the Hayden and Reed properties, which embrace an area of 200 acres. Between these and Cariboo Lake, the serpentines extend as an apparently continuous ridge, and show at intervals very good indications of asbestos, but this portion has not as yet been explored to any extent, and but little can be said from actual examination of the value of this section of the serpentine belt, though that it will be found equally productive with adjoining areas seems reasonable.

"In the vicinity of Coleraine station serpentine also occurs, but the main ridge, extending south-west from Black Lake, keeps to the north-west about one mile and a half, where it forms a conspicuous hill feature. This has been but little examined, but an opening was made on its south-east extremity during the present year by Mr. Kennedy, disclosing the presence of a number of veins of asbestos, one of which

was, near the surface, nearly four inches thick. Sufficient work was not done to determine the persistence and value of these veins. An interesting feature in connection with this opening is the presence of mica in considerable quantity in direct contact with the asbestos, a feature not as yet noted at any other point.

"The asbestos area of Wolfestown is situated on the north-east extremity of a serpentine ridge, which extends south-westerly, with several interruptions, from the road leading from Coleraine station to Wolfestown, to the vicinity of Lake Nicolet. It is owned by Mr. John Bell, of London, Eng., and though a considerable sum of money has evidently been spent on this property, it has been largely on explorations. The surface indications, while not equal to those of Black Lake, yet show at several points numbers of veins, some of which reach a thickness of an inch and a half and even two inches. Only a small force of men is employed, and the property cannot yet be said to be fairly proved. Considerable deposits of chrome iron are found in the hills on this area, which embraces 600 acres. At present it would be exceedingly difficult to give any decided opinion as to the merits of this property. A very fair showing of workable veins has been exposed in the upper part of a deep cut which it is now proposed to intersect at a considerably lower level. Should the same rule of increase which holds at Black Lake and Thetford apply here, there should be good paying ground when the lower level is driven in past the capping of barren rock, provided the veins already disclosed are not cut off by faults, whose presence is noted here as at other points. The total amount of asbestos taken from the Belmina area is about twenty-five tons.

"In addition to the properties already described, the only other point where this mineral is worked successfully is on lot 9, range 3, Shipton, about four miles from Danville on the Grand Trunk Railway. The outcrop of the serpentine here is quite limited, with steep sides all round, and contains a number of veins of asbestos, mostly of small size, though the quality of the fibre is good. Faults have affected the value of this property considerably, some very good veins with a thickness reaching two inches having been cut off completely at a depth of 50 feet from the surface. The output, however, is considerable, being 455 tons, for the year ending 28th August, 1886, but from various causes it is at present much less, the mine not being worked to its full capacity.

"It will be seen from the facts here presented that the asbestos interests of the province are very important, and, judging by the rate of increase in production for the last six years, it will soon assume large proportions. The demand is annually increasing, as new uses for the

raw material are being found, and from the prospects presented not only at the mines already opened, but in those areas contiguous which appear equally rich, the supply is practically limitless.

"During the past year attention was directed to the deposit of marble situated near Marbleton, in the township of Dudswell. This was described by the late Sir Wm. Logan in the *Geology of Canada*, 1863, p. 827. A great variety of marble is here presented, some of which are very fine, notably a black ground, with veins of ochre yellow. Though the deposits of marble in the vicinity have been extensively used for some years for the manufacture of lime, the desirability of utilizing the finer grades as marble was such that a company was formed during the past year for this purpose. The ground has been cleared and a channelling machine set to work. The area of the present quarry is about forty feet square. The black and gold variety is interbedded with others of dove-grey and variegated shades, all of which present a fine appearance when polished, some bands entirely composed of fossils (corals) notably so. The rock bids fair to be sufficiently solid to extract valuable blocks of large size in the second cut, and it is the intention of the company to erect, in that case, sawing and polishing machinery for its manufacture.

The work of the season began on the 17th of May, and extended to the 1st of November.

At the end of July Mr. H. M. Ami was instructed to join Mr. Ells in the Eastern Townships for the purpose of assisting him in collecting fossils and in examining the various fossiliferous localities which had been discovered, with the view of fixing the age of parts of the rock series of the district. Messrs. Ami and Ells together obtained about five hundred specimens from various places near Lake Memphremagog, in Stukely, Stoke and Dudswell; along the Chaudière River, at Quebec City, and at Montmorency and the Island of Orleans.

Rev. Professor J. A. K. Laflamme having consented to continue the work previously carried on by him in connection with the accurate definition of the boundary of the Lower Palæozoic rocks on the Archæan to the north of the St. Lawrence, and of the areas respectively occupied by the various sub-divisions of the Cambro-Silurian, sketches the result of his labors as follows:—

"I have traced on the map, with as much precision as possible, the limits of the Laurentian and of the Palæozoic rocks between Quebec and Three Rivers, as well as the several divisions of the Cambro-Silurian which are found in this part of the country. I have, however, unfortunately, been unable to complete the stratigraphical study of the region immediately surrounding the city of Quebec.

"The geological map received from Ottawa for use as a basis of

work was found exact in its principal lines. Some slight errors which I have noted have been carefully corrected, and will be indicated on the map which will be submitted with my report.

“Certain facts which appear worthy to be remarked are as follows :

“(1.) The discovery of some small deposits of apatite in the Canton de Caxton merit special attention, as it is not impossible that more important deposits will be found in the future, as the Laurentian gneiss of the neighborhood is traversed in different directions by veins of crystalline calcite, rich in mica and pyroxene.

“(2.) The great thickness and quantity of sand which occurs on the banks of the St. Maurice renders the observation of the exact limits of the different geological formations impossible, particularly as regards the boundary between the Utica and the Trenton limestone. The sand contains a great quantity of ferruginous matter, giving rise to abundant deposits of limonite wherever the surface is occupied by swamp. Thus in this part of the country we find the most ancient iron furnaces of Canada, several of which are now, however, not in operation, owing to the scarcity of fuel.

“(3.) The Utica shales preserve there one of their distinctive characters in giving rise to strong and highly saline mineral springs, the therapeutic value of which has long been known.

“(4.) The same shales with the subjacent Trenton limestones produce considerable quantities of light carburetted hydrogen, almost pure, and capable of being utilized at several places very profitably. One in particular of these flows of combustible gas occurs quite close to the old forges, abandoned on account of the scarcity of fuel, and there, it appears, all the conditions exist which would justify boring operations with the object of augmenting the flow of gas, for the purpose of resuming the smelting operations. The boring made at St. Grégoire leads to the belief that the gas is stored principally in the Utica shales. If this be the case, it would be necessary only to sink wells through the thick bed of clays which cover this formation here, to produce an abundant flow of gas.

“(5.) The Trenton limestones have a great development at St. Alban, where are found the well known quarries which yield the best building stone of the province of Quebec. The limestone is crystalline and fossiliferous. The quarries yield annually from four to six thousand toises of stone.

“(6.) The study which I have made of the immediate vicinity of Quebec, though superficial, leads me to the belief that there are on the northern side of the rock mass of this vicinity tongues of Utica shale. These would be somewhat analogous stratigraphically to those shown by Sir W. E. Logan's section of the Island of Orleans. It appears to

me impossible to class as Trenton the whole of the exposures comprised between the left bank of the river and the heights of Beauport, Charlesbourg and Lorette.* There is quite close to the edge of the Laurentian a band of variable width of Trenton limestone, but the remaining space is occupied by shales very like those which are again found to the south-east of the Montmorency Fall, between the fall and the river."

NEW BRUNSWICK.

Prof. L. W. Bailey was again occupied during the summer in the geological survey of New Brunswick, with the object in view of completing the sheets of the geological map yet remaining unfinished. Prof. Bailey was personally assisted during the season by Mr. J. W. Bailey. His preliminary account of the work, with that of Mr. W. McInnes in the same province, is given below.

"In accordance with instructions, my own attention was directed chiefly to the study of the Silurian system of northern New Brunswick with a view to the determination of the succession of its rocks and their relations to the formations above and below it. With this object in view, examinations begun in the previous year on the northern side of the Silurian basin, where it comes into contact with the rocks, supposed to be of the age of the Quebec Group, in the vicinity of Lake Temiscouata, were renewed and extended both easterly and westerly, while an examination was also made of the neighboring portions of Aroostook county, Maine, where the same Silurian rocks are associated with others which have been supposed to be Devonian. The result of these examinations was to show a general parallelism between the succession of rocks as seen on Lake Temiscouata, on the northern side of the Silurian tract, with that previously made out on its southern side, on the Beccaguimic River, in Carleton; while portions of the rocks of Aroostook county, previously regarded as Devonian, would seem also to occupy a position in the Silurian system. The final determination of these points, however, is largely dependent upon the examination of their contained fossils. Of these, somewhat numerous collections were made on Lake Témiscouata, on the Tuladi and Squaw Lake rivers, at Squaw Lake, Maine, and at Ashland, and along the course of the Aroo-took River in the same state. These are now in the hands of Mr. Whiteaves for determination.

* This is quite true, but there seems no great difficulty in considering them to represent the Trenton group, i. e., the Chazy, the Birds-eye, Black River, Trenton, Utica and Hudson River formations. In any case, the fossils of the Citadel Hill rocks ally them more closely to the Trenton group than to the Levis, the graptolitic fauna of which belong to a much older horizon. The main point now to be decided is whether the Citadel Hill rocks are below or above the Black River limestone formation.—A. R. C. SELWYN.

“The work in the Témiscouata region has already sufficed to show, irrespective of fossils, that a considerable area about the lake of that name, regarded by Sir W. E. Logan as of the age of the Quebec Group, is at least as recent as Silurian, while other areas to the north, referred by Mr. Richardson to the Silurian, really belong to the more ancient Cambro-Silurian system. A complete exploration of the region intervening between the Témiscouata Portage Road and Lake Metapedia on one side, and between the same road and the Chaudière district on the other, is required before the real structure of this region can be fully understood.

“The essential object of the work carried on by Mr. McInnes was the completion of the information necessary for sheets No. 2 south-west, and 2 north-west of the geological map of New Brunswick, on this work Mr. McInnes reports as follows:—

“I left Ottawa on the 3rd of June and arrived at Fredericton on the 9th, spending three days, in passing, in a brief examination, in company with Mr. Ells, of the region about Lake Témiscouata. After a week in Fredericton, occupied in making tracings of Crown Land plans and in completing arrangements for the season's work, I started for the Upper St. John district on the 14th of June. Arriving at Andover, advantage was taken of the high water prevailing in the streams to make a survey by micrometer telescope of the right hand branch of Tobique River, of Campbell River, and of Trousers, Long, and Serpentine lakes; in descending the Serpentine, a sketch survey of that stream was also made. The country passed through on this exploration lies mostly within the pre-Cambrian and the granite areas; the latter extends from Little South-West Miramichi Lake across to a point about midway between the outlet and inlet of Long Lake, and the former occupies most of the district between the granite and the main Silurian area.

“The region in general is very rough and broken with high hills and ridges, and the surface is often thickly strewn with large blocks and boulders of the underlying hard crystalline rock. The forest growth is chiefly black spruce and fir, mixed with cedar along the watercourses, and with scattered pine, birch, mountain ash, &c. What is probably the first representative yet noticed in New Brunswick of the Oriskany sandstone, so common in the neighboring state of Maine, occurs near the confluence of the Don and Campbell rivers. A broad band, three miles or thereabouts in width, of buff weathering dolomitic sandstone, with fossiliferous layers, crosses the river at this point. This seems to be an isolated patch lying upon the older rocks which has escaped the general denudation.

"In the latter part of July, two weeks were spent in making odometer surveys of the roads between Edmundston and St. Francis, in Madawaska county, and between Edmundston and Notre Dame du Lac, Témiscouata, chiefly for the purpose of topographical detail. During August a micrometer survey was also made of Lake Témiscouata, and a sketch survey of Horton Branch of Tuladi River.

"The remainder of the season, September and part of October, was spent in exploring the region lying between the Tobique and Campbell rivers, by ascending the stream flowing into the Tobique from the south, and by a paced survey of the portage road to Trousers Lake. This whole area is very hilly and rough, and presents a marked contrast to the rest of the valley of the Tobique below the forks, where the soft and calcareous character of the Silurian and Lower Carboniferous strata has produced a soil of great fertility, with numerous fine alluvial flats and islands which, when cleared of the large elms and balsam poplars with which they are generally wooded, form nice meadow lands. Extensive beds of gypsum, which occur near the summit of the Lower Carboniferous outlier, add to the value of the lands.

"Collections of fossils were made from the Silurian beds on Campbell River and Riley Brook, which are in the hands of the palæontologist of the survey for identification.

"Leaving Fredericton on the 20th October, after a few days spent there in packing and labelling specimens, &c., I arrived in Ottawa on the 22nd, and resumed work in the office.

"During the summer, about 200 miles of lakes and streams were surveyed with the Rochon micrometer telescope, 100 miles of roads with the odometer, and about 70 miles of rough roads and streams by pacing and sketch surveys."

The joint report of Messrs. Bailey and McInnes on the work above referred to is Part N of this volume.

Mr. R. Chalmers left Ottawa on the 1st June, with instructions to work out in detail the surface geology of the districts comprised within the two quarter sheet maps, 2 N.E. and 6 S.W., New Brunswick. Mr. Chalmers' preliminary statement with regard to the work carried out is as follows:—

"Certain sections included in sheets 3 S.E. and 3 S.W., the surface geology of which was investigated during the previous summer, had first to be further examined to obtain additional data to complete these maps, and accordingly a part of June was devoted to this object. On finishing this I started on a canoe trip to explore Shippegan and Miscou Islands and the adjacent mainland, and then ascended the Nepisiquit River to the limit of the map. Thence I crossed over to the North-West Miramichi River, and examined the intervening coun-

try as well as portions of that lying north of the Nepisiquit as far as time would permit. The general elevation and topographic features of this interior region were noted, and some points of interest relative to the peculiar character of the Nepisiquit as a drainage channel, observed. Immediately thereafter I went up the North-West Miramichi from Newcastle, and on the return trip ascended its affluent, the Little South-West, some distance. Interesting observations on the country drained by these rivers, and on the terraces and intervalles skirting them, were made. Subsequently, another canoe trip was made down the Miramichi Bay, and the coasts and islands examined as far as Portage Island and Escuminac Point. These explorations occupied my time till about the middle of September. The remainder of the season was devoted to the study of the character and distribution of the deposits in those sections lying at a distance from the coasts and rivers and in mapping the forest-covered areas. All back settlements and places accessible by roads of any kind were visited. The old Indian camping-grounds at Tabusintac and Derby were also explored and some relics found.

“The investigations of the season have resulted in showing a much wider extension of pre-glacial gravels and sands than was hitherto supposed to exist in New Brunswick. From the evidence afforded in numerous sections in different parts of the area under discussion, it would seem that they must have formed a general covering of some thickness, especially upon the flat Carboniferous plain, and probably mantled the crystalline rocks of the interior as well, although the proofs of this are not so abundant. These gravels were no doubt considerably reduced in bulk previous to the advent of the ice age, by atmospheric erosion, especially on the latter tract, or wherever the country was hilly or had an uneven surface, and along the lines of drainage. Near the coast large areas are still covered by them, however, but overlain by stratified materials. Either the ice of the glacial period has passed very lightly over the tract, or it has never been glaciated, and was probably submerged during the greatest extension of the ice.

“Some interesting facts were observed regarding boulder distribution. Blocks of granite, felsite, gneiss, diorite, &c., are abundantly strewn over the whole area examined. These together with the courses of striæ show that the general ice movement, as stated in my preliminary report, Annual Report, 1885, page 566, was eastward or north-eastward from the higher grounds of the interior. Besides this, however, other and probably smaller local glaciers followed the valleys in different directions. The boulders of crystalline rocks met with below the 200 feet contour line do not now occupy the sites to which

they were borne by glacier ice, but appear to have been shifted about by floating ice since on the shores of the receding post-Tertiary sea, as they are found almost wholly on the surface.

"Within the Miramichi basin no maritime terraces were found at a greater height than 150 to 160 feet above sea level, and it therefore seems probable that the post-Tertiary subsidence was hardly as great there as in the Baie des Chaleurs district.

"Regarding river terraces, a number of facts were collected which serve to throw light on their origin and on the relation they bear to the rivers which formed them. The Little South-West Miramichi, the most rapid river in north-eastern New Brunswick, has the highest and finest terraces.

"Close attention was given to the agricultural character of the country examined. Large intervalles and considerable tracts of good uplands were seen along the Miramichi River.

"Observations were also made regarding the forest growth. The approximate limits of the burnt forest areas, particularly that of the great Miramichi fire of 1825 was located, and the extent of country cleared and inhabited was likewise noted.

"Extensive beds of peat were observed at Point Escuminac, Tabusintac, Miscou Island and elsewhere near the coast. The bottoms of these seem now to be slightly below high tide level, and their thickness in some places is known to be upwards of 20 feet. They apparently owe their growth to proximity to the sea, where the conditions of temperature, moisture, &c., are favorable. Sand beaches, drift wood, and in one instance a charred log, were found at the bottom of these peat deposits.

"Beaches of blown sand are characteristic features of the coast along the Straits of Northumberland. They appear to have been produced by the action of the sea along a shallow, stationary coast margin. Under some of these, rock, *in situ*, was seen nearly as high as sea level. A singular beach formation is now being thrown up at the north-east point of Miscou Island, in which bones of the walrus were found.

"The field work was brought to a conclusion on the 11th of November."

Mr. Chalmers' full report, with the quarter sheet maps 3 S.E. and 3 S.W., is Part M of this volume.

NOVA SCOTIA.

Mr. H. Fletcher and assistants were engaged during the season in continuing and extending the geological work carried on by them in Nova Scotia in previous years. It was found advantageous to detach

Mr. Faribault for the investigation of a separate district. The following summary of the work of both parties is presented by Mr. Fletcher, that portion of it referring to Mr. Faribault's exploration having been supplied by him :—

“Surveys were made during the summer of 1886 to the westward of the district referred to in the Summary Report for 1885, page 20, so that a geological map can now be constructed of all that portion of Nova Scotia lying east of longitude $62^{\circ} 30'$, including the whole of Antigonish and Guysborough counties and part of Pictou and Halifax counties.

“Mr. Faribault was again put in charge of the work among the gold-bearing rocks of the Atlantic coast. Mr. Robert assisted me in Antigonish and Pictou counties, and was for a long time engaged in mapping the plications of the Lower Carboniferous rocks and studying their relation to the metamorphic rocks of the hill ranges.

“The general distribution of the Carboniferous rocks over most of this area was described in the above mentioned Summary Report. Many additional details of structure have, however, been obtained, and the various basins into which the different sub-divisions can be separated have been carefully traced. The Carboniferous limestone runs in a narrow belt along the eastern shore from Antigonish to Morristown, and a patch of this formation occurs also at the mineral spring in Hallowell Grant; but the greater part of the Carboniferous rocks between Antigonish and Cape George, including the so-called coal mines of Malignant Brook, Hallowell Grant, and other places in the neighborhood, belongs to the “Metamorphic Carboniferous,” Horton or Basal conglomerate group. Underlying the Lower Carboniferous at McAra's Brook, is a small area of red and greenish slates and sandstones, apparently Upper Devonian; from which Mr. Weston obtained certain tracks and fossil plants. Beneath these lie the Silurian rocks of the well known Arisaig shore, running in a narrow belt eastward to McNeil's Brook, and underlaid by Cambro-Silurian and perhaps older rocks. In addition to this Silurian area, several others were found in the region in question. (1) Two small patches on the sea shore at Cape George; (2) a small patch west of Vamey's Brook; (3) a long narrow basin in the deep picturesque valley along the railway from James' River to the west end of Marshy Hope; (4) a broader belt extending from Bailey's Brook to Avondale, thence up Barney's River to Kenzieville, thence along the telegraph road to Glenshee, thence to the St. Mary's road at McPherson's mills to join the area of pre-Carboniferous rocks, shown on Sir Wm. E. Logan's and Hartley's map of the Pictou coal field, a large part of which, however, belongs to the underlying Cambro-Silurian; (5.) a small patch at Moose River; (6).

the broken basins north of the East River of Pictou, extending from the vicinity of Beaver Lake down stream towards Springville, and described by Sir J. W. Dawson in *Acadian Geology*, and by Dr. Honeyman in the *Transactions of the Nova Scotian Institute of Natural Science*.

"But by far the greater part of the districts underlain by pre-Carboniferous rocks is occupied by rocks older than Silurian (those containing the iron ore at Londonderry mines, probably Cambro-Silurian), and by a series of felsitic, mica, hornblende, chlorite, talc and other schists resembling those in the Cobequid Hills called Archæan by Mr. Ells, but which have not yet been examined with sufficient care in Antigonish and Pictou counties to determine that they are not a part of the Cambro-Silurian series. On the sea shore at Arisaig and Georgeville are exposures of very crystalline limestone and other rocks, which have also been referred to the Archæan, but of which no more can be at present affirmed than that they form pebbles in certain conglomerates, which are apparently Cambro-Silurian.

"In the Cambro-Silurian strata only a few obscure fossils were found at McNeil's Brook, where also, as well as in the Malignant and Doctor's Brooks, deposits of red hæmatite, probably of great thickness and value, have been exposed in many places; but the want of a convenient shipping place has hindered the development of these ores. Iron has also been found in Barney's River, French River and other places. Small quantities of the precious metals are reported to have been found in the numerous quartz veins of the Cambro-Silurian rocks at Vamey's Brook, Bailey's Brook, Rights River, Malignant Brook, Georgeville and other places; but nothing to warrant the belief that they exist in paying quantity was seen by us.

"In addition to the coal found in the Lower Carboniferous, as stated above, it has been sought, of course in vain, in the black Silurian slates of Arisaig, Kerrowgare and other places.

"Traces of copper and lead have been found in all of the formations above described, as at Arisaig, Moose River, Blue Mountain, and other places, but apparently not of economic importance. Innumerable veins, usually of white quartz, cut the Cambro-Silurian rocks as at Sutherland River, but seem to be invariably barren.

"Mr. Faribault was assisted during the season by Mr. M. H. McLeod, and part of the summer by Messrs. A. Cameron, G. B. Faribault, and A. H. McLeod.

"The first four months were spent in making a detailed topographical and geological survey of the country lying between the Liscomb and Sheet Harbor rivers and the Atlantic coast. The country examined consists entirely of the gold-bearing rocks (Lower Cambrian?)

which are much less altered than those seen last year in the vicinity of the granite dykes south of West River, St. Mary's. No fossils, however, could be found in them. Some seven miles up *Ecum Secum* River, many Silurian fossils were discovered in the drift, but whether they were carried from Antigonish county or belong to an isolated patch of Silurian in the gold-bearing rocks, could not be ascertained. Much attention was paid to the stratigraphy of these latter rocks with the view of ascertaining the position of possible new gold districts.

"The only gold mine now being worked in the region surveyed is the well-known Salmon River mine, where much work is still being done with very good returns. The following gold mines, not worked at present, were also examined:—Hattie's mine, quarter of a mile east of that at Salmon River, Harrigan Cove mine, Moose Head mine and *Ecum Secum* mine. Besides the quartz leads which have been prospected at various places and are known to contain gold, many quartz veins of very good appearance were also seen at the head of Moser's River.

"Over a month was employed in the latter part of the season in revisiting the country previously surveyed along the south shore from Liscomb River to Cape Canso, in order to obtain more definite information relating to the general structure of the gold-bearing rocks, the map and report of which will be ready for publication next spring. A large number of rock specimens, illustrating the alteration of the various strata as they come near the granite, was collected. Five hundred and thirty-eight miles of stream and 130 miles of road were measured by Mr. Faribault, and many heights taken with the barometer.

"Field work was begun on the 2nd of June and continued till about the end of November."

The detailed report of this work is now presented in Part P of this volume.

PALÆONTOLOGY AND ZOOLOGY.

Under these headings, Mr. Whiteaves reports that the systematic catalogue of the zoological specimens contributed by the Department of Fisheries to the Colonial and Indian Exhibition, of which mention was made in last year's report, has been revised and published in the shape of an octavo pamphlet of 42 pages, 1000 copies of which have been distributed in London.

The study of by far the larger portion of the extensive series of recent marine invertebrata dredged or otherwise collected by Dr. G. M. Dawson and Mr. D. B. Dowling, in 1875, in the Strait of Georgia,

Discovery Passage, Johnstone Strait and Queen Charlotte and Quatsino Sounds, as well as that of the whole of the marine fishes, birds and other vertebrates from the same region, has been completed, and a paper upon them, which is now in the printer's hands, has been read before the Royal Society of Canada at its last meeting. All the species of Foraminifera, Anthozoa, Echinodermata, Brachiopoda, Mollusca, Ophidians, Batrachians, birds and mammals, have been determined and labelled, and the duplicates made up into sets for distribution, as far as the time would permit. The Crustacea obtained in these dredgings have been sent to Professor Sidney J. Smith, of Yale College, and the hydroids and polyzoa to the Rev. Professor Hincks, of Leigh Woods, near Bristol, England, who have kindly promised to report upon them.

A paper entitled "Illustrations of the Fossil Fishes of the Devonian Rocks of Canada," which is also now in the press, has been prepared and read at the last meeting of the Royal Society of Canada. This paper, which is illustrated by quarto plates, contains fuller descriptions than have yet been published of four out of the eight remarkable species discovered in 1880 and 1881 in the Upper Devonian rocks at Scaumenac Bay, Que., and the homologies of the Canadian *Pterichthys* or *Bothriolepis* are discussed at some length.

A considerable portion of the letter-press of Part II of the first volume of the "Contributions to Canadian Palæontology" has been written, and the lithographic plates required to illustrate it have been prepared. This report, which it is hoped will be issued early in the spring of 1887, will contain descriptions of the fossils, and more especially of the crinoids and blastoids, of the Hamilton Formation of Western Ontario.

A preliminary examination has been made of the large and interesting collections of Palæozoic and Mesozoic fossils made this year by Mr. R. G. McConnell in the Rocky Mountains, and of the Cambro-Silurian or Silurian fossils collected by Mr. A. P. Low on the Fawn branch of the Severn River.

The skeleton of the Harp Seal obtained by Mr. T. C. Weston in 1861, from the Post-Pliocene clays of Montreal, and that of the White Whale or Beluga (*Delphinapterus catodon*) found in deposits of similar age at Cornwall, Ont., in 1870, have been skilfully articulated by Mons. Jules F. D. Bailly, and now form conspicuous objects in the upper flat of the Museum.

Sixteen additional specimens of mammalia, six of which are seals, and thirty of birds, have been mounted and placed on exhibition during the year, and the number would have been greater but for the fact that Mr. Herring's time up to the first of April was occupied in clean-

ing and remounting a large number of specimens of birds, &c., which were sent to the Colonial and Indian Exhibition. All the species added to the Museum during the year in the department of zoology, a list of which will be found on pages 48-54 A, have been examined and determined, and the whole series of mammals and birds now in the cases has been re-labelled and re-arranged. Some progress also has been made in the labelling and classification of the numerous specimens of fossils and recent invertebrates that have also been lately added to the Museum.

The number of letters written is 270, many of which partake of the nature of "reports."

Most of Mr. T. C. Weston's time has been spent in museum work, in the classification and arrangement of the Carboniferous, Cretaceous and Laramie fossils, in conjunction with Mr. Ami, in labelling and planning the arrangement of specimens of gold, *Eozoon*, &c., selected for transmission to the Colonial and Indian Exhibition, and in field exploration.

During the months of July, August and September, he made large collections of fossils and lithological specimens from the Carboniferous, Devonian and Silurian rocks of Nova Scotia and Cape Breton. A list of these fossils, with other information, will be embodied in a forthcoming report* by Mr. Hugh Fletcher.

Mr. Weston has also visited Côte St. Pierre, where he has collected as large a series of specimens as possible of *Eozoon* for exhibition in the museum and for distribution.

Mr. H. M. Ami has been occupied chiefly in the classification and labelling of fossils in the museum. All the species enumerated in Mr. Whiteaves' recently published Report on the Invertebrata of the Laramie and Cretaceous rocks of the Bow and Belly Rivers and adjacent localities in the North-West Territory, and the fossil plants of the "Jurasso-Cretaceous," Cretaceous and Laramie rocks of the North-West Territory, described by Sir William Dawson in 1885 and 1886, have been labelled, classified and placed upon exhibition in the museum. A number of fossils from the Devonian rocks of the North-West and Hudson's Bay Territory, and the whole series of fossil plants from the Carboniferous formation of New Brunswick, Nova Scotia and Cape Breton, in the possession of the Survey, have also been labelled and classified.

Collections of fossils made by Professor L. W. Bailey, Messrs. Hugh Fletcher, W. McInnes and W. H. T. Reed, at various localities in the provinces of Quebec, New Brunswick and Nova Scotia, consisting in

* Part 2 of this volume.

all of some eight hundred specimens (some of which appear to belong to species not previously represented in the museum) have been examined with a view to determine, as far as possible, the exact geological horizons of the rocks from which they were collected. The Palæozoic fossils collected by Mr. R. G. McConnell in 1885 from eight different localities in the Rocky Mountains, and in the early part of the season of 1886 from the Bow River Pass, have also been examined and provisional reports thereon prepared. The Cambro-Silurian fossils collected by Mr. F. D. Adams, in 1885, at Lake St. John, and those collected by Colonel Grant on the Island of Anticosti in the same year (which latter were sent to the Colonial and Indian Exhibition), have been studied, and the species determined.

Collections of duplicate fossils, &c., have been sent to the Redpath Museum at Montreal, to the museums of Queen's University, Kingston, and of the University of Fredericton, N.B., also to those of the Agassiz Association of Montreal, and of the public schools at Berlin and Blair, Ont.

During two months of the year, Mr. Ami has been engaged in the field in the examination of fossiliferous rocks at various localities in the Eastern Townships of the province of Quebec, and in central Ontario, with the object of determining their exact geological horizons, as already stated on pages 20 A and 36 A.

The following collections have been received during the year from members of the staff or gentlemen engaged in the work of the Survey:—

R. Bell :—

- One Harp Seal (*Phoca Grænelandica*) from Blanc Sablon.
- One Peregrine Falcon (*Falco communis*) from Cape Chudleigh, Labrador.
- One Gyr Falcon (*Falco sacer*) also from Cape Chudleigh.
- One King Eider (*Somateria spectabilis*) from Ashc's Inlet, Hudson's Strait.
- One Long-tailed or Buffon's Skua (*Stercorarius cepphus*) from Cape Chudleigh.
- One Glaucous Gull (*Larus glaucus*) from Resolution Island, Hudson's Strait.
- One Ivory Gull (*Pagophila eburnea*) from Resolution Island.
- One Kittiwake Gull (*Rissa tridactyla*) from Cape Chudleigh.
- One Fulmar Petrel (*Procellaria glacialis*) from Resolution Island.
- Two Black-throated Divers (*Colymbus arcticus*) from near Cape Digges, Hudson's Bay.

Thirty-six specimens of fossils from the Albany River between its mouth and the forks.

Twenty-one specimens of fossils from the Attawapishkat River.

R. G. McConnell;—

(From the Rocky Mountains near the line of the Canadian Pacific Railway):—

One specimen of the Hoary Marmot or "Siffleur" (*Arctomys pruinosus*) from mountains near Devil's Head Lake.

One specimen of the Rocky Mountain variety of Parry's Marmot (*Spermophilus Parryi*, var. B.) from the base of Castle Mountain.

One specimen of the Missouri Ground Squirrel (*Tamias quadri-vittatus*) from the base of Grotto Mountain.

One Red Squirrel (*Sciurus Hudsonius*, var.) from the base of Wood Mountain.

One Virginian Owl (*Bubo Virginianus*) from Gap Siding, C.P.R.

About 700 specimens of Palæozoic and 100 of Mesozoic fossils.

J. B. Tyrrell and D. B. Dowling:—

(From the Upper North Saskatchewan and its vicinity.)

One Coyote or Prairie Wolf (*Canis latrans*) from Egg Lake.

Two Badgers (*Taxidea Americana*) one from Sounding Creek, and one from Dried Meat Lake, near Battle River.

One Striped Gopher (*Spermophilus tridecemlineatus*) from Nose Creek.

Two Northern Pocket Gophers (*Thomomys talpoides*) from near Edmonton.

One specimen of the western variety of the White-footed Mouse (*Hesperomys leucopus*, var. *occidentalis*.)

One specimen of Cooper's Shrew (*Sorex personatus*) from Pigeon Lake.

Fifty-two skins of Birds, including three Magpies (*Pica melano-leuca*, var. *Hudsonica*), one Swainson's Buzzard (*Buteo Swainsoni*), two Avocets (*Recurvirostra Americana*), one Wilson's Phalarope (*Steganopus Wilsoni*), one Black-tailed Godwit (*Limosa Hudsonica*), two Willets (*Totanus semipalmatus*), two Upland Plovers (*Actiturus Bartramius*), one White Pelican (*Pelecanus trachyrhynchus*), and two Sooty Terns (*Hydrochelidon lariformis*.)

Eggs of Swainson's Buzzard, Avocet and Upland Plover.

One hundred and twenty-five butterflies, and a small series of fresh-water shells.

About four hundred specimens of Cretaceous and Tertiary fossils.

T. C. Weston :—

Six hundred and eighty specimens of fossils from various localities near Arisaig, N.S.

Twenty-four specimens of fossils from Lochaber, Antigonish county, N.S.

Thirty-six do do do Escasoni, C.B.

Eighty do do do George River, Bras d'Or, C.B.

Forty-five do do do Lévis, Que.

One hundred and twenty-five fossil plants from the Devonian rocks at various localities in Nova Scotia.

A. P. Low :—

Fifty-four specimens of fossils from the Cambro-Silurian or Silurian rocks of limestone rapid on the Fawn branch of the Severn River.

A. C. Lawson :—

Black variety of the Wood Chuck (*Arctomys empetra*) and five fresh-water shells (three *Unio luteolus* and two *Anodonta Footiana*) from Rainy Lake.

H. M. Ami :—

About one thousand specimens of fossils from the Cambro-Silurian and Silurian rocks at various localities in the provinces of Quebec and Ontario.

Seventy-two specimens of fossils from the Post-Pliocene nodules of Green's Creek, near Ottawa, Ont.

L. W. Bailey :—

About six hundred specimens of fossils, chiefly of Silurian age, from different localities in the provinces of Quebec and New Brunswick or from the adjacent parts of Maine.

W. McInnes :—

Ninety specimens of fossils from the Silurian and Devonian rocks of New Brunswick.

R. Chalmers :—

Fifty specimens of fossils from the Upper Devonian rocks of Scaumenac Bay, Que.

Four arrow-heads, a number of quartz chipped flakes and an ancient iron axe head, all from the Tabusintac River, N.B.

Walrus bones from Miscou Island, N.B.

The additions to this branch of the museum, by presentation and purchase, are as follows :—

By Presentation :

The Department of Marine :—Specimens of the following species of mammals, birds, &c., all collected by Mr. F. F. Payne, in 1886, at Cape Prince of Wales, Hudson's Strait :—

Two Arctic Foxes (*Vulpus lagopus*) in summer fur; three Hudson's Bay Lemmings (*Cuniculus torquatus*) two in summer and one in winter fur, and one Polar Hare (*Lepus timidus*, var. *arcticus*) in winter fur.

One Stone Chat (*Saxicola oenanthe*) the first known to have been taken in Canada; one Shore Lark (*Eremophila alpestris*); one Water Thrush (*Siurus naevius*); one Lapland Longspur (*Plectrophanes Lapponicus*); one Raven (*Corvus corax*); one immature Gyr Falcon (*Falco sacer*) in very dark plumage; one Rough-legged Buzzard (*Archibuteo lagopus*); two Rock Ptarmigans (*Lagopus rupestris*) one in full summer, the other in winter plumage; one Ring-necked Plover (*Ægialitis semipalmatus*); pair of red Phalaropes (*Phalaropus fulicarius*); one purple Sandpiper (*Tringa maritima*); one White-rumped Sandpiper (*Tringa Bonaparti*); male Brant Goose (*Bernicla brenta*); one Hutchins' Goose (*Bernicla Hutchinsi*); two Long-tailed Ducks (*Harelda glacialis*), one male in summer plumage and one female; one Harlequin Duck (*Histrionicus torquatus*) adult male; one Herring Gull (*Larus argentatus*); one common Tern (*Sterna hirundo*); one Great Northern Diver or Loon (*Colymbus torquatus*); one male Red-throated Diver (*Colymbus septentrionalis*); three Black Guillemots (*Uria grylle*), one an adult male in summer plumage and two in winter plumage; and one little Auk (*Mergulus alle*), Four Eggs of the Shore Lark, twenty-two of the Water Thrush, twenty-four of the Snow Bunting (*Plectrophanes nivalis*), eight of the Ring-necked Plover, four of the King Eider (*Somateria spectabilis*), five of the Herring Gull, one of the Common Tern, two of the Red-throated Diver, and seven of the Black Guillemot.

One rather large variety of the Speckled or Brook Trout [*Salvelinus fontinalis*].

Department of Fisheries :—

One Black Porpoise (*Phocæna communis*) and one Hooded Seal (*Cystophora cristata*) both stuffed.

Smithsonian Institution, Washington :—

Specimens of the following shells, viz. : Five *Strombus gigas*, two *Tridacna elongata*, two *Mopalia Wossnessenskyi*, two *Pteroceras bryonia*, one *Triton tritonis*, one *Fusus probosciferus*, one *Cassia cornutum*, one *Spondylus sp.*, and six *Capsa deflorata*.

Dr. R. Bell, Ottawa :—

Black variety of the American Hare (*Lepus Americanus*) from the Hudson Bay district.

Dr. Percy M. Mathews, York Factory, Hudson's Bay :—

One Weasel or Ermine (*Putorius ermineus*) in winter fur, and one young Musk Rat (*Fiber zibethicus*) both from Fort Severn, Hudson's Bay. One Belted Kingfisher (*Ceryle Alcyon*) from Fort Severn. One Golden-winged Woodpecker (*Colaptes auratus*) and one Goshawk (*Astur palumbarius*) from York Factory ; three Goslings of the Canada Goose (*Bernicla Canadensis*) and one Lesser Scaup Duck (*Fulix affinis*) from Fort Severn ; one Long-tailed Duck (*Harelda glacialis*) in spring and one in autumn plumage, and one King Eider (*Somateria spectabilis*) all from York Factory ; two Surf Scoters (*Ædemia perspicillata*) from Fort Severn ; and one Black Guillemot (*Uria grylle*) from York Factory. These, though presented in 1885, were not received until 1886.

Arthur Laperrière, Temiscaming :—

Fine specimen of the Ringed Seal (*Phoca (Pusa) foetida*) from Cape Digges, Hudson's Bay.

W. Skinner, Toronto :—

Specimen of the Harbor Seal (*Phoca vitulina*) from Nackvak, Northern Labrador, and siphuncle of a species of *Orthoceras*, from Fort Churchill, Hudson's Bay.

Sir William Dawson :—

Twenty-eight species of marine shells and seven of echinodermata from the Gulf of St. Lawrence.

Montague Chamberlain, St. John, N.B. :—

One Merganser (*Mergus merganser*), pair of Long-tailed Ducks (*Harelda glacialis*), one Kumlien's Gull (*Larus Kumlieni*), one Great Black-backed Gull (*Larus marinus*), two Gulls, immature, one young Cormorant (*Graculus carbo?*), two young Loons (*Colymbus torquatus*), and two Red-necked Grebes (*Podiceps Holbolli*).

James Deans, Victoria, B.C. :—

Three fine specimens of a *Trigonia* (probably *T. intermedia*, Fahrenkohl), one of *Thracia semipalmata*, one of *Unio Hubbaridi*, a cast of an *Inoceramus*, one *Stephanoceras cepoides*; a fossil fruit (*Dioonites Columbianus*) two pieces of fossil wood and three concretions, all from the Middle Cretaceous rocks of the Queen Charlotte Islands.

Walter R. Billings, Ottawa :—

Two specimens (each the types) of *Archæocrinus desideratus* and *Euspirocrinus obconicus*, from the Trenton Limestone of Ottawa.

Andrew B. Henderson, Ottawa :—

Skull of Black Bear (*Ursus Americanus*) and do. of Beaver (*Castor fiber*) from the Sturgeon River.

W. G. Allan, Marlbank, Ontario :—

Stone implement of Indian manufacture.

W. Moore, Bowesville, Ont. :—

Stone gouge from the Black Rapids on the Rideau River.

Rev. W. A. Burman, Griswold, Ont. :—

Skin of Striped Gopher (*Spermophilus tridecemlineatus*) and skin of Ermine (*Putorius ermineus*), also two roots of "Cree Turnip" (*Psoralea esculenta*) as prepared for food by the Indians; all from Manitoba.

F. R. Latchford, Ottawa :—

Six fresh-water bivalve shells, viz., four *Unio nasutus* from Toronto Bay, and two *Unio borealis* from the Ottawa River).

James Fletcher, Ottawa :—

One Jumping Mouse (*Zapus Hudsonicus*), two Field Mice (*Arvicola*), one Striped Gopher (*Spermophilus tridecemlineatus*), and a Snake; all from Regina.

P. B. Winning, Plantagenet, Ont. :—

Specimens of characteristic fossils of the Trenton Limestone of that locality.

T. A. Burrows, Winnipeg :—

Fine specimen of the left valve of *Inoceramus problematicus*, from the Cretaceous rocks of Vermilion River, Riding Mountain, Manitoba.

H. K. Jordan, Newport, Monmouthshire:—

Specimen of *Buccinofusus Bernicien:is*, a rare deep sea shell from the Dogger Bank, coast of Northumberland, and ten species of British Chitonidæ.

Lyndwode Pereira, Ottawa:—

Stone Maul from the Qu'Appelle District.

R. L. Johnston, Banff, N.W.T.:—

Rocky Mountain Rat (*Neotoma cinerea*).

W. Craig, Russell, Ont.:—

Adult male Porcupine (*Erethizon dorsatus*) from the township of Russell.

Samuel Edey, Aylmer, Que.:—

Short-eared or Marsh Owl (*Asio brachyotus*) from Aylmer, Q.

J. G. Vincent, Osnaburgh House, via Wabigoon, C.P.R.:—

Two fossil shells from the Albany River.

T. Probert, New Edinburgh, near Ottawa:—

Female Marsh Harrier (*Circus Hudsonicus*).

By Purchase:—

Skin, &c. (since mounted), of Northern Fur Seal (*Callorhinus ursinus*) from the west coast of Vancouver Island, and skeleton of another specimen of the same, which latter has been cleaned and mounted by Mons. Jules F. D. Bailly.

One Blue Jay (*Cyanurus cristatus*), one Barred Owl (*Syrnium nebulosum*), one Acadian Owl (*Nyctale Acadica*), and a pair of Snowy Owls (*Nyctea Scandiaca*); all from the neighborhood of Ottawa City.

One Killdeer Plover (*Egialitis vociferus*), and a young Eared Grebe (*Podiceps auritus*); both from the vicinity of Toronto.

Two Cretaceous fossils, one *Placenticeras placenta*, var. *intercalaris* and an unusually large and perfect specimen of *Cyprina ovata*, var. *alta*, from the Bow River.

Some large and interesting exotic shells have also been acquired by exchange with Prof. H. A. Ward, of Rochester, N. Y.

BOTANY.

Prof. John Macoun was occupied during the early part of the past year in completing the third part of his catalogue of Canadian plants and in preparing a collection of Canadian plants for display in connection with the Colonial and Indian Exhibition. Prof. Macoun left on the 8th of April for England, returning to Ottawa at the close of his duties in connection with the Exhibition on the 29th of November.

The third part of the catalogue of Canadian plants above referred to, including a complete index to the first three parts, is a pamphlet of 228 pages. The three parts now published are arranged to bind together as a volume, which incloses in all 623 pages, and enumerates all the known dicotyledonous plants of the Dominion, with the geographical range and synonymy of each, constituting a *flora* of the Dominion, though without description of species. The volume contains the names of 101 orders, 584 genera and 2,207 species, exclusive of varieties. In consequence of Prof. Macoun's absence, much of the work connected with the preparation of the index to the first volume was attended to by Mr. J. M. Macoun, while, for the same reason, Mr. James Fletcher, of the Parliamentary Library, devoted a large amount of time and attention to the critical revision of the proof-sheets during the printing of the work.

The only important collection made during the past year is one by Mr. J. M. Macoun, while acting as assistant to Mr. A. P. Low, in the country between Lake Winnipeg and Hudson's Bay.

While in England, in connection with the Colonial and Indian Exhibition, Prof. Macoun devoted himself to giving information in regard to the collection of woods and natural products shown there, in which much interest was manifested, both from a strictly scientific point of view and in their commercial bearings. Relations were also established with various institutions, which will prove of advantage in connection with the prosecution of the botanical work.

In addition to the work above mentioned, as having been performed by Mr. J. M. Macoun, while acting as assistant to Prof. Macoun, he has mounted for the Herbarium during the past year 1,367 sheets of specimens of Canadian, United States and European plants.

These have been sent to various institutions and individuals in exchange for other specimens, or in consideration of assistance rendered in the prosecution of the work.

CHEMISTRY AND MINERALOGY.

Mr. G. C. Hoffmann furnishes the subjoined summary of work carried out by him, or under his direction, in the laboratory of the survey, with a list of donations to the mineralogical section of the museum. In addition to the work mentioned in Mr. Hoffmann's report, he has devoted a portion of his time to superintending the arrangement of the specimens in the museum, and in determining and naming them.

In accordance with the practice of preceding years, the work carried out in the chemical laboratory during the past year, may, on the whole, be said to have been of a purely practical character; the time having been almost entirely occupied in the examination and analysis of such minerals, etc., as were considered likely to prove of commercial importance. The work embraced:—

I—Analyses of numerous iron ores.

II—Analyses of copper and manganese ores.

III—Analyses of platinum ore.

IV—Analyses of several mineral waters.

V—Gold and silver assays—The number of which far exceeded that of any preceding year.

VI—Miscellaneous examinations—under which heading are included cement-stones, marls, saline deposits, etc., etc.

There has been a very marked increase in the number of mineral specimens received for examination; these amounted to five hundred and forty-six, as compared with three hundred and thirty-nine for last year. By far the greater number of these were brought by visitors, and the results of the examination, together with information in regard to their economic value, were, in most instances, communicated in the course of a personal interview. The number of letters written amounted to one hundred and fifty-one, the majority of which constituted reports embodying the results of the examination, analysis or assay of mineral specimens—chiefly those received from distant parts.

Mr. F. D. Adams, assistant chemist, was engaged in laboratory work up to the close of the first week in April, when he left for England on matters connected with the Colonial and Indian Exhibition. Mr. E. B. Kenrick, who has been acting as junior assistant chemist, merits commendation for the diligence with which he has applied himself to the work entrusted to him.

In the mineralogical section of the museum many of the old specimens have been replaced by better ones, and one hundred and fifty-one new ones added, including the following presentations:—

Allan, W. A., Ottawa :—

Four specimens of muscovite, from the Villeneuve mica mine, Villeneuve, Ottawa county, Que.

Elwyn, T. Victoria, British Columbia :—

Platinum ore, from Granite Creek, Similkameen River, B.C.

Ells, R. W., of the Geological and Natural History Survey, Ottawa :

Steatite, from Gouverneur, Lawrence county, N.Y.

Asbestos, from Maryland, U.S.A.

Asbestos, from Italy.

Asbestos yarn and sheeting, manufactured from the asbestos of Thetford, Megantic county, Quebec.

Fletcher, James, Ottawa :—

Chabazite, from the Bay of Fundy, N.S.

Concretionary nodule, from Green's Creek, Gloucester, Carleton county, Ont.

Harrington, Dr. B. J., Montreal :—

Sodalite, from Mount Royal, Montreal, Que.

Huronite, from between Lochalch and Missinabi stations, C.P.R.

Hill, Albert J., C.E., New Westminster, British Columbia :—

Molybdenite, from Lillooet River, vicinity of New Westminster, B.C.

Keefer, T. A., Port Arthur, Ont. :—

Five specimens of argentite and one specimen of argentite associated with native silver, from the Porcupine mine, district of Thunder Bay, Ont.

Kirkland, —, Port Arthur, Ont. :—

Two specimens of native silver from the Beaver mine, district of Thunder Bay, Ont.

Leatch, J. A., Ottawa :—

Specular iron ore, from Shefford, Shefford county, Que.

Moberly, H. J., Fort Vermilion, N.W.T. :—

Four specimens of gypsum, from Peace Point, Peace River, N.W.T.

Onésime Frère, Professeur d'histoire naturelle, Pensionnat des Frères des Ecoles Chrésiennes, Lyons (Rhône), France :—

Arseniosiderite, from a manganese bed at Romanèche, Department of Saône-et-Loire, France. A rare mineral found only at this locality, and then but at rare intervals.

Walchowite, from between Thonon and the Château des Allignes, Haute Savoie, France.

Amianthus (fibrous hornblende) from the Piedmontese Alps, Italy.

Talc, from the quarry of Braly, near Pinnerolo, Piedmont, Italy.

Vangnerite, from Vangnerais, near Lyons, France.

The foregoing are all handsome specimens.

Powell, E. Grant, Ottawa:—

An association of quartz, mica and apatite, from the township of Miller, Frontenac county, Ont.

Specimens of mica, with inclusions, from the same locality.

Reed, Dr. James, Reedsdale, Megantic county, Que. :—

Specimens of chromite from the townships of Thetford, Coleraine and Leeds, Megantic county, Que.

Rehm, Gustav Von, Ottawa:—

Specimen of muscovite, with inclusions of garnet, from the Villeneuve mica mine, Villeneuve, Ottawa county, Que.

Rhodes, Curry & Co., Amherst, N.S. :—

A specimen of red sandstone (cube, dressed), from Amherst, N.S.

Russell, M. L., Renfrew, Ont. :—

Pyrrhotite, from the township of McKin, near Sudbury, district of Nipissing, Ont.

Shirley, L. H., C.E., Buckingham, Ottawa county, Que. :—

A crystal of black tourmaline, from Wakefield, Ottawa county, Que.; and the following from the Villeneuve mica mine, Villeneuve, Ottawa county, Que. :—

Five specimens of microcline.

Specimens of quartz.

An association of quartz, muscovite, albite and garnet.

Specimens of albite.

A large fragment of albite (in association with some muscovite, a little quartz and garnet) penetrated by crystals of black tourmaline. This is a very handsome specimen.

Torrance, J. F., Montreal:—

Infusorial earth, from Folly Lake, Colchester county, N.S.

Treen & Fish, Newcastle, N.B. :—

A specimen of grey sandstone (cube, dressed), from the vicinity of Newcastle, Northumberland county, N.B.

Welden, F. C., Grenville, Que. :—

A specimen of disseminated graphite, from Grenville, Argenteuil county, Que.

Wylie, W. H., Carleton Place, Ont. :—

Two specimens of barite, from Pakenham, Ont.

Young, James :—

A specimen of dolomite (cube, dressed), from the Narrows of Lake Manitoba.

Mr. C. W. Willimott was actively engaged, up to the time of his departure for England, at the close of March, in receiving, cataloguing and packing the mineral collection for the Colonial and Indian Exhibition.

The greater part of Mr. R. L. Broadbent's time has been devoted to the permanent labelling of the mineral collection, re-adjusting of some of the cases, and work of a like nature. He has made up and catalogued six mineral collections, comprising 340 specimens, for distribution. He also rendered some assistance to Mr. Willimott, and, after the latter's departure, attended to matters connected with the shipment of such goods as arrived too late to be forwarded with the first consignments.

MAPS.

The greater part of the time of Mr. S. Barlow, chief draftsman, has been devoted, as usual, to the general superintendence of the mapping work, and in discussing the material for the selection of fixed points in the various sheets in progress.

Mr. Barlow furnishes the following memoranda of maps completed, or in course of completion :—

British Columbia.—A map of the western part of Vancouver Island and adjacent coast on a scale of eight miles to an inch, which is intended to illustrate a forthcoming report on the geology, is now nearly ready for the engraver. Mr. Bowman's revised map of the southern interior of the same province is in the draftsman's hands, and will probably be finished this winter. The map of the Cariboo mining district is also in course of compilation, and will be pushed through as rapidly as possible.

British Columbia and North-West Territory.—Dr. Dawson's map of a portion of the Rocky Mountains, mentioned in the last summary report, has been completed and published as a reconnaissance map, including all available information up to date.

North-West Territory.—A map of the Cascade coal basin, on a scale of $1\frac{1}{2}$ inch to the mile, in the Rocky Mountains, has been drawn and photo-lithographed, and is published in Dr. Dawson's report. Mr. McConnell's map of the Cypress Hills and Wood Mountain has been engraved and published. Mr. J. B. Tyrrell's map, comprising the third sheet on an uniform scale of 8 miles to an inch, and including the country between the upper parts of the Bow and North Saskatchewan rivers, will, it is hoped, be completed for publication in a few months.

Manitoba and Western Ontario.—Mr. Lawson's map of the Lake of the Woods and its vicinity is in the hands of the engraver, and will very shortly be published; various unforeseen difficulties, in connection with the topography of this map, have unavoidably delayed its publication. Work to the south and south-east of the above sheet, also carried out by Mr. Lawson, is in the draftsman's hands, but will not be completed for publication before the work of another season in the field is available.

Ontario.—Mr. E. D. Ingall has, in the course of completion a contoured map of Silver Mountain and vicinity, Thunder Bay district. This covers an area of forty square miles, and will be published in a few months.

Mr. Cochrane has continued the work of last season in sheet No. 115, referred to as in course of revision in the last summary report. During the past season he was occupied from June 28th to October 24th in examining and correcting 900 square miles of the area embraced, leaving about 300 square miles to be revised before the completion of the sheet. In the course of this work, various measurements were made where found necessary. The progress of the mapping work by Mr. Coste and assistant is referred to elsewhere. Copies of 57 township plans in Ontario have been procured, and about 750 miles of railway lines, on a large scale, have been copied, for the purpose of checking and correcting the township surveys.

Quebec.—The map of Lake Mistassini has been published in Mr. Low's report. In the course of Mr. Ells' examination of a part of the Eastern Townships, a number of road surveys have been made, and are being added to the engraved map. It has been found impossible, owing to

the press of work in the office, to add much to the map of Ottawa and Pontiac counties during the past year.

New Brunswick.—One sheet (plan 2 S.W.) has been published.

Nova Scotia.—One sheet (plan 4 N.W.) has been published.

The work in progress in Nova Scotia and New Brunswick, with surveys carried out in the region between Hudson Bay and Lake Winnipeg, is fully noticed in connection with the field work of the various parties.

LIBRARY.

The Librarian, Dr. Thorburn, reports that during the year 1886, from January 1st to December 31st, 8,185 copies of the Geological and Natural History Survey publications were distributed; of these, 6,924 were distributed in Canada; the remainder, 1,261, were sent as exchanges to scientific and literary institutions and individuals in America, Europe, India, Japan and Australia, &c.

Seven hundred and twelve publications, including books, transactions, memoirs, periodicals, pamphlets and maps, were received as exchanges. There were added to the library, during the year, by purchase, 101 volumes, besides 43 scientific magazines and periodicals on geological, mineralogical and natural history subjects which were subscribed for.

During the year 189 volumes were bound. There are now in the library about 6,500 volumes. The number of letters received was 1,060, the number sent out, 898.

During the past year a card catalogue has been completed, and is now in use. It will be found to be of great practical value, and will materially assist the members of the Geological Survey in finding, more readily than formerly, what books there are in the library which treat of any subject on which information is wanted.

VISITORS.

The number of visitors to the museum during the year ended 31st December, 1886, was 14,465, an increase, as compared with the previous year, of 1,022.

STAFF, APPROPRIATION, EXPENDITURE AND CORRESPONDENCE.

The strength of the staff at present employed is 50, viz., professional, 34, ordinary, 16.

During the year the following promotions were made in the permanent staff:—

Messrs. L. M. Lambe and A. P. Low from third class to second class clerks.

The amount available for the fiscal year ended 30th June was:—

Civil list salaries, appropriation	\$ 36,200 00
General purposes do	78,853 01
Total	<u>\$115,053 01</u>

The expenditure may be summarized under the divisions named as follows:—

Pay-list salaries	\$ 35,936 03
Wages, temporary employees	19,142 65
Exploration and survey	36,395 44
Printing and lithography	15,383 45
Purchase specimens	1,722 05
Purchase books and instruments	3,334 16
Laboratory apparatus and chemicals	329 14
Stationery	591 89
Incidental and other expenses	3,828 02
	<u>\$116,662 83</u>
Less paid in 1885	11,006 59
	<u>\$105,656 24</u>
Advances to field explorers and others on account 1886-87	8,837 48
Unexpended balance civil list appropriation	263 97
Unexpended balance contingency appropriation	295 32
	<u>\$115,053 01</u>

The correspondence of the branch shows a total of 10,673 letters sent, and 8,420 received.

I have the honor to be, Sir,

Your obedient servant,

ALFRED R. C. SELWYN,

Director.

ADDITIONS TO THE LIBRARY.

FROM JANUARY 4TH TO DECEMBER 31ST, 1886.

CANADA.

Department of Inland Revenue, Ottawa :—

- Report, Returns and Statistics of the Dominion of Canada. 1885.
- Report on Canal Statistics, Supplement No. 1 to Report for 1885.
- Report on Inspection of Weights and Measures, Supplement No. 2 to Report for 1885.
- Report on Adulteration of Food, Supplement No. 3 to Report for 1885.

Department of Agriculture, Ottawa :—

- Report from 1869-73.
- Report for year 1885.
- Appendix to Report for 1885 (3 copies).
- Report on Canadian Archives. 1886.
- Colonial and Indian Exhibition. Official Catalogue. 1886.
- Report on Agricultural Colleges and Experimental Farm Stations, with suggestions relating to Experimental Agriculture in Canada, W. Saunders, 1886.
- Canada : its Resources, History and Natural Productions, Ottawa. 1886.

Department of Justice, Ottawa :—

- Report of Minister. 1885.

Department of Public Works, Ottawa :—

- Annual Report, 1885.

Auditor-General's Office, Ottawa :—

- Estimates for year ending June, 1887.
- Report on Appropriation Accounts. 1885.

Department of Marine, Ottawa :—

- Eighteenth Annual Report. 1885.
- Report of the Hudson's Bay Expedition Under Command of Commander Gordon, R.N., 1885.
- Charts of Temperature of H. B. region. 1884-85.
- Georgian Bay Channel Pilot, Chaps. 1, 2, 1886, Cabot Head to Cape Smith, Commander Boulton, R.N.

Department of Fisheries, Ottawa :—

- Annual Report. 1885.
- Catalogue of Canadian Pinnipedia Cetacea, Fishes and Marine Invertebrata, by J. F. Whiteaves. Colonial and Indian Exhibition. 1886.

Department of the Interior, Ottawa :—

Annual Report. 1885.

Descriptions of the Townships of the N.W. Territory, W. 4th and 5th Initial Meridian. 1886.

Report of the Commissioner of N. W. M. Police. 1885.

Detailed report upon all Claims of Land and right to participate in the North-West Half-Breed Grant by settlement along the South Saskatchewan, &c. 1886.

Department of Militia, Ottawa :—

Annual Report. 1885.

Report upon the Suppression of the Rebellion in the North-West Territories and Matters in Connection therewith in 1885.

Department Secretary of State, Ottawa :—

Report for 1885.

Civil Service List of Canada. 1886.

Report Board of Civil Service Examiners of Canada for 1885.

Department of Indian Affairs, Ottawa :—

Annual Report for 1885 (five copies).

Department of Railways and Canals, Ottawa :—

Annual Report. 1885.

Railway Statistics of Canada. 1884-85.

Report Canadian Pacific Railway. 1877.

Post Office Department, Ottawa :—

Report for 1885.

Postal Atlas, Province of Quebec. 1880.

Postal Map of Ontario. (no date.)

Official Postal Guide. 1886.

Department of Customs, Ottawa :—

Trade and Navigation Returns for years 1860-83. 1885.

Department of Finance, Ottawa :—

Shareholders of the Chartered Banks of the Dominion of Canada. 1885.

Canada Gazette, Ottawa :—

Vol. 19. 1885-6.

Vol. 20. 1886-7.

House of Commons, Ottawa :—

Hansard. Vol. 17. 1885.

The Senate, Ottawa :—

Debates of the Senate of Dominion of Canada. Session 1886.

Legislative Assembly, Toronto :—

Journals Vols. 2-10. 1868-77. Vols. 12-18. 1879-85.

Sessional Papers. Vol. 1. Parts 1-2. 1868-9. Vol. 2. 1869. Vol. 3.

Parts 1-2. 1870-1. Vol. 4. Parts 1-2. 1871-2. Vols. 5-7. 1873-4. Vols. 9-17. 1877-85.

Commissioner Crown Lands, Toronto :—

Reports 1870-71. 1881-85.

Accounts of the late Province of Canada and the Provinces of Ontario and Quebec with the Dominion of Canada, from July, 1867, to June, 1885.
Public Accounts of Province of Ontario for year 1885.

Manitoba Gazette :

Vol. 15. 1886.

Statutes of the Province of Manitoba. Vol. 1. 1885.

Census of the Three Provisional Districts of the North-West Territory. 1884-85.

Minister of Mines, British Columbia :—

Annual Report. 1885.

Department of Mines, Nova Scotia :—

Report for 1885.

Report of the Committee consisting of Dr. E. B. Tylor, Dr. G. M. Dawson, Sir H. Lefroy, Dr. D. Wilson, Horatio Hale, R. G. Haliburton and G. W. Bloxam, appointed for the purpose of investigating and publishing Reports on the Physical Characters, Languages, &c., of the North-West Tribes of the Dominion of Canada. 1886.

Canadian Institute, Toronto :—

Proceedings (3 ser), Vol. 4. No. 1. 1886.

Le Naturaliste Canadien, Cap Rouge :—

Vol 16. 1886.

Canadian Entomologist, London :—

Vol. 16. No. 12. 1884.

Public Library, Toronto :—

Second Annual Report. 1885.

Field Naturalists' Club, Ottawa :—

Transactions. Vol. 2. No. 1. 1885.

Historical and Scientific Society, Winnipeg :—

Transactions. Nos. 19-21. 1885-6.

Annual Report for year 1885-6.

Université Laval :—

Annuaire 1886-7.

Seminaire de Chicoutimi :—

Annuaire No. 6. 1885-6.

Royal Society of Canada :—

Proceedings and Transactions. Vol. 3. 1885.

Wycliffe College, Toronto :—

Calendar 1885-6.

Commissioner of Crown Lands, Quebec :—

Report. 1868. 1870-85.

Annual Report of the Inspector of Prisons and Public Charities upon the Common Gaols, Prisons, &c., of Province of Quebec. 1885.

Abstract of Life Insurance in Canada for 1885.

Diplome d'Honneur, Exposition Universelle d'Anvers 1885, Awarded to the Geological Survey of Canada. 1885.

AMOS BOWMAN :—

Preliminary Report on Field Notes in Cariboo District, B.C. 1885.

W. A. ALLAN, *Ottawa* :—

Report on the Property of the St. Onge Gold Mining Company, 1886, by Prof. E. J. Chapman.

Dominion Land Surveyors, Ottawa :—

Proceedings. 1886.

Hamilton Association :—

Journal and Proceedings. Vol. 1. Part 2. 1884-85.

Natural History Society, St. John :—

Bulletin No. 5. 1886.

Weekly Sentinel, Port Arthur :—

Vol. 11. Nos. 4, 5. 1886.

Notes on Gaspesia (2nd ed.) 1885.

A. M. MACKAY, *Pictou* :—

Organic Siliceous Remains in the Lake Deposit of Nova Scotia. 1885.

Note on the Fresh-Water Sponges of Nova Scotia. 1886.

New Fresh-Water Sponges from Nova Scotia and Newfoundland. 1886.

REV. D. HONEYMAN, *Halifax* :—

Geological Notes of Excursions with Members of the British Association and others. 1884.

DR. J. B. BAKER EDWARDS, *Montreal* :—

Paper on Arsenical Poisoning due to the Commercial and Domestic Uses of Arsenic. 1885.

School Architecture and Hygiene with Plans and Illustrations for use of School Trustees in Ontario. 1885.

SIR WILLIAM DAWSON, *Montreal* :—

On Rhizocarps in the Erian (Devonian) Period in America. 1886.

The Geological History of the North Atlantic. (Presidential address. B. Association. 1886.)

H. W. GANONG, *St. Stephen, New Brunswick* :—

Is *Littorina Litorea* Introduced or Indigenous. 1886.

A. K. MONTPETIT, *Levis* :—

L'Amiante c'est le Million. 1884.

C. W. ROBB, *Montreal* :—

Investigations between Mingan and Labrador, by W. Couper. 1868.

Davenport Academy of Nat. Sciences. Vol. 1. 1875-76.

Royal Society's Proceedings, London. No. 219.

PROF. RAMSAY WRIGHT, *Toronto* :—

Summer Camp, with Notes on the Anatomy of Fishes. 1885.

J. G. BOURINOT, *Ottawa* :—

Canada as a Home. 1882.

G. M. DAWSON, *Ottawa* :—

The Canadian Rocky Mountains, with special reference to that part of the

Range between the 49th parallel and the Head Waters of the Red Deer River. 1886.

L'ABBÉ J. C. LAFLAMME :—

Le Saguenay, Essai de Géographie Physique. 1886.

E. SETON :—

The Birds of Western Manitoba. 1886.

H. HALE, *Clinton, Ont.* :—

The Origin of Language and the Antiquity of Speaking Man. 1886.

UNITED STATES.

United States Geological Survey, Washington :—

Monograph. Vol. 9. 1885.

Bulletin Nos. 27-30. 1886.

Fifth Annual Report. 1883-4.

Mineral Resources of the United States, by A. Williams. 1883-4.

United States Coast and Geodetic Survey, Washington :—

Report 1884.

Library Surgeon-General's Office, Washington :—

Index Catalogue. Vol. 7. 1886.

Director of the Mint, Washington :—

Fourteenth Annual Report. 1886.

Secretary of the Treasury, Washington :—

Annual Report. 1886.

Census Department, Washington :—

Tenth Census of the United States. Vols. 14, 16, 18, 20. 1885-6.

Smithsonian Institution, Washington :—

Reports for 1883, 1884.

List of Foreign Correspondents of the Smithsonian Institution. 1885.

List of Institutions in the United States receiving publications of the Smithsonian Institution. 1886.

U. S. Entomological Commission :—

Fourth Report. 1886.

Treasury Department, Washington :—

Report upon Alaska and its People, by Capt. G. M. Baily. 1880.

Report of a Military Reconnaissance in Alaska, 1883, by Lieut. F. Schwatka.

Report of the Cruise of the U.S. Revenue Steamer Corwin in the Arctic Ocean, by Lieut. C. L. Hooper. 1880.

Ordnance Department, Washington :—

Annual Report. 1885.

Chief of Engineers U.S. Army, Washington :—

Annual Report. Parts 1-4. 1885.

State Geologist, New York :—

Report for 1882-83-84, accompanied by a Geological Map of the State.

Report of the State Geologist, giving an account of the condition of the work upon which he is engaged. 1881.

Natural History of the State of New York. Palæontology of New York. Vol. 5. Part 1. Nos. 1-2. Text and plates.

American Chemical Society, New York :—

Journal. Vol. 7. Nos. 9, 10. 1885.

“ “ 8. “ 1-8. 1886.

State Museum of Natural History, New York :—

33rd-38th Annual Reports. 1880-85.

American Museum of Natural History, New York :—

Annual Report of Trustees. 1885-86.

Bulletin. Vol. 1. Nos. 6-7. 1885-86.

American Geographical Society, New York :—

Journal. Vol. 1. Nos. 2-10. 1859.

“ “ 2. No. 2. 1870.

“ “ 3. 1873.

“ “ 5. 1874.

“ “ 6. 1874.

Bulletin. “ 1. 1852.

“ “ 2. 1856.

Proceedings. Vol. 1. Nos. 1-4. 1862-63.

“ “ 2. “ 1-4. 1863-64.

Cornell University, Ithaca :—

Library Bulletin. Vol. 2. Nos. 1-2. 1886.

American Ornithological Union, New York :—

Bulletin. No. 1. 1886.

Academy of Natural Sciences, New York :—

Annals. Vol. 3. No. 9. 1885.

Transactions. Vol. 5. Nos. 4-5. 1886.

Military Service Institution, Governor's Island, New York :—

Journal. Vol. 7. Nos. 25, 26, 28. 1886.

Geological Survey of New Jersey :—

Annual Report. 1885.

Brachiopoda and Lamellibranchiata of the Raritan [Clays] and Greensand Marls, by R. P. Whitfield. 1885.

Engineers' Club of Philadelphia :—

Proceedings. Vol. 5. 1886.

Geological Survey of Pennsylvania :—

Reports of Progress. RR. T3. C5. AA. Also Atlas AA. 1885.

Product and Exhaustion of the Oil Regions of Pennsylvania and New York, by C. A. Ashburner. 1885.

Geology and Natural Gas in Pennsylvania and New York. 1885.

List of Publications of the Survey. 1885.

Annual Report and Atlas. 1885.

Lehigh University, Ithaca :—

Library Bulletin. Vol. 2. No. 1. 1886.

Zoological Society, Philadelphia :—

Fourteenth Report of the Board of Directors. 1886.

University of Vermont and State Agricultural College, Burlington :—

Catalogue. 1885-86.

Museum of Comparative Zoology, Cambridge .—

Memoirs. Vol. 10. No. 2. 1884.

Bulletin. " 12. Nos. 3-4. 1886.

" " 13. No. 1. 1886.

Report of the Curator. 1885-86.

Peabody Academy of Sciences, Salem :—

Eighteenth Annual Report. 1886.

Peabody Museum of American Archæology and Ethnology, Cambridge :—

Eighteenth and Nineteenth Annual Reports. Vol. 3.- Nos. 5, 6. 1886.

Appalachian Mountain Club, Boston :—

Appalachia. Vol. 4. No. 3. 1886.

Annual Register. 1886.

American Society of Arts and Sciences, Boston :—

Proceedings. Vol. 13. (N. ser.) Parts 1, 2. 1885-6.

Society of Natural History, Boston :—

Memoirs. Vol. 3. Nos. 12, 13. 1886.

Proceedings. Vol. 23. Part 2. 1884-86.

Harvard University, Cambridge :—

Bulletin. Vol. 4. 1886.

Annual Report. 1884-85.

Brown University, Providence, R.I. :—

Annual Report of the President. 1885-86.

Catalogus Universitatis Brunensis. 1886.

Natural History Society, Newport :—

Proceedings. 1883-84.

Public Library, St. Louis, Mo. :—

Annual Report. 1884-85.

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