GEOLOGICAL SURVEY OF CANADA
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SUMMARY REPORT

ON THE

OPERATIONS OF THE GEOLOGIGAL SURVEY

FOR THE YEAR 1896

BY

THE DIRECTOR

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SUMMARY REPORT

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FOR THE YEAR 1896.

OTTAWA, 1st January, 1897.

The Honourable CLIFFORD SIFTON, M.P.,

Minister of the Interior.

SIR,—I have the honour to submit herewith the Summary Report on the operations of the Geological Survey for the year 1896, which Report it is directed in the Act relating to the Department shall be presented as soon as may be after the close of each calendar year. In this Report, as is customary, special prominence is given to facts ascertained in the course of the work which are of immediate economic importance, as well as to original observations or deductions and to the exploration of new ground in the field. Promptitude in publication is often particularly important in such cases, while in the detailed reports and maps which form the greater part of the annual volumes and are of more permanent value for the districts they cover, thoroughness of elaboration, both in the field and office is more essential.

Annual volumes.

Volume VII. of the new series of Annual Reports was completed in September last. Unlike previous volumes, which were issued in paper covers, this has been bound in cloth, and it is proposed, if possible, that succeeding volumes of the series shall be similarly bound. The additional expense is not great, and it is believed that a much larger proportion of the issue will thus be preserved for use and future reference. Volume VII. consists of 1239 pages and contains, or is accompanied by, eleven maps and numerous plates and illustrations. In addition to the reprint of the Summary Report of 1894, it comprises the following reports on special districts and subjects:—

Contents of Vol. VII.

Report on the area of the Kamloops map-sheet, British Columbia.
Report on an exploration of the Finlay and Omenica Rivers, B.C.

Report on the country in the vicinity of Red Lake and part of Berens River, Keewatin.

Report on a portion of the province of Quebec comprised in the south-west sheet of the "Eastern Townships."

Report on the Surface Geology of eastern New Brunswick north-western Nova Scotia and a portion of Prince Edward Island.

Report of the Section of Chemistry and Mineralogy.

Report of the Section of Mineral Statistics and Mines.

The edition of volume VII. in French, has also been prepared and printed, and is nearly ready for issue.

The printing of volume VIII. is now well advanced, and it is anticipated that this volume will be ready at a date much earlier than the last.

Separate reports.

It may here be explained that the reports contained in the Annual Volumes are also issued separately, and in this form are made available to the public as soon as received from the press, at a nominal charge. The volumes combining the separate issues and furnished with general indexes, serve as continuous records of the work of the Survey, and the reports are sent out in this form to scientific exchanges, libraries and institutions.

Maps in preparation.

The number of maps actually printed during the past year is considerably less than in 1895, owing to circumstances elsewhere explained by the Chief Draughtsman, and also to the fact that a number of maps printed previous to 1895 were issued together in that year. There are, however, at the present time no less than 26 map-sheets of various parts of the Dominion in process of engraving or of reproduction by different lithographic processes.

New editions required.

As a result of the important mining development in progress in the western part of Ontario, all separate copies of two of the maps relating to that country have been exhausted. These are the maps of the northern part of the Lake of the Woods and of Rainy Lake, published respectively in 1885 and 1888. Corrections and additions to the engraved stones of the first-named map are now in hand, and a new edition of it will be printed at the earliest possible moment, in order that it may be available to prospectors and miners in the spring. The Rainy Lake sheet will also eventually require to be reprinted, but as it has in large part been reproduced in a map printed by the Ontario Bureau of Mines, it is not so urgently required.

Palæontological publication.

Part 3 of volume III. of the series of publications entitled *Palæozoic Fossils*, by Mr. J. F. Whiteaves, will shortly be published. This part

deals with the Cambro-Silurian fossils of the Winnipeg basin, and is based upon the study of extensive and interesting collections made in that region, by several members of the staff.

General index.

Work on the general classified index of reports of the Survey subsequent to the *Geology of Canada* (1863) has been continued by Mr. D. B. Dowling during the year, and is now completed to the beginning of the new series of reports in 1885. It includes 25,813 references. The indexing of the *Geology of Canada* (1863) is now in hand, and will add about 6000 additional references. As this volume constitutes a summary of all the Reports of Progress of still earlier years, and as the volumes subsequent to 1885 have separate indexes, the completion of the work now in progress will, with these, practically afford easy reference to the entire work of the Survey since its inception in 1843. It is intended to print the general index as a separate publication as soon as possible.

Educational collections.

The preparation and distribution to educational institutions of small collections illustrative of Canadian ores, rocks and minerals has been continued during the past year, fifty-four such collections having been sent out, aggregating over 5000 specimens in all. It is endeavoured as far as possible to confine the supply of these collections to institutions in which some elementary natural science is actually taught, but even as thus restricted, the labour and time involved in obtaining material, making up, labelling and cataloguing the collections is very considerable.

Some duplicate mineral specimens of particular interest or rarity, brought in from various parts of the Dominion, have been sent to the museums of several Canadian universities, and a few specimens of the same kind specially requested by foreign institutions have been furnished.

Contributions to Imperial Institute.

Further samples of economic minerals have been supplied from time to time, with all necessary particulars, to the Canadian section of the Imperial Institute in London, which now affords an excellent medium of making known in Great Britain products likely to find a market there. Through correspondence with Mr. Harrison Watson, the efficient curator of the Canadian section, and by means of the recently established Research Department of the Institute, producers and consumers have already in a number of instances been brought into relation with each other. The Geological Survey Department will be happy to forward to the Imperial Institute, from time to time, any approved specimens of mineral products. Such samples should in all cases be accompanied by particulars as to price, place of shipment, freight charges, etc.

Correspondence.

The correspondence of the department has greatly increased in late years and while much of this is of a routine character, a large proportion of the letters written are in reply to specific questions of various kinds, or of the nature of reports upon specimens sent in for determination or examination. Work of this character consumes a good deal of the time of several members of the staff, not otherwise accounted for, but is of direct importance, being one of the modes in which the knowledge of the mineral resources and geology of the country can most profitably be employed.

New museum building urgently required.

The number of visitors to the museum again shows a notable increase, having risen to 31,595 in 1896, and every year the necessity for a modern and safe building of greater size, becomes more urgent. A computation shows that, for the museum, such a building should have about double the floor-space of the present one, with provision in the plan for further enlargement in future years. Considerable additions to the space now employed for offices, library and for purposes of storage, etc., are also required. The situation and construction of the present building render the danger from fire excessive, a fact particularly evidenced during the past summer by the occurrence of a conflagration in lots adjacent and to the rear, which under slightly different conditions might easily have involved this building. The collections, embracing as they do more than 2000 unique "type" specimens, with the entire supply of reports and maps, and the manuscripts and notes representing over fifty years of work, would constitute an irremediable loss to the country if destroyed.

Field-work of the Director.

The session of Parliament occurring during the past summer, with difficulties arising from the want, during some part of the season, of any appropriation to cover the work in progress in the field, rendered my continued presence in Ottawa necessary and prevented me from undertaking any considerable amount of work in the field, of any kind. A few days were, however, spent in Pictou county, Nova Scotia, in company with Mr. H. Fletcher and Dr. Ami in examining some critical and interesting points connected with the geological structure of that region, of which the map-sheets by Mr. Fletcher are now in process of engraving. To Mr. H. S. Poole, who accompanied us on several occasions, acknowledgments are particularly due for information which his accurate local knowledge of the Pictou coal-field enabled him to afford.

Notable progress in mining development.

During the past year, very notable progress has been made in the development of the mineral resources of Canada, both in the way of actual work and in attracting the attention and interest of capital. British

Columbia has begun to evidence its value as a permanent producer of the precious metals, in a manner long foreseen by those who have paid attention to its geological structure and position. In Ontario, wherever the Huronian system is developed and has been examined, valuable mines—more particularly those of gold—are being discovered and opened up. In Nova Scotia, renewed interest has been shown in gold mining, and with improved machinery and methods, the output is likely soon to be greatly increased. Other mineral industries throughout the country, whether already established or in course of development, share in a general appreciation.

Resulting demand for geological information.

The fundamental work of the Geological Survey is that of providing geological maps and reports of the several parts of the country, such as to be of value to the explorer, the miner and others, and in consequence of the activity above alluded to, the demand for information of the kind has been greater than ever before. This has been largely met by the results of surveys previously planned and completed, with such foresight as a study of the geological conditions existing in different parts of the Dominion has rendered possible. Detailed surveys have been made in some districts, while in others it has so far been possible only to carry out general explorations and preliminary reconnaissances. Thus, when an increased interest is simultaneously shown concerning all parts of the vast area of Canada, it is not possible to provide, in every case, information of the kind and on the scale that may be asked for. With the available force of properly trained men and the money actually at the disposal of the Geological Survey, all that can be done is to continue the work steadily, in those which appear to be the most important fields, with a due recognition of the fact that this work must be carried out in such a manner as to have a permanent value to those actually interested in employing it upon the ground, while at the same time commanding the respect and confidence of the scientific world.

Efforts to meet this.

Want of trustworthy maps.

With the partial exception of the Topographical Surveys Branch of the Department of the Interior, by which a great portion of the North-west Territory, Manitoba and the Railway Belt of British Columbia have been or are being mapped in varying degrees of detail, the Geological Survey is the only organization under the Dominion Government occupied with anything of the character of a general mapping of the country as a whole. From the very inception of this Survey, the want of even reasonably accurate maps of any of the provinces, has constituted the principal difficulty in connection with the geological work. Wherever the operations of the Geological Survey have extended, it is universally admitted that the maps published by it are the best

The chief cause of delay in Geological Surveys.

that exist; but in producing these maps a vast amount of time and labour is involved which should not properly be thrown upon the Geological Survey. With two very limited exceptions, in the cases of Nova Scotia and British Columbia respectively, the surveys conducted by the provincial governments have been confined to the running of lines of a cadastral nature, or to the partial measurement of rivers and lakes, without any attempt at exact geodetical work or the delineation of the relief of the land.

Provincial assistance desirable in mapping.

The production of good topographical maps and the construction of roads or other means of communication in the several mining districts, are, it is believed, the most important means by which the provincial authorities may readily afford additional legitimate aid to the development of the mineral wealth of the several provinces. The work of the Mining Bureaus, or Departments of Mines, of Ontario, Quebec, Nova Scotia and British Columbia, besides its function in the inspection and regulation of the mines, is assisting materially in making known the opportunities for investment and in reporting the progress actually made, in detail. The Geological Survey is conducting its operations in complete accord with these organizations, but as the provincial revenues are those actually benefited by the sale of mining lands and royalties on output, it is surely not too much to ask for some further action on the part of the provinces in the matter of topographical surveys.

Death of Mr. Giroux.

I have to record, with great regret, the death of Mr. N. J. Giroux, who had been connected with the Geological Survey since 1883. This occurred November 30th, shortly after the completion of his field-work of the season. Mr. Giroux was a most careful and conscientious observer, and although he had not contributed any detailed reports to the volumes of the Survey, he had aided materially in the collection of facts which have found a place in these volumes. His loss is sincerely deplored by all the members of the staff.

Apart from the vacancy caused by Mr. Giroux's death, there have been no changes in the permanent staff of the Survey during the year 1896.

Parties in the field.

Fifteen field-parties have been at work during the greater part of the past season, distributed as follows:—

British Columbia	2
North-west Territories	3
Ontario	3
Ontario and Quebec	2
Quebec	1
Labrador	1
Nova Scotia	3
Total	15

Besides the above, special investigations were carried on for shorter periods by various members of the staff. Dr. H. M. Ami, spent some time in palæontological work connected with the mapping of formations in Nova Scotia. Mr. W. F. Ferrier, was instructed to endeavour to ascertain the locality in Hastings county, Ontario, from which specimens of corundum had reached him. This he successfully accomplished, with results which may prove to be of considerable economic importance. Mr. J. White, continued and extended the survey of measured lines in Central Ontario, necessary for the purpose of ascertaining the geographical position of the map-sheets already blocked out there. Mr. Willimott spent some time in collecting minerals and rocks at several localities, and Messrs. E. D. Ingall and L. L. Brophy made short excursions in Ontario and Quebec for the purpose of completing information for mineral and mining statistics.

Synopsis of field-work.

Briefly reviewing the field-work accomplished during the year, in regard to which fuller statements are made in the sequel by the several gentlemen engaged in it, the following points may be referred to :—

In British Columbia, the supplementary work necessary to complete the topographical and geological information for the Shuswap map-sheet, was completed by Mr. J. McEvoy. A small area of rugged mountainous country in the north-east corner of this sheet was left unsurveyed, as it was thought to be more important for Mr. McEvoy to join Mr. McConnell in the mapping of the West Kootanie district. In West Kootanie, Mr. R. G. McConnell geologically investigated a tract of country to the south of Slocan and Ainsworth, including the Nelson or Toad Mountain, Rossland and Trail mining centres. As already stated, the region generally is divided between highly altered stratified rocks, chiefly of volcanic origin, and granitic rocks, largely of later date than these, which have broken up through them. Fossils believed to be of Carboniferous age were found in some parts of the stratified series. The Rossland ores occur in association with an eruptive mass of gabbro, about four miles long by one in width, and the definition of this is of great importance, as the principal ore-bodies appear on or about its periphery. A close study of the conditions of occurrence of the ores here promises to be most instuctive. It is proposed to prepare, as soon as possible, a preliminary geological map of that part of the West Kootanie district which has already been covered.

To the north of Lake Winnipeg, Mr. J. B. Tyrrell's explorations were of the character of a reconnaissance, by means of which a considerable area of country hitherto unknown geologically can now be

Synopsis of field-work—*Cont.*

approximately mapped. He succeeded in defining the area of considerable bodies of the metalliferous Huronian series of rocks, and also found an unexpectedly large region characterized by good soil and presumably susceptible of ultimate agricultural occupation.

By Mr. W. McInnes, the work of mapping the mining regions of Rainy Lake district in western Ontario was continued, his time being devoted in the first place to the revision of some parts of the Seine River sheet, of which a preliminary edition had been issued, and afterwards to the Manitou country, to the north of Rainy Lake. A report on the areas covered by the Seine River and Shebandowan sheets is now approaching completion, but a considerable amount of further field-work is required for the Manitou sheet, before this can be sent to the engraver. Much general information respecting the progress of mining in the region is given in Mr. McInnes's report in the sequel, and, as in the case of the work last referred to, the knowledge being gained respecting the associates and mode of occurrence of the auriferous veins is likely to be of great practical utility.

Investigation of Archæan rocks.

Messrs. F. D. Adams and A. E. Barlow, associated in field-work on the area of the Haliburton sheet of Central Ontario, make a joint report on its progress. Besides the economic importance of this region, the examinations in progress there have a special scientific interest, being designed, if possible, to ascertain definitely the relations of the rocks of the Grenville series, the Huronian, and those long ago named the Hastings series, by Mr. Vennor. The whole question of the relations of the several members of the Archæan in North America is peculiarly a Canadian one, originating some fifty years ago in the epoch-making investigations of Sir William Logan, in consequence of which he first introduced a rational classification of the more or less completely crystalline masses underlying the Cambrian. The application of modern methods of research, however, necessarily opens for review many of the conclusions originally formed with less perfect means and knowledge, and the enormous area of these Archæan rocks in Canada renders it particularly important that the best and most natural classification should now be arrived at, for the purpose of delineating them upon our maps. Definite statements on the results so far obtained in the work here particularly referred to, are for the present purposely avoided, in order to leave the subject entirely open for the unbiassed formation of opinion in the light of all the facts. Messrs. Adams and Barlow, however, find reason to entertain the opinion that the Grenville series is the highly altered representative of the Hastings series, and with that opinion Dr. Ells, as a result of his work in the adjoining district is inclined to concur, although he thinks the equivalency of

the Hastings is distinctively with the upper part of the Grenville series. The necessity for any reconsideration of the relations of the Huronian to the above-mentioned series, must remain rather a matter of conjecture than of opinion until the detailed work in progress shall have advanced further. Synopsis of field-work—*Cont.*

Work by Dr. Ells, above alluded to, has been chiefly in connection with sheet 119 of the Ontario series, which forms a continuation of the region covered by two sheets previously surveyed. One of these sheets includes the plumbago, mica, asbestus and apatite deposits of the Gatineau, Buckingham and Grenville districts, and both will be prepared for publication, with an explanatory report, as soon as practicable.

The work in progress by Mr. Giroux, on a map-sheet to the east of Ottawa, including portions of both Ontario and Quebec, was approching completion ; but has been most unfortunately interrupted by the death of that gentleman, as elsewhere mentioned. It will be necessary to endeavour to provide next summer for the additional surveys still required and for the working up of the remaining area and of Mr. Giroux's notes and plans.

The basin of the Nottaway or Noddaway River, one of the largest rivers flowing to James Bay, has been further explored during the past season by Dr. Bell, and with results of interest both geographically and geologically. Thirteen branches of the main stream were surveyed for portions of their lengths, and a route was explored northward from Waswanipi Lake to Nemiskau Lake, an expansion of the Rupert River, by means of various streams and lakes. Mr. R. W. Brock, Dr. Bell's assistant, also carried out a track-survey to the eastward along the Waswanipi River, by which he ultimately reached Lake Mistassini. The more important geological results obtained are those relating to the distribution of the Huronian rocks in the region, which it will now be possible to lay down with some accuracy on the map.

In the "Eastern Townships" of Quebec, researches on the gold-bearing deposits and on the superficial geology generally, have been continued by Mr. R. Chalmers. With the results already obtained in 1895, it will be possible to produce a useful general report on the district, and upon this, work is now in progress in the office. Some interesting particulars relating to gold mining are given by Mr. Chalmers in his progress report, on a later page, as well as facts showing the existence of two boulder-clays and the presence and height of old shore-lines indicating remarkable differential changes in elevation.

Synopsis field-work—*Cont.*

Mr. A. P. Low's investigations were again directed to the further exploration of the great peninsula of Labrador, across the northern part of which another exploratory line was surveyed, from Richmond Gulf on Hudson Bay, to Fort Chimo on Ungava Bay. The actual distance, in a straight line, between the two points mentioned, is about 350 miles, but the total distance travelled, via Missinabie, Moose River, Hudson Bay and return round the eastern coast of Labrador, was about 4200 miles. The Cambrian rocks, with their iron ores, were again found on the northern line of traverse, but no formations of late date were met with, the greater part of the district being characterized by granitic and gneissic rocks of the Archæan. It was found that the rock-striation indicated a flow of ice, during the glacial period, from the vicinity of the present watershed, both to the westward and to the eastward, nearly in conformity with the general slopes of the surface.

In Nova Scotia, Mr. H. Fletcher, Mr. E. R. Faribault and Prof. L. W. Bailey, were engaged in geological work. Prof. Bailey devoted his time to the further examination of the south-western part of the province, with the object of obtaining data for a somewhat detailed general report, such as to fulfil requirements until the regular mapping on the scale of one mile to the inch can be extended to these counties. Attention was given to the relations of the Cambrian gold-bearing rocks and the granites, in connection with the recent renewed activity in gold mining. The Devonian rocks of Digby county were also investigated, with interesting results in respect to their distribution and the horizon which they occupy. Mr. H. Fletcher's time was again particularly directed to the surveys required for new and revised editions of the geological maps of the Sydney coal-fields. The field-work necessary for this is now complete, and the preparation of the new maps will be proceeded with as soon as possible. Some work was also done in Pictou county, and a beginning was made toward the detailed mapping of the Springhill district in Cumberland county. By Mr. Faribault, work was continued in the gold-bearing Cambrian formation of the Atlantic coast region of the province. Surveys have now extended to the westward as far as Mahone Bay, in Lunenburg county, it having been decided, for the time being, to pass over the granitic country between this and the Halifax City sheet, as of minor practical importance. The geological mapping of the structural features of the auriferous Cambrian rocks, is much appreciated by those engaged in mining, and it is hoped shortly to publish some of the large-scale plans of special mining districts which have been made by Mr. Faribault.

Boring at Athabasca Landing.

Work on the experimental boring for petroleum at Athabasca Landing, in northern Alberta, was resumed early in May last by Mr. W. A. Fraser. A depth of 1731 feet had been attained before the suspension of operations in December, 1895, the Cretaceous strata penetrated had been proved to be almost exactly similar to those coming to the surface in natural outcrops further down the river, and it was believed that the top of the lowest member of the Cretaceous—the so-called "tar sands"—in which petroleum is to be looked for, would be met with within the next 100 feet. Under these circumstances it was decided that no effort should be spared to accomplish the additional amount in depth, before abandoning this first experimental hole. It was further intended to carry the boring through the "tar sands" if these should be proved to exist under Athabasca Landing, and to a depth of about 2000 feet, if possible. Boring operations in Northern Alberta.

As explained in the last Summary Report, the difficulties in executing this experimental boring have proved to be exceptionally great, in consequence of the incoherent character of the beds; while the unexpectedly great thickness of the strata, under the actual circumstances, led to the reduction in size of the original boring, in depth, to such a degree as to make further operations extremely troublesome. So long, however, as any reasonable prospect existed of carrying the boring down a few hundred feet further, it was deemed advisable to continue work on it, and Mr. Fraser was so instructed, as will appear by his report. Almost the entire working season was spent in endeavouring to enlarge the bore, by under-reaming below the smallest (or $3\frac{5}{8}$ inch) casing, so as to enable that casing to be driven down to arrest the caving in of the shales. The work has been very arduous and slow, but with all his efforts, Mr. Fraser could not succeed in advancing more than thirty-nine feet in further depth. The boring was eventually abandoned when further progress became absolutely impossible. Attention was then directed to withdrawing as much as possible of the steel casing, and a considerable proportion of this has been recovered for future use. Difficulties encountered.

The bore-hole eventually abandoned.

Although this first experiment at Athabasca Landing has thus proved inconclusive, and has not absolutely settled the question as to the existence or otherwise of the "tar sands" so far to the south-west of their natural outcrop, nor the further question of the continued presence of petroleum in them, much valuable information has been gained. As explained in the last Summary Report, the great regularity Information gained by the work.

and persistency of the Cretaceous formations in the region has been established, and the depth at which the " tar sands " and base of the Cretaceous may be found, over a wide region, has been determined. We now also know the nature of the overlying strata to be penetrated, and although this is unfavourable to boring operations, it may be stated with confidence that, with this knowledge, a second boring at the Landing could now be begun and carried down to any required depth without much chance of failure or loss of time.

Proposed further operations.

Sooner or later in the course of testing the great oil-bearing territory believed to exist in Athabasca and Alberta, it will probably be necessary to arrange for such a second boring at the Landing, but in the meantime, it is proposed, in the light of the facts now known, to make, in the first instance, a second experimental boring about eighty miles further down the Athabasca Valley, near the mouth of the Pelican River. At this place the summit of the " tar sands " should be reached at a depth of about 700 feet, and the base of the same formation (probably resting on the Devonian limestones from which the petroleum is originally derived,) at 800 or 900 feet. It is hoped that a boring to such a depth may be made with facility, in adopting the necessary precautions, during next summer.

Two boring plants might be employed.

As explained in the last report, it would greatly accelerate the proving of the field if money sufficient to enable two borings to be carried on concurrently in different localities could be obtained. This would, in fact, practically enable the experimental work now possible in two years to be executed in one, because of the restricted length of the favourable season for operations of the kind. It may be supposed that this work could be prosecuted throughout the year, and this may no doubt eventually be the case, should petroleum be discovered; but at the present time, the difficulty of communication, the distance from the base of supplies and the great expense and almost impossibility of having every appliance on hand in duplicate or triplicate, renders this practically impossible.

Conditions as to probable occurrence of petroleum unaltered.

It is proper to add that the work so far accomplished, although without positive results in the matter of petroleum, has not in the least degree tended to render the existence of petroleum, even at Athabasca Landing, more doubtful than before. It means only that the stratum in which the petroleum is likely to occur has not been reached in this instance, because of its unforeseen depth and other difficulties encountered. The importance of the inquiry, and its probable eventual success remain unchanged, and all that has been said on this subject in the Summary Reports for the years 1894 and 1895, might here be repeated.

Had petroleum been found in the boring at Athabasca Landing, it would probably have been decided to at once move the boring plant to some place in the valley of the North Saskatchewan, for the purpose of tracing the productive beds further south, where their economic development might be of greater importance, because of the adjacent settlements and proximity to railway communication. With this possibility in view, it was thought proper to instruct Mr. R. G. McConnell, before returning to his work in West Kootanie, to spend a few days in making a special investigation of part of the North Saskatchewan valley below Edmonton, of such a character as to supplement that already carried out by Mr. J. B. Tyrrell, by whom this part of Alberta had been geologically mapped. The result of this investigation is thus summarized by Mr. McConnell:— Examination of North Saskatchewan.

"It was found that the central anticline of the plains, which has been traced northwards from the International boundary to beyond Battle River, dies away or becomes inappreciable before the Saskatchewan is reached. The beds, so far as can be judged by the eye, are practically horizontal along the valley, from Edmonton eastward as far as the examination extended, or to Saddle Lake Crossing, some thirty-five miles below Victoria. The choice of a site for a bore-hole, in the absence of any evident arching up of the strata, becomes a difficult one, and will necessarily be largely speculative. If a test is decided on, I would advise the selection of a site in the vicinity of Victoria. The upper beds disappear gradually going eastward, and a hole of less depth would therefore be required here than further west; also, if the anticline referred to above continues north in a reduced form, it must cross the Saskatchewan in this vicinity." Site recommended for boring there.

As already stated, the results at the Landing were not such as to enable any further boring elsewhere to be attempted during the season. Mr. McConnell's observations will, however, serve as a guide for future explorations.

The greatest credit is due to Mr. W. A. Fraser for his indefatigable and skilful conduct of the work at Athabasca Landing, under circumstances often very discouraging, and for most of the time without any prospect, under the arrangements made, of obtaining any adequate remuneration for his time and labour. His report is as follows:— Report on boring operations.

"During the season of 1895, the boring had been carried to a depth of 1731 feet, and had reached into the Clearwater shales which overlie the 'tar sands.' Further progress at that depth had become impossible owing to caving in of the sides of the bore. The casing had been carried down to a depth of 1473 feet. Reaming had then been

Report on boring operations—*Cont.*

resumed with the 'under-reamer,' and the casing had been carried down to 1624 feet. This was the condition of the bore when work ceased, owing to the severe weather, on the 5th of December, 1895.

"The under-reaming had ceased in an extremely hard stratum of sandstone; presumably one of the concretionary nodules, similar to those found in this formation below Grand Rapids. The reaming had been carried into this for six feet, and the constant wearing away of the reamer by the emery-like rock, had reduced the shoulder the reamer was carrying down, until the bore was not larger than the casing. It became evident that an entirely different reamer was required.

"Great difficulty was experienced in making a reamer strong enough to stand this hard rock, owing to the small size of the bore. Before going up in the spring of the present year, I had one made in Toronto from patterns of one used successfully in Australia, and resumed work on the 4th of May.

"The new under-reamer worked fairly well for a time, but finally the steel legs broke. An extra pair of legs had been provided, but these also were used up before the hard stratum was reamed through. Two of the legs broke off in the bore, but were fished out successfully. Another pair of legs was got from Calgary, and reaming was resumed. Most of the summer was taken up in reaming through this hard stratum, for it proved to be about 18 feet thick.

"It was thought to be of great importance to get the casing through this hard streak, for we were probably not over a hundred feet from the 'tar sands,' the reaching of which might make the test a successful one and determine whether the sands carried oil at this place or not. The bore had cost so much, that it was thought wise to spend a little more time and money in an endeavour to get down the short remaining distance.

"Finally, on the 27th of July, the reamer passed through the hard streak. But it took several days more to enlarge the hole to $4\frac{5}{8}$ in. diameter to allow the casing to pass through. On the 4th of August the casing was tried for the first time, and it just managed to scrape through.

"From this depth (1635 feet) to 1720 feet, the reaming and casing went very well, but on another very hard streak which was encountered at 1670 feet, the reamer broke again, and much time was lost trying to fish it out.

"When the casing was down to 1720 feet, the bore caved very badly, the shale being often forced up into the casing 100 feet, and

requiring to be drilled out. From 1720 to 1731 feet the caving was again very bad. Report on boring operations—*Cont.*

"Drilling was now resumed, and five feet drilled, when the casing was put down a few feet again. At 1735 feet, the casing was only a foot off the bottom, and the sand-pump could not be got to the bottom, even then, because of the caving. As no progress could be made, I was forced to put the casing on the very bottom. If the formation below had been soft, the casing might have been carried on, but it turned out that about a foot below this (1736 feet) a very hard streak of about six feet occurred, and further reaming was impossible, because at least three feet of space was required between the casing and the shoulder to work the reamer.

"For the last few feet, the casing had been put down a few inches at a time, trying to shut off the caving sufficiently to work without getting it on the bottom, if possible. But it was found impossible to even get to the bottom before the casing was actually on the very bottom. This was owing to two causes.—The gas travelling down outside the smaller casing and forcing the caving shale up on the inside, and the great pressure of 1736 feet of overlying strata acting on the shale in much the same manner.

"Under these circumstances drilling was again resumed, and if the formation had continued hard, no further casing would have been required, but unfortunately, it soon again changed to a very soft shale and the caving became so bad that all progress was finally stopped at 1770 feet.

"My instructions had been to carry on the bore while there was any prospect of getting down to the 'tar sands,' and not to abandon it until further progress had become impossible. Recognizing the wisdom of this, I had used every endeavour to get down to a depth which would make it a test and had laboured against obstacles seemingly unsurmountable.

"Acting in compliance with instructions received by wire, I now made preparations to pull out and recover as much of the casing as was possible, as soon as I had found that further progress was stopped. I succeeded in cutting off the 4 inch casing at a depth of 1100 feet, and pulled that much out of the bore. Of the 4½ inch casing I cut off and saved 700 feet. In pulling it, it parted three times, owing to a defective joint. The 5⅝ inch casing was parted at 200 feet from the top, and this was all I was enabled to save of it.

"After this the derrick was pulled down, the casing all piled up in good order, and the material left in good shape for an early move down

Report on boring operations—*Cont.*

the river. Logs for a large raft have been taken out and landed just at the rig, and a large boat has been built and made ready for moving next spring. A contract has also been let for chopping 60 cords of wood at the Pelican River.

"From the work that has been accomplished much valuable information has been obtained. The bore has demonstrated that all the strata which overlie the 'tar sands' at their outcrop lower down the river, extend as far as Athabasca Landing. The 'tar sands' appear to be at a greater depth than estimated, but the discovery of the overlying strata in very regular order, would seem to indicate that the 'tar sands' also will be encountered within the next few hundred feet.

"The want of success in reaching the depth necessary to decide by actual boring whether the 'tar sands' are beneath the Landing or not is to be deplored, but every endeavour was used to get the bore as deep as possible.

"The strata actually penetrated before the abandonment of the hole, and beneath those reported on last year, are as follows :—

"1731—36, very soft shale, dark, caving badly.
"1736—47, very hard sand-rock.
"1747—52, shale.
"1752—59, shale and sand sandstone, shale caving badly.
"1759—63, shale, caving badly.
"1763—67, hard, supposed sandstone.
"1767—1770, soft shale, caving badly."

It will be understood that the above strata may now be added to the thickness of the Clearwater shales, as given in the Summary Report of 1895 (p. 12 A.) The thickness of the entire Cretaceous section known at the Landing, now amounts to 1950 feet.

In accordance with the practice previously followed, the succeeding reports of work accomplished, are arranged by order of provinces and districts, from west to east.

British Columbia.

British Columbia.

The winter months of 1896, were spent by Mr. R. G. McConnell in working up the geological and topographical surveys of the previous season in West Kootanie, and in other investigations related to the preparation of a detailed report on that very important mining district

British Columbia—*Cont.*

Mr. McConnell left Ottawa for the west on May 13th, and was instructed in the first place to devote a short time to an examination of part of the North Saskatchewan River, below Edmonton, with the object of determining the most favourable place for an experimental boring, should it prove to be desirable to move the plant then employed at Athabasca Landing to the Saskatchewan. Mr. McConnell's observations on this point are given elsewhere, in connection with the report on boring operations (p. 15A).

Work by Mr. McConnell, West Kootanie.

Respecting the work accomplished during the summer in West Kootanie, Mr. McConnell reports as follows :—

"From Edmonton, I went to Nelson, B. C., arriving there on June 1st. Owing to the late season, snow still covered the higher peaks and ridges in this region and I was unable to commence regular mountain work for some weeks. The time, however, was fully occupied in an examination of the Kootanie and tributary valleys. In the latter part of June a traverse was made up Sproule Creek, a stream flowing into the Kootanie from the north, four miles below Nelson. From the head of Districts examined. Sproule Creek, a summit about 4500 feet in height was crossed to Cedar Creek, and the latter stream was followed down to Slocan River, which it joins about thirteen miles below Slocan Lake. A traverse was also carried up Slocan River to Lemon Creek, connecting there with the work of the previous year. We returned by the Slocan River, down which a track-survey was carried. In July, the work was extended south of the Kootanie to Toad Mountain and neighbourhood, and to the North Fork of the Salmon. In August we moved to the Columbia River, and the remainder of the season was spent on Trail, Murphy, Champion and other creeks flowing into that river below Robson. Work was discontinued on the 20th of October.

"Mr. H. Y. Russel, my assistant during two previous years in this region, having resigned, Mr. W. W. Leach, B.Ap.Sc., was engaged as field assistant for the season. I was also joined on the 1st of August by Mr. J. McEvoy of the Geological Survey staff, who assumed charge of the topographical work.

Character of country.

"The region examined forms part of the southern continuation of the Selkirk Range, and is everywhere of a rugged and mountainous character. It is traversed by several large and deep valleys running in different directions, the principal ones being those of the Columbia, the Kootanie, the Slocan, the Beaver and the Salmon. Draining into these are numberless small streams, usually of no great length, which take their rise among the higher peaks and summits and descend through deep wooded valleys to the main rivers. The present rough condition

British Columbia—*Cont.*

of the country is mainly due to the slow but persistent wearing action of these streams, or their predecessors, on rocks of differing hardness, the process having continued long enough to entirely obliterate all traces of the earlier configuration.

"The most prominent range south of the Kootanie, is the group called on some of the maps the Beaver Mountains, situated in the granite belt west of the North Fork of the Salmon. The higher peaks of this range approach an altitude of 8000 feet. A number of peaks of scarcely inferior height also occur south of the head of Hall Creek. South of the Beaver Mountains the country declines 1000 feet or more in general elevation and the contours of the hills and ridges become more uniform and rounded. Portions of the interior of this district bear a strong resemblance to a boldly rolling plateau. West of the Columbia River, an apparently endless succession of deep branching valleys and lofty ridges crowned at intervals with sharp peaks and crests, are everywhere met with.

Forest.

"The whole country is, or rather has been, covered with heavy forests, for, since mining operations began, destructive fires have raged every summer over large areas. The forest is principally coniferous, but is relieved by a few broad-leaved trees, among which are the aspen (*Populus tremuloides*), the cottonwood (probably *Populus trichocarpa*, a birch (*Betula occidentalis*), and a small maple (*Acer glabrum.*) Among the coniferous trees the pines are represented by the red pine (*Pinus ponderosa,*) the black or bull pine (*P. Murrayana*), the white pine *P. monticola*), and the high mountain species (*P. albicaulis*). The firs by the Douglas fir (*Pseudotsuga Douglasii*), two mountain species (*Abies subalpina* and probably *A. amabilis*), and by a species usually of fair size, growing on the lower flats, which is possibly *bies nobilis.* The spruces include Englemann's spruce (*Picea Englemanni*), and a couple of other varieties not determined. Other trees well represented are the larch (*Larix occidentalis*), the cedar (*Thuya gigantea*), the hemlock (*Tsuga Mertensiana*). Of occasional occurrence are the juniper (*Juniperus Virginiana*), and the yew (*Taxus brevifolia*). The above list of forest trees has been revised by Professor Macoun.

Prevalence of igneous rocks.

"The most notable feature in the geology of the district examined, is the marked predominance of rocks of igneous origin. Two great series are represented, of which the older consists mostly of porphyrites, diabases, gabbros, tuffs and agglomerates, and the younger of granites.

Granites.

"The granites belong to the same mass so largely developed in the country north of Kootanie Arm and outlined in my summary of last year. The normal type is a medium-grained grayish rock, consisting

mostly of biotite, hornblende, quartz, orthoclase and plagioclase ; but great variations in both texture and composition are frequent. In places and over considerable areas the development of large felspar crystals give it a distinct, porphyritic appearance. When crushed, this form results in a typical augen-gneiss. With variations in the proportion of its constituents the granite passes into hornblende-granite, granodiorite and mica-syenite. The latter, cut by dykes from the more acidic varieties, occurs largely along the Kootanie River west of Nelson. British Columbia—*Cont.*

"The granites, except for some small inliers of schists, are found in their various phases all along the Kootanie River and down the Columbia to near the mouth of Bear Creek. The south-eastern edge of the area crosses the Columbia River, below the mouth of Bear Creek and continues south for some distance along Lookout Mountain ridge. West of the Columbia River from Lookout Mountain north to China Creek, the granites occur in a band from one to two miles in width, following the river and sending out occasional spurs to the west, one of which partly encircles the Kootanie-Columbia and Monte-Cristo mountains ; but north of China Creek it spreads westward beyond the edge of the district treated of. East of the Columbia River, the granites extend, in an irregular-shaped mass from three to ten miles in width, northeastward to Hall Creek. Besides the main granite area, numerous bosses and reefs of granite, evidently of the same age, break through the older rocks throughout the district. The largest of these crosses the Nelson and Fort Shepherd Railway near Salmon siding, and extends eastward into the still unknown country between the Salmon and Kootanie rivers. Distribution of granites.

"The rocks on the Columbia River, for some miles above and below the mouth of Champion Creek, have some resemblance to parts of the Shuswap series. They consist of mica-schists and gneisses, evidently derived from granites interbanded with pegmatites, and the ordinary gray granites of the district in a more or less schistose condition. Somewhat similar rocks were also found on the Slocan River, near the 15-mile House, but the presence there of some bands of lustrous mica-schists, typical of the Shuswap, led me to refer them to that series.

"The older system of predominantly porphyritic rocks, through which the gray granite breaks, occurs under so many forms and in such different degrees of preservation that it is highly probable rocks of different ages are represented in it. The prevalent rock of the series is a greenish augite-porphyrite often passing into a porphyrite. The groundmass of this rock is usually diabasic, and in many places the augite phenocrysts of the porphyrite disappear and it passes into a fine-grained diabase. The Porphyrites and associated rocks.

British Columbia—*Cont.*

porphyrites, while often massive and uniform in texture and appearance, usually show a more or less brecciated structure on weathered surfaces. The embedded fragments and the groundmass, except for slight differences in coloration, appear macroscopically almost identical. Besides the augite-porphyrites and diabases, massive eruptive rocks are also represented by gabbros, small areas of which occur at Rossland and on the North Fork of the Salmon, and by the grayish porphyrites with plagioclase phenocrysts of Toad Mountain and Spokane Mountain. Fragmental volcanic rocks, consisting of tuffs and agglomerates, occur on Granite, Spokane and Sophia mountains, and also on the ridges south of Lake and Bald mountains and in other places in the district. The agglomerates are calcareous in places and are interbedded occasionally with bands of fossiliferous limestones. The fossils collected are imperfectly preserved, but are probably Carboniferous in age.

Slates

"The eruptive series of rocks inclose bands and patches of dark fissile slates, which appear in most cases to be residual portions of the formations amid which the igneous rocks, were erupted, as none of the bands, even where a thousand feet or more in thickness, can be traced for any distance along the strike. Slates holding small limestone bands occur on Hall Creek, on the North Fork of the Salmon, on Trail Creek and in other places.

Dykes.

"The granites and other rocks of the district are cut by numerous dykes and bosses mostly belonging to about the same period, but showing extreme variations in texture and composition, specimens showing a range from a light-coloured acidic rock to a dark basic one, and from a microcrystalline to a coarse granitic condition.

"The distribution of the various members of the eruptive series is extremely irregular, and owing to the large proportion of the surface concealed by drift and forests, and the limited time at our disposal, it was found impossible in many cases to trace out junctions except in an approximate manner. A brief statement of the distribution and character of this group so far as known, will, however, be given here; being of great economic interest, inasmuch as it contains the gold-bearing pyrrhotite ores which have made the district famous. The principal rocks of the series are now being examined microscopically by Mr. Ferrier and some of the names given here may be altered when his investigation is completed.

Distribution of gabbros.

"At Rossland, the central member of the group is a fine- to coarse-grained gabbro, apparently passing in a couple of places into a uralitic granite. The gabbros occupy an irregular-shaped area with a length of about four miles and an average width of one mile. They extend

from Deer Park Mountain eastward to the western base of Lookout Mountain. The line of junction between the gabbros and the bordering porphyrites, commencing at the north-west corner of the area, runs south through the Cliff, War Eagle and Le Roi claims; then turning to the west, circles round a spur from the main area which covers part of Deer Park Mountain and continues eastward in a sinuous line, passing about a quarter of a mile north of the Crown Point mine to the foot of the west slope of Lookout Mountain. The northern edge of the area runs from the Cliff mine eastward to Monte Cristo Mountain, then bends more to the south, and skirting the southern base of the Kootanie-Columbia Mountain, continues in a south-easterly direction towards Lookout Mountain. The eastern edge of the area has not been precisely defined owing to the absence of sufficient exposures. The gabbros are fringed with a varying width of augite- and uralite-porphyrites, and fine-grained green diabases. The passage from the porphyrites to the gabbros is nowhere sharply defined and the two rocks have apparently originated from the same magma, but have cooled under different conditions. The gabbros and bordering porphyrites are important from an economic standpoint, as most of the ore-bodies at present being worked are situated either on or close to their line of junction.

British Columbia—*Cont.*

Relation of gabbro to ore bodies.

"In passing outward from the gabbro area, a section taken at almost any point, shows a bordering zone of brecciated porphyrites and diabases of varying width, but seldom exceeding a mile, beyond which comes an alternating series of porphyrites, tuffs and slates, and still farther away agglomerates, associated in places with fossiliferous limestone, make their appearance. Slates and tuffs occur with the porphyrites on Red Mountain, on Kootanie-Columbia Mountain and south of the gabbro area on Lake and Bald mountains, and the ridges running south from them. Agglomerates make up the main mass of Sophia Mountain and occur with slates, tuffs and porphyrites on Granite, Spokane, Grouse and Lookout mountains, and on the ridge immediately east of Sheep Creek.

Massive and fragmental igneous rocks surrounding gabbros.

"The roughly concentric arrangement of the Trail Creek rocks, and the gradual passage outward from a holocrystalline central area through semi-crystalline rocks to bedded volcanic fragmentals, suggest an ancient (although now deeply eroded) volcanic centre, situated near the site of the present town of Rossland, from which lavas and ashes deluged the surrounding district. The presence of small bands of coral-bearing limestones with the agglomerates and tuffs, also makes it probable that a shallow sea existed at the time of the outburst, and that the eruptions were intermittent and continued during a lengthened period.

Volcanic origin of rocks.

British Columbia—*Cont.*

Serpentines.

"The porphyrites on Spokane and O. K. Mountain and on Lake Mountain are much fresher looking than those on Red Mountain, and may belong to a more recent period. An area of partly, and wholly serpentinized rocks occurs on Sheep Creek between the western base of Deer Park Mountain and O. K. Mountain.

"From Rossland, porphyrites and associated rocks, often crushed into a schistose condition and accompanied by bands of argillites, were traced northward across Rock and Murphy creeks to China Creek, where they are cut off by the gray granites.

Distribution of porphyrites and associated rocks.

"West of the Columbia River, porphyrites and other igneous rocks similar to those at Rossland have a wide distribution. They are found along the Columbia River from the boundary north to near the mouth of Bear Creek, where they are replaced by granites, and thence were followed in a north-easterly direction along the line of the Nelson and Fort Shepherd Railway to within a couple of miles of the Kootanie River. The width of the band was not ascertained, as the country east of the N. and F. S. Railway was not examined except at a couple of points. From the railway west to the granite area, a variable distance, dependant on the sinuosities of the latter, the country is altogether occupied by these rocks. They were found at the head of Bear Creek and Champion Creek and along the lower part of the North Fork of the Salmon. Near the mouth of the latter stream is a small area of gabbro indistinguishable in appearance from that at Rossland, while farther up augite-porphyrites of the ordinary type, accompanied by diabases and slates, make their appearance. The series here, as over most of the district, is traversed in all directions by porphyrites and other dykes of a later age.

"The eruptive series bends round the end of a spur of the granite area near the head of Hall Creek, and extends eastward across Toad Mountain as a broad band penetrating the granite, to Rover Creek, and then continues in a more southerly direction to near Waterloo on the Columbia River. In parts of this area, as on Toad Mountain,

Schistose eruptives.

the porphyrites and other igneous rocks have been crushed and altered into finely foliated diabasic, chloritic and hydro-mica schists. The strike of the schists usually corresponds very closely with the edge of the bordering granite. The derivation of the schistose rocks from the massive eruptives, as already noted by Dr. Dawson (Annual Report, N.S., vol. IV., p. 56 B) admits of little doubt, as gradations from one to the other are frequent, and in many places the crushed and flattened phenocrysts of the original porphyrite are still apparent. On Rover Creek and southward towards Waterloo, where they disap-

pear, the narrowing bands of porphyrites and associated volcanic and argillaceous rocks are broken up by numerous granitic intrusions, and assume a more or less schistose character, although the alteration is nowhere so complete as on Toad Mountain. British Columbia—*Cont.*

"No systematic examination of the mines in the district treated of was made during the past season, as Mr. Carlyle, recently appointed Provincial Mineralogist of British Columbia, was devoting his time to this particular work, and it was thought best, in consequence, to give all possible attention to the geological structure of the country. A bulletin descriptive of the Trail Creek mines has already been published by Mr. Carlyle, and another, which will embrace those of the Slocan, Toad Mountain and other parts of the district, is in course of preparation. A large number of mines and prospects in different parts of the district were, however, examined in connection with the geological work, and with a view to the elucidation of their character and the classes to which they may be referred. A brief statement of the results of these examinations is given below. Examination of mines.

"The auriferous iron and copper sulphide-ores of Trail Creek, occur almost exclusively in the massive members of the eruptive series, and most of the important ore-bodies which have so far proved productive, are situated either on or close to the line of contact between the gabbros and surrounding porphyrites and diabases. The Le Roi, War Eagle, Cliff and a number of other leads west of Centre Star Gulch, cut through the line of junction almost at right angles, while the Josie is situated a short distance to the left of it, in the porphyrites, and the Centre Star workings almost immediately east of it in the gabbros. The Monte Cristo and Deer Park claims occur close to the same line, the Kootanie-Columbia, a few hundred feet to the north of it in a band of porphyrites, and the Crown Point, Homestake, Gopher and other leads of the south belt, a short distance to the south of it, in diabases and porphyrites. The ore-bodies are, however, not altogether confined to the neighbourhood of the central gabbro area, but are also found in the bands of massive porphyrites which alternate with the surrounding volcanic fragmental rocks and argillites. The Jumbo is situated on one of these belts, as is also the Coxy, the Giant and a number of other claims. The tuffs, agglomerates and associated slates, with few exceptions, and those of little promise, do not carry the typical iron and copper sulphide-ores characteristic of the Trail Creek region, but are traversed by occasional quartz veins which appear to belong to a later date. Distribution of ore-bodies. Quartz veins.

"The ores of the massive eruptive rocks, as stated above, consist principally of sulphides of various metals. Of these pyrrhotite or mag- Trail Creek ore.

British Columbia—*Cont.*

Pyrrhotite.

netic iron-pyrites is by far the most abundant. This mineral constitutes the common Rossland ore and also occurs in quantity, among other places, on Bear Creek, Champion Creek, the North Fork of the Salmon, and at Waterloo. It is found as a rule in a massive condition, ranging in texture from a fine to medium grain, but it is also disseminated through the country-rock. The massive variety usually holds blebs of quartz, and grains and irregular patches of other sulphides. The pyrrhotite contains gold and silver in varying quantities, a small percentage of nickel and traces of cobalt. A specimen from the Iron Colt, analysed in the laboratory of the Survey gave 0·234 per cent of nickel, and one from the Monte Cristo 0·13 per cent. The gold contents are exceedingly irregular, ranging from traces up to several ounces to the ton, and the silver from traces to four or five ounces to the ton.

Chalcopyrite.

"The pyrrhotite is usually accompanied by a certain amount of chalcopyrite or copper-pyrites, intimately commingled with it. The copper-pyrites is extremely irregular in its distribution, in some places constituting a considerable proportion of the ore-body and in others occurring only as isolated and occasional grains and patches. It was nowhere seen pure in large masses. It is auriferous and holds apparently about the same percentage of gold as the inclosing pyrrhotite.

Mispickel.

"Mispickel or sulph-arsenide of iron, is found associated with the pyrrhotite in a number of the mines, and in places occurs in considerable quantities. It is auriferous, and at the Evening Star mine and possibly at other places, a portion of the iron is replaced by cobalt and

Cobaltiferous mispickel.

it passes into cobaltiferous mispickel or danaite. Dr. Hoffmann furnishes the following note on this mineral.—The specimen consists of a fine to coarse crystalline calcite carrying a cobaltiferous mispickel—most probably the variety known as danaite. It is coated in parts with ferric hydrate and peach-blossom red, hydrous cobalt arsenate (earthy cobalt bloom a variety of erythrite) resulting from the decomposition of the mispickel. The mispickel may not improbably contain sufficient cobalt to be of economic importance, a point which will shortly be determined; the analysis of the mineral having been entered upon.

Molybdenite.

"Molybdenite or sulphide of molybdenum, occurs at some of the mines, notably at the Coxy and Deer Park. At the latter mine it is stated to be highly auriferous.

Other minerals.

"Besides the above minerals, galena and blende occur at the Lilly May and other locations in the south belt and also at the Union and other mines to the north of the main mineral area, but are not found,

so far as I am aware, in the principal Red Mountain mines. Ordinary iron-pyrites is met with in greater or less quantities nearly everywhere. British Columbia—*Cont.*

" The ores are usually oxidized on the surface, but the alteration seldom extends downwards for more than a few feet, and in some cases a single shot brings the unchanged sulphides into view.

" The ores in the schistose eruptive rocks differ markedly from those in the massive eruptives. In the well known Silver King mine, on Toad Mountain, the ore consists mostly of argentiferous bornite with some copper- and iron-pyrites, tetrahedrite, argentite, blende, galena and stromeyerite. A specimen of the latter interesting mineral, which has only recently been detected, was handed to me for determination before leaving Nelson, and was submitted to Dr. Hoffmann who reports as follows.—It consists of stromeyerite, a sulphide of silver and copper with a little galena and pyrite in a gangue composed of a grayish felspathic rock. An approximate determination of the silver in this particular specimen of the mineral after separation of all gangue etc., gave 51·9 per cent, of silver. The analysis of this mineral will shortly be taken in hand. Ores in schistose eruptive rocks. Stromeyerite.

In the Dandy, a claim adjoining the Silver King, argentiferous galena is the principal mineral, and associated with it in more or less abundance in different places are tetrahedrite, blende, bornite and copper- and iron-pyrites.

" The classification of the Trail Creek ore-bodies, and the sulphide deposits generally of the igneous rocks of the district, is a difficult problem and one which has given rise to considerable differences of opinion. They may be original segregations from a cooling magma, like the Sudbury pyrrhotite ores, secondary segregations from the basic rocks which inclose them, replacement veins along lines of fissuring, or, as the majority of the miners are inclined to believe, true fissure veins. Isolated examples might be cited in support of any of these views, but taking the deposits as a whole, the theory which fits in best with the prevailing conditions is undoubtedly the third. The blunt irregular outlines of some of the ore-bodies, and their fissure-like regularity in others, the presence in most cases of a single wall which is often meaningless as a confining line, and the occasional lack of any wall, the gradual blending of the ore with the country-rock, and the presence of the latter as the principal gangue, are all characters consistent with the deposition of the ore from ascending heated waters, which have eaten away portions of the country-rock along lines of fracturing, and replaced it by the minerals held in solution. The definite and approximately parallel direction and dip of the majority of the Rossland Classification of ore-bodies.

British Columbia—*Cont.*

leads, the siliceous character of many of the ores and the presence of calcspar in seams and irregular pockets, tell against the theory of original segregation, which has of late years been applied to somewhat similar deposits in different parts of the world, while the ordinary ear-marks of fissure veins, as usually understood, are seldom observable.

Permanency of ore-bodies.

" The miners of the district are generally prejudiced in favour of fissure veins, under the belief that they are the only ones which are apt to be continuous in depth. There is no reason, however, why replacement veins following lines of fissuring, and filled with material derived from below, though subject to greater variation in volume, should not be equally permanent.

Auriferous quartz veins.

" Besides the pyrrhotite and associated sulphide-ores characteristic of the basic volcanics, an important system of siliceous ore-bearing fissure veins has a wide distribution in the district. The quartz leads are not confined to one formation, but occur indiscriminately in all. The O. K. occurs in an altered and partly serpentinized basic volcanic rock, the Fern in massive porphyrite, the Poorman, Maud S. and Clearwater in granite, the Exchequer in schistose eruptives, the Elise in slates, and the Gold Hill and Helen in eruptive rocks later than the granite. The quartz leads vary greatly in size, but seldom exceed six to eight feet in width, and usually average less. They contain free gold, auriferous pyrites, chalcopyrite and galena. Stamp-mills have been erected at the Poorman, O. K. and Fern, and a number of the other leads are being prospected.

Mineralized belts.

" A third class of gold leads includes the Starlight, Golden King and others in the vicinity of Toad Mountain, and consist of pyritized belts, often a hundred feet and more in width, traversing the schistose eruptives. These leads are simply more or less mineralized portions of the schistose country-rock, carrying occasional ribs and stringers of quartz. They are low grade, the Starlight, which has been prospected during the past summer by Mr. Francis for an English company, averaging about $3 in gold per ton, but owing to the practically unlimited amount of material available, they may possibly in some instances be profitably worked.

" Mining has made satisfactory advances on all sides in West Kootanie during the past season. Prospectors, the pioneers of the industry, swarmed over the country making numberless locations everywhere. A fair percentage of the prospects of previous years on which development work has been done, promise to become mines, and the older mines show no signs of deterioration as developed. Several new camps, notably Waterloo, Champion Creek, the North

Fork of the Salmon, and the Springer Creek district, have come into prominence, while the older ones have developed into recognized mining centres. The output of ore has largely increased and the capacity of the smelters has been more than doubled in order to meet the demand. Favourable reports from competent men have been received in regard to a number of outlying districts which have not yet been examined, and it is altogether probable that, with the advent of easy communication, the successes of Trail Creek and the Slocan will be repeated in East Kootanie, Boundary Creek, the Lardo, the Big Bend and other places. Capital has flowed freely into the district during the season, but it is to be feared that an undue proportion of it has found its way into the pockets of speculators rather than into legitimate mining. British Columbia—*Cont.*

"In Rossland and vicinity, although there has been a good deal of scarcely warranted speculation, much conscientious development and prospecting work is being carried on, the result of which, in large part, will not be known for some time yet, as the hard eruptive rocks of the district necessarily make mining a slow and expensive operation. Compressor plants have, however, been erected at a dozen or more of the principal mines, and machine drills with their quicker results are rapidly supplanting hand labour. The Le Roi and War Eagle are still the principal producing mines in the camp, but considerable shipments at irregular intervals have also been made from the Josie, Iron Mask, Cliff, Evening Star, Crown Point and others, and it is highly probable that, with the extensive development work now in progress, the output from these will be largely increased in the near future. Development in Rossland.

"The Rossland ores, as a rule, are not of high grade, and a large proportion of those in sight cannot be profitably worked under present conditions. The cost of freight and treatment is given by Mr. Carlyle at $10 to $14 per ton.* If the cost of mining, a variable factor, is added to this, it will be evident that ores carrying less value than $15 per ton can only be worked at present at a slender profit, if at all. In order to utilize this material, reductions in both freight and smelting charges are imperative, and will doubtless be made as the treatment of the ore becomes better understood and competing lines of communication are opened up. Should the railway now projected through the Crow Nest Pass be built, and the mines connected with the extensive coal-fields known to exist in the Rocky Mountain Range, fuel, the principal item in the expense of smelting, could be obtained at a much lower figure than at present, and the smelting charges reduced in pro- General character of the ores. Importance of reducing smelting charges.

* Bulletin No. 2. The Provincial Bureau of Mines, Victoria, B.C. Aug., 1896.

British Columbia—*Cont*

portion. A large percentage of the ores are of too low grade to be worked under any circumstances, but it is believed that with smelters built on the spot, cheap fuel and improved processes, those with a valuation of $8 and upwards will eventually be profitably treated.

"The Slocan and Ainsworth camps, accounts of which were given in last year's Summary Report, were not visited by me during the past season."

Work by Mr. McEvoy.

In the early part of the year, Mr. J. McEvoy was chiefly engaged in compiling the information obtained during the previous summer for the completion of the Shuswap map-sheet, with a view to ascertaining if any further geological investigation would be desirable. Some time was also spent in the final revision of the Kamloops map-sheet for publication.

Mr. McEvoy left for the field on the 10th of June and returned on the 1st of November. The first part of the season was occupied in filling in certain portions of the Shuswap sheet which had proved to be wanting in detail. Upon this work Mr. McEvoy reports as follows:—

Completion of surveys for Shuswap sheet.

"Arriving at Kamloops on the 15th of June, and having secured the necessary equipment, I started with pack-horses up the North Thompson River. Some days were spent in examining the country in the vicinity of the Barrière River, where the outline of the rocks of the Adams Lake series was uncertain.

"A short trip was next made to the north-east side of Mount Tod to define the boundaries between the Shuswap and Nisconlith series there.

"Attention was then turned to the geology of the south-west corner of the sheet, where little was known of the arrangement of the rocks. Here the discovery of a small area of rocks of the Shuswap series (gneisses and mica-schists) on Sucker Creek, to the east of Chaperon Lake, gave a definite point to work from. From this an ascending series of rocks was traced up to the Triassic, similar to that found elsewhere on the area of the sheet as well as upon the adjacent Kamloops sheet. A couple of weeks spent in this vicinity resulted in obtaining satisfactory outlines for the formations.

Surveys undertaken near Rossland.

"After this a few days were spent on Shuswap Lake, and then, leaving the horses at Kamloops, I proceeded to Rossland to commence a survey of the country in that vicinity.

British Columbia—*Cont.*

"The methods of surveying employed were triangulation with the transit, extended from points fixed by Mr. J. H. McGregor of the Provincial Survey, with topographical sketches supplemented by odometer and paced surveys. Barometers were used for heights going from and returning to definite points.

"Much trouble was experienced on account of the dense smoke which prevailed during the greater part of the season and prevented any distant views. This difficulty was partly overcome by taking more small and partial sketches than would otherwise have been necessary.

Area covered.

"The area surveyed extends from the International boundary-line northward to Robson, and from the head of Murphy Creek on the west to the mouth of Salmon River on the Pend D'Oreille River.

"I was assisted in carrying out this work by Mr. W. W. Leach."

NORTH-WEST TERRITORIES AND KEEWATIN.

Work by Mr. Tyrrell.

Subsequent to the date of the last Summary Report, Mr. J. B. Tyrrell was employed chiefly in completing a report on the country between Athabasca Lake and Churchill River, and in working up the results of his expedition of 1893, through the Barren Lands.

Country north of Lake Winnipeg.

On June 13th, Mr. Tyrrell left Ottawa for the west, having been instructed to undertake a preliminary geological examination of a tract of country to the north of Lake Winnipeg and lying between the upper part of the Nelson River and the longitude of Cumberland House. The existence of rocks referable to the Huronian system in this region had been conjectured, from information already gained by Mr. Tyrrell in adjoining areas, and as it is comparatively easy of access from Lake Winnipeg, it appeared to be of particular importance to define the area occupied by these rocks and to ascertain their character. Mr. Tyrrell reports as follows on the work done, and it will be observed that he believes the region to be one of considerable promise and worthy of the attention of the prospector.

"On the 29th of June I left Selkirk, Manitoba, accompanied by two canoemen who had been with me through two previous seasons, and the following day reached Selkirk Island, near the mouth of the Saskatchewan River. On the morning of the 1st of July we were taken by a small fishing tug northward to Limestone Bay, and thence we proceeded by canoe along the north shore of Lake Winnipeg and through Playgreen Lake to Norway House.

Enumeration of routes surveyed.

"Here two Indians and an extra canoe were hired, and we turned westward into the country lying to the west of Nelson River, explor-

North-west Territories—*Cont.*

ing Goose-gut, Pine and Wolf rivers ; returning from the latter stream to Norway House, where the two Indians were paid off.

"We then descended Nelson River to Cross Lake, where two other Indians were hired, and the descent of the Nelson River was continued to the north end of Sepaywisk Lake, whence we crossed several portages and small lakes until we reached Burntwood River, which was ascended to Nelson House, where the Cross Lake Indians were paid off and allowed to return home. With one canoe, and the two men from Selkirk, I returned to Paint Lake, and then ascended Grass River, through Setting, Herb and Reed lakes to its source in Cranberry Lake. From the south end of Cranberry Lake, we crossed the Cranberry Portage to Athapapuskow Lake, and thence descended Goose River, through Goose Lake, to Sturgeon River, which was descended to Cumberland on the Saskatchewan River.

"From Cumberland we ascended the Saskatchewan River to Fort à la Corne, where the canoe was stored for the winter, and we drove to Prince Albert, arriving there on the evening of the 9th of October, three months and eleven days after leaving Selkirk, having travelled in all about 1100 miles, largely over routes previously unexplored.

Northern edge of Palæozoic limestone

"From Lake Winnipeg and the Saskatchewan River, the horizontal Palæozoic limestone was found to extend northward to the south end of Hills Lake, on Pine River, and Herb Lake, on Grass River. Thence, the northern limit of the limestone extends westward, keeping to the south side of Grass River, and generally forming an escarpment from fifty to one hundred feet high. Goose and Athapapuskow lakes lie in a deep bay in the face of this escarpment. West of the latter lake the northern edge of the limestone is known to extend along the south-west side of Beaver Lake, and thence onward towards Lac la Ronge, south of Churchill River.

Laurentian and Huronian rocks.

"North of the limestone escarpment, the country is underlain by Archæan rocks, which have usually a gently undulating surface contour. From the Nelson River westward as far as longitude 99° 30′ they consist chiefly of gray and reddish-gray Laurentian gneisses and granites. Along the Nelson River these are cut by numerous dykes of dark-green, highly basic traps, and in the vicinity of Pipestone and Cross lakes they are associated with an area of micaceous, hornblendic and sericitic schists, stretched schistose conglomerates and fine-grained slates of Huronian age.

"On the south side of this area, and near the edge of the gneiss, is an eruptive mass of light greenish-gray anorthosite, and a gabbro con-

taining a large quantity of mispickel, associated with some copper-pyrites. North-west Territories—*Cont.*

"On the south side of the Indian Reserve Island in Cross Lake, the hornblende-schists are cut by wide veins of coarse, white, pegmatitic granite, containing large crystals of black and white mica, some of the latter being nine inches in diameter, and very possibly indicating deposits of commercial value. On account of the evenly rounded nature of the surface, and the want of blasting materials, none of the larger crystals could be taken out, but some of the smaller fragments obtained were clear and unbroken.

"Thinly foliated green schists, probably of Huronian age, were again found on another Pipestone Lake, on the way from Cross Portage to Burntwood River.

"But the most extensive and interesting area of Huronian rocks was discovered on the upper part of Grass River. Beginning a short distance east of Herb Lake it extends almost continuously westward through Reed, Elbow and Cranberry lakes, and crossing to the drainage basin of the Saskatchewan River, underlies parts of Athapapuskow and Goose lakes. Largest Huronian area.

"Seven miles east of the north end of Herb Lake, the Huronian rocks are first encountered, in a hill of massive or slightly foliated diabase largely altered to chlorite, and a short distance further west is a ridge of dark-gray micaceous schist studded with rather large crystals of staurolite. On the east side of Herb Lake is a ridge of thinly foliated light-gray micaceous gneiss, containing a good deal of white mica, and cut by many veins of white quartz.

"On the west side of the same lake, and extending south to Wekusko Point, is an eruptive mass of coarse gabbro, approaching a diabase in texture. South of this is a considerable area of dark-green, slaty schists. On the south-west side of the lake these are cut by another large eruptive mass of a finer grained and more typical gabbro. The schists are also disturbed and altered by a large mass of red granite.

"Almost everywhere the schists are cut by larger and smaller veins of white quartz. The river above Herb Lake runs for a considerable distance along the line of contact of red granite on the west, and Huronian schists and conglomerates on the east, above which it crosses an area of coarse, dark-gray gabbro, returning, near the entrance into Reed Lake, to the red granite. Near the contact are many quartz veins, associated with a good deal of iron-pyrites. Numerous quartz veins.

North-west Territories—*Cont.*

"On Reed Lake, the Huronian rocks consist chiefly of fine-grained, green, slaty schists, holding much pyrites, and cut by many stringers of quartz.

Rocks of Reed and Cranberry lakes.

"Above Reed Lake the country becomes more rugged and the hills more precipitous. The river circles round an area of basic igneous rocks, as far as Cranberry Lake, often occupying a valley along the line of contact of these rocks with the surrounding granite or gneiss. Near the contact, the rocks have been much disturbed and are cut by many veins of quartz, often containing a large quantity of pyrite.

"On Cranberry Lake the Huronian rocks are often altered to a silvery sericitic schist. The same schists extend across the watershed to Athapapuskow Lake, and thence continue westward, perhaps beneath the undisturbed Palæozoic limestones.

Promising field for prospectors.

"This area of Huronian rocks, extending about seventy-five miles from east to west, and an unknown distance towards the north, presents a good field of exploration for the prospector for gold and other precious metals, on account of the number and variety of eruptive masses that break through it, surrounded by zones of highly disturbed and fissured rocks.

Superficial deposits.

"From Nelson River westward to longitude 100° 30′, and from the north end of Lake Winnipeg northward to beyond latitude 56°, the country is generally covered with a coating of stratified clay, varying in thickness from a few feet up to fifty, sixty or even one hundred feet. This clay is of much the same character as that of the Red River valley, having been, like it, deposited in the bed of the old post-glacial lake that once occupied the basin of Lake Winnipeg. The rivers have, as a rule, cut down through this clay to the underlying rock, but away from the water-stretches, rock-exposures are not of very frequent occurrence. The soil is rich and fertile, and since summer frosts do not seem to be very prevalent, the country will doubtless produce in abundance all the hardier roots and cereals grown in the province of Manitoba, and cattle, sheep and horses could be successfully raised. If the country were made accessible by a railway passing through it to Hudson Bay, it would certainly support a considerable agricultural population."

Soil and climate.

Mr. Tyrrell returned to Ottawa on October 16th.

Ontario.

(With adjacent parts of Quebec.)

Work by Mr. McInnes.

The greater part of the winter of 1895-96 was spent by Mr. W. McInnes in plotting surveys of the previous summer, in preparing for

the engraver the Shebandowan Lake sheet, correcting the Seine River sheet, and in compiling a report on these two sheets, shortly to be issued. On the field-work accomplished in 1896, Mr. McInnes reports as follows :— Ontario—*Cont.*

"I left Ottawa on the 5th of June, and arrived at Port Arthur on the 8th. Mr. William Lawson, B.A., of Toronto, who had been engaged as assistant for the summer, joined the party here. During the early part of the summer Mr. Lawson was employed in making independent surveys in the region immediately east of Lake of the Woods. He first made a survey by boat-log of the canoe-route leading from the head of Long Bay, Lake of the Woods, to Eagle Lake. A series of lakes lying to the north of this route, between it and the line of the Canadian Pacific Railway, was also surveyed. This included Hilly, Whitefish, Narrow, Windy, Porcupine, Buzzard and Pine lakes, with connecting streams and portages. A survey was then made of the long westerly arm of Eagle Lake known as Vermilion Bay, and of the greater part of the main body of Eagle Lake, with its easterly extension, Osborne Bay. Geological notes were taken by Mr. Lawson throughout, and a set of typical rock specimens was collected. Surveys by Mr. Lawson.

"While Mr. Lawson was so engaged, I made a trip from English River station on the Canadian Pacific Railway, southwards to the Seine River, for the purpose of supplementing the information on that region contained in the notes of the late Mr. W. H. Smith. Re-examination of Seine River country.

"The route led through Upper and Lower Scotch lakes, Irish Lake, Welsh Lake, Norway Lake and a number of small lakes and streams to Upper Seine Lake and the Seine River.

"About midway on this route, the belt of Keewatin which forks from the Seine River band at Steep Rock Lake, was crossed. It has here, at its narrowest, a width of about two and a-half miles, and is made up of diorites and kindred eruptives of the Keewatin, with considerable areas of greywacke and crushed quartz-porphyry, and of felsitic and quartzose schists, all more or less pyritous. Belts of the schist, in a number of places, show pyrites in thin sheets along the planes of cleavage, as well as scattered irregularly through the mass of the rock. Route from English River station.

"Large angular blocks of quartz with iron- and copper-pyrites, which evidently had not travelled far, were noted about the shores of two of the small lakes near the height-of-land.

"Along the southern edge of this belt, a band of hornblende-gneiss or crushed hornblende-granite occurs, and forms a rim along the

Ontario—*Cont.*

northern edge of the large biotite-gneiss area of Caribou Lake. This hornblende-gneiss band, where crossed on this route, has a width of a little over a mile, and is without doubt continuous with the area of the same rock about Sawbill and Moose lakes. The area just described with its extension towards the head of Sawbill Lake seems to offer a promising field for the prospector.

Sawbill Lake.

"Sawbill mine (location 313X.) was visited and the rocks about Sawbill Lake examined. They were found to consist in the main of hornblende-gneisses and hornblendic granites and syenites often much crushed and sheared, in places becoming schists in structure.

Sawbill mine.

"In one of these much crushed and sheared bands the vein occurs on which the Sawbill shaft has been sunk. The shaft, which follows the vein, was down about 40 feet at the time of my visit, and work was continued actively during the summer. The vein at the surface has a width of about 4 feet. It strikes N. 9°E. astronomical (or N. 15° E. mag.) * and can be followed in a southerly direction for 300 feet, where it bends to a direction S. 24° W. for another 300 feet, gradually failing in width until it becomes very small. In a northerly direction it has been traced about 900 feet, beyond which point the surface falls away into a swamp. It was stated by those in charge at the time, that the vein could be picked up again beyond the swamp. The hade of the vein is easterly at an angle of a little over 10 degrees from the vertical. Though running 'with the formation' there seems to be no doubt about the true fissure character of the vein. The walls are well defined, the hanging-wall particularly so, often showing slickensided surfaces and a parting of crushed chloritic material between the wall and the vein-matter. On the foot-wall, there is a certain amount of mingling of the vein-matter with the inclosing rock and a number of stringers and small parallel veins, so that the vein contents do not come away so freely from this wall as from the hanging-wall. The dump showed quartz carrying iron- and copper-pyrites and a considerable amount of free gold, and the vein at the bottom of the shaft was well defined and solid.

Harold Lake.

"After a few days spent in an examination of some points about Steep Rock and Moose lakes, where the geology is somewhat complicated, Harold Lake was visited. A number of veins have been exploited here, and half a mile of tramway has been built, connecting the different openings with a five-stamp mill at the lake shore. The outlet of the lake has been deepened to allow sinking on a vein known

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

as the shore vein, which outcrops at the base of a low cliff near the south-west corner of the lake. This vein strikes N. 29° W., with a hade to the north-east of a few degrees from the vertical; it is rich in free gold, but small and somewhat irregular. On No. 1 and No. 2 veins, which vary in width from one to two feet, were drifts about 200 and 140 feet respectively with a shallow winze on each. The mill was not working at the time of my visit. Work was continued during the summer, and Mr. Wiley informs me that a more promising vein, near the tramway, was being opened up. The veins occur near the contact of a highly crushed and altered granite with Keewatin schists and diorites. Ontario—*Cont.*

"At Nonwatin or Calm Lake, the Seine River route was left for the purpose of exploring the Pipestone River. Pine Lake, at the head of Pipestone River, is reached from Calm Lake by two portages with a small intervening lake. On the first of these portages the ascent from Calm Lake is about 130 feet, and on the next there is a descent of a few feet to Pine Lake. As Calm Lake has probably an elevation of nearly 100 feet above Rainy Lake, the descent by the Pipestone River must be a little over 200 feet. The river proved very rough, with many falls and rapids, and along its upper stretches was barely large enough for canoeing. Evenly foliated, fine biotite-gneisses of the Coutchiching, occur all along its course, striking about east-and-west, with minor local deviations from this direction. These gneisses are an extension easterly on their strike of those described by Dr. A. C. Lawson as occurring about the most easterly extension of Rainy Lake, into which this river empties. Exploration of Pipestone River.

"A week was next spent in the region about Bad Vermilion Lake, in an examination of some of the gold locations. In this vicinity, on the north shore of Shoal Lake, at Foley's (locations 174E. and 175E.), the veins occur in the so-called protogine granite area. This granite is first seen on the road leading northwards from the shore of the lake, at a point about 200 yards from the shore, and extends continuously northwards nearly to the southern shore of Bad Vermilion Lake. Two shafts have been sunk on a vein on this property to depths of a little over 200 and 100 feet respectively, with drifts aggregating over 300 feet. The vein is a true fissure, and has a width; as exposed on the surface, of from 18 inches to 3 feet. At the bottom of the deeper shaft it is stated that the vein has widened to 5 feet or more. The dump shows very rich looking quartz with iron- and copper-pyrites, galena, and a good proportion of visible free gold. Bad Vermilion Lake. Foley's

"Other good looking veins occur on the same property. One of these about 100 feet to the south-west of the first-named vein promises very

Ontario—*Cont.*

well. It has a surface width of about 2½ feet, and shows free gold in good quantity. Since my visit the company have continued active work on the property, and a mill is in course of construction.

Mine Centre, Shoal Lake.

"Further to the east, on the road running northward from Mine Centre towards Hillier's and Ferguson's, the first rock exposures after leaving the Keewatin rocks, which are seen on the immediate shore, are met with about half a mile south of Hillier's, or about three miles north-west of Mine Centre, on Shoal Lake. They are greenish, highly altered granites with prominent blebs of opalescent quartz. The same granite is continuous to and beyond Ferguson's (A.L. 110). To the north, between the granite and the south shore of Bad Vermilion Lake, occurs a belt of alternating bands of gabbro and Keewatin diorite and schist. A great part of the area crossed by the road is covered with a thick coating of fine white sand, with large boulders of granite, which conceals the underlying rock, except where occasional bosses protrude.

Ferguson's.

"At Ferguson's (A.L. 110 and adjoining locations) in addition to a considerable amount of surface stripping, cross trenching, etc., two shafts have been sunk to depths of about 50 feet each. On one of these the vein is divided into two small veins of a few inches each, separated by an intervening mass of granite about 18 inches in thickness, which continues to the bottom of the present shaft though narrowing down to a few inches.

"In the other shaft on the same vein, further west, the vein is better defined though still narrow. Among the other veins on the property is one, on which only stripping has been done, which can be traced for over 1000 feet, varying in width from 6 inches to between one and two feet. These veins carry free gold in quantity sufficient, it is claimed, to well repay working. Work was continued during the summer on this property, preparatory to the building of a mill.

Lucky Coon.

"At Hillier's (the Lucky Coon, 655 P.) the mill was idle and nothing was being done. The shafts, which were filled with water at the time of my visit, have been sunk on two parallel veins about 80 yards apart, one vein showing a surface width of from 3 to 6 feet and the other varying from a little over a foot to a broad, irregular vein showing about one foot of crushed country-rock, a foot and a-half to three feet of quartz, and 2 to 3 feet of mixed stringers of quartz and country-rock. These are fissure veins cutting the granite mass. This whole area of granite lying between Bad Vermilion and Shoal lakes has been very much crushed and is fissured in all directions, so that the number of veins is very great, some of them promising well. On

locations A.L. 103-4-5-6, are many good veins, the principal among them striking from N. 20° W. to N. W. They vary in size up to a width of from 3 to 7 feet and generally show good walls. Many show visible free gold and others are strong in sulphides. At K. 244, on the north shore of Bad Vermilion Lake, a band of greenish-gray, quartzose, massive rock, fairly mineralized with iron- and copper-pyrites and from 50 to 100 feet in width, is inclosed in green hornblendic schists of Keewatin age with a trend parallel to the strike of the schists. This band appears to be an arm from the granitic area; it is cut in all directions by stringers and small veins of quartz from 9 inches in thickness to mere threads, running generally across the trend of the band but following also every possible direction. These stringers, where weathered on the surface, it is stated, pan well.

Ontario—*Cont.*

Other gold properties.

"On K. 231, are a number of veins, some of good size but irregular and difficult to trace on account of a swamp on one side and a sand-hill on the other. What their gold content is was not ascertained. Many other properties from which good assays are stated to have been obtained, have been taken up in the neighbourhood, some in the granite, and others both in the interbanded gabbro and diorite and in the Keewatin bands.

"There does not seem to be any good reason why gold-bearing lodes in these last-mentioned rocks should be less permanent or persistent than in the granite.

"Prospectors in the district informed me they have observed that the gabbro in places sends arms or apophyses into the granite mass. This I was not able to verify. My own observation has been to the contrary, and where the two were seen in contact on the south shore of Bad Vermilion Lake, the granite cuts the gabbro in an unmistakable manner. The gabbro at this point has an indistinct schistose or foliated structure from crushing, and this foliation is cut across abruptly by the granite.

Relations of gabbros and granite.

"Fort Frances was next reached by steamboat, and after refitting there, a log-survey was carried from Lawrence Lake through Rowan, Denmark and Sturgeon lakes to Caribou or Deer Lake. The western shore of this lake and its northern and north-eastern arms were surveyed, together with a route by a number of small lakes to one of the southerly bays of Eagle Lake.

Surveys in the Manitou district.

"Lake Rowan was found to be entirely within the Keewatin area of Crow and Whitefish lakes. The exposures along its northern shore consist of diorites and felspathic greywacke-like rocks of the agglomerate type, with bands of green and gray schist. The western

Lake Rowan

Ontario—*Cont.*

end of Denmark Lake shows the same rocks, and its eastern end extends into the band of hornblende-syenites and gneisses which form a rim between the Keewatin and the extensive biotite-gneiss area lying to the north-east.

Caribou Lake.

"Caribou Lake lies within the biotite-gneiss area. The eastern edge of the arm of Keewatin, which extends north-easterly to Eagle Lake, after crossing Caribou Lake at its extreme south-western end, keeps about two miles to the west of that lake, with the same narrow rim of hornblende-gneiss intervening between the Keewatin and the biotite-gneiss area.

Keewatin belt

"This Keewatin belt gradually narrows down as it is followed northward from a width of about six miles between Dryberry and Caribou lakes, to little more than a mile where it crosses the narrows between Eagle Lake and Vermilion Bay. It, however, widens out again almost immediately and bends around to the east to join the Keewatin area of Wabigoon and Manitou lakes.

Eagle and Wabigoon lakes.

"Surveys by micrometer telescope were next made of parts of Eagle and Wabigoon lakes and of the routes between them, both north and south of the Canadian Pacific Railway. Two other routes to Caribou Lake were traversed, one leaving Eagle Lake at the narrows between the lake and Vermilion Bay, and the other starting from the western side of Osborne Bay. Each leads through a series of small lakes which were surveyed by boat-log. The easterly one lies wholly in the biotite-gneisses; the western cuts across the Keewatin band, referred to above as connecting the Crow and Whitefish Lake areas, and gives a good cross-section of that band.

Routes to Caribou Lake.

Areas which invite attention.

"The regions lying immediately to the south of Eagle and Wabigoon lakes offer a field which promises well for the prospector. In both these districts are bands of Keewatin of very irregular outline, with intrusive areas of hornblende-granites and saussurite-gabbros. These two districts and that to the south of Lower Scotch Lake, have been particularly mentioned only because they are all easily accessible and do not seem to have attracted the notice of prospectors to any great extent, though the character of their rocks is such as to warrant their examination.

Caribou Lake to Whitefish Bay.

"The micrometer survey was continued through Caribou, Sturgeon and Whitefish lakes to Whitefish Bay on Lake of the Woods, and the long easterly bay known as Lobstick Bay was also surveyed. From the foot of Caribou Lake this route lay for the whole distance in Keewatin rocks, excepting where the granite area on which the Regina mine is situated, extends easterly about the mouth of Lobstick Bay.

Ontario—*Cont.*

Lake of the Woods.

Regina.

"While on Lake of the Woods, the Regina and Sultana mines were visited. The vein in the case of the former of these, traverses both an intrusive area of altered hornblende-granite and a Keewatin diabase, the line of contact between the two cutting the drifts in the mine and showing an overlap of the diabase by the granite.

Sultana.

"At the Sultana, the vein occurs in a very much crushed and sheared hornblende-granite which occurs here, as it does generally, as an intrusive mass not far from the contact between the biotite-gneiss area and an area of Keewatin rocks. The Scramble mine, which lies to the north of the railway, within six miles of Rat Portage, occurs in a band of Keewatin hornblendic schists or crushed diorites, and close to the edge of the Rossland granitic area. Some surface stripping has been done here, and a shallow shaft has been sunk on a band 25 to 35 feet in width, made up largely of quartz and heavily charged with iron-pyrites, occurring both in thin sheets along the planes of cleavage, and irregularly distributed through its mass. Parts of the band were found to pan well, and an average value of over twenty dollars to the ton is claimed for the whole band.

Scramble

Shoal Lake.

"Considerable activity has been shown in developing and exploiting gold properties about Lake of the Woods generally, and attention is being again devoted to various properties which have lain undeveloped for years. New discoveries of gold-bearing veins have been made in various places in the district, notably about Shoal Lake, where the Mikado and other properties have been attracting attention.

The gold-bearing rocks.

"Here, as in the Seine River country, the gold has been found, in every case of which we have any record, at no great distance from the contact between the Keewatin and intrusive granitoid rocks, which occur most frequently as narrow rims along the edge of the more extensive areas of biotite-gneiss, but which also invade the Keewatin rocks as isolated intrusive masses. I know of no case where gold-bearing veins have been found to occur in the main body of the biotite-gneiss areas which we have classed as Laurentian. On a preliminary edition of the Seine River sheet, the rocks in which the Sawbill vein occurs were so classed, but this was owing to a misinterpretation of the notes of the late Mr. W. H. Smith, and it has been corrected on the regular edition of the map.

Manitou Lake.

"As surveys of Manitou Lake were already available from the work of previous seasons, it was not thought necessary to visit this lake during the summer. A number of claims have been located along the shores of the lake as well as about Little Manitou Lake. These claims lie in the Keewatin belt, which extends all along the lake in the form

Ontario—*Cont.*

of a narrow band, between the large Laurentian areas to the east and west, and connecting the Keewatin area of Pipestone Lake with that of lakes Wabigoon and Minnietakie. It was known from last seasons' work that the Laurentian areas approach the shores of the main Manitou closely, and a trip eastward from the foot of Osborne Bay, made by Mr. Lawson last summer, proved that the gneiss area of Eagle Lake extends eastward at least to beyond Niven's 22-mile post on the Base Line of 1893-94. The marginal area of hornblende-gneiss which so commonly surrounds the biotite-gneiss areas, was found to intervene here also between the main gneiss area and the Keewatin.

Minnietakie Lake.

" Prospecting was extended northward during the summer into the region lying to the north of the Canadian Pacific Railway along the Minnietakie Lake Keewatin belt, which is a continuation north-easterly of the Wabigoon Lake area. Promising veins are reported in this district, and assays of specimens from there made in the laboratory of the Survey gave small quantities of gold, enough at least to confirm the occurrence of gold in the region.

Lake Superior. Empress mine.

" Work for the season was closed on the 6th of October, but on the way back to Ottawa, the Empress mine, situated on the north shore of Lake Superior, was visited. This is a low-grade proposition, largely free milling. It lies to the north of the Canadian Pacific Railway, near Jackfish station. At the lake-shore, the rock exposed in the cuttings on the line of railway is a medium-grained, red, hornblende-granite, and along the road leading to the mine the same rocks are seen to within a half-mile or less of the mill. The veins on which work is being done occur in green, somewhat hornblendic schists striking N. 67° E. and dipping eastwards at an angle of 64°. Where work was being carried on, there is a series of closely parallel veins, striking and dipping with the cleavage of the schists. The largest of these was about six feet in width where stripped. The belt has been uncovered by cross-trenching for upwards of a mile along the strike, varying, of course, very considerably in quartz contents in that distance. The outcrop occurs on the slope of a southerly-facing hillside at a height of two hundred feet or more above the valley bottom. The ten-stamp mill now on the property, has been placed near the bottom of the hill, so that a tunnel may readily be driven which will catch the veins at a depth of about 140 feet below their outcrop, and will prove the property pretty thoroughly and permit also the economical stoping of a large amount of vein-matter. At the time of my visit no mining work of a permanent character was being done, the ore for the mill was being taken by shallow shaft and drift from wherever it could be got at most conveniently. It was the intention of the management, however, to

proceed with the driving of the tunnel during the winter. The owners claim only a low grade ore, but they claim also that the unusual facilities for working economically will ensure them a reasonable margin of profit. Ontario—*Cont.*

"Other discoveries of gold-bearing veins were reported during the summer from different points along the north shore, but none of these were seen. Ottawa was reached on the 11th of October."

Before the commencement of field operations in 1896, Mr. A. E. Barlow was engaged in the collection and compilation of the material necessary for the completion of the report and maps in connection with the exploration and surveys made in the Temiscaming region (Sheets Nos. 131 and 138 of the Ontario series of geological maps). These two maps, as will be seen by a reference to the Chief Draughtsman's statement, are now in the hands of the engraver, and it is hoped that both report and maps will be ready for issue shortly. The plotting of the various surveys made during the previous season and the labelling of the large number of rock specimens then collected, consumed a considerable proportion of the time. In addition to this, detailed petrographical studies were made, in conjunction with Mr. W. F. Ferrier, of a large number of thin sections of the various gneissic rocks which cover much of the area examined, and a subdivision based upon their lithological and mineralogical characters will be incorporated in the forthcoming report. Work by Mr. Barlow.

The work on the Nipissing and Temiscaming sheets having thus been practically completed, it was deemed advisable to associate Mr. Barlow with Dr. Adams in the continuation of the work already begun by the latter on the Haliburton sheet in Central Ontario (Sheet No. 118, Ontario). Mr. Barlow had already spent the month of September in 1895, on work in connection with this sheet, and its geographical position is described in his preliminary report of that year.* Field-work in Central Ontario by Messrs. Barlow and Adams.

The construction of the Ottawa, Arnprior and Parry Sound Railway renders accessible the northern part of this area, as a portion of this line, from a short distance east of Barry's Bay to a point a few miles beyond Whitney, lies within the confines of the area. The extension of the Irondale, Bancroft and Ottawa Railway to Baptiste Lake in the Township of Herschell, affords an easier entrance to the southern portion, while the Central Ontario Railway with its present terminus at Coe Hill, opens up the south-eastern portion.

*See Summary Report 1895, p. 63A.

Ontario—*Cont.*

Surveys of roads, &c.

Mr. A. A. Cole, B.A.Sc., as in previous years acted as assistant, his attention being mainly directed to the prosecution of some of the various topographical surveys necessarily undertaken. The surveys of the roads were made with Rochon micrometer and compass, although occasionally, in the measurements, the chain or steel tape was substituted for the former. Leaving Ottawa on May 31st, Mr. Barlow accompanied by Mr. Cole reached Peterborough the following day. A couple of days were spent in Peterborough and Lindsay, engaging men, procuring supplies, and making other preparations for the season's work. Gelert station on the Victoria Branch of the Grand Trunk Railway was made the starting point, and all the roads in this vicinity were surveyed, while a detailed geological examination was made of the adjoining townships of Snowdon and Glamorgan. This occupied the time till the 10th of June, when a few days were spent at Minden, completing surveys in the townships of Minden, Lutterworth and Anson, when a move was made to Haliburton. The latter part of June was occupied in making similar road-surveys, with Haliburton as a centre, in the townships of Dysart, Guilford, Dudley, Harburn and Monmouth. The northern shore of Twelve-mile Lake was the next stopping place, from which surveys and geological examinations were made northward through the townships of Stanhope and Sherborne as far as the village of Dorset on the shores of Trading Lake.

Districts geologically examined.

Dr. Adams joined the party on July 1st, at Haliburton, and spent the first month in a detailed geological examination of the shores of most of the lakes situated in the western and north-western parts of the sheet, and also of the portion of the Muskoka River running through the townships of Peck, Finlayson and McClintock. During this time also he made paced and compass surveys of the roads around Dorset, as well as of the colonization and lumber road from Dorset northeastward to Tea Lake, in the township of Peck.

The month of August was spent in geological and topographical surveys in the central and southern parts of the sheet, chiefly in the townships of Cavendish, Monmouth, Dudley, Harcourt, Cardiff, Anstruther, Chandos, Herschell, Faraday, Wollaston, Limerick, Dungannon and Monteagle. At the same time, Dr. Adams was engaged in making examinations of the country bordering the lakes in these townships, as well as some paced surveys of roads in the same neighbourhood.

A few days (September 7th to 10th) were spent by Dr. Adams and Mr. Barlow in the examination of the various rock-cuts along the line of the Ottawa, Arnprior and Parry Sound Railway between

Killaloe and Whitney stations, for which facilities were kindly given by the Chief Engineer of the road. Dr. Adams returned to Montreal on September 10th to resume his duties at McGill University, while Mr. Barlow went northward to complete certain surveys in the Temiscaming district, returning to Ottawa on October 2nd. Ontario—*Cont.*

Surveys made in September by Mr. James White, in this region, for the purpose of fixing the necessary geographical positions, are referred to on a later page.

The surveys and examinations which Messrs. Barlow and Adams are carrying out in the area of the Haliburton map-sheet and its vicinity, have a special importance because of their bearing upon some of the most intricate questions of Archæan geology, including the relations of the Grenville and Hastings series, the Fundamental gneisses, and also those of rocks probably equivalent to the Huronian system. Upon the results so far arrived at, the gentlemen above named make the following joint report :— Geological importance of the work.

" The rocks exposed within the boundaries of the present sheet belong to several subdivisions of the Archæan. 1. Lower Laurentian. 2. Grenville series. 3. Hastings series. The Lower Laurentian covers by far the largest portion of the area examined, as rocks belonging to this formation occupy the whole northern and north-western half of the district, while a smaller area occurs at the south-western corner of the map in the townships of Lutterworth, Snowdon and Glamorgan. In the southern and south-eastern parts of the sheet, there are other occurrences of similar rocks which, however, present a more normal granitic character. Rocks present in Haliburton sheet.

" 1. The Lower Laurentian of Logan is also frequently referred to under the names of the Basement Complex or the Fundamental gneiss, as it seemed to be composed of an assemblage of crystalline foliated rocks, of which the macroscopical appearance, causes them to be constantly spoken of and described under the general term of 'gneiss.' Petrographical studies have of late amply demonstrated the inapplicability of this latter name, save as a 'field' term or for the purpose of rough correlation and description, or as an affix to describe the structural features of the rock-type examined. In petrographical character the Fundamental gneiss is more or less monotonous, consisting as it does of several varieties of plutonic rocks, belonging chiefly to the granitic and dioritic families, with which are intimately associated dark basic masses of amphibolite and pyroxene-granulite. These have the appearance of igneous masses in which a more or less distinct foliation is usually present, the persistence of such a structure over large areas having Lower Laurentian or Fundamental gneiss. Origin of foliation.

Ontario—*Cont.*

suggested the term 'gneiss', as all were supposed to be of the same origin and composition. Although it seems quite certain that the foliation so common in these rocks is, in many cases, a structure developed during the solidification of the magma from which they have crystallized out as a result of differentiation, it is in other cases probably the result of movement or flowing in the mass itself, or again it may be owing to subsequent pressure exerted at a time when the rock had acquired much of its present rigidity. This has in many instances rendered foliation originally present, more pronounced, by the breaking down of the large felspar individuals and the drawing of these out into lenses or pod-shaped areas, in the direction of motion. Thus it usually happens that the most beautifully and evenly foliated rocks are those in which the constituents have undergone excessive granulation as a result of such pressure. It would therefore seem evident that this foliation, which may generally be seen in the hand specimen, is in the first place but an illustration in miniature of the effects of magmatic differentiation, by which probably the immense bodies of the more basic constituents have become segregated out, forming the dioritic or amphibolitic bands which are so commonly found associated with rocks of the granitic type.

Complicated intrusions.

"The different varieties of gneissic rocks, alternate with or succeed each other across the strike, and sometimes cut one another off, suggesting a complicated intrusion of one mass through the other, but there is usually a general strike, to which in any particular district the foliation of all the varieties conform. The associated basic masses are very dark or black in colour. They are usually rather distinctly foliated, but are sometimes quite massive, occurring in pieces and fragments of all sizes and shapes scattered through the more acidic portions, and in the great majority of cases so intimately mixed with the latter, that it is impossible to separate the two in mapping. The smaller of these masses can be distinctly seen to have been separated from the larger ones, which are often of enormous size, and this process may be observed in all its stages. The different varieties of granite-gneiss, which are perhaps the most prevalent of these gneissic rocks, invade the great basic masses, partially absorbing and sending wedge-like arms into them which tear them apart and anastomose through them in the most complicated manner. The smaller masses may then be seen to be separated into still smaller fragments, which either from the fact that they split more readily in the direction of their foliation, or owing to subsequent movements when the rock was in a more or less plastic condition, often assume long ribbon-like forms. That great movements have taken place in the whole series at a later date, is shown by the

complicated folding and curving of these darker bands and masses into all sorts of curious forms, as well as in the frequent rolling out of great masses of the amphibolite when penetrated in all directions by little pegmatite veins, giving rise to masses of a dark, basic, gneissoid rock, filled with strings, bunches or separated fragments or grains of quartz and felspar, giving a pseudo-conglomeratic appearance. Ontario—*Cont.*

"2. The Grenville series differs in a marked manner from the Fundamental gneiss. In the region under examination, it comprises a great development of limestones, with which are associated certain gneissic rocks whose minute structure and appearance mark them as highly altered sediments. In the Archæan area to the north of the St. Lawrence and Ottawa rivers, where these rocks have been studied in much detail by Dr. Adams both in the field and under the microscope, these are seen to be very different from the prevailing types of granitic and dioritic gneisses. The Grenville series.

"The various analyses made, indicate in most instances a composition almost identical with that of ordinary shale or slate, while more quartzose specimens resemble the siliceous bands frequently met with in many slate quarries. These gneissic rocks frequently contain garnet, sillimanite, graphite, rutile and pyrite, the last-named mineral when present, as it usually is, causing the rock to weather in a very rusty manner, which suggested the name 'rusty gneiss' so commonly applied to this member of the series. Under the microscope, they are seen to have undergone such complete recrystallization as to entirely mask their original character, although the appearance and arrangement of the component minerals is often suggestive of the contact-zones bordering granites. Their almost invariable association with the limestones was also an additional argument in favour of their original clastic character. In the Haliburton sheet, similar gneissic rocks are found associated with the crystalline limestones. Composition of gneisses.

"The gneiss, on a fresh fracture, is generally light-gray in colour, sometimes nearly white, the rusty weathering of the rock being caused by the abundant dissemination of pyrite and pyrrhotite. Frequently the pyritous matter is so abundant that the exposure is capped by a veritable 'gossan' of the decomposed mineral, and their resemblance to the Sudbury nickeliferous deposits appeared to be so close as to warrant a detailed examination of some of the occurrences. Their total dissimilarity in origin to the Sudbury deposits as well as their analogy to pyritous deposits so abundant in the Laurentian was, however, clearly shown by Dr. Adams's work in this region in 1893.

"These rocks constitute an irregular belt, between the great area of Fundamental gneiss in the north-west portion of the sheet and the Relation to Fundamental gneisses.

Ontario—*Cont.*

Hastings series exposed in the south-east. The strike of the foliation of the Grenville series follows, in a general way, the boundaries of the Fundamental gneiss, and is seen in an especially distinct manner to wrap itself around the long and narrow area in the south-western corner of the map. Isolated masses of the limestone and gneissic rocks characteristic of the Grenville series are also found in the form of outlying patches in the Fundamental gneiss about its margin, as for instance, in the townships of Lutterworth and Stanhope.

"The limestones and associated gneisses which characterize this series, form but a very small proportion of the rocky complex of the areas in which they occur, and which, owing to their presence, has usually been referred to as the Grenville series. They are associated with and usually inclosed by much greater volumes of gneissic and amphibolitic rocks identical in character with those of the Fundamental gneiss. The limestones are also almost invariably penetrated by great masses of coarse pegmatite, and in some cases large occurrences of the limestone are embedded in the Fundamental gneiss.

"The whole thus presents the character of a series of sedimentary rocks, chiefly limestones, invaded by great masses of the Fundamental gneiss, and in which possibly some varieties of the gneissic rocks present may owe their origin to the partial commingling of the sedimentary material with the igneous rocks by actual fusion. There is, however, no reason to believe from the evidence at present available that any considerable part of the series has originated in this last-mentioned manner.

Separation from Fundamental gneiss difficult.

"It will be readily seen that the exact delimitation of areas of the Grenville series is thus often a matter of great difficulty, as there is no sharp boundary between this series and the Fundamental gneiss, and it has hitherto been difficult, in the case of the Grenville series, to account for the existence of such a comparatively small proportion of sedimentary strata intimately associated with such great volumes of igneous gneissic rocks.

Bearing of recent observations.

"The relations of the two series in Central Ontario, as they appear by the investigations of the last two seasons, throw new light on the subject and indicate its probable explanation. These are such as to suggest that in the Grenville series we have a truly sedimentary group of strata, which has sunk slowly down into, and has been invaded by great intrusions of the igneous rocks of the Fundamental gneiss, when these were in a molten or plastic condition. The limestones however do not show any distinct evidence of absorption or solution in the invading rocks, unless some of the highly garnetiferous gneisses often associated

with the limestone are really formed by an intimate admixture of the two rocks. The limestones are always highly metamorphosed, presenting the characters of coarsely crystalline, although often more or less impure, white and pink marbles. Masses of this highly crystalline limestone or marble in some cases lie quite isolated, imbedded in the gneissic rocks as if they had been separated from the parent mass and pressed outwards or downwards into the gneissic magma. The contact of the Fundamental gneiss and the Grenville series would therefore appear to be a contact of intrusion. Ontario—*Cont.*

" 3. The south-eastern portion of the sheet is chiefly underlain by rocks of the so-called Hastings series, consisting in the main of thinly bedded limestones, dolomites, &c., cut through by great intrusions of gabbro-diorite and granite. These limestones and dolomites are usually fine-grained and bluish or grayish in colour, with thin interstratified layers holding sheaf-like bundles of hornblende crystals, and as compared with the limestones of the Grenville series, are usually much less altered. They constitute beyond all doubt a true sedimentary series, and in the region to the south of the present map are associated with conglomerates or breccias and slates of undoubtedly clastic origin. Hastings series.

" Although repeated traverses have been made from the Grenville to the Hastings series, no sharp line of division has as yet been found. Toward the south-eastern part of the area, the limestones of the Grenville series in many places, while still highly crystalline, seem to be less altered, and finally, as the Hastings series is approached, they present in places the bluish colour of the limestones of the latter series, so that it is often impossible to determine to which series they should be referred. The limestones of both series have the very numerous interstratified impure or gneissic bands so frequently referred to in descriptions of the limestones of the Grenville series, making the resemblance still more complete. In fact, although the true relations of the two series are obscured by the presence of numerous great intrusions of granitic and basic pyroxenic rocks, and can only be determined with absolute certainty by the completion of the mapping, the investigations so far indicate that, in the region in question, the Hastings series probably represents the rocks more nearly in their original form, and that the same rocks, when invaded, disintegrated, fretted away and intensely altered by and mixed up with the underlying gneissic magma into which they had sagged down, became identified as the Grenville series. If this should prove to be a correct diagnosis of the relations of the two series, we have in the Grenville series an extremely metamorphosed portion of the Hastings series. Its relation to Grenville series.

Ontario—*Cont.*

Huronian.

"Concerning the age of the Hastings series but little is known as yet, but the character and composition of some of its members, chiefly the breccias and conglomerates, as well as the nature of its contact with the associated igneous gneissic rocks, seem to offer some presumptive evidence in favour of its ultimate correlation with the Huronian.

Nepheline-yenite.

"The occurrence of nepheline-syenite within the boundaries of the present sheet has been previously noticed.* A small additional mass not previously noted, was found by Mr. Barlow on lot 30, con. IV, of the township of Glamorgan. In the townships of Dungannon and Faraday three distinct masses of these rocks were roughly outlined. One of these covers portions of concessions XIII. and XIV., extending from lots 25 to 29 in the former and 23 to 26 in the latter. With this are associated large masses of a deep blue sodalite, much of which

Blue sodalite.

might be utilized for jewellery and ornamental purposes. Another much smaller mass occurs on the Mississippi road, to the east of the bridge crossing the York River in the township of Dungannon, near the line between lots 12 and 13 in concession XI. The sodalite found at this locality is in small quantity, but the nepheline occurs associated with the albite in very large individuals, forming pegmatite-like masses and segregations. The rock is usually of a pale gray colour, and, especially when foliated, presents a strong resemblance to the gray or dioritic gneisses so common in the Laurentian. Although the rock is sometimes massive, it has usually a very distinct foliation, this foliation corresponding in direction with that of the ordinary gneissic rocks exposed in the vicinity.

Hastingsite and Cancrinite.

"The syenite weathers with a curious pitted surface, the depressions being occupied by the nepheline, which is usually very abundant, leaving the irregular-shaped felspar and bisilicate individuals standing in relief. At the York River mass, the bisilicate present seems to be mainly hastingsite (so called by Dr. Harrington who made an analysis of the material) the most basic hornblende yet described. Cancrinite was found intimately associated with the nepheline on lot 25, concession XIII. of Dungannon.

"A small area of nepheline-syenite occurs to the north-west of the village of Bancroft, sending a spur crossing the Hastings road about half a mile north of the village.

Iron ores of the district.

Deposits of iron ore are somewhat frequently associated with the dark basic amphibolites of the Fundamental gneiss in the southern

*Annual Report, Geol. Surv. Can., Vol. VI. (N.S.), part J., p. 5. Am. Journ. Sci., July 18, 1894.

part of the district, but although frequently of very large extent they usually contain a great deal of intermixed pyritous matter, while frequently the ore itself is rendered more or less impure by the presence of black ferruginous silicates such as hornblende, pyroxene and garnet. The ore is in general a magnetite, in places containing a small though varying proportion of ilmenite, but many deposits are entirely free from this objectionable mineral. The quantity of sulphur in many of the deposits, owing to the presence of sulphides, would lessen the value of the ore considerably, while in many cases its abundance would render the ore unsuitable for smelting purposes. Further search may however reveal workable deposits of iron sufficiently free from these sulphides to justify their development. Ontario--*Cont.*

Iron ores from the following places have been examined in the laboratory of the Geological Survey Department :— List of those examined.

a. Minden, Haliburton County, lot 11, Range I., Report 1894, page 19 R, No. 14.
b. Lutterworth (Paxton mine), Haliburton County, lot 5, Ranges V. and VI., Report 1894, page 19 R, No. 16.
c. Lutterworth (Paxton mine), Haliburton County, lot 5, Ranges V. and VI., Report 1892–93, page 8 J.
d. Lutterworth, Haliburton County, lot 16, Range VII., Report 1878–79, page 16 H.
e. do do do 5, do VI., do 1878–79, page 15 H.
f. Snowdon, Haliburton County, lot 20, Range I., Report 1873-74, page 211, No. 8.
g. do do do 20, do I., do 1894, page 19 R, No. 18.
h. Wollaston, Hastings County, lot 16, do II., do 1887–88, page 24 T, No. 4.
i. do do do 15, do II., do 1887–88, page 24 T, No. 5.
j. do do do 9-10, Range XV., Report 1887–88, page 24 T, No 6.
k. Carlow, do do 6-7, do XVI., do 1887–88, page 24 T, No 9.

Analyses of the above ores. Analyses.

Specimen.	Ore.	Met. Iron.	Ox. of Manganese.	Alumnia.	Lime.	Magnesia.	Sulphur.	Phosphorus.	Titanium.	Insoluble.
a.	Magnetite	30·29	.....	.....	.....	.. .	.....	.....	Traces.	.....
b.	do	.....	.....	.....	.....	.....	.....	.....	None ..	.....
c.	do	48·64	.. ..	6·24	3·81	3·38	·03	None.	0·15	19·30
d.	do	46·50	....	....	.....	.....	.....	.....	None ..	20·16
e.	do	49·26	.....	.....	.....	.....	....	.....	.....	26·55
f.	do	60·19	·13	·42	1·43	2·56	·04	·07	·73	11·17
g.	do	.....	.....	.....	.. ..	.....	.....	.....	None ..	.....
h.	do	26·94	.....	.....	. .	.....	.....	.....	None ..	.....
i.	do	56·50	.....	.....	.....	.....	.....	.....	None ..	.....
j.	do	28·42	.....	.....	.....	.....	. .	.....	Trace..	.....
k.	do	46·66	....	.....	.....	.....	.....	.....	Trace..	.....

" Ores from the following localities have been examined and reported on by various chemists (see Report Royal Commission on the Mines of Ontario, pages 130-132.) Other occurrences of iron ores.

Ontario—*Cont.*

"The Howland mine (sometimes also called the Snowdon or Pusey mine) is situated on lots 26 and 27, concession IV. of Snowdon. The shaft is on lot 26 and the analysis of the ore gave metallic iron 59·50, phosphorus ·005, sulphur ·06.

"The Imperial mine on lot 33, concession III. of Snowdon is in a brown hæmatite. The analysis shows the ore to contain 45·82 per cent of metallic iron. The phosphorus is very low; no sulphur or titanium, a little lime and a large amount of silica.

"The Pine Lake mine on lot 35, concession IV. of Glamorgan, is in a magnetite running from 52 to 55 per cent of metallic iron. It is low in phosphorus but contains considerable lime and titanium.

"The National mine is on lots 30 and 31 in concession XIII. of the township of Glamorgan. This is likewise a magnetite.

"The New York mine is on lot 27 in concession XV. of the township of Glamorgan, and contains over 70 per cent of metallic iron, traces of phosphorus, and no sulphur or titanium.

"The Coe Hill mine is situated on lot 16, concession VIII. of Wollaston, and seems to occur as a consequence of the local enrichment of a dark basic amphibolite coming in contact with a granite. The ore is a magnetite but contains a considerable admixture of pyritous matter, and some of the lumps piled on the ore-heap are falling to pieces owing to the abundance of the sulphides undergoing decomposition.

"In the township of Wollaston, magnetite occurs on lots 14 and 15, concession II., and on lots 17, 18, and 19 in concession VIII., being an extension westwards of the Coe Hill deposit. Magnetite also occurs in considerable quantity associated with the masses of nepheline-syenite, but in no place where seen are the deposits of economic importance.

Apatite

"Apatite, as might be expected, is found at various points throughout the region, but hitherto the inaccessibility of the district together with low prices have forbidden the shipping of the material, although considerable development work has been done in the township of Monmouth to the north-west of Tory Hill station on the I. B. & O. Railway

The mineral has however been found at the following places:

Township of Dudley, lot 4, concession III.
" Dysart, lot 11, concession V.
" Harcourt, lot 21, concession XI.
" Monmouth, lots 14, 15 and 17, concession XI.
" Cardiff, lot 22, concession XIV.
" Faraday, 5 miles south-west of Bancroft.
" Monteagle, lot 26, concession VI.

" Mica, both phlogopite and muscovite, occurs in considerable quantity at a number of places. A promising deposit was being developed close to the I. B. & O. Railway about two miles west of Wilberforce. In the townships of Herschell and Dungannon, the mineral was noticed at several localities. Ontario—*Cont.* ica.

" The discovery of a large deposit of corundum on lot 14, concession XIV. of the township of Carlow, by Mr. W. F. Ferrier of the Geological Survey Department is elsewere described (p. 116A). Corundum.

" The various crystalline limestones are often sufficiently pure to yield the very finest quality of lime, while some of the beds would doubtless furnish material for use as marble. Marble.

" Graphite, has been found associated with rocks of the Grenville series in the townships of Dysart and Glamorgan. It is probably widely distributed throughout the region, but no deposits of economic importance have yet been discovered." Graphite.

About four months of the first part of the year, were devoted by Dr. R. W. Ells to the plotting and compilation of notes of survey made during the preceding season, chiefly connected with map-sheet 122 of the Ontario series. This sheet covers the Ottawa valley from the vicinity of the city of Ottawa to Petewawa, and with sheet 121, lying to the east of it, now only requires final compilation and adjustment previous to publication. Early in May, Dr. Ells began his work in the field, attention being chiefly directed to the area of sheet 119, which adjoins No. 122 on the south. Work by Dr. Ells.

On the work accomplished during the summer, Dr. Ells reports as follows:—

" The surveys of the present season extended over portions of the counties of Renfrew, Addington, Frontenac, Lanark and Carleton, included in map-sheet No. 119. The first part of the season was devoted to the examination of the country along the Rideau River and Lakes; including several large lakes connected with this system, or in the vicinity, among which were Bobs Lake, Sharbot Lake, and others easily accessible by short portages. The Mississippi River and its chain of lakes, as well as the country adjacent on both sides, was carefully examined from Carleton Place to the head-waters, as also were the lakes on the upper part of the south branch of the Madawaska, including Weslemkoon Lake and others of that chain. Area covered by surveys in Ontario.

" The latter part of July and the first part of August were spent in examining the Black and Coulonge rivers, on the north side of the Black and Coulonge rivers.

Ontario—*Cont.*

Ottawa. The first-named was ascended for about seventy miles, to Forans Creek, whence a route extends through a series of lakes and streams, to Bryson Lake, which is about one mile west of the Coulonge, into which it empties by Bryson Creek about seventy-two miles above the mouth of the Coulonge. This portion of the map of Quebec is practically a blank on the Crown Lands plan, though a number of large lakes occur in the area, some of them ten or twelve miles in length.

In Quebec.

Road surveys along the Madawaska and Mississippi.

"The last two months of the season were spent in the survey, with wagon-odometer, of the roads in the country between the Madawaska and Mississippi rivers, and in the country to the north of the latter stream. Much of this country is very rough and hilly, and in certain portions, the surface is largely bare rock, the timber and soil being almost entirely burned off. While the great mass of the rocks observed belong to the crystalline formations, certain, often large, areas of the newer sedimentary formations from the Potsdam to the Black River, both inclusive, were met with. The largest developments of these belonged to the latter formation, the characteristic fossils being tolerably abundant. These frequently rest upon the crystalline rocks without the intervention of the lower formations of the Cambro-Silurian.

Rocks of Black and Coulonge rivers.

"The area traversed by the Black and Coulonge rivers, is largely occupied by reddish granite and gneiss. The latter is, however, sometimes grayish and hornblendic, and occasionally garnetiferous. Bands of crystalline limestone are well exposed along the lower forty miles of the Black River, and similar bands occur along the Coulonge as far as the 70-mile post from its mouth. The general strike of the gneiss and limestone in this area is N. 30° W., but this is frequently deflected, apparently by masses of granite. The upper part of these streams flow through a comparatively level country, largely covered with sandy drift which is, in places, underlain by clay. Isolated masses of reddish granite rise here and there, but this area is much less rugged than that nearer to the Ottawa.

Course of Black River.

"The Black River has a very tortuous course, flowing for a great part of the way through banks of sand, with a steady current of two to three miles an hour, when the water in the stream is low. The ascent of the stream is therefore somewhat arduous. Rapids occur at frequent intervals, necessitating a number of portages, some of which are very heavy. The worst of these is past the Long Rapids, sixty miles from the mouth, where a carry of three miles is necessary, over the spur of a mountain. The heavy rapids along the lower part of the stream, from the twentieth to the fortieth mile, are passed by

taking the Green Lake route, through a chain of lakes with six portages, returning to the river just below the Manitou Rapid. The longest carry on this route is about half a mile. A band of crystalline limestone extends along the route, and is associated with rusty and garnetiferous gneiss. Ontario—*Cont.*

"The country between the Black and Coulonge rivers, south of Forans Creek and its chain of lakes, is generally rough and hilly. No limestone was observed on any of these lakes or streams, or along the portages. The character of the country to the north is similar to that seen on the upper portions of the Gatineau and Rouge rivers, further to the east. About Bryson Lake, which is not laid down on the map of Quebec, and which is from twelve to fourteen miles in length with a breadth of from one to two miles, great cliffs of grayish quartzose gneiss occur along the east side, with a dip of 10° to 50° eastward. These, in places, appear almost as flaggy as the Potsdam sandstone, and they dip beneath the limestone of the upper Coulonge. The limestones show on that stream at and above the mouth of the Crow River, which enters the main stream from the east at about the 70-mile post, and by which a route for canoes extends to the Désert and thence to the Gatineau. Bryson Lake.

"The strike of the rocks along the Black and Coulonge, as contrasted with that seen on the Gatineau and the streams further east, is worthy of note. This is still more marked when contrasted with the trend of the rocks as noted on the Bonnechère and the Madawaska to the south, where the general strike of the different bands is 40° to 60° east of north. On the Kingston and Pembroke Railway, south of Calabogie Lake, the course of similar rocks is north or a few degrees west of north. The formations therefore appear to follow a broad sigmoid curve over a very considerable area. The details have not yet been laid down on the map, but sufficient data have now been obtained to do so with a fair degree of accuracy. At the same time, it must be recognized that the presence of large areas of intrusive rocks, such as diorites, syenites and granites, has influenced, to a very considerable extent, the disposition of the rocks as shown by the strikes at many points. General trend of Archæan rocks.

"A marked feature in the formations in the vicinity of the Madawaska, in the area to the south of that river, is the great development of crystalline limestones. In character these differ somewhat from the limestone found in the Grenville district. They are often characterized by the presence of bluish and bluish-gray shades, and by a well-defined banding, which imparts a peculiar striped aspect to the rock over large Crystalline limestones.

Ontario—*Cont.*

areas. The limestone is also often highly dolomitic, and in places weathers to a peculiar ochreous brown. Instead of the usual association of grayish and reddish-gray gneiss found north of the Ottawa, the associated rocks are mostly schists, either hornblendic, micaceous or chloritic. The characteristic mica-schists are beautifully exposed on the line of the Kingston and Pembroke Railway, between Lavant and Flower stations, as well as along certain portions of the Mississippi River on the north side of Mud Lake, about a mile below Ardoch. They are also well seen on the south side of Marble Lake, in the township of Barrie. The hornblende-rocks, however, have a much greater development, being often massive and without any schistose structure.

Associated schists.

Argentiferous galena.

"North of the Long Lake, an expansion of the Mississippi, the lime stone is mostly blue in colour and often slaty. This character is well seen along the road from Ardoch to the head of Long Lake; but in the vicinity of the intrusive masses the bluish colour disappears and the rock changes to a highly crystalline cream-coloured mass in places affording a white marble, often of great beauty. Serpentine, though sometimes seen, is rare. In this area the presence of argentiferous galena in the limestone, in close proximity to the hornblende-rock, is worthy of remark, the percentage of silver in some of the veins being sufficient to render them economically valuable. In the hornblende-rocks and other schists of this area, quartz veins also occur which carry gold in small quantities, but these veins, so far as known, are generally pockety in their distribution. As these rocks are apparently the eastward extension of those which carry gold in Marmora and Madoc, it is quite possible that true gold-bearing veins may some day be found.

Gold.

"In this connection, it may be noted that an assay of a sample of quartz from the 28th lot of range VIII. of Clarendon, in Frontenac county, made in the laboratory of the Survey, showed gold at the rate of 2·098 oz. to the ton. This locality is about two and a-half miles northwest of Ardoch, on the Mississippi River, the rocks being those of the Hastings series. Another specimen from the west half of lot 10, concession VI. of Lavant, in the county of Lanark, yielded gold at the rate of 0·195 oz. to the ton. These assays clearly indicate the existence of the gold-bearing belt of the Madoc and Marmora region, in this area. Gold has also been reported from several points in the western part of the township of Denbigh, and several mines have been opened in this area, but nothing definite as to the true value of the quartz has yet been ascertained.

Iron ores.

"The principal mineral of economic importance yet found in the hornblende-rocks and associated limestones are the ores of iron.

Ontario—*Cont.*

These are of two kinds, magnetite and red hæmatite. An examination of these deposits was made in 1895 by Mr. Ingall, of this Survey, whose report is now in course of preparation. A preliminary report on the subject by Mr. Ingall has already appeared in the Summary Report for 1895. A number of these deposits occurring in the area of the present season's work, were carefully examined with reference to their geological relations. It was found that the hæmatites, of which only three were recognized, viz., that at the Dalhousie mine and two on the south side of White Lake, in the township of Darling, occurred in the crystalline limestone formation, in connection with which no eruptive rocks were visible. The magnetites, on the other hand, were invariably associated with eruptive masses, mostly dioritic, hornblende largely predominating. Some of the largest and apparently most important deposits are associated with the limestones, in which case, however, masses of greenstone or hornblende-rock were present, as at the Caldwell and Yuill mines. In no case was any distinctly bedded deposit observed. In many of the ores small quantities of pyrites were observable, but in some cases this was almost entirely absent and the ore was of excellent quality.

Mount St. Patrick iron ore.

"An outcropping of magnetic iron ore was observed near the road from Dacre to Mount St. Patrick, about a fourth of a mile south of the former village, but no attempt has been made to develop the deposit and the quantity is yet unknown.

"The iron ores of the district, in the vicinity of the Kingston and Pembroke Railway, occur in what has been styled the Hastings formation. Small deposits of apatite and mica were observed at several places in the area surveyed, but the associated rocks differ largely from those which occur throughout the lower Ottawa mineral belt, or to the south of the Rideau Lakes, and the observed quantity of these minerals was not such as to warrant the expenditure of much capital in their investigation.

Crystalline limestones north of the Madawaska.

"North of the Madawaska, in the townships of Griffith, Brougham and Bagot, while the surface of the country is often exceedingly rough and broken, great areas of crystalline limestone, often dolomitic, are seen. These calcareous masses occur, not only in the valleys but constituting large hills. In places the rock is highly charged with tremolite, and this character is also well seen in the limestones to the north of Calabogie Lake, as well as at certain places in the township of Darling, and in South Elmsley. Great areas of these limestones, often well exposed, occur in McNab, Darling, Lanark and Ramsay.

Ontario—*Cont.*

Graphite mine of Whitefish Lake.

"In the 18th lot of range III. of Brougham, at the south end of Whitefish Lake, an important deposit of graphite occurs. The containing rocks are crystalline limestone, but dykes of granite also appear in the vicinity. At the shore of the lake, the deposit has been uncovered to a distance of one hundred and fifty feet or more, showing a bed of graphite eight to ten feet in thickness. The mineral appears to be, for the most part at least, amorphous, but a flakey structure is seen in certain portions. This mine is about twelve miles distant from the railway at Calabogie, and a new road has been constructed for the purpose of shipment. A small deposit of similar graphite occurs in the township of Darling, near Tatlock.

Mazinaw Lake.

"The country from about the middle of Mazinaw Lake, northward into Denbigh, and thence westward for some miles, including the greater part of the townships of Ashby, Effingham and Abinger, is occupied for the most part, by grayish and reddish-gray gneiss and granite, generally having a well defined foliation. This may probably represent the Fundamental gneiss of the Laurentian. The area is very rough and settlements are few. To the south of Mazinaw Lake, the rocks are mostly hornblendic, often with a well marked green shade, passing in places into well-defined chloritic schists. These often become micaceous, and are associated with slaty bands which sometimes contain an abundance of quartz pebbles, thus constituting true conglomerates, in which the pebbles are ususually elongated along the lines of schistosity. They are well seen in the township of Kaladar, near the gold mine, not far from Flinton.

Boundaries of the Hastings series.

"The northern limit of the Hastings series proper on the Ottawa River, as at present recognized, is a short distance west of the mouth of the Bonnechère; whence the line of division between this and the underlying portion of the Laurentian, passes a short distance west of the town of Renfrew. Continuing south-west, it crosses the Madawaska in the township of Griffith, near the Denbigh road, and extends thence to Mazinaw Lake as already indicated. Its southern limit has not yet been continuously traced. On the Kingston and Pembroke Railway, the hornblendic rocks with bands of limestone extend for at least four miles to the south of Sharbot Lake, and they apparently occupy the greater part of the township of Lanark, north of the Mississippi River. Certain areas in South Elmsley also contain masses of tremolitic limestone, and in this respect, as also in the character of the associated rocks, resemble the Hastings series.

Mica mine.

"Mining operations in the area examined during the past season, are at present almost entirely suspended. On the south side of Rideau

Lake, about four miles from the Narrows at Oliver's Ferry, a very considerable deposit of mica was, however, being worked at the time of our visit. Ontario—*Cont.*

"The graphite deposit near Oliver's Ferry is not now being worked, though the mineral appears to be abundant and of good quality. Graphite of Oliver's Ferry.

"Great masses of white binary granite, in which the felspar largely predominates, were seen at a number of places, and certain of these, where not too far distant from a point of shipment, should be commercially important for the manufacture of porcelain. Very large masses of these whitish rocks occur a short distance west of the Kingston and Pembroke Railway between Lavant and Snow Road stations. A large deposit of this rock also occurs at Black Lake in North Burgess, not far from the Rideau Lake, and in North Crosby, near the upper lake. Binary granites.

"A possibly important deposit of good looking iron-ochre was noted, on a rough road a short distance west of the Kingston and Pembroke Railway, in Blythfield township. It is situated on ranges II. and III., between lots 5 and 10. Iron-ochre.

"A number of lakes containing marl beds were observed at various points, in some of which the deposits seemed to be extensive. These lakes can easily be recognized by their peculiar light bluish-green colour. Marl.

"The season's work extended from May 10th to October 3rd."

After the close of field-work in the autumn of 1895, Mr. N. J. Giroux began the plotting of his surveys made during the summer, but early in 1896, he was forced to suspend this work on account of severe illness. Upon his recovery, some further progress was made in collecting the material for the geological maps upon which he had been engaged, and on June 1st he returned to the field to continue and if possible to complete the mapping of sheet No. 120, which covers portions of Ontario and Quebec between the Ottawa and St. Lawrence rivers, including the city of Ottawa and Cornwall. As elsewhere stated, Mr. Giroux's labours were unexpectedly ended by death, shortly after his return from the field. The following preliminary report, which had in part been prepared by him, has since been edited by Dr. Ells:— Work of Mr Giroux.

"The first few days of field-work, for the season of 1896, were spent with Dr. Ells in the survey of the area along the junction of map-sheets 120 and 119, on which he is engaged; and on the 1st of June, Surveys near Ottawa.

Ontario—*Cont.*

I left for my own field of work, nearer the St. Lawrence. The surveys were resumed in the county of Glengarry, in continuation of those of the previous year, in order to complete, as far as possible, the mapping from east to west.

" A small amount of work yet remains to be done in Soulanges county, as well as in Huntingdon, on the east side of the St. Lawrence, in order to complete the map-sheet No. 120, for publication.

Area traversed.

" Surveys of roads were made, principally to the south of the Canada Atlantic Railway, and extending as far south as the town of Prescott, on the St. Lawrence, which is near the southern limit of the map-sheet. Connections were made with the city of Ottawa and with the work on the sheet to the west, No. 119. The greater part of the area between the Ottawa and the St. Lawrence was traversed, so that the surveys in the area of this sheet are now nearly completed.

Rocks seen.

" The rocks found are entirely confined to the lower Palæozoic formations, extending from the Potsdam to the Lorraine, both inclusive. Large areas are occupied by Calciferous and Trenton beds, and an outcrop of red shales was noted, similar to those classed as Medina to the east of the St. Lawrence, near Three Rivers. The surveys were all made with the wagon-odometer, and the number of miles measured amounted to nearly 1150.

Calciferous formation.

" The rock formations throughout the area surveyed have generally a nearly horizontal attitude. A line of disturbance was observed, running almost north-and-south, for a distance of about four miles, in the township of Mountain, Dundas county, extending from Lockville to Van Camp's mill. The Calciferous rocks which outcrop on each side of the line and not very far distant, do not show the least sign of alteration and lie in the usual horizontal attitude. But at a short distance north of Lockville, ledges of fine-grained gray conglomerate, light in colour, with greenish bands, and of Potsdam age, occur. At the northern end of this line, on a small brook, near Van Camp's mill, there are ledges of whitish-gray grit, of Potsdam age, holding small rounded pebbles of white quartz, along with banded micaceous, somewhat twisted, sandy slates or slaty sandstones, probably of Chazy age. These outcrops are, however, so limited in extent, that it will be impossible to show them on the four-mile scale map. So far as I know this is the most easterly disturbance recognized on the area of map-sheet 120.

" The Calciferous limestones have a very considerable development on this sheet, and the soil overlying them is generally poor and thin

or sandy, unless covered with heavy beds of clay, as in Soulanges county, the eastern part of Glengarry and some parts of Huntingdon.

Areas in Dundas Co.

" The principal places at which the Calciferous formation has been observed are as follows. At Manotick, on the Rideau River, the beds resembling those seen at Glen Nevis. They are also well exposed at Manotick station and to the south of this place. Similar rocks also occur on lot 20, range VI., Osgoode township, Carleton county, the dip of which is S. 88° E. < 6°. They are also well exposed along the road between ranges VI. and VII., Osgoode, from Vernon Corner, north for about three miles, as also on lot 23, range XII., Mountain, Dundas county, and near Van Camp's mill, and they again appear about three and a-half miles west of Winchester, with a dip of S. 45° E. < 4° to 6°.

" About two miles, in a north-easterly direction from Van Camp's mill, Calciferous limestone occurs in thin beds and much disturbed, with characteristic vugs of pink and white calcite. This place has been opened as a quarry.

Development in Grenville Co.

" The formation is also well exposed in the neighbourhood of South Mountain, and all along westward of this place towards Kemptville and Merrickville, and southward towards Easton's Corners and Irish Creek. It thence continues on to North Augusta and to the shore of the St. Lawrence as far as Prescott and down the river to Cardinal.

" This formation is also seen on the Castor River, at about three and a-half miles south-east of Russell. Sandy calcareous basal beds of the same formation can be seen about two miles south of Smirleville, where they have been greatly altered, and hold pebbles and lenticular pieces of quartz.

" Rocks of this formation extend westward from the eastern half of the township of Grenville, and beds of the same can be seen near Hickston Corners, Hell Gate swamp and Spencerville station on the Prescott and Ottawa Railway. On the Nation River, near Spencerville station, the rocks have been disturbed and altered, so that, along with the ledges of characteristic brownish-weathering, dolomitic, fine-grained, gray limestone of Calciferous age, patches of banded sandy limestone occur, which probably are of Chazy age, or else represent much altered portions of the Calciferous.

Grenville and Dundas counties.

" On the road from Mountain to Smirleville, similar outcrops (Calciferous) also appear, and at about one mile and a-half north of Mountain station, this limestone is full of rounded and angular pieces of quartz, varying in size from a pea to a melon, and angular pieces from a

Ontario—*Cont.*

fourth of an inch to a foot across. This conglomeritic rock has a very homogeneous matrix, which exhibits plainly all the characters of the Calciferous. The dip of these beds on the south of the exposure, is S. 20° E. < 18°, and on the north side is about 100 yards wide, the dip is N. 10° W. < 12°.

"The Calciferous also appears near Ormond Corner in the township of Winchester, Dundas county, in beds of limestone, as well as on the east point of Racket River, on the south side of the St. Lawrence, where ledges of dark-gray, sandy limestone outcrop. The south shore of the river, northward for some distance from this place, is low and without rock exposures, but Calciferous blocks are numerous.

"At the bottom of Hungry Bay, these limestones appear in a small knoll, holding large pockety vugs of pink and white calcite associated with iron-pyrites. Some of the upper beds are slaty, and where the calcite occurs the rock is of a grayish-buff colour, compact and with a very fine grain, almost fine enough to be used for a lithographic stone, were it not that it contains certain inclusions which unfit it for that purpose. The dip is here S. 30° <5. This place has been opened for a quarry and some of the material used in the construction of the Canada Atlantic Railway bridge was obtained from it.

"The Calciferous also appears on a small brook which empties into the River à la Graisse, lot 17, range VII., Lochiel, but the dip could not here be ascertained.

Chazy formation.

"The Chazy, in this area, has not so wide a distribution, but is generally well defined, both by the character of its shales and sandstones and by the fossils contained in the upper or limestone portion. In the western part of the sheet, about one mile north of Manotick station, ledges of bluish-gray and grayish limestones appear, which probably belong to this formation. Not far from Berwick, also, are ledges of dark bluish-gray limestone dip S. 40° E. <4°. These beds extend north-west from this place as far as Cannamore post-office, and continue on in this direction. A similar rock also occurs in the northern part of Dundas and the southern part of Russell.

"Limestones of this age are also seen about two and a-half miles west of Grantley, and at about three miles south of Chesterville. They also appear, associated with shales, about two miles north-east of West Winchester, as well as on lot 22, range XII., Winchester township.

"On the north shore of the St. Lawrence, at a small point opposite the north-east corner of Barnhart Island, there is a fine exposure of greenish and black Chazy shales. They are very concretionary and

nodular in places. but no fossils were observed. The dip is N. 10° W <2°. These shales are exceedingly thin and splintery and are easily crushed in the hand. Ontario—*Cont.*

"At the north-east end of Sheick's Island, opposite Mille Roches, are fossiliferous flat-lying Chazy limestones. A quarry has been opened here and a quantity of material taken out for the construction of the canal. Specimens were collected from these quarries. The limestone at this place is bluish-black in colour, very hard, with a flinty fracture, highly fossiliferous, and holds small dots or specks of clear calcite. It is of fairly good quality, though somewhat seamy in places. On weathered surfaces, which are of a brownish-gray colour, it is seen to be concretionary, and the partings of the beds, which vary from six to twenty-four inches, are very rough, blackish and pitted. I am told that 15,000 cubic yards a year have been taken out. The rock, in some places, is in beds of nine to ten feet thick, with generally a parting at about five feet from the surface. Quarry near Sheick's Island

"The Trenton formation, with which is associated the Black River, has a very extensive development in this area. In the western part of the sheet, beds are well exposed from Billings Bridge along the main road to Britannia, where also the Chazy is well seen. The Trenton is also well exposed near Mr. Henry Onderdonk's, a short distance to the north-west of Aultsville, as well as in the township of Russell, on one of the branches of the Nation River. It also appears about Crysler in the township of Finch, Stormont county, and thence extends eastward towards Moose Creek. Trenton limestone.

"Near South Finch, the bed of the Payne River consists of Trenton limestone, and there are also fine exposures about South Finch, Lodi, and other points in the vicinity.

"A valuable quarry in rocks of this formation is located near Alexandria, on lot 27, range V., of Lochiel, about 200 yards to the south of the road. The rocks are heavily bedded and dip S. 10° E. <7°. They are vertically jointed and blocks of any dimensions can be obtained as the limestone is easily split horizontally. It is highly fossiliferous, and contains small seams of a black bituminous substance. It is rather hard to work but of very good quality. In places the rock contains small veins of white calcite, and in certain portions has a mottled pinkish aspect from the presence of pink calcite. In others it assumes a greenish hue, due to a thin coating of a shaly bituminous mineral. This stone is used in the construction of the new reformatory at Alexandria. Quarry near Alexandria.

Ontario—*Cont.*
Utica shales.

"The Utica is well exposed in the township of Cumberland, Russell county, near Navan Corner, and also about one mile and three-fourths south-east of Cyrville, in the township of Gloucester, county of Carleton. Near Ottawa, at Janeville and Billings Bridge, large outcrops of this formation are seen, as well as in New Edinburgh and in portions of the city of Ottawa itself. These black Utica shales pass upward into the grayish beds of the Lorraine formation which are well seen on the road south of Hawthorne Corner. A belt of these rocks occurs near Maxville, and fine exposures are visible on lot 16, range X., Caledonia, on Mr. McRae's property. The black shales were struck at about eight feet from the surface, and Mr. McRae penetrated these for about ten feet, obtaining excellent water. These shales have a very considerable development in the townships of Caledonia and Kenyon, but large areas are covered with drift and clay, so that the exact limits of the formation cannot be accurately ascertained.

"Red shales, probably of Medina age, occur in the township of Russell, lot 31, range III., but the distribution of these rocks has not been worked out.

"The glacial striæ, where observed, were uniform in a southerly direction, ranging from fifteen degrees east of south to five degrees west."

Mr. Giroux's field-work extended from the 1st of June to the 1st of October.

QUEBEC.

Work by Dr. Bell.

After the close of the season of field-operations last autumn and until the time for beginning the work of the present season, Dr. R. Bell was occupied in plotting his surveys of 1895 from his field-books and mapping the results; also in working up the geological data for the region covered by the French River sheet (No. 125, Ontario), and putting these upon the map for publication.

Dr. Bell reports as follows on the field-work of the past season, which was directed to the same region, between the Upper Ottawa and James Bay, in which his explorations of the preceding year had been carried out:—

Further exploration of Nottaway River basin.

"The region explored lies in a general way between the Upper Ottawa and Rupert River and thence eastward to Lake Mistassini. The exploration was in continuation of the work which had been commenced

beyond the height-of-land in this region in 1887 and resumed in 1895. Grand Lake was an objective point on the journey from Ottawa to the field of operations, and I determined to make my way to it via the town of Mattawa and Keepawa Lake. The newly opened Lake Temiscaming Colonization Railway facilitating this course, and another reason for choosing this route was that I could follow a chain of lakes between Keepawa and Grand Lake which I had never before travelled and would thus be enabled to make some useful geological notes by the way. Quebec—*Cont.*

"Besides voyageurs and a cook, my party consisted of R. W. Brock, M.A., who had been my assistant during several previous seasons, Mr. J. M. Bell and Mr. D. A. Rankin. I relied on being able to hire competent Indian or half-breed voyageurs for the work in the north country at Keepawa or Grand Lake. Supplies were obtained partly from Ottawa and partly from Grand Lake. Mr. Brock left Ottawa on the 10th June and was joined by Mr. Bell at Mattawa on the following day. With the help of temporary canoemen they started as soon as possible to convey our outfit and other supplies as far as Grand Lake.

"I left Ottawa on the 19th of June in time to join Mr. L. Christopherson of the Hudson's Bay Company (who has charge of the Upper Ottawa district) a few days later at Keepawa on his way to Grand Lake house. Chief Factor Rankin had kindly arranged for my passage with this gentleman on his return to that post. It was not till the 27th, however, that Mr. Christopherson was able to leave Turtle Portage on Keepawa Lake, but we took only four days to cover the whole distance of about 160 miles, with some thirty portages, and reached Grand Lake on the 1st of July. Mr. Brock had already arrived with our outfit, and the above-mentioned supplies, and I obtained the heavier part of our provisions for the whole season through the accommodation of the Hudson's Bay Company at this post, thus saving much time which would otherwise have been required to transport them to this distance by my own party. Here I also obtained from the company a four and a-half fathom bark canoe, which proved of great service in navigating the strong rapids of the larger rivers. In the course of a few days I succeeded in securing four good Indian canoemen, and our party started from Grand Lake house in two sections on the 6th and 8th of July. Journey to Grand Lake.

"After leaving Grand Lake, my own share of the work consisted in making a combined geographical and geological exploration of eleven branches of the main river surveyed in 1895, and of a chain of lakes Extent of explorations.

Quebec—*Cont.*

and rivers extending from the Waswanipi to the Rupert River, while Mr. Brock explored the region between Shabogama and Waswanipi lakes by way of the Mekiskan, and afterwards the region lying east of the latter lake by way of the Waswanipi River and Lake Mistassini, from which he returned home by the Ashuapmouchouan River, Lake St. John and Quebec.

Observations made.

"The above explorations resulted in demonstrating the existence of large areas of Huronian rocks which give promise of valuable metallic ores and other economic minerals, as well as of extensive tracts of agricultural lands and forests of northern timber trees, which are no doubt destined to be of great future value to the country.

"Careful track-surveys were made of the lakes and streams on the routes followed by both Mr. Brock and myself. Numerous observations for latitude and the variation of the compass were taken wherever I went, so that, with the work of last year added, the topography of an extensive region can be laid down on a general map with sufficient accuracy for present purposes. We brought home as many specimens of the rocks of the country as could be conveniently transported, and also about twenty samples of quartz and other vein-stones for examination. Mr. J. M. Bell paid particular attention to the flora of the country traversed. Although many observations were made on the zoology of the country, neither time nor circumstances permitted of the preservation of specimens. A number of Lepidopterous insects, incidentally captured, have been handed to Dr. James Fletcher for determination.

Nomenclature of places.

"The geographical names to be made use of in describing the exploration from Grand Lake northward, are those which have been given by Indians, wherever such names exist; some were given by my late assistant Mr. Cochrane in 1887, and some by Mr. O'Sullivan in 1894, all of which I have adopted. But it often happened that owing to the absence of any name whatever—Indian or otherwise—I was obliged for the purpose of description to give appropriate designations to some of the geographical features. The few Indians of this great region attach little importance to geographical names, and such as they make use of are generally only temporary and recognized by but few families. They have no idea of a uniform or permanent geography, and each little band of natives coming from a different part of the region, when they have occasion to use the same lake or river, has usually its own name for it, irrespective of what other natives may call it.

"As pointed out in my summary report for 1895, the stream followed northward from the height-of-land near the north end of Grand

Lake, to Mettagami Lake, of which I made an instrumental survey last year, had been supposed to be identical with a river flowing into Hannah Bay, which, on the sketch-maps of the region, was called Hannah Bay River or Harricanaw River. This latter, however, proved to be an independent stream lying to the west of the one in question, reaching the sea direct and known to the coast Indians as Washahow or Bay River; while the one I surveyed had been confounded with it. At the time of Mr. Cochrane's visit in 1887 and his track-survey of about 70 miles of it from the Boggy portage downward, the river was believed by the Hudson's Bay Company's people and the Indians whom Mr. Cochrane met with, to fall into Hannah Bay. (See Summary Report for 1887, page 24 A.) The same notion prevailed in 1895 when I started on my survey of the stream, and even my guide for the upper part of the river assured me that it did not ultimately fall into Rupert Bay, but into the sea somewhere to the west of it.

Quebec—*Cont.*

Erroneous notions as to geography of the country.

" In my report for 1895 (page 77) reference was made to the Hannah Bay River or Washahow River, above mentioned, and to a lake called Michigami or Michigama (big lake) lying east of it and discharging north-eastward by a large branch into the Noddawai (or Nottaway) River, not far from its mouth. From various sources I have learned that there is another lake of the same name (big lake) to the west of Washahow River, the outlet of which flows directly into Hannah Bay. The want of more definite names is apt to lead to confusion and difficulty of description. In addition to the various 'big lakes' in this region mentioned in the present report, the largest sheet of water between Waswanipi and the Ashuapmouchouan River of Lake St. John is also called Big Lake. Indeed, in every part of the Dominion, east of the Rocky Mountains, the Indians (who only know their own district) have their local 'big lake'.

" After crossing the height-of-land, my first exploration of the main line of our route was from Simon Lake eastward, via the Mudge Manitou or Devil River to the lake of the same name. On the way, thither (from Simon Lake) our course for ten miles lay through a large unnamed lake whose existence is not yet indicated on any map. While engaged in this work, I sent Mr. Brock to explore a western branch coming in at two miles below Simon Lake and also a small river falling into Obaska Lake,—the next expansion of the main river below Simon Lake.

Mudge Manitou River.

" On arriving at Shabogama Lake, Mr. Brock was given an efficient Indian voyageur and one of the cedar canoes, with instructions, as

Route from Shabogama Lake to Waswanipi.

Quebec—*Cont.*

already stated, to follow a route leading thence to Waswanipi Lake, while I proceeded with the remainder of the party down the main river in order to explore its branches. This was on the 20th of July, and we arranged to rendezvous on the 10th of August at the first narrows of Gull Lake, and accordingly on the morning of that day we met at the appointed place.

Branches of upper Mekiskun.

"Mr. Brock reported that, having made a track-survey by the Mekiskun to a point about due south of Waswanipi Lake, he turned northward and passing over the watershed of this river, continued his survey through the chain of lakes and streams which had been followed by Mr. H. O'Sullivan in 1894 to the lake first mentioned. In this part of his route, the largest of the lakes traversed were successively Ash-pa-bonka, five miles, We-tet-nagami, seven miles, and Pus-ki-tam-ika, fifteen miles in length. Track-surveys showing the details of topography were made of these three lakes. He found that the river discharging We-tet-nagami Lake, instead of falling as supposed into Pus-ki-tam-ika Lake, flowed off north-eastward and joined the lowest southerly branch of the Waswanipi. The Mekiskun here proved to be a difficult stream to ascend, as it flows rapidly down the east slope of the great or leading depression of this whole region. At fourteen miles from Lake Shabogama, it is joined by the Ka-ge-tes-ki-nuk from the south. This branch forms part of a canoe-route to Mudge Manitou Lake, of which I have located the termination in the north-eastern bay of the latter. The Mekiskun also receives a second good-sized branch from the south and two others from the north side in the portion which Mr. Brock surveyed and which had never before been explored by a white man. In this part of its course, the river passed through a lake surrounded by hills and twelve miles in length, which Mr. Brock named Lake Millie.

Various tributary streams.

"During the three weeks between the above-mentioned dates, I was occupied in exploring and mapping the large north-east bay of Shabogama Lake, a long branch from the west, which I named the Coffee River, from its water bearing the colour of *café au lait*, the Kiaak River from the east, Kamshigama River, also from the east, and the lake of the same name at its head; Clay River from the west, the Florence River or first branch from the east below Wedding River, of Mr. O'Sullivan, a river from the south-west falling into Taibis Lake and a stream from the west which my Indians at once named Deer River from having shot a deer on one of its branches. In addition to these eight branches explored by myself and the three by Mr. Brock, I may here add that on my return journey, in the autumn, I explored

and mapped the lower twelve miles of the considerable tributary which falls into the extremity of Mattagami Lake, and which my guide in 1895 called the 'way-to-Abittibi' river, and also the Shabogama River, a large stream entering the head of the north-east bay of the lake of the same name, but which, within four miles of its mouth, divides into three branches. Quebec—*Cont.*

"The geological facts ascertained in the explorations of the above-mentioned thirteen branches and the further geological examinations of the main river itself, together with Mr. Brock's observations between the Mekiskun River and Waswanipi Lake, will enable me to indicate, in a general way at least, the distribution of the principal rocks of this region; and some notes on this subject will be given further on.

"When Mr. Brock rejoined me, although we had already accomplished the work planned out for the season, there still remained six or seven weeks before the rivers might be expected to begin to freeze over, and I decided to devote all of this time not required for the homeward journey, to an exploratory survey of a chain of rivers and lakes from Gull Lake northward to Nemiskau Lake—an expansion of Rupert River,—while Mr. Brock was to proceed eastward by the Waswanipi River to Lake Mistassini, in order to make a track-survey of that large stream and to ascertain as much as possible of the geology of the country it traverses. This journey he successfully accomplished Waswanip Lake to Rupert River.

"Leaving Mr. Brook at Waswanipi post, I proceeded northward making at the outset track-surveys of the east side of Gull Lake (of which I had surveyed the west side last year) and of its two northern expansions, which give it a total length of thirty miles. A considerable river from the east falls into the head of each of these expansions. Our route followed the second of these streams for a short distance and then turned up a northern branch and crossed the height-of-land to a river-system lying between the Waswanipi and the Rupert. Our course then lay northward through a number of large lakes, connected by a river which finally discharges them all into Rupert Bay, at a point eleven miles southward of the mouth of Rupert River.

"A track-survey was made of all these lakes, as well as of the connecting links of rivers. The Indians and the Hudson's Bay Company's people told us that some of these lakes had no names, but that the largest of them—about the size of Lake Simcoe, Ontario, was known simply as 'the big lake' and another as 'the long lake.' Several long streams from the eastward fall into this chain of waters, and Mr. Large lakes on this route.

Quebec—*Cont.*

Brock was told at Lake Mistassini, that two of them rise near that sheet of water, and also that the two rivers flowing into the northern expansions of Gull Lake, south of the local divide already referred to, have their sources close to Mistassini post. The large river which discharges the collected waters of all the streams and lakes of the intermediate basin, comes within six miles of Nemiskau Lake on the Rupert. Here we left it, but from this point down it is said to be a very rapid stream with a course parallel and close to the Rupert all the way to Rupert Bay. It is named Broad-backed or Broad-back River by the voyageurs at Waswanipi Post, who follow the route which has just been described to Nemiskau Lake on their way to Rupert house, but at the latter post the same stream is known as Namaigoose's River, after the Indian who hunts at present along its course. The above chain of lakes and their connecting streams appear to receive no notable tributaries from the west, which would show that the country across which they lie slopes westward, like the channel of Rupert River itself, all the way from the rim of Lake Mistassini to Rupert Bay, and the rate of the inclination appears to increase from the line of lakes to the sea-level.

Broad-back or Little Nottaway River.

Character of country north of Waswanipi.

"The country between Gull Lake and Rupert River became poorer, in a general way, as we proceeded northward. As a rule, it may be described as tolerably level, but now and then isolated hills, several hundred feet high, could be seen from the canoe-route. A good deal of solid rock was exposed on the lake and river shores, but inland, much of the country appeared to possess a good soil. The waters of the upper lakes were tolerably clear, but those of 'the big lake' and the lakes below it were quite muddy, owing to the wash from the surrounding clay land. The timber on the whole became smaller as we went northward from Gull Lake, even where it had attained its full size, but much of the forest consists of second growths of various ages. The black ash does not appear to extend north of Gull Lake and the last white cedars were seen at the outlet of 'the big lake,' but all the other species of trees are known to continue far to the north of Rupert River.

Climate and agriculture.

"The general character of the country which was traversed this year, as far as Gull Lake, was described in my preliminary report of last year, as to its rocks, soil, timber, climate and agricultural capabilities. In regard to the last mentioned, at my request, Mr. D. Baxter, the gentleman in charge of Waswanipi post, kindly agreed to make some additional experiments with wheat, oats, barley and a variety of other seed which I obtained from Dr. Saunders of the Central Experimental Farm and sent to him during the past

winter. When we visited his post on the 12th of August, the various grains looked well. They had headed out some time before and would soon be ripe. New potatoes were as large as hen's eggs, turnips six inches in diameter, and carrots and some other vegetables ready for use. Indian corn was showing its silk, tobacco plants were growing well and almost every kind of garden crop grown in an average district of Canada, was flourishing under Mr. Baxter's care

Quebec—*Cont.*

"In my preliminary report of last year, the rocks which had been met with in that part of the district then examined were briefly described. The following is now added as a general outline of the geology of the whole region, between the main height-of-land and Rupert River, and as the result of both years explorations. It is supplemented by Mr. Brock's account of the rocks he met with east of Waswanipi Lake.

Geology of the region.

"*Mr. Brock's Geological Observations.*—Mr. Brock, on his journey from Shabogama Lake towards Waswanipi, in ascending the Mekiskun River, found only granite in the first twenty-three miles, following the general course of the stream, but at this distance he came upon an exposure of chloritic schist. Thence, along his route, which has been already described topographically, gneiss of different varieties prevails as far as Pus-ki-tam-ika Lake. Granite and greenish schist occur around the western part of this large lake and gneiss and similar schist with a little granite around the eastern part. Around Waswanipi Lake the rocks were found to consist of granite with some green schist.

Observations by Mr. Brock.

"In ascending the Waswanipi River on his journey to Lake Mistassini, Mr. Brock observed only granite, like that of Waswanipi Lake, for the first fourteen miles by the general course of the stream. Then for the next seven miles, there are greenstones and green schists, with whitish quartzite in the central part of this distance and granite near its eastern extremity. At one mile further on, syenite containing epidote, occurs, and gneiss and granite occupy the next eight miles. Above this, still measuring along the general course of the river, schists of various kinds were the only rocks seen for the next twenty-six miles. At the end of this distance, or at about fifty-four miles in a straight line easterly from Waswanipi Lake, the route turns off the main river at a right angle and follows up a branch in a due south direction for four miles to Mik-wa-sash Lake, which connects by a short link of river with Opa-mis-ka Lake, eight miles in length. The general course of these two lakes and of this branch river above them is easterly. Greenstones, with a little granite and green schist, were found all

Rocks noted along Waswanipi River.

Quebec—*Cont.*

around the above lakes and along this branch above them, to a point thirty miles in a straight line eastward from its junction with the main Waswanipi. From this point, gneiss was found to within four miles of Wahwanichi Lake. The geology of the route followed by Mr. Brock from this lake to Mistassini post of the Hudson's Bay Company, has already been described by the late Messrs. Richardson and McOuat and by Mr. Low in the reports of the Geological Survey.

Great belt of Huronian.

"*General Geological Description.*—The rocks around Grand Lake consist of Laurentian gneiss, which appears to extend thence south-westward continuously all the way to Georgian Bay of Lake Huron; but when we leave the northern extremity of Grand Lake, we enter at once upon an immense tract of Huronian rocks, with intrusive granites and greenstones, and broken by some areas of gneiss. This great tract of mixed rocks has a breadth of about 150 miles on a line running due north from the head of Grand Lake, and it constitutes an expansion of what I have elsewhere described as the 'great belt' of the Huronian system, extending from Lake Superior to Lake Mistassini, a distance of about 700 miles. From the central point of the above north-and-south line, the southern extremity of Lake Mistassini lies about 170 miles in a north-easterly direction, and Mr. Brock's exploration continues the tracing of this belt of Huronian rocks, with a narrowing breadth, all the way to that locality. The northern boundary of this great belt passes through the northern portions of Gull and Mattagami lakes.

Boundaries of this area.

"Leaving the height-of-land near Grand Lake, on the route which I followed, schists, greenstones and granites are found as far as about five miles down Shabogama Lake, beyond which gneiss prevails to and also all around the north-east extremity of Shabogama Lake, and it probably connects with the gneisses which Mr. Brock found everywhere on his way from the Mekiskun River to Pus-ki-tam-ika Lake. I came upon the north-westerly boundary of this gneissic area on the south branch of the Kiaak River. Another area of gneiss begins at Clay River and extends for several miles down the main stream. Areas of the same rock, separated by others of Huronian schists, occur in two places between the one last mentioned and Mattagami Lake.

Smaller northern belt.

"North of the principal belt above referred to, a smaller band of Huronian rocks was found on the route from Gull Lake to Rupert River. It begins at the outlet of 'the long lake' and extends to the southern bay of 'the big lake,' and has a breadth of about seventeen miles. Deposits of iron-pyrites, sometimes with traces of copper, were found in several places along this band, and these may prove

large enough to be of economic value. This Huronian band is flanked on its northern side by granite at the first narrows of 'the big lake' and this again is followed by gneiss, which continued all the way to Rupert River. Quebec—*Cont.*

"From Mattawa, on the Ottawa, northward to Rupert River, the average course of the glacial striæ changes very gradually from about south-south-west to about south-west (true), but it is very constant over large districts. From the neighbourhood of Shabogama Lake, northward, the drift or till contains a varying proportion of rock-fragments derived from the Manitounuck formation (Cambrian), which may have come from the east coast of Hudson Bay, as far as their lithological characters are concerned; but as the glacial striæ of the whole region, except along a part of the Nottaway River, all run south-westward, these fragments may have been derived from the rocks of the broad belt of the same formation which Mr. Low found running north-westerly through the central part of the Labrador Peninsula. Glacial striæ and erratics.

"On Mattagami, Gull and Waswanipi lakes, and for some distance up the Waswanipi River, many small and some good-sized boulders occur, of a grayish unaltered limestone, containing obscure fossils, but no fixed rock of this kind has yet been found in the surrounding country.

"The brownish clays, formed of thin horizontal layers and usually containing small nodules, which overspread the river-valleys and the lower levels of the country generally, are not confined to any particular elevation, but occur at all heights from about 100 feet below the watershed, down nearly to the sea-level, where they are replaced by clays of a bluish-gray colour. The brown clays rest upon the till and are sometimes covered by local deposits of sand or more rarely of gravel. Clay deposits.

"In returning from Rupert River to Grand Lake, I followed the same route as in going and reached the latter place on Saturday, 26th September. Owing to a continuous downpour of rain, we were unable to resume our journey southward till the 1st of October and on the 6th we arrived at Mattawa, where I settled with my men and started them off on their homeward journey.

"In carrying out the above explorations we were indebted for assistance in a variety of ways to several of the officers of the Hudson's Bay Company, among whom I may mention the Chief Commissioner Mr. C. C. Chipman, Chief Factor Rankin of Mattawa, Mr. L.

Quebec—*Cont.*

Christopherson of Grand Lake, Mr. David Baxter of Waswanipi, and Mr. William Miller of Lake Mistassini."

Work by Mr. Chalmers.

Throughout the winter of 1895-96, Mr. R. Chalmers was engaged in correcting final proofs of maps and report on the Surface Geology of Eastern New Brunswick, north-western Nova Scotia and Prince Edward Island, and in compiling the data obtained in the field during the previous summer in the "Eastern Townships" of the province of Quebec for publication. A portion of the field-work relating to the surface geology of sheets No. 1 N. W., and No. 2 S. W., New Brunswick, was also put down upon the maps, and the post-Tertiary fossils of that province were catalogued. The specimens of boulder-clays and other Pleistocene deposits which had been collected from time to time for the museum were also classified and labelled.

The field-work of 1896, which was again devoted to the "Eastern Townships" of Quebec, is reported on by Mr. Chalmers, as follows :—

Surface geology of the 'Eastern Townships.'

"On the 19th of May I left Ottawa to resume the investigation of the gold-bearing alluviums and to study some questions pertaining to the surface geology of the 'Eastern Townships' and adjacent portions of south-eastern Quebec, remaining in the field till the 19th of November. Operations, though somewhat restricted for a considerable portion of the season owing to the scarcity of funds, were, nevertheless, carried on continuously throughout the summer, and the region referred to, especially where it is occupied by auriferous deposits, has now been examined in as much detail as time and circumstances would permit. The glaciation and the deposits due to glacial action, especially in their relation to the gold-bearing gravels, have been closely studied.

Observations in gold mining districts.

"On entering the field, observations were first made in the different districts in which gold mining was in progress, especially where shafts, tunnels, etc., were open. Development work was found to be going on at Dudswell, Ditton, Massawippi Lake, and in Beauce county, though only to a limited extent. On the west side of Massawippi Lake, Mr. James Stark, representing an English company, was at work with twenty-two men, in the bed of a small stream on lot 14, range VI., Hatley, Stanstead county. Some gold was found in the gravels, but not sufficient quantities to pay for working. Mr. Stark's object was, however, to find it in the matrix. Broken quartz seams, with pyritous, slaty and talcose minerals, traverse the rocks mapped as pre-Cambrian there. Specimens of these were brought to the office for assay in the laboratory of the Survey. The work at this place was discontinued after a month or two.

Massawippi Lake.

"The stream along which the gold occurs runs entirely across pre-Cambrian rocks and falls into Massawippi Lake, and the gold seems, therefore, to be derived from these rocks. Their character is very much the same as that of the rocks in Dudswell Mountain. Quebec—*Cont.*

"On lot 5, range XV., Magog, near the foot of Orford Mountain, mining for gold was undertaken by a Mr. Lacroix, and several men were at work in a pit in the bank of a small stream, at the time of my visit. The Cambrian slates there contain some thin quartz seams accompanied by pyritous minerals; but Mr. Lacroix could not show me any gold obtained from this opening, and later on it was closed. Magog.

"*Gold Mining at Dudswell.*—From Magog I proceeded to Dudswell, where some time was spent, and repeated examinations were made during the summer as work progressed. At Harrison's, lot 1, range VI., Westbury, free gold was found in the autumn of 1895 in a thin seam of quartz in a sort of conglomerate rock.* The exposure in which it occurred was uncovered to a still greater extent, along a low ridge, during the winter, and an opening made in the conglomerate, but without any further result than as stated in the Summary Report referred to. It is evident, however, that this conglomerate exists here in much greater thickness and extent than at first supposed; but whether auriferous throughout has yet to be proved. Mr. John Armstrong, of Marlow, Beauce county, has leased this property and was preparing to have the auriferous character of these rocks tested preparatory to working them. Dudswell.

"In Kingsley Brook, a considerable amount of work has been going on this season. A company has been formed to operate the mines on this stream, called The Rodrigue Mining Company, and the mining rights along the whole stream have been secured. Mr. H. C. Donnell, of Boston, U.S., is manager. Early in the season a dam was constructed near the source of Kingsley Brook, and an 80-horse-power boiler and hydraulic pump were put in, principally to work the gravels, Mr. Donnell informed me that he finds gold in paying quantities in these, but his ultimate object is to find the auriferous quartz or matrix, which he hopes to do as he sluices the gravels and uncovers the rock surface in the valley of the stream from the foot of the mountain up towards the dam. The boiler, Mr. Donnell states, is large enough to furnish power to drive a 50- or 60-stamp mill, and can be utilized for that purpose when gold is found in the rock in sufficient quantity to warrant the purchase of a mill. Kingsley Brook.

* Summary Report, Geol. Surv. Can., 1895, p. 93.

Quebec—*Cont.*

"The rocks of Dudswell Mountain are, like those on the west side of Massawippi Lake, pre-Cambrian slates and schists. Kingsley Brook crosses them nearly at right angles to the strike and has dropped considerable quantities of gold into the joints and crevices. Mr. Donnell informed me he was finding gold in these to a depth of two or three feet below the surface of the rock. Latterly, he was mining the decayed or partially rotten rock to that depth along with the overlying gravels and had sunk his sluice-boxes to that level. The discovery of gold in the rock-fissures means a continuance of operations for many years longer than if the gravels alone were worked.

Difficulties in mining.

"In regard to the difficulties encountered in gold mining in Kingsley Brook, and probably also in the valleys of the other small streams flowing off Dudswell Mountain, the first is the scarcity of water during the midsummer months, if operations are conducted on anything like a large scale. This difficulty can only be overcome by the construction of dams and reservoirs. The second is the presence of large boulders in the gravels. These interfere, to some extent, with hydraulic work, and have to be blasted or removed by derricks before the whole of the gravels can be sluiced. No quicksands occur in the valley of these small streams as they do in Beauce county, except in the terraces at the foot of the mountain. Mining has not yet been undertaken in any of these terraces.

Rowe's Brook.

"On a stream from one to two miles north-east of Kingsley Brook, called Rowe's Brook, lot 8, range IV., Dudswell, alluvial gold mining has been prosecuted this season by Messrs. Hayemal and Sotero, for some months and gold in paying quantities obtained by the ordinary process of sluicing. A clean-up which I witnessed while visiting this 'ocality, seemed to prove this statement. The character of the deposits is very much the same as in the Kingsley Brook valley, as described in the Summary Report for 1895 (p. 91), except that the thickness is perhaps, fully greater.

Ditton.

"*Gold Mining in Ditton.*—In the valley of the Little Ditton River, some work has been performed during the past season by Messrs. McCritchie and McKay of Scotstown, about a quarter of a mile above the bridge on the road to Chartierville. The gravels at this point were washed for some weeks by these men previous to the date of my visit and some gold was obtained. One nugget weighing an ounce was found at the bottom of the gravel, close to the bed-rock. The chief auriferous deposits here are those resting upon the rusty rotten rock, and are themselves highly oxidized, though stratified. Overlying them are alternating gravel and sand beds, which must be

largely of post-glacial origin. The boulder-clay is, however, rarely seen in contact with these. They contain but little gold. Quebec—*Cont.*

"To the south of the locality mentioned, along the Little Ditton valley, gold has been washed from the gravels at several points, nearly as far up as the International boundary, *e. g.* at a point a mile north of the cross-road going west from Chartierville, also south of that road and near the source of the stream in the vicinity of Prospect Hill, where it is reported to have been found in quartz, but I could obtain no authentic information on this point. It has also been discovered in the alluviums of the main Ditton River to the south of Chartierville village. No work has been done, however, in the two last-mentioned localities.

"*Gold Mining in the Chaudière Valley.*—Along the Chaudière River and its tributaries, very little gold mining has been carried on during the past season. Work in the tunnel at St. George, referred to in the Summary Report for 1895 (p. 87), was continued until September last, when it was found that the old pre-glacial channel of Slate Creek was not likely to be reached by following the course in which the tunnel was started, and it was abandoned for the present. At the time operations were suspended, the tunnel had been run in nearly 900 feet. Great difficulties were experienced in keeping it open, owing to the presence of quicksands and to the quantities of water in the ground overhead seeking outlet and carrying these sands with it. The succession of the deposits disclosed in the tunnel is interesting from a geological point of view. In descending order it is as follows:—(1) surface soil; (2) boulder-clay with an intercalated band of stratified clay, or stratified boulder-clay; (3) stratified clay and sand (pipe-clay and quicksands); (4) coarse, stratified gravel with pebbles and a few boulders one or two feet in diameter—colours of gold occur in this gravel; (5) a local bed of coarse slaty material with quartz bands running through it. It is apparently a decomposed slate which may have originally been thrown down as a talus at the base of a boss on the slope; (6) fine yellow sand with ochreous streaks through it, passing into rotten rock *in situ* beneath, the strata being in the same position as in the solid rock; (7) unglaciated rock. Chaudière valley. St. George.

"The most remarkable member of the series is number 6. It is unlike any other bed met with in connection with the gold-bearing deposits of Beauce county, and is noteworthy as showing the slight erosive action of the Pleistocene ice, exposed, as this slope of the Chaudière valley must have been to the full force of the glacier which moved over this distri t from north-west to south-east.

Quebec—*Cont.*
Rivière du Loup.

"In the valley of the Rivière du Loup, Mr. L. Gendreau is endeavouring to open up a series of gravel banks on the west side, which extend from three to five miles above its mouth. These gravels are reported to contain gold in workable quantities, but I have seen no competent tests made. The following is a section of one of these banks situated about four miles above the confluence of the du Loup and Chaudière rivers. (1) Surface soil; (2) boulder-clay, the upper part stratified in places; (3) a thin seam of stratified sand graduating into the following bed (4) stratified clay, (pipe-clay); (5) stratified sand and gravel, the latter usually in lenticular seams with ochreous bands, especially in the upper part. This is the deposit said to be auriferous; (6) fine, gray, stratified sand, the bottom not reached as it lies below the level of Rivière du Loup.

"Whether gold exists in paying quantities in these gravels does not appear, but Mr. A. A. Humphrey, of the Canada Gold Mining Association, formerly washed a good deal of gold out of the gravels of the du Loup valley in his No. 1 pit, just below the mouth of Gold Stream, *i.e.* about two miles lower down than the above section; and also in No. 2 pit near the river's mouth (see Summary Report for 1895, p. 89, where it is called No. 1 pit), though so far as known not in sufficient quantities to pay for hydraulic work.

Gilbert River.

"In the Gilbert River valley, some gold mining was carried on during the past season by the Leclerc Brothers, who are reported to have met with fair success and to have taken out in a few weeks about $400 worth. Two nuggets valued at $50 and $60, I am informed, were obtained by these men. One of these nuggets was shown to me.

Mill Stream.

"On Mill Stream, near St. François, Beauce, some work has been performed by Messrs. Copal and Pomerleau, and gold has been found in parts of the valley of that stream not hitherto prospected. In the valley of Black River, a branch of Des Plantes River, joining it from the south, gold was discovered in the gravels at the confluence of the main tributary.

General aspect of mining operations.

"The present languishing condition of the gold mining industry in Beauce county, appears to be due to causes other than the scarcity of gold in the alluviums. It would be invidious to make any remarks, however, concerning these causes. That gold still exists in a number of these valleys in paying quantities, *i.e.* in quantities sufficient at least to warrant a skilful and economic expenditure of capital in their exploitation, is a fact which no one who has examined the district can deny. But on the other hand it must be remembered that this district can show a total of a large number of failures in gold mining,

and that there are other causes for this besides want of scientific knowledge or skill and want of capital. In much of the Chaudière district, the gold exists in a very thin and scattered condition, and the gravels containing it are capped by such thick beds of boulder-clay and quicksands that it is doubtful whether it can be profitably mined. In the deeper parts of the river-valleys there are still greater difficulties to contend with. In the old pre-glacial channels, the gold has, of course, been more or less concentrated, but when it is considered that these often lie below the present water-courses, and that tunnels or shafts at these levels are likely to receive a portion of the drainage waters, the expense of exploration would be great and only deposits of considerable richness would probably prove remunerative. Quebec—*Cont.*

"The failure hitherto to find workable gold-bearing qua rtz, ha given wrong impressions concerning the district, leading miners and mining engineers to suppose that it has been but very imperfectly explored. As a matter of fact a considerable number of geologists, mining engineers and experts have visited and examined this district, and the literature pertaining to it is somewhat voluminous. There are, of course, different local conditions existing here as regards the distribution of the gold in the alluviums from what prevail in non-glaciated countries, and these diverse conditions may not have been sufficiently taken into account. But the Chaudière district has not suffered for lack of competent and skilful exploration, nor for want of capital.

"Notwithstanding the backward condition of gold mining here, this district, or at least some portions of it, offers inducements to miners and capitalists equal in some respects at least to those of some other gold regions more favourably regarded.

"The further development of the gold mines of the Chaudière area should, it seems to me, lie in the direction of introducing machinery and plant adapted to alluvial mining under the peculiar local conditions which are found there. But first the gold-bearing gravels, in a great number of places, should be tested anew and their gold content per cubic yard proved, with the view of ascertaining whether it is sufficient to pay for the expenditure in the direction indicated. To effect this exploration adequately, it would seem that boring machines are absolutely necessary. The great thickness of the boulder-clay, which never contains gold in paying quantities, but which must be penetrated by shafts or tunnels before the auriferous deposits can be reached and worked, as well as the difficulty of locating the old river-channels in which the auriferous deposits mainly lie, have hitherto proved serious obstacles to exploration in the deep-lying beds. With boring appli- Improvement in methods.

Quebec—*Cont.*

ances these difficulties could be overcome, at least to a much greater extent than by the methods hitherto employed, the position of the old channels could be located in less time and at much less expense, and the thickness of the auriferous beds in these ascertained before commencing actual mining operations.

Quartz veins.

"*Quartz Veins.*—In addition to the facts obtained relating to alluvial gold mines, a considerable body of data concerning quartz veins and other rocks which might be likely to yield gold was collected in the field, with a view of ascertaining, if possible, its primary source. The details regarding these will be given in my forthcoming general report; while such specimens as were brought in from the field will, meantime, be subjected to examination and assay in the laboratory of the Survey.

Observations on glaciation.

"*Glaciation.*—A portion of the season, at intervals, was spent in the investigation of the glaciation of this region, which undoubtedly has a close relation to the distribution of the gold throughout the gravels of the river-valleys. The direction of movement of the ice of the glacial period, the causes of its greater accumulation in certain localities than in others, particularly in the depressions of the surface, the denudation of all the superficial material on portions of the higher grounds, the transport of the drift from one locality to another, are questions bearing intimately upon the problem, and in this respect are of economic importance. The facts now at hand have been collected from all parts of the region from the Lake Champlain valley eastward to Gaspé, and are sufficient to enable us to arrive at conclusions with some confidence. They are mainly in confirmation of the observations recorded in the last Summary Report (p. 94), viz., that the earliest glaciation of this region was caused by ice which moved northward from the Notre-Dame Mountains into the St. Lawrence valley, the striæ produced by it being still preserved on the south and west sides of ridges and hills where the Laurentian ice, which flowed southward and south-eastward subsequently, did not efface it. Each of these two glacier-movements seems to be represented by its own boulder-clay as well as by striæ, and consequently the boulder-clay is found to have a two-fold division in a number of places. The lower, so far as it has been possible to examine it, consists of local material, while the upper contains Laurentian and other transported boulders from the north. The two boulder-clays were observed in the St. Francis River valley east of Angus station, Quebec Central Railway, where the intercalated bed consists of 12 or 15 feet of tough, stratified clay in a horizontal attitude. The boulder-clay was also seen in an upper and lower divi-

Two periods of glaciation.

sion in the bank of Clifton River, south of Sawyerville, Compton county, as well as in other places referred to in the Summary Report for 1895 (p. 95). It has been noted as occurring in the tunnel at St. George, Beauce county, on a preceding page, in the same two-fold bed. Quebec—*Cont.*

"*Changes of Level.*—A good deal of evidence has been obtained tending to show that this region has undergone remarkable changes of level in later geological ages and especially during the Pleistocene period. The basins of those long narrow lakes extending north and south, such as Memphremagog, Massawippi, Little Magog, Megantic, St. Francis, etc., appear to be merely dislocated portions of old river-valleys, interrupted by differential movements, the axes of these movements following mainly the direction of the present mountain ranges. The uplift of the range nearest the St. Lawrence, *i.e.* the range forming the extension of the Green Mountain Range into Canada, probably took place long before the Pleistocene period. It was this movement which principally affected the old valleys of the rivers referred to, and which appear to have flowed northwardly. Changes of level. Lake basins.

The great changes of level of which the evidences still remain in the form of raised beaches and terraces, however, took place in the later Pleistocene. These beaches and terraces extend along the slopes of the mountain range referred to, and face the open St. Lawrence valley from the Gulf to the International boundary in the vicinity of Lake Champlain. The uplift which raised these shore-lines has been unequal, or differential, as shown in the Summary Report for 1895 (p. 96), the gradient increasing in height above sea-level from Gaspé till we reach Arthabaska. Here a series of three shore-lines occurs at heights of 600 to 625 feet, 700 to 720 feet, and 875 to 885 feet, as levelled by aneroid, starting from the known elevation of the nearest railway station. From this point south-westward, they descend gradually towards the International boundary on the north-west slope of Sutton Mountain. Beaches and terraces. Amount of uplift variable.

The lower shore-lines are tolerably well preserved throughout, but the higher are greatly denuded, and on the slopes between St. Francis River and the Vermont boundary are very difficult to trace, owing to their broken, detached condition. These slopes are much intersected by valleys extending transversely to the direction of the ridge, as well as by others running longitudinally, and the Pleistocene shore-lines can be traced only around the denuded hills or along the sides of the broken ridges which remain. In many instances the hills are isolated. Two of these isolated hills, near the Canadian Pacific Railway at West Shefford

Quebec—*Cont.*

station, have furnished examples of Pleistocene shore-lines upon their slopes—Shefford Mountain and Brome Mountain. Here they occur at heights of 650, 700 and 820 feet. West of Sweetsburg two of these were observed at 600 to 610 feet and at about 700 feet. Near Frelighsburg and Abbott's Corner and north of 'The Pinnacle' in Sutton Mountain, the inner border of the marine plain is 475 or 480 feet high, the first shore-line above it from 600 to 625 feet, and another very broken and imperfect one, not yet accurately traced, at about 785 feet. This point is within a few miles of the International boundary. Further detailed examination and levelling of these shore-lines are desirable.

Shore-lines are marine.

"All the shore-lines noted face the open plain of the St. Lawrence valley, in the deposits of which marine fossils occur at various points. No barriers exist or could have existed, capable of holding in a body of fresh water at heights sufficient to allow the formation of these shore-lines; and the only reasonable theory as to their origin seems to be that they were formed along the margin of a sea which occupied the St. Lawrence valley in the Pleistocene period.

"Photographs of several of these shore-lines have been taken during the past season.

Differential uplift.

"Evidences of uplifts, with probably corresponding subsidences, were noted in other parts of the area under review. A differential change of level of this kind has occurred at the Devil's Rapids on the Chaudière River. As pointed out in the Summary Report for 1895 (p. 97) there must have been a local uplift here, with perhaps, a correlative subsidence in a parallel belt of country which crosses the Chaudière valley to the south between these rapids and the mouth of the du Loup. Further detailed observations during the past summer confirmed the conclusion previously arrived at. This uplift probably commenced before the Pleistocene, and may have been part of the movement which dislocated the old river-valleys and produced the lake basins referred to on a previous page.

Post-glacial dislocations.

"Dislocations or slips of the slates over each other, along certain zones or bands, since the glacial period, were observed in a great number of places, the displacements ranging in extent from two or three inches to five or six feet. One of the most remarkable examples of these movements in the rocks, was seen in the southern part of the seigniory of Aubert Gallion, Beauce county, where a band of slates from three to four feet thick and several hundred yards in length had sustained an upward shove of nearly six feet above the general level of the glaciated rock-surface, as evidenced by the parallel and well-

marked striæ. The rocks on both sides of the protruding band were also more or less dislocated for several feet distant from it. Whether the upthrust is due to great lateral pressure, or to some other cause, remains to be determined." Labrador Peninsula.

Labrador Peninsula.

Mr. A. P. Low, during the past winter, was engaged in writing a report on the previous season's work on the Manicuagan River, to be incorporated in his report on Labrador, also, with the assistance of Mr. Eaton, in the continued compilation of the map of the Labrador peninsula. Work by Mr. Low.

In the spring, plans were made for an additional traverse across the northern portion of Labrador, and Mr. Low was entrusted with the execution of this exploration. One principal object of the work was to trace out the northern continuation of the iron-bearing Cambrian rocks previously met with in Labrador. The results accomplished are outlined by Mr. Low as follows :—

"I left Ottawa on May 29th by the Canadian Pacific Railway for Missinaibie, to explore the country between the east coast of Hudson Bay and Ungava Bay. My party was made up as follows :—Mr. G. A. Young, assistant; Mr. W. Spreadborough, collector of natural history, and three canoemen, all of whom completed the entire trip. From time to time extra Indians were engaged as canoemen and guides as will be mentioned later.

"Two days were spent at Missinaibie in securing four extra Indians to assist in conveying the outfit to Moose Factory. On the 30th we left the railway, with everything in one large bark canoe and two wooden ones. The next day Brunswick post was reached, at the outlet of Missinaibie Lake, where four more Indians were engaged to assist in passing the strong rapids which extend for twenty miles below the lake. Having passed these, we continued down stream with the spring freshet, and without mishap arrived at Moose Factory on June 8th. Missinaibie to Moose Factory.

"At Moose, a Collingwood fishing boat, the property of the Geological Survey was launched, but owing to its having been out of the water for several years, a number of repairs were necessary before it was fit for use, and in consequence we were detained until the 14th. The boat was heavily loaded with provisions and outfit for a three months' trip, and its deck was encumbered by the two wooden canoes, which could not be carried otherwise. Moose to Richmond Gulf.

Labrador Peninsula—*Cont.*

"After crossing Hannah Bay, a course was taken to the east of Charlton and Strutton islands, and the east coast of James Bay was reached near Cape Hope, where a hurried examination of the rocks showed them to be chiefly green chloritic and hornblendic schists of Huronian age. From Cape Hope the coast was followed northward to Richmond Gulf, about 500 miles from Moose Factory. Stops were made at Paint Hills, some forty miles south of Fort George, at Fort George and at Great Whale River. At Paint Hills another area of Huronian rock was noted. Several interesting groups of Indians and Eskimo were photographed at Fort George and Great Whale River, and at the latter place an Indian guide, who had, in 1885, been over the route we proposed taking, was engaged for the trip across country to Ungava.

East coast of Hudson Bay.

"The east coast of James Bay is very irregular, being broken by long rocky points, and it is fringed with innumerable islands of rock and drift that extend outward from five to twenty-five miles from the mainland, often with very shallow water between them. To the northward of Cape Jones, the coast is higher and the water along shore much deeper, while the islands are arranged in chains parallel to the coast and often afford excellently sheltered channels for boats. For forty miles to the southward of Great Whale River, and for thirty miles in the vicinity of Little Whale River, there are no islands, and boating is somewhat dangerous, as the shores are high and rocky and landing is impossible with the wind from seaward.

"The past season was remarkable for the small quantity of ice in Hudson Bay and Hudson Strait. On our passage from Moose Factory to Richmond Gulf only one small field was seen, to the southward of Great Whale River, whereas usually ice blocks James Bay and the coast to the northward until July. The ice left the coast about Great Whale River early in the year and did not return. In Hudson Strait, Capt. Gray, of the H. B. Co's Steamer *Erik*, reports that on the passage to Churchill, in July, he encountered practically no ice, and similar conditions prevailed on the return trip late in August.

Richmond Gulf.

"Richmond Gulf is a body of water separated from Hudson Bay by a high ridge of Cambrian rocks. It is roughly triangular in shape, being about eighteen miles along the base, from the entrance eastward to the mouth of the Clearwater River, and about twenty-five miles from north to south. It is connected with the bay by a channel from 200 to 1000 yards wide and about one mile long, formed by a break in the ridge, which rises perpendicularly on both sides to elevations varying from 200 to 1200 feet. The rise and fall of the tide causes

a tremendous rush of water in and out through the channel, which renders the passage dangerous to small craft, except at slack water at the change of tide. Labrador Peninsula—*Cont.*

"The gulf is surrounded by sharp hills of Cambrian rock, which also forms several large islands. The hills rising abruptly from the water on all sides, vary in altitude from 500 to 1000 feet, and are quite barren on top, with small trees growing only in the lower gulleys and about the edge of the water. At the time of our visit, great patches of snow still remained on the tops and steep sides of the hills, and added to the wild and desolate aspect of the scenery of the place. Two days were spent here examining the rocks, collecting specimens and obtaining photographs.

"We then proceeded to the east side of the gulf where a portage-route to Clearwater Lake begins. This route was surveyed by me as far as the lake in 1888.* Having unloaded the boat we started over the first portage of three miles and a-half, up and over a hill 800 feet high, and ending on a small stream, which has a fall of 315 feet just below. This stream was ascended some twenty miles, passing a fall of sixty-five feet, to another portage of two miles up hill, to the beginning of a chain of small lakes nearly on a level with the country of the interior, or about 800 feet above sea-level. The next week was spent mostly in carrying loads over portages between small lakes, and in this manner Clearwater Lake was reached on July 11th. Portage-route to Clearwater Lake.

"This lake is about thirty-five miles long from north-west to south-east, and about eighteen miles across in its widest part. The coast-line is very irregular and many islands are scattered over its surface, especially along shore. The surrounding country is broken by rounded hills of granite and gneiss that vary from 100 to 400 feet in elevation above the lake, which is about 800 feet above sea-level. All the hills are bare and rocky with very little soil on or about them, the valleys being chiefly filled with boulders. The summits of the higher hills rise above the tree-line, and are clothed only with white lichens and arctic shrubs. The trees about the lake are all very small black spruce or larch. The water, as the name of the lake implies, is remarkably clear, and is well stocked with fish. Clearwater Lake.

"Having finished the survey of the lake on July 20th, we next crossed a portage-route fourteen miles long to Seal Lake. This route follows the course of a small stream, which empties into Clearwater Lake near its north-east corner. It passes through several small lakes Seal Lake.

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*Annual Report, Geol. Surv. Can., vol. III. (N.S.), pp. 80-82A and 55-62J.

Labrador Peninsula—*Cont.*

connected by rapids, and ends in an irregular narrow bay that stretches southward from the main body of Seal Lake. This lake takes its name from the number of seals living in it. During our stay we saw three seals, but unfortunately could not kill one. From skins seen in possession of the Indians they are known to be either the true Harbour seal (*Phoca vitulina L.*) or a variety of the same species.

"Seal Lake is a long and comparatively narrow body of water lying nearly east-and-west. Its greatest length is about fifty miles, and it varies in breadth from one to five miles. Its western end is situated some twenty-five miles north of Clearwater Lake, where it discharges by the Nastapoka River into Hudson Bay. About the middle of the lake there is a short narrows, with strong current, which practically divides it into two lakes. About fifteen miles from its east end it is split into two long bays, and the northern of these is again divided by a deep bay running north-west from near its mouth. Like Clearwater Lake it is studded with islands, but its water is not nearly so transparent and has a brownish tinge. The surrounding country is similar to that about Clearwater Lake. The hills toward the east end are higher than elsewhere, the trees are smaller and the barren areas more extensive.

Height-of-land Portage.

"Seal Lake was left on August 4th, by a small stream flowing into the head of its northern bay at the east end. This stream was ascended nine miles, through four small lakes, to the watershed between the rivers of Hudson Bay and Ungava Bay. The height-of-land portage is about 900 feet above sea-level, and is only fifty yards long, ending in a narrow lake seven miles and a-half long, out of the east end of which flows the main stream of the Natuakami or Stillwater Branch of the Koksoak River. This stream was surveyed to its mouth.

Stillwater Branch.

"For the first fifty-five miles it is an almost continuous succession of rapids, there being sixty-four such in that distance. The general course is nearly east-north-east with minor bends to the north and south. At first it is small and narrow, but is soon enlarged by the addition of several branches from the northward. At the end of the above distance, it is joined by a large northern branch, and then flows with slackened current for nine miles, when it widens out into a delta as it enters Natuakami or Stillwater Lake. This lake is fifteen miles long and varies from a quarter of a mile to four miles in width, merely occupying an expansion of the river-valley.

"The country surrounding the river, from its head to Stillwater Lake, is very rugged and barren. The river flows in a distinct valley

from an eighth to a half mile wide, and the valley is bounded by rocky hills, that rise from 100 to 800 feet above the river, being highest for about twenty miles above Stillwater Lake. Trees are confined to the valleys and are very small. Labrador Peninsula—*Cont.*

"Below Stillwater Lake, both the valley and the river widen, the former varies from a half to two miles between the hills, and the latter from a quarter to a half mile across. Several heavy rapids occur in the next thirty miles, to the junction of the Kenogami Branch, but none of them are sufficiently bad to entail a portage in descending.

"In the valley, the trees are somewhat larger and in several places small straggling trees of balsam poplar were seen. Between the river and the hills there is usually a wide swamp, from twenty to fifty feet above the river, caused by the impervious stiff clay of the valley. Below Stillwater Lake, terraces are almost continuously seen along the hillsides.

"The Kenogami Branch joins from the southward, and has at least twice the volume of the stream descended. We ascended it about six miles, and then climbed a hill from which a good view was obtained of its course, showing continuous rapids for several miles. The Indians state that the rapids continue for about thirty miles, or to where the river divides into two branches to the southward of Stillwater Lake. Kenogami Branch.

"Below the junction of the Kenogami, the river averages half a mile in width, and to the mouth of the Kaniapiskau River, sixty-five miles below, it flows generally with an even current from three to four miles an hour, and is broken by three heavy rapids, the last one being nearly five miles long, immediately above the junction with the Kaniapiskau. From the Kenogami the course is nearly north-east for twenty-five miles, when the river takes a sudden bend to the southward as it passes out of the Laurentian region into an area underlain by bedded Cambrian rocks. It then again slowly bends back to a nearly north-east course, and continues so to the forks. The character of the country changes with the underlying rocks, and in the Cambrian area the hills are lower and sharper with frequent cliff-faces. As the Kaniapiskau is approached, these sharp hills increase in height and at the forks attain elevations of more than 1000 feet above the river. River below the Kenogami

"The river below the Kaniapiskau widens out to about a mile across, and from there to its mouth, ninety-five miles below, it varies in width from one mile to two miles and a-half. The valley is also wide and the hills soon decrease in attitude, so that as the sea is approached they seldom rise more than 300 or 400 feet above sea-level. The river

Labrador Peninsula—*Cont.*

has everywhere a strong current, and its shallow channel is often obstructed by sand and shingle bars and islands. Only one rapid occurs along this portion, being situated at the head of tide, or sixty-three miles above the mouth.

Reach Ungava Bay.

"We arrived at Fort Chimo on August 26th, and finished the remaining thirty-three miles of survey to the mouth of the river on September 5th. From Fort Chimo, passage was taken on the Hudson's Bay Company's steamship *Erik*, on September 13th. On the way down the Labrador coast, stops were made at George River, Nachvak and Davis Inlet, and Rigolet was reached on September 28th. Here an exchange was made to a schooner, which had been luckily delayed, and in which we took passage directly for Quebec, thus escaping a long trip by way of Newfoundland. Rigolet was left on October 2nd, and after a remarkably quick passage Ottawa was reached on the 10th.

Distances travelled and results of the work.

"The distance travelled in all is approximately estimated at 4200 miles—in canoes, 700 miles; in boat on Hudson Bay, 500 miles; by steamship and schooner, 2000 miles, and by railway 1000 miles. The results of the exploration include a micrometer survey of the route from Hudson Bay to Ungava Bay, together with observations on the resources and climate of that region. A large collection of plants was made, useful as an index to the climate and also in extending the range of many species. Collections of bird-skins, birds' eggs, small mammals, shells and insects were also made and are at present in the museum, together with a small collection of Eskimo carved ivory.

Geology.

"The rocks of the country were carefully examined and a number of interesting and practically valuable facts observed in connection with the geology, including the location of a large area of valuable iron-bearing rocks which form an extension of the Cambrian area of the Kaniapiskau River previously discovered.* Iron ores were also discovered in the gneisses along the upper part of the Stillwater River. Attention may further be called to the areas of Huronian rocks at Cape Hope and Paint Hills on the east coast of James Bay, which from their resemblance to those of the same age elsewhere, may yet be found to contain valuable ores.

Glaciation.

"Interesting notes were also made as to the glaciation of this northern region, and it was found that the ice flowed downwards and outwards on both sides of the present watershed.

Climate.

"The climate of the region is such as to totally unfit the country for agriculture. Along the coasts it is almost arctic, owing probably

* Annual Report, Geol. Surv. Can., vol. VII. (N.S.), p. 67A.

to the low temperature of the sea. Inland, although much less severe, as is shown by the plants, it is yet too cold to grow crops. Snow was seen in gulleys until the middle of August, and on the 8th of that month ice one-eighth of an inch thick formed during the night. Snow flurries occurred throughout July. The value of the region will be found in its minerals and fisheries. All the lakes and streams are abundantly stocked with fish, including large lake-trout, brook-trout. whitefish and suckers. Salmon are abundant in the rivers flowing into Ungava Bay and young salmon were caught on the Stillwater River to within a few miles of Stillwater Lake. A northern trout, probably Hearn's salmon, is very plentiful in the lower parts of the rivers and along the northern coasts from Cape Jones to Ungava Bay. This fish is not quite as fat and fine flavoured as the salmon, but has a good red colour and may be found to answer well for canning. It is as before mentioned, abundant, especially about Ungava Bay, where it varies in weight from 2 lbs. to 15 lbs. and averages about 5 or 6 lbs. Barren ground caribou were found in large numbers along the route eastward from Clearwater Lake to the Kenogami Branch, while everywhere throughout the region the willow grouse or ptarmigan breeds in thousands. Other game is scarce."

Labrador Peninsula—*Cont.*

Fish.

Nova Scotia.

The general geological examination of the south-western part of Nova Scotia, was continued by Professor L. W. Bailey during the past summer. Prof. Bailey, who was assisted by Mr. Roy Van Wart, reports as follows on the work accomplished:—

Work by Prof. Bailey.

"These explorations were made in compliance with your letter of instructions of May 28, directing me 'to continue and if possible to complete, for a final general report, the geological examination of south-west Nova Scotia, filling as far as possible the gaps in our knowledge of the geological structure of the part of Nova Scotia indicated, and giving particular attention to the character and mode of occurrence of minerals of economic value.' At the same time, at my request, the two manuscript reports previously submitted and accepted for publication, were returned for revision, with directions that they should be combined into a single report in connection with the work of the season just passed.

South-western counties of Nova Scotia.

"The special objects to which my efforts were directed and the results relating thereto may accordingly be summarized as follows:—

Particular objects of the work.

"1. The more complete delimitation of the Cambrian system and the granite in portions of Queens and Shelburne counties. The tracts

Cambrian rocks.

Nova Scotia—*Cont.*

more particularly examined for this purpose were portions of Lunenburg county bordering on that of Queens, portions of the coast of Queens county west of Liverpool Harbour, the peninsula between Shelburne Harbour and Jordan Bay, and the region about the Brookfield mine. Among the results attained were the recognition of some anticlines not previously worked out, the more exact limitation of others, and the establishment of the staurolitic and andalusitic schists of Shelburne county as the metamorphosed equivalents of the green slates (Div. 1.*b*) of the Cambrian succession. The facts ascertained have also an important bearing on the age of the similar strata in Yarmouth county.

"2. The determination, by the evidence of fossils, of the rocks referred to the Cambrian system. Much time was devoted to the solution of this question, but without result, prolonged search at many different points or wherever there seemed to be any promise of success, uniformly failing to show any trace of undoubted organic remains.

Boundaries of the Devonian.

"3. To determine the position and extent of the Devonian rocks of Digby county as distinguished from the rocks of supposed Cambrian age, and to fix the boundary between these two systems. This was found to be a work of much difficulty, and the conclusion reached can hardly yet be regarded as final. While evidence is abundant as to the co-existence of both systems in the region referred to,—the evidence in the one case being the occurrence of fossils and in the other the close correspondence, both in the nature and succession of the beds, to the so-called Cambrian rocks of Queens and Shelburne counties,—there are many points of resemblance between the two, while the difficulty of identification is greatly enhanced by the metamorphism to which both groups of rocks have been subjected. The areas as to which this uncertainty still attaches, include certain tracts about Mistake River, a branch of the Sissaboo, the vicinity of Cape Cove near Cape St. Mary, and portions of the high land between the Grand Joggins and Bear River. The data obtained during the past summer have not yet been sufficiently studied to permit of any definite conclusions being stated here.

Age of the Devonian and Silurian.

"4. To ascertain the exact age of the rocks referred to the Devonian system at Mistake settlement, Bear River and Clementsport, whether wholly Devonian or partly Silurian; to fix the order of succession of these beds, and their structural relations.

"These points were of the first importance, not merely as tending to settle questions as regards the age of the beds themselves, about which in past years there has been much controversy, but also as

bearing upon economic questions, such as the distribution of iron ores, and as helping to afford data for the more certain separation of the Devonian and Cambrian strata as referred to above. For the reasons mentioned, a large part of the summer was devoted to the study of these rocks, and the results were most satisfactory. In addition to large collections of fossils from localities previously known, many new localities were ascertained, and these in such relations to each other and to the principal ore-beds, as to leave no doubt as to the general structure of the whole region. In pursuance of these investigations it was found necessary to devote especial attention to the rocks at and about Nictau, and thence to the vicinity of the Torbrook mines, while a short excursion for the purpose of comparison was made as far eastward as New Canaan. Through this great tract, for a distance of over fifty miles, the beds were found to be essentially the same as regard both their nature and succession, the latter occurring in inverse order on either side of a general axial line, and thus revealing a general synclinal structure. The fossils referred to are now in the hands of Dr. Ami for examination. Other results were the recognition of fossiliferous strata well within the areas assigned in all previous maps to the granite, and the working out of the often intricate contacts of these two groups of rocks. Nova Scotia—*Cont.*

"5. The occurrence of economic minerals. These embrace gold, iron, copper, ornamental stones, sand, brick-clays, infusorial earth, and asbestus. Economic minerals.

"*Gold.*—In addition to the work of ascertaining and defining the position of anticlines not previously made out, a visit was made to the Brookfield mines in Queens county, which have recently assumed a position of great importance as a gold producing centre. This visit afforded a striking illustration of the uncertainties of gold mining, as also of the fact that mines regarded for a time as unproductive may under more effective treatment prove highly remunerative. Thus, at the time of my first visit to Brookfield in 1890, the work then in progress was confined to what was known as the Philadelphia mine, employing about 40 hands, to reach which it was necessary to pass the McGuire mine where work had wholly stopped for want of satisfactory returns. On the second visit, made last summer, but little was being done at the Philadelphia mine, while the McGuire mine was making returns of from $7,000 to $10,000 per month. About 50 men are at present employed here as miners, with as many more in other ways, the proprietors being so encouraged by what has been already done as to have entered upon the construction of a new and large mill of 40 stamps, in which the ore will be subjected to combined processes of Gold.

Nova Scotia—*Cont.*

amalgamation and chlorination. It is also proposed that all the tailings resulting from former workings shall be subjected to the same process.

"At Molega also, as well as at Whiteburne, there have been similar vicissitudes, the Parker Douglas mine, which for several years past has been lying idle, having resumed work. The Ballou mine is also being worked here, with good results. At Whiteburne, on the other hand, formerly a centre of much activity, but little is now being done, a 10-stamp mill being the only one in operation, on ore from what is known as the 'Graves Mine,' formerly owned by the Whiteburne Mining Company.

"In Yarmouth county, work, chiefly of a prospecting character, was being carried on both at Kempt and at Carleton, but as yet with very meagre results.

"Gold is reported to have been found in small quantities in some parts of Digby county, but reliable information on this point is wanting.

Iron.

"*Iron.*—The study of the iron ores of Annapolis county was wholly incidental to the working out of the geological structure of the region, but led to some important results. Thus ores of this character were recognized as occurring on not less than thirty-four different properties, these being further so disposed as to indicate the existence of several parallel belts, which are, in part at least, repetitions of the same beds along the crests of anticlinal folds. The diversity in the nature of the ores, whether red or black hæmatite or magnetite, seemed apparently to have no direct relation to the neighbourhood of granite, all these varieties being sometimes found in close proximity to each other. At Nictau, the ores are abundantly fossiliferous, even though the rock be magnetite. At Torbrook the rock, though hæmatite, is without fossils, these being confined to the associated beds. Some of the latter, were it not for the fossils, could not well be distinguished from the hardest quartzites of the Cambrian system. Work at Torbrook had been suspended and the pumps removed from the mines, as a result of diminished demand for the product.

Copper.

"*Copper.*—The trappean rocks of the North Mountains and Digby Neck, frequently exhibit green stainings resulting from the presence of this metal, and occasional strings of native copper are met with. One of the best localities for the latter is the shore about the eastern side of the entrance of Digby Gut. There is, however, no reason to suppose that any workable veins will be found either at this point or elsewhere in the rocks referred to.

Nova Scotia—*Cont.*

Ornamental stones.

"*Ornamental stones.*—Varieties of quartz, such as agate chalcedony, amethyst and jasper, were frequently observed, but not of such quality as to deserve special notice here. Thomsonite, sometimes associated with *analcime*, was found rather abundantly either side of the entrance of Digby Gut. At Paradise, in Annapolis county, veins in the granite sometimes exhibit quartz penetrated by black acicular crystals of tourmaline. Garnets were observed abundantly in different parts of Yarmouth county, but of poor quality.

Sands and clays.

"*Sand.*—The only deposits of this material deserving special notice here, are the dunes or hills of blown sand which occur at various points upon the southern coast. The largest beds are those found on the west side of Port Mouton Harbour and the east side of Barrington Bay. In each case they cover many acres of surface, and are piled up to heights of from 50 to 60 feet. Though destructive to the soil and trees of the region they invade, their purely siliceous character would seem to fit them admirably for glass making, for the manufacture of artificial stone and for kindred purposes.

"Fine white sands were also observed at several points in the Annapolis valley, especially near Middleton.

"*Brick-clays.*—Clays suitable for brick making are also found in the vicinity of Middleton. They are tough, brick-red in colour and of unknown depth. Bricks are manufactured here in considerable quantities. About a mile south-east of Marshalltown Church, Digby county, is a deposit of fire-clay. This has not been visited by me, but it is described by Mr. J. Lonergan, of Saulnierville, as extensive. Specimens received from this gentleman are reported by Dr. Hoffmann to be non-calcareous, fusible with difficulty and susceptible of employment in the manufacture of fire-brick.

Other minerals.

"*Infusorial earth.*—Specimens of this material, said to have been found in the vicinity of Meteghan River, in Digby county, and of good quality, have been shown to us, but we are without definite information as to location or amount.

"*Asbestus.*—Veins of this mineral occur in connection with dioritic rocks between Clementsport and Bear River, and some specimens of good quality as to purity and length of fibre, have been shown to us, but such as we have seen *in situ* have been small in amount and of inferior character.

"*Scheelite.*—Among some specimens sent to the Geological Survey by Mr. W. H. Prest, from the Ballou mine, Molega gold district, Queen's county, Dr. Hoffmann has detected this mineral, valuable as an

Nova Scotia—*Cont.*

ore of tungsten. It is not known to be present in any considerable quantity but may be worth looking for in connection with future mining operations.

"The following additional results of the summer's work may be noticed here as of some interest :—

Rocks possibly newer than the Trias.

"In connection with the examination of the red sandstones and associated beds about Digby and in the Annapolis valley, and which have generally been regarded as having antedated in origin the traps of the North Mountain, these were at several points found to contain numerous and in some instances very large blocks of the same traps. It would seem to follow from this observation that the beds in question are either of later origin, as has been supposed by Dr. Ells in the case of certain *whitish* sandstones observed by him in Scott's Bay, near Blomidon, *resting on the traps*, or that they are agglomerates of contemporary origin. As similar beds, often whitish, but as far as known without embedded traps, occur all the way from Digby to Kentville, underlying the fertile Annapolis valley, the observations referred to and the conclusions to be drawn have a wide application.

Marine organisms in clays.

"In the brick-clays in the vicinity of Middleton, remains of marine shells and star-fishes, (Ophiurans) have been found, as well as remains of true fishes. This would indicate that the Annapolis valley was in the post-Tertiary (Champlain) period wholly occupied by salt water, the North Mountains being then an island in the Bay of Fundy.

"The work of revision of the two large reports previously submitted, and covering the whole of the four south-western counties, is now in hand, and will be carried on to completion, in connection with the work of the past season, as rapidly as circumstances will permit."

Work by Mr. Fletcher.

Mr. Hugh Fletcher was engaged during the winter of 1895-96 in plotting his surveys and in revising those made by his assistants in Cape Breton; in reducing his plotting sheets, the Dominion Coal Company's map and plans of Sydney Mines, North Sydney, and other places, as well as in compiling on a scale of one mile to an inch, many surveys made in Cumberland county by the late Mr. Scott Barlow, Mr. McOuat and others in the immediate neighbourhood of Springhill Mines, on twenty chains to an inch, with a view to further operations in that part of Nova Scotia. Some time was also spent in connection with the preparation of the map-sheets including the Pictou coal-field. As preparatory to this, all Mr. Poole's field-maps were compared with Mr. Rutherford's twenty-chain plan. Sir William

Logan's large plan and other sources of information were also consulted and the map finished to date by the addition of roads, brooks, crops, faults and other geographical and geological features. Nova Scotia—*Cont.*

During the winter, connected sections were also made from the various holes bored by the diamond drill in the Sydney coal-field, for comparison with others measured on the sea-coast. One of these, Mr. Fletcher states, seems to show that in the bore-hole near the crossing of the Hines road and old Louisburg railway, the Tracy seam lies only about four hundred and fifty feet from the surface, where it had previously been supposed to be more than fourteen hundred. A recent opening at the Tracy mines gave an opportunity to examine the coal of this seam which showed: Sections constructed from borings.

Top coal	2 feet	7 inches
White fire-clay	0 "	3 to 9 "
Bottom coal	0 "	11 "

By miners who have worked in this seam and by Lyman, the clay parting is said to run out or decrease to one or two inches in thickness. The quality and thickness of the coal at the bore-hole above mentioned are still to be tested by careful boring or by a deep trial-shaft.

Respecting operations during the past summer, Mr. Fletcher writes as follows:—

"Leaving Ottawa on June 10th, 1896, to resume field-work in Nova Scotia, I remained in Cape Breton until August 1st, to make additional surveys, particularly in the neighbourhood of the Cow Bay, Morrison and Macpherson roads, and on the west side of Sydney Harbour, necessary to complete information for the new editions of the Little Glace Bay, Sydney, and Cape Dauphin map-sheets in the Sydney coal-field, and returned twice afterwards (Sept. 23-25 and Dec. 4) to examine the results of explorations subsequently made by Mr. E. T. Moseley and the Messrs. Burchell at the west end of the Cow Bay basin and along the anticline between the Lingan and Glace Bay coal-basins. I was in Pictou county with Dr. Dawson and Dr. Ami (August 3rd to 19th and again on September 19th,) to make supplementary surveys required near New Glasgow, also from Nov. 20th to 25th, to discuss with Mr. Poole geological relations of the rocks of certain portions of the sheets of the Pictou coal-field. The remainder of the season was spent in an examination of the country covered by the Springhill map-sheet, between Thompson and Athol railway stations; and from November 9th to 18th, a section was measured of the strata exposed on the shores of Chignecto Bay, between Shulee and Spicer's Cove, for comparison with Sir William Logan's Joggins section Outline of field-work.

Nova Scotia—*Cont.*

on the opposite side of the basin, with the object of endeavouring to fix the age of the various groups of rocks.

Observations in Cape Breton.

"In Cape Breton, the coal seam at the head of Bridgeport Basin (Summary Report 1895, p. 109) has been successfully traced round the anticline by Mr. Burchell's explorations, and its identity with the seam found in Macdougall's pits, I find apparently established. The bottom of the Cow Bay basin has been defined more precisely, as well as the position of the anticline between the basin and that of Glace Bay, by a continuation of the explorations of Messrs. Moseley and Kennelly; but more work is necessary to prove the existence of workable coal seams among the lower strata of these basins. It has been already stated that the axis of the former anticline lies further north than was at first supposed. To verify this, pits were sunk at Allan Nicholson's, Lauchlin McLean's and Angus McDonald's (Shoemaker) some distance north of the Cow Bay road, in all of which a low northerly dip was obtained. Consequently, the coal-seam of the Martin pit and those underlying it, must be carried for some distance to the westward, unless an easterly dip of the bottom of the basin throws the crops to the surface, of which there is no proof from the dip observed, while a line of strong springs points to the continuity of the strata as far as John D. McDonald's.

"It was also stated in last Summary Report, that the steep dips of the Cow Bay basin pass the old Louisburg Railway. Southerly dips have also been found on the west side of the Macpherson road. Here and on both sides of the Cow Bay and Morrison roads, certain belts of rock were followed as an indication of the structure, and the Buchanan seam was traced by the shale or coherent flag which overlies it. Near the shore of Bridgeport Basin, above Lingan Bar, a seam of coal about four feet thick, but twisted, dirty and unfit for burning, with a roof of coherent argillaceous shale and sandstone, was lately opened in a shaft and level on the line between the General Mining Association and Mr. Rabbit.

"Several bore-holes, some of them more than two hundred feet in depth, have been sunk by the Messrs. Routledge in search of the Tracy seam, in the grey sandstone of the North-west Brook and towards Sydney Harbour. At Mira Bay red strata cease some little distance above the Tracy seam, very few bands being found beneath it, whereas at the Cow Bay road it is overlain—if it be the equivalent of the Fitzpatrick seam, as has been generally assumed—by a great thickness of gray sandstone with thin layers of grey argillaceous shale, as far as Mr. Hugh Cusack's, where a belt of gray coherent

flag is associated with one of red sandstone and shale. The line of replacement of the red rocks by the gray has not yet been definitely determined. Nova Scotia—*Cont.*

"A section was made of the strata overlying the Coalbrook seam of Mira Bay, not before closely measured, but necessary for comparison with the rocks of the bore-holes along the old Louisburg Railway. They were found to be all regular, to contain no coal and to lie flatter than estimated, so that only 457 feet 4 inches was found instead of 683 feet of the alternations immediately overlying the Coalbrook seam given in the Report of Progress for 1874-75 (p. 177).

"The Dominion Coal Company continues to develop its mines, and a larger coal-washer has been erected at Morrison Lake. There was no interruption to the shipment of coal from Louisburg last winter. At the North-west Arm of Halifax Harbour, the People's Heat and Light Company has built works capable of converting annually 20,000 tons of coal from their mine into "crushed coke" for domestic, foundry and manufacturing purposes and all the uses to which anthracite is generally applied, gas for illuminating and heating purposes, and coal tar, sulphate of ammonia, ammonia, ferrocyanide of potash, benzol and other bye-products. Coal mining.

"On December 10th I visited, in company with Mr. C. P. Moffat of North Sydney, the copper mine at George River, where a considerable quantity of chalcopyrite, remarkably free from admixture with other sulphides, has been taken from a shaft 80 feet deep, on a vein said to vary in thickness from 12 to 28 feet, with 6 feet very rich, but not accessible at the time of my visit because the shaft was full of water. The ore is associated chiefly with quartz, calcite, chlorite, serpentine and other minerals of the George River limestone formation (Laurentian?) described in the Report of Progress for 1875–76, pages 381 to 387. Specimens of this ore were collected for the museum. Copper ore.

"At Long Island Barachois, 300 or 400 tons of rich hæmatite have been taken from the contact between the Carboniferous and pre-Carboniferous rocks. Other mineral products.

"From St. Anns about 10 tons of infusorial earth were shipped last year by the Victoria Tripolite Company, from a deposit three or four feet thick, in a lake.

"About 60,000 bricks were made last summer by Mr. A. D. McLeod from a large clay deposit near the Cossitt mine, about 2¼ miles south-east of Sydney.

"Graphitic shales, said to be suitable for the manufacture of carbons for electric lights, have been worked near Christmas Island,

Nova Scotia—*Cont.*

among quartzites and dark slates underlying soft, red, Carboniferous marl and conglomerate and perhaps of Cambrian age.

Work in Cumberland county.

"Of the work in the neighbourhood of Springhill Mines, but little can be said at present, as the district requires more study and closer examination. The scarcity of outcrops and similarity of composition of the different groups of rocks, makes the determination of the geological structure difficult and has led to the different views held regarding their age and relative position. Surveys were made of various branches of Black and Maccan rivers, River Philip, Polly Brook, and other streams not already mapped by Dr. Ells and the late Messrs. Scott Barlow and Walter McOuat, whose reports contain much valuable information concerning the geology of the district. A general description of the rocks of the section on the Chignecto Bay, may be found in the Summary Report for 1892 (p. 42).

Infusorial earth.

"Near Castlereagh in Cumberland county, a large deposit of infusorial earth has been worked in Bass River Lake, which has been drained for the purpose. Buildings have been erected for the workmen and for cleaning and drying the 'silica,' a considerable quantity of which has been transported over a pole railroad to a shipping-place on Minas Basin.

"I have again to express my appreciation of the work done by Mr. M. H. McLeod in the capacity of assistant in the field."

Work by Mr. Faribault.

Mr. E. R. Faribault's office work, since the date of the last Summary Report, has been wholly in connection with the compilation of the results of his surveys in the gold-bearing regions of Nova Scotia. The first part of the winter of 1895-96 was spent plotting the surveys made during the previous summer, and revising those made by assistants, as described on pages 111-114 of the last Summary Report. Much time was also occupied in compiling, from these surveys and other sources, the manuscripts for the four following sheets, on the scale of one mile to an inch :—

Map-sheets in course of completion.

No. 53—Lawrencetown sheet.

" 54—Preston sheet.

" 55—Middle Musquodoboit sheet.

" 56—Stewiacke sheet.

These sheets are now almost completed for the engraver. They cover an area of 864 square miles, extending along the Atlantic coast from Musquodoboit Harbour to Halifax Harbour, and inland to the

Stewiacke and Shubenacadie rivers, and are included in the counties of Halifax and Colchester. A structural section has also been made for the Fifteen-mile Stream sheet, and similar sections have still to be prepared for the seven sheets numbered 49, 50, 51, 53, 54, 55 and 56, in order to complete these. Nova Scotia--*Cont.*

A special plan of the central part of the gold-mining district of Goldenville was also plotted on the scale of 150 feet to an inch, and a cross-section prepared.

Mr. Faribault's report on the work accomplished during the season is as follows :—

"According to your instructions, received May 23rd, I left Ottawa on May 25th, to resume field-work in Nova Scotia and to continue the mapping and study of the structural geology of the gold-bearing rocks of the Atlantic coast region, including the completion of the surveys required for the sheets numbered 67, Waverley sheet, 68, Halifax City sheet, 69, Prospect sheet and 88, Mahone Bay sheet; but a severe illness prevented me from reaching my field of operations before June 17th. My assistants, Messrs. A. Cameron and J. McG. Cruikshank, however, began field-operations on the date appointed, June 5th, and they completed the surveys required for the Waverley sheet, the Halifax City sheet and the Prospect sheet, on August 14th, when they proceeded to survey the Mahone Bay sheet. The intervening granitic country between this sheet and the Halifax City sheet, being of relatively small importance geologically or from an economic point of view, has been passed over for the time being, in conformity with instructions received. Districts surveyed in 1896.

"Continued heavy rains in September and October interfered greatly, however, with the progress of work in the field, and bush-work had to be discontinued on September 29th. From that date Mr. Cruikshank was engaged surveying the sea-shore from East Chester westward, reaching La Have River on October 26th, and Mr. Cameron resumed the surveys, by odometer, of the roads included in the Mahone Bay sheet, and those in the Lunenburg sheet on the east side of La Have River, ceasing field-work on November 19th.

"My own time in the field was principally devoted to the study of the structural geology of the Waverley sheet and the Halifax City sheet. The area covered by these two sheets and the Prospect sheet, is nearly all included in Halifax county, the north-west corner of the Waverley sheet only being included in Hants county. It comprises the country surrounding Halifax City and extending along the Atlantic coast from Devil's Island, at the eastern entrance of Halifax Harbour,

Nova Scotia—*Cont.*

to Dover Bay, and inland to the Shubenacadie Grand Lake and Mount Uniacke.

Waverley sheet.

"The Waverley sheet is almost entirely occupied by rocks of the gold-bearing series, only a small area at its eastern limit, to the east of Soldier Lake, being covered by the western extremity of the granite ridge extending from here to Sheet Harbour; while, at its western end, the gold-bearing rocks are cut by the mass of granite forming the back-bone of the country, extending from here to Yarmouth.

Halifax City sheet.

"The Halifax City sheet is about equally divided, the north-east part being occupied by gold-bearing rocks and the south-west part by the most eastern extremity of the last above-mentioned granite ridge, which also entirely covers the Prospect sheet.

"The gold-bearing rocks of the region examined have been forced into a series of folds, almost parallel to each other, bearing a general easterly and westerly course. Eight double folds, each composed of one anticline and one syncline, were located across the belt of twenty-five miles extending from the coast to Mount Uniacke. The structure of these plications was carefully studied and the anticlinal axes were traced and worked out with as much accuracy as possible, on account of their importance in regard to the occurrence of gold.

Anticlines between Cow Bay and Mount Uniacke.

"The names given to the eight anticlines, in order of their occurrence from Cow Bay to Mount Uniacke, and their location, with notes in the gold mines worked and quartz veins observed along their course, are as follows:—

De Said Lake anticline.

"1. *De Said Lake Anticline*—Crosses the middle of McNab Island about the Garrison pier, where only the upper strata of the lower quartzite group are brought up to the surface on the axis; and, extending eastward, it passes at the outlet of De Said Lake. The fold ends at the beach, before reaching Cole Harbour, where a few quartz veins, especially on the east side of the harbour look promising. About three-quarters of a mile south of this anticline, a true fissure vein running north and south and cutting at right angles the highest strata of the lower quartzite group at their junction with the upper slate group, was discovered to contain gold in the autumn of 1895. Since then a number of other fissure veins quite similar and parallel to each other have been found to be auriferous at this place on the Hill and Thompson, the Foster and other properties. A crusher was built last summer, and development is being pushed with activity.

Lawrence town anticline.

"2. *Lawrencetown Anticline*—Crosses the city of Halifax between Buckingham and Jacob streets, and running westward traverses the

north end of the Citadel Hill and the Commons about Egg Pond, whence following the south side of Quinpool Road about Shirley street, it crosses the North-west Arm at Melvin Island Cove, where it is cut off by granite. Only rocks of the upper slate group are brought up to the surface by this fold in the city of Halifax, but on the east side of the harbour, it has brought up to view the lower quartzite group. Passing near the lunatic asylum, the axis then crosses the middle of McDonald Lake and the Big Salmon River at its discharge into Cole Harbour, on its course to Lawrencetown gold district. Gold has often been found in the rock débris while trenching along Quinpool road and the streets to the south; and a few small quartz veins cut across between Pepperell and Shirley streets are reported to have exhibited a few 'sights' of gold. Promising quartz veins, a few of them prospected, have been observed at the head of Cole Harbour. Nova Scotia—*Cont.*

"3. *Montague Anticline*—Crosses the west side of Bedford Basin at Birch Cove, and comes in contact with the granite but a short distance west of the basin. Eastward, it passes about Navy Island in the basin, at the foot of Lake Charles and through the Montague gold district. The belt of numerous quartz veins so extensively worked in length and depth at Montague for over thirty years, is wholly comprised in the south dip of this fold, nothing but exploratory work having so far been done on the northerly dipping veins. A rich vein, however, was reported to me to have been found on the north dip last autumn. Numerous very promising quartz veins, many of them of a barrel-structure, have been noticed on the west side of Bedford Basin at Birch Cove and on Carney Road, also directly west of the cove as far as the granite, and on the east side of the basin, about Taylor and Spectacle lakes. Montague anticline.

"4. *Waverley Anticline.*—From the edge of the granite south of Hammond's Plains, this runs eastward and crosses the Hammond's Plains road, at its junction with the new road to Bedford. Then it crosses Sandy Lake, and from the Windsor road it follows the old Cobequid road to the Intercolonial Railway, passing thence through the gold district of Waverley and terminating at the south end of Soldier Lake, where it is cut off by granite. The wide belt of quartz veins occurring at Waverley has been extensively worked both in depth and length, especially on the north side of the axis, but a number of veins have also been worked on its south dip, some of them having been traced on the surface completely around the westerly end of the elliptical dome of the fold. Waverley anticline.

"*Caribou Anticline.*—This fold only brings up here the upper black slate group. Leaving the granite west of Hammond's Plains, it passes Caribou anticline.

Nova Scotia—*Cont.*

the post office of this place and crosses the Sackville River at the outlet of Middle Sackville Lake, runs about the middle of Lake Fletcher and Kelley Long Lake, and crosses the road to Oldham, half a mile north of Goff post-office. A few quartz veins have been prospected along this line, and some have been found to contain gold on the road to Oldham and at Hammond's Plains, but most of them are small and not promising.

Horn settlement anticline.

" 6. *Horn Settlement Anticline*—Leaves the granite at the west end of Pockwock Lake, and, following the south side of this lake eastward, it crosses the Windsor road at the south end of Lewis Lake, the Windsor and Annapolis Railway at the saw-mill, one mile north of Long Lake, the Beaver Bank River at the north end of Square Lake and the Beaver Bank road on Joe. Shaunahan's farm. Thence, passing on the north side of Sandy Lake and following down King's Meadow Brook, it strikes the north-west side of Shubenacadie Grand Lake at Sleepy Cove, and its south-east side at the Horn settlement. Very promising quartz veins, showing free gold, were opened up at the Horn settlement a few years ago, but no exploratory work of any importance has since been done on them. Gold-bearing drift is reported to have been found in many places along this line between the Beaver Bank road and Shubenacadie Grand Lake, mining areas have been taken up from time to time, and a few quartz veins tried between Sandy Lake and Gold Lake. Quartz veins were also observed south of Lewis Lake and along Pockwock Lake, some having a barrel structure.

South Uniacke anticline.

" 7. *South Uniacke Anticline.*—Leaves the granite east of Lacy Mill Lake, crosses the Windsor road one mile north of the county-line, passes 700 feet south of the belt of quartz veins worked at South Uniacke, to the east of which it degenerates into an undulation crossing the Beaver Bank road half a mile south of North Beaver Bank post-office. Only a few veins have so far been worked at South Uniacke, one of them, however, the Hard lead has been mined 1000 feet along a very rich and most regular and persistent pay-streak, dipping at an angle of 30° and averaging 50 feet broad and 4 to 5 inches thick, with a uniform yield from the outcrop to the bottom of the pay-streak of 7 to 12 ounces to the ton. It is most probable that good pay-streaks exist in this district in parts of other quartz veins which occupy the same structural position as that held by the pay-streak of the Hard lead with reference to the anticlinal fold. On veins south of the Hard lead, pay-streaks should then be looked for to the west of the outcrop of the pay-streak of that lead; and on veins north of the Hard lead, pay-streaks should be sought for to the east of

the same outcrop. These conclusions have been arrived at from the study of the structure of the principal gold districts in the province. They are of the most practical importance in locating pay-streaks in a gold district, and should be well understood by gold miners. As the anticline at South Uniacke dips east, so does the pay-streak, and the interbedded quartz veins, like the strata, curve to the south-east around the eastern end of an elliptical dome; but, as the south side of the anticline has an almost flat easterly dip, the veins will not in this district curve completely around the anticline, and there will be no southerly dipping veins. Nova Scotia—*Cont*

" 8. *Etter Settlement Anticline.*—Leaving the granite at the north-east cove of West Lake, this crosses the Windsor road 500 feet north of the Etter settlement church and Lewis Mill road at the bridge on the head of Sackville River, where the lower quartzite group is capped by the upper slate group to the eastward beyond the limit of the Waverley sheet. No quartz vein has been observed along this line within the latter sheet. Etter settlement anticline.

" Detailed observations have been made of the structural geology of the city of Halifax and its immediate surroundings, by taking advantage of the many miles of trenching made along the streets by the People's Heat and Light Co., to lay their pipes.

" I have done so far but little geological work in examination of the area covered by the Mahone Bay sheet, (No. 88), the surveys of this sheet having been made entirely by my assistants. It has been observed that the upper slate group of the gold-bearing rocks predominates in the area covered by this sheet, and the lower quartzite group is only brought up in narrow belts along anticlinal folds. On the northern limit of the sheet the gold-bearing series comes in contact with the granite mass of the interior; and along the sea-shore, at Indian Point and East Chester, it is overlain by small patches of Lower Carboniferous limestones, conglomerates and sandstones, apparently denuded outlyers of a great Carboniferous basin extending far into the Atlantic. Beds of Carboniferous limestone are quarried at East Chester on Indian Point and on the shore of Goat Lake. The gold mining districts of Chester Basin and Blockhouse are included in this sheet, but have not yet been surveyed. Operations were being carried on at both places last summer. Rocks near Mahone Bay

" A few faults, bearing a general north-and-south course, cut the stratification at right angles, and some time was taken up in tracing these and working out the magnitude of the displacements. Some very interesting facts have also been gathered bearing on the surface geology.

Nova Scotia—*Cont.*

Report in progress.

"A report is now in progress, which will, it is hoped, be ready for the printer next spring, on the gold-bearing rocks covered by the following eight sheets, which are in different stages of advancement toward publication.

No. 39 Tangier sheet.
" 40 Sheet Harbour sheet.
" 41 Fifteen-mile Stream sheet.
" 42 Trafalgar sheet.
" 48 Eastville sheet.
" 49 Upper Musquodoboit sheet.
" 50 Moose River sheet.
" 51 (& 52) Ship Harbour sheet.

"The area covered by these sheets contains the gold districts of Tangier, Killag, Fifteen-mile Stream, Caribou, Moose River, Mooseland, Salmon River, Ragged Falls, Little Liscomb Lake, Beaver Dam and Gold Lake. Plans of the six first-named districts have also been prepared on the scale of 500 feet to an inch, the intention being that they shall accompany the report above referred to."

Chemistry and Mineralogy.

Report of Dr. Hoffmann.

Reporting on the work done in these branches of the Survey's operations, Dr. Hoffmann, says:—"The work carried out in the chemical laboratory during the past year, has been, in pursuance of the practice of former years, almost exclusively confined to the examination and analysis of such minerals, ores, etc., as were considered likely to prove of more or less economic value and importance. Briefly summarized, it embraced:—

Character of analyses and assays made.

"1. Analyses of natural waters—with the object of ascertaining their suitability for domestic or manufacturing purposes or probable value as a remedial agent—from various parts of the provinces of Nova Scotia, Quebec and British Columbia.

"2. Analyses of various fossil fuels from the province of Nova Scotia, the North-west Territory and the province of British Columbia.

"3. Analyses of iron ores from the provinces of New Brunswick, Quebec, Ontario (chiefly from the townships of Bedford, Palmerston, Storrington and Portland, in Frontenac county; the townships of South Sherbrooke, Bathurst, Darling and Lavant, in Lanark county; and the township of Bagot, in Renfrew county), and British Columbia.

"4. Analyses of limestones and dolomites—in continuance of the series of analyses of limestones and dolomites already carried out, in connection with an enquiry into the individual merits of a number of these stones, from various localities, for structural purposes, for the manufacture of lime, or of hydraulic cement, *etc.* Chemistry and mineralogy—*Cont.*

"5. Assays, for gold and silver, of ores from the provinces of Nova Scotia, New Brunswick, Quebec and the Ungava district of the Labrador Peninsula; from the districts of Nipissing, Algoma, Thunder Bay, Rainy River, and other parts of the province of Ontario; from the districts of Alberta and Athabasca, in the North-west Territory; and from the East and West Kootanie districts, Interior Plateau region and Coast Ranges and Coast region, of the province of British Columbia.

"6. Analyses of several highly interesting and, in most instances, from a commercial standpoint, important minerals, comprising, among others—'altaite,' a lead telluride, from a new locality; 'scheelite,' a tungstate of calcium, also from a new locality; and the following, not previously recognized as occurring in Canada, namely, 'tetradymite,' a bismuth telluride; and a mineral obtained by Mr. R. G. McConnell, which proves to be 'stromeyerite,' a sulphide of silver and copper; and which was found to contain over fifty-one per cent of silver. A specimen has also been received of another somewhat recently discovered mineral, which is new to Canada, that is to say 'hessite,' a silver telluride, which also contains a very high percentage of silver, and not unfrequently more or less gold. An analysis has also been entered upon of another mineral, collected by Mr. McConnell, which is evidently a highly cobaltiferous mispickel, most probably referable to 'danaite,' and which also carries free gold. This, if occurring in quantity, would, apart from its gold content, be of some economic importance as an ore of cobalt. Among other minerals identified in this laboratory, and which were not previously known to occur in Canada, may be mentioned 'bismite' or bismuth-ochre, a trioxide of bismuth; 'smithsonite,' a carbonate of zinc, and some few others of lesser importance.

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

"8. Miscellaneous examinations, such as the partial analysis or testing, as the case might be, of samples of manganese ore, graphite, carbonaceous shales, iron-sand, clay, marl, and of other material not included under the above headings.

"The number of mineral specimens received, during the past year, for identification or for an expression of opinion in regard to their economic value, amounted to six hundred and ninety-seven. Of these, Mineral specimens examined.

Chemistry and mineralogy—*Cont.*

a large number were brought by visitors, to whom the desired information was communicated at the time of their calling, or failing that—owing to a more than mere cursory examination being necessary, or when a partial or even complete analysis was considered desirable—it was subsequently conveyed to them by letter. The number of letters personally written—chiefly of the nature of reports and embodying the results of the examination, analysis, or assay, as the case might be, of mineral specimens—amounted to two hundred and ten; and the number of those received to one hundred and fifteen.

Work of assistants.

"Messrs. R. A. A. Johnston and F. G. Wait, assistants in the laboratory, have, by their application and assiduity in carrying out the work respectively entrusted to them, proved most efficient aids. Of these, the former has, apart from the carrying out of a very lengthy series of gold and silver assays, made many important mineral analyses, and likewise conducted a great variety of miscellaneous examinations; whilst the latter has made very many analyses of natural waters, iron-ores, limestones, etc., as also many miscellaneous examinations.

"In the work connected with the mineralogical section of the museum, I have been, as heretofore, diligently assisted by Mr. R. L. Broadbent. He has, in addition to the general museum work—such as the labelling and cataloguing of all newly received specimens, and the maintaining of the collection generally in an orderly condition—been engaged in correcting printer's proof of labels for the collections illustrating the distribution of iron, copper, lead, antimony, and other ores; and in preparing the manuscript of similar labels for the collection of gold and silver ores from certain sections of the province of British Columbia, and from the Thunder Bay district of the province of Ontario.

Contributions to museum.

"The additions to this section of the museum—which now contains some nine thousand specimens, of which about seven thousand are on exhibition in the cases, and two thousand placed away in drawers—during the past year, amounted to one hundred and thirty-one. Of these, the following were:—

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

Ami, Dr. H. M.:—

a. Pyrolusite from Teny Cape, Hants county, N.S.

b. Limestone from the St. Louis de MileEnd quarry, Montreal, Q.

c. Limestone from the St. Laurent quarry, Montreal, Q.

Contributions to museum—*Cont.*

d. Raw cement stone from the Gale Farm, Hochelaga, Montreal, Q.

Barlow, A. E., and Adams., Dr. F. D. :—

a. Sodalite from the township of Dungannon, Hastings county, O.
b. Nephelite " " "
c. Hastingsite " " "
d. Magnetite " " "
e. Pyroxene from the township of Herschell, Hastings county, O.
f. Biotite " " "
g. Diabase showing concretionary structure from two miles west of Sudbury, district of Algoma, O.

Ells, Dr. R. W. :—

Calcareous nodule attached to crystalline limestone boulder from Besserer's Wharf, Ottawa River, Carleton county, O.

Faribault, E. R. :—

a. Limestone from quarry at Indian Point, East Chester, Lunenburg county, N.S.
b. Limestone from quarry at Goat Lake East Chester, Lunenburg county, N.S.

Ferrier, W. F. :—

a. Andradite from the Emily mine, Tudor, Hastings county, O.
b. Stilpnomelane (var. chalcodite) from the Wallbridge mine, Madoc, Hastings county, O.
c. Pyroxene from the township of Carlow, Hastings county, O.

Low, A. P. :—

Crystal of pyrite from the Ungava River, Labrador Peninsula.

McEvoy, J. :—

a. Alunogen from Blair Creek, a branch of Bolean or Six-mile Creek, Salmon River, Grande Prairie, Yale district, B.C.
b. Clinochlore from Fadear Creek, a branch of Louis Creek, North Thompson River, B.C.

McConnell, R. G. :—

a. Stromeyerite from the Silver King mine, Toad Mountain, West Kootanie district, B.C.
b. Cobaltiferous mispickel with erythrite from the Evening Star mine, Rossland, B.C.
c. Sphalerite from the Enterprise mine, Ten-mile Creek, Slocan mining district, B.C.

Contributions to museum—*Cont.*

McInnes, W. :—

a. Tourmaline from a small island near Partridge Point, Eagle Lake, Rainy River district, O.

b. Auriferous quartz from the main shaft, Regina mine, loc. 566 P, Whitefish Bay, Lake of the Woods, O.

c. Auriferous quartz from the west shaft, Regina mine, loc. 566 P, Whitefish Bay, Lake of the Woods, O.

(B.) Received as presentations :—

Ahn, Robert H., Rat Portage, O. :—

a. Auriferous quartz from the Mikado claim, Bag Bay, Shoal Lake, Lake of the Woods, district of Rainy River, O.

b. Auriferous quartz from the Cornucopia claim, Bag Bay, Shoal Lake, Lake of the Woods, district of Rainy River, O.

Appleby, B. H., St. John, N.B. :—

Granite from Spoon Island quarry, Hampstead, Queen's county, N.B.

Armstrong, Wm., Armstrong's Mills, Hastings county, O., per W. F. Ferrier :—

Tremolite in dolomitic limestone from the township of Lake, Hastings county, O.

Bache, R. P., Buckingham, Q., per E. D. Ingall :—

Prepared graphite from the Weart mine, Buckingham, Ottawa county, Q.

Baker, Hon. James, Victoria, B.C. :—

a. Auriferous quartz from the Câche claim, Cayoosh Creek, Lillooet district, B.C.

b. Lignite from St. Mary's River, West Kootanie, B.C.

Baycroft, Thomas, Copper Cliff, O.

Anthraxolite from the township of Balfour, district of Algoma, O.

Chambers, F. H., Westville, N.S., per Dr. H. M. Ami :—

a. Manganite from Bridgeville, East River, Pictou county, N.S.

b. Limonite from Bridgeville, East River, Pictou county, N.S.

c. Stalactites from cave in Lower Carboniferous limestone at Springville, Pictou county, N.S.

Contributions to museum—*Cont.*

Cinnabar Mining Company of British Columbia, Savona, B.C., per F. C. Innes, Managing Director :—

a. Cinnabar (retort ore) from the Yellow Jacket claim, Kamloops Lake, B.C.

b. Average furnace ore from the Yellow Jacket claim.

c. Cupriferous ore from the Big Dyke claim, Kamloops Lake, B.C.

d. Average furnace ore from the Big Dyke claim, Kamloops Lake, B.C.

Cowie, Isaac, Edmonton, N.W.T.

a. Iron-pyrites from a little below Vermilion River on the Athabasca River, N.W.T.

b. Iron-pyrites from a point between Pelican and Vermilion rivers on the Athabasca River, N.W.T.

c. Iron-pyrites from above Pelican Rapid, Athabasca River, N.W. T.

Doyle, Owen :—

Felspar from the township of March, Carleton county, O

E. B. Eddy Company, Hull, Q :—

Sandstone used for the manufacture of pulp grindstones :—

a. Scotch sandstone.

b. Ohio (U.S.) sandstone.

Fraser, J.D., Ferrona, N.S. :—

Malachite from Cameron's mine, Bridgeville, Pictou county N.S.

Gray, Robert T., Madoc, O., per W. F. Ferrier :—

a. Erythrite on magnetite from the Dominion mine, Madoc, Hastings county, O.

b. Hæmatite (var. specular iron) from the Kane mine, Huntingdon, Hastings county, O.

Grüner, H. :—

Coke from Sheep Creek (Alberta) coal.

Hill, A. J., New Westminster :—

a. Pyrrhotite with arsenopyrite from Capt. Jones' claim, Jervis Inlet, B.C.

b. Chalcopyrite and pyrrhotite " " "

Contributions to museum—*Cont.*

Jennings, Herman, Johannesburg, Transvaal, S.A.R. :—

Auriferous conglomerate—

a. From the Main Reef, Ferreira mine, Witwatersrand, S.A.R.
b. " " (Leader) " " "
c. " South Reef " " "

Johns Manufacturing Company, The H. W., 87 Maiden Lane, New-York :—

a. Asbestus Roofing.
b. " Fire-proof Rope.
c. " Sewing Twine.
d. " Building Felt (about 6 lbs. per 100 sq. ft.)
e. " " " (" 10 " " .)
f. " " " (" 14 " " .)
g. " Fire-felt covering.
h. " " " with Superated Jackets.
i. " National covering.

King, J. G., Port Arthur, O. :—

Specimen showing weathering of dolomite.

Lanigan, R., Calumet, Q. :—

a. Kaolin from the township of Amherst, Ottawa county, Q.
b. Quartz " " " " "

Martineau, Salomon, Rivière Desert, Q. :—

Molybdenite from the township of Egan, Wright county, Q.

McKenzie, H. R., Sydney, N.S. :—

Chalcopyrite from the Old French Road, Gabarus, Cape Breton county, N.S.

McKellar, John, Fort William, O. :—

Auriferous quartz from the Empress location, Jackfish Bay, Lake Superior, district of Thunder Bay, O.

McRae, Hector, Ottawa, O. :—

Graphite (core from boring) from the township of Brougham, Renfrew county, O.

Moberley, Frank, Rossland, B.C. :—

a. Chalcopyrite and pyrrhotite from the Josie claim, Trail Creek mining district, B.C.
b. Galena and pyrite from the Mayflower claim, Trail Creek mining district, B.C.
c. Pyrrhotite with chalcopyrite, Monte Cristo claim, Trail Creek mining district, B.C.

Contributions to museum—*Cont.*

d. Chalcopyrite and pyrrhotite, from the LeRoi mine, Trail Creek mining district, B.C.

e. Chalcopyrite and pyrrhotite, from the Commander claim, Trail Creek mining district, B.C.

f. Galena with pyrite from the Deadwood group.

g. Bornite from the Silver King claim, Nelson, B.C.

Nadeau, J. A., Iberville, Q. :—

Two specimens of nepheline-syenite (polished) from the Mt. Johnson Quarries, Iberville county, Q.

Nadon, F. X. :—

Molybdenite from the township of Egan, Wright county, Q.

North American Graphite Company, Ottawa, O., per H. P. H. Brumell, manager.

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

b. Flake plumbago, grade L.A.

c. " " " L.B.

d. " " " L.C.

e. " " " L.D.

f. " " " L.K.

Pennock, J. T., Ottawa, O. :—

Magnetite from the township of Grenville, Argenteuil county, Q.

Poole, H. S., Stellarton, N.S. :—

Coal from the Acadia Colliery, Westville, Pictou county, N.S.

Prest, W. H. :—

Mineral associations of gold from the Jumbo vein, Westfield and the Ballou mine, Molega, Queen's county, N.S.

Rutherford, J. G., Stellarton, N.S. :—

a. Coal from the main seam, Fan pit, Albion Mines, Pictou county, N.S.

b. Coal from the McGregor seam, McGregor pit, Albion Mines, Pictou county, N.S.

Saunders, H., Victoria, B.C. :—

Chalcopyrite and molybdenite from the Van Anda Copper Company's mine, Texada Island, B.C.

Selwyn, Dr. A. R. C., Ottawa, O. :—

Carbonaceous schistose quartzite traversed by vein of quartz, from Quesnel, B.C. :—

Contributions to museum—*Cont.*

Seymour, T. F., Madoc, O., per W. F. Ferrier :—

a. Calcite crystals in hæmatite, from the Kane mine, Huntingdon, Hastings county, O.

b. Magnetite crystals from the Seymour mine, Madoc, Hastings county, O.

c. Garnets in mica-schist from Green Island, Moira Lake, near Madoc, Hastings county, O.

Sparham Fire-proof Roofing Cement Company, Montreal, Q. :—

Specimens of fire-proof roofing cement.

Spotswood, G. A., C.E., Parsons Pond, west coast of Newfoundland :—

Borings from great Greenland meteorite.

Stewart, Archibald, Ottawa, O. :—

a. Limestone (six inch cube) from the Rockland quarries, Clarence, Russell county, O.

b. Sandstone showing dendrites from the Soulanges Canal, Q.

Todd, Wm. :—

Steatite from Kennington Cove, four miles W. of Louisburg, Cape Breton county, N.S.

Turner, G. H., Mission City, B.C. :—

Bog-iron ore from Mount Leaman, vicinity of Mission City, New Westminster district, B.C.

Von Müller, Baron, Melbourne, Australia :—

Forty-seven specimens of borings from Oodnadotta, Lake Harry and William Creek, South Australia.

Vye, George A., Digby, N.S. :—

Limonite from Bridgeville, Pictou county, N.S.

Wakeham, Commander W., Gaspé Bay, Q. :

a. Petroleum from Block 42, Galt, Gaspé county, Q.

b. Petroleum from Block 40, Larocque, Gaspé county, Q.

c. Mineral tar from near the west line of York township, Gaspé county, Q.

Whitton Granite Company, per L. J. Frechette, M.P., St. Ferdinand, Q. :—

Granite from lot 34, range IV, of Whitton, Compton county, Q.

Wilkinson, Lieutenant-General H. C., Rat Portage, O. :—

Asbestus from Island S. E. of Rendezvous Point, Long Bay Lake of the Woods, District of Rainy River, O.

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

1. Leslie Street School, Toronto, Ont.....	consisting of	80	specimens.
2. Board of Trade, Edmonton, N.W.T.....	"	120	"
3. Collegiate School for boys, Windsor, N.S..	"	120	"
4. Church School for girls, Edgehill, Windsor, N. S.....	"	80	"
5. Collegiate Institute, Niagara Falls, Ont...	"	120	"
6. High School, Port Elgin, Ont.....	"	120	"
7. Dist. School No. 14, Sharp, Kings Co., N. B.....	"	80	"
8. Public School, Apohaqui, N. B.....	"	80	"
9. Collegiate Institute, Portage la Prairie, Man.	"	120	"
10. Model School, Robinson (Bury), P.Q.....	"	120	"
11. Public School, Surrey, Hillsborough, N.B.	"	80	"
12. High School, Omemee, Ont.....	"	120	"
13. Pictou Academy, Pictou, N.S.....	"	160	"
14. Monument National, Montreal, P.Q.....	"	108	"
15. Public School, Dist. No. 3, Hampton village, Kings Co., N.B.....	"	80	"
16. Public School, Sheet Harbour, Halifax Co., N.S.....	"	80	"
17. Institute of Mines and Forests, Georgetown, British Guiana.....	"	120	"
18. Villa Maria Convent, Notre Dame de Grâce, P. Q.....	"	120	"
19. Truro Academy, Truro, N.S.....	"	120	"
20. High School, Florenceville, Carleton Co., N.B.....	"	120	"
21. Queen's University, Kingston, Ont.....	"	77	"
22. High School, Wolseley, N.W.T.....	"	90	"
23. High School, Hawkesbury, Ont.....	"	120	"
24. Public Library, New Westminster, B.C...	"	120	"
25. Public School, Indian Head, N.W.T.....	"	80	"
26. Public School, Whitewood, N.W.T.....	"	80	"
27. Public School, Moosomin, N.W.T.....	"	80	"
28. Public School, Doaktown, N.B.....	"	80	"
29. High School, Maitland, Hants Co., N.S..	"	120	"
30. High School, New Glasgow, N.S.....	"	120	"
31. Kings County Academy, Kentville, N.S...	"	120	"
32. County Academy, Annapolis, N.S.....	"	120	"
33. Mother House Congrégation de Notre Dame, Montreal, P.Q.....	"	80	"
34. Sisters of Charity, Mt. St. Vincent, Halifax, N.S.....	"	80	"
35. Graded School, Norton Station, N. B.....	"	80	
36. McGill University, Montreal, P.Q.....	"	77	"

Educational collections supplied—*Cont.*

37. Toronto University, Toronto, Ont.....	consisting of	56	specimens.
38. Laval University, Quebec, P.Q.....	"	50	"
39. Public School, Memramcook, N.B.....	"	80	"
40. Grammar School, Shediac, N.B.....	"	120	"
41. Public School, Clifton, Kings Co., N.B....	"	80	"
42. Convent of Holy Names, Hochelaga, P.Q..	"	80	"
43. Public School, Shubenacadie, N.S.....	"	80	"
44. Fredericton University, Fredericton, N.B.	"	37	"
45. Sisters of the order of Notre Dame, Antigonish, N.S.....	"	80	"
46. High School, Springhill, N.S.....	"	120	"
47. Bureau of Mines, Victoria, B.C.....	"	100	"
48. Public School, Harcourt, Kent Co., N.B..	"	80	"
49. Our Lady of Good Counsel, Montreal, P.Q.	"	80	"
50. Central School House, Middle Sackville, N.B.....	"	80	"
51. Weymouth School, Weymouth, N.S.....	"	80	"
52. Minister of Agriculture, Dunnville, Ont...	"	80	"
53. Montreal College of Commerce, Montreal, P.Q.....	"	25	"
54. School of Mining, Kingston, Ont.....	"	60	"

"Making a total of 5,040 specimens, aggregating over two tons in weight of material.

Minerals collected by Mr. Willimott

"Mr. Willimott subsequently spent some time in rearranging and cataloguing the contents—representing balance of material on hand—of two hundred and eighty-eight drawers, one hundred racks and forty-eight shelves; and afterwards visited with the object of procuring further material for future collections, the townships of Hull, Wakefield, and Calumet, in the province of Quebec; and those of March, Bagot and Burgess in that of Ontario. Whilst so engaged he collected:—

	Specimens.	Weight.
Apatite, crystals.....	100	
" in calcite.....	....	100 pounds.
Anorthosite.....	....	200 "
Biotite.....	....	200 "
Celestite.....	....	250 "
Calcite.....	....	215 "
"	70	
Calcareous conglomerate.....	40	
Diorite.....	....	125 "
Felspar.....	2	
Graphite.....	....	225 "
Garnet.....	....	220 "
Galena.....	....	130 "
Gneiss.....	88	
Perthite.....	....	165 "

	Specimens.	Weight.
Pyrite	....	300 pounds.
Phlogopite, crystals	100	
Sphalerite	....	210 "
Serpentine limestone	....	200 "
Scapolite	....	120 "
Serpentine	....	150 "

"Mr. Willimott has, in addition, received—

(*a*) in exchange.

Stellarite	....	75 "
Bituminous shale	....	125 "
Hæmatite	....	100 "
Limonite and pyrolusite	....	125 "

(*b*) by purchase,

Chromite	....	275 "
Chrysotile in serpentine	....	450 "

and further—

Anthracite, presented	....	170 "
Sodalite, through Mr. A. E. Barlow	....	350 "
Nephelite, " " "	....	75 "
Magnetite, " " "	4	
Pyroxene, " " "	50	
Hæmatite, through Dr. H. M. Ami	....	200 "

"In all, some four hundred and fifty-four hand specimens, and four thousand seven hundred and fifty-five pounds of massive material."

Lithology.

On the work accomplished by him during the past year, Mr. W. F. Ferrier makes the following report:—

"In the museum label-holders have been prepared for the upright cases of the Stratigraphical Collection of Rocks, and will shortly be placed in position. Cabinets, furnished with locking doors, are now ready for the reception of those rock specimens which are undergoing petrographical investigation, and drawers have been set apart in the museum, and for the most part filled, with sets of rocks from various localities which have already been examined and reported on. Museum.

"Since the appearance of the last Summary Report two petrographical reports have been printed, and one is ready for the printers. Of those printed, one, entitled Petrographical Characters of some Rocks from the Area of the Kamloops Map-sheet, British Columbia, appears as Petrographical reports.

Lithology—*Cont.*

an appendix to Dr. Dawson's report on that region* whilst the other, under the title of Notes on the Microscopic Structure of some Rocks from the Labrador Peninsula, is to form an appendix to Mr. Low's report on the interior of Labrador.† Separate editions of both appendices have been issued.

Examinations in progress.

"The report on Mr. Barlow's rocks from the areas of the Nipissing and Temiscaming sheets is now almost ready for printing. The study of these rocks has yielded many important and interesting facts regarding the origin of the Laurentian.

"Mr. McConnell's rocks from the West Kootanie district, British Columbia, are now being examined. One hundred and thirty thin sections of specimens collected by him during the past season have been prepared to supplement those already in hand. Much interest attaches to these rocks because of their association with the rich ore-deposits of this important mining district.

"Various blowpipe examinations of rocks and minerals have been, as usual, undertaken during the year, and memoranda of results furnished to those from whom the specimens were received. A new microscope, model II, made by Fuess of Berlin, Germany, with all the latest improvements, has been purchased, and is giving good satisfaction and greatly facilitating the petrographical work.

Discovery of corundum.

"One of the most interesting occurrences upon which I have to report, is the recent discovery of corundum in Hastings County, Ontario. This came about in a somewhat unusual way. In 1893 I came into possession, by purchase, of a number of specimens collected by Mr. John Stewart, formerly of Ottawa, amongst them being a package labelled 'Pyroxene crystals, south part of Carlow.' On examining these specimens some time ago I recognized them as corundum, and immediately took steps to ascertain, if possible, the precise locality from which they came. As you are aware, I communicated the facts to you and was authorized in October to visit the township of Carlow, endeavour to locate the mineral, and determine the extent of the deposit. I was accompanied by Mr. Cole, and after considerable difficulty found the mineral on lot 14, con. XIV. of the township of Carlow, Hastings county, Ontario.

Its mode of occurrence.

"It was there found to occur in a coarse-grained, red, felspathic rock having the appearance of a pegmatite. Microscopic sections are in course of preparation, and the precise nature of the rock will then

* Annual Report, Geol. Surv. Can., vol. VII. (N.S.) part B, Appendix I.

† Annual Report, Geol. Surv. Can., vol. VIII. (N.S.) part L, Appendix V.

be fully determined. The difficulty of preparing sections, consequent on the hardness of the contained corundum, has rendered it impossible to make the examination in time for this report. This rock, together with a red and brown micaceous gneiss, forms a perpendicular cliff from 80 to 100 feet high, at the base of a sloping mountain. The corundum-bearing rock runs into the gneiss on the side of the mountain along the strike, which is about N. 65° E., as well as occurring, as already stated, on the face of a cliff across the strike. Lithology—*Cont.*

"Well developed crystals, often of large size, and generally of a grayish or brownish colour, as well as irregular masses of the corundum, are thickly distributed through the rock, and the mineral was observed throughout this rock for a distance of about 300 feet across the strike, more or less continuously and traced along the strike for about 700 feet. The grain of the mineral varies with that of the rock. The quantity is not uniform throughout the mass, portions of the rock being more thickly studded with the crystals than others, and in places they seemed to form 'stringers' in the rock.

"The interest of the find lies not so much in the possibility of the discovery of the gem varieties of the mineral, ruby and sapphire, about which so much has lately been said in the press, and which is improbable in view of the mode of occurrence, but in the fact that this is the first time that the mineral has been found to exist in Canada in any quantity and that it is valuable as an abrasive material on account of its great hardness, which is, in the pure mineral, next to that of the diamond.

"In the *Geology of Canada* (1863) p. 499, mention is made of corundum in the following words:—'Corundum has been observed on the second lot of the ninth range of Burgess, and in the immediate vicinity of a deposit of copper-pyrites. Here, in contact with the crystalline limestone, occurs a rock made of felspar, quartz, calcite, silvery white mica and sphene. Disseminated throughout this aggregate were small grains of a mineral whose colour varied from light rose-red to sapphire-blue, while its hardness, which was greater than that of topaz, showed the mineral to be corundum. Small crystals of light-blue corundum have been found elsewhere in the limestone of the vicinity. Where previously reported in Canada.

"No specimens of this occurrence have found their way into the collections of the Survey, and I have not met with anyone who has seen the mineral from this place. It is the only locality cited for Canada in the report on American corundum by Francis P. King,* the information being furnished by Dr. F. D. Adams.

*A Preliminary Report on the Corundum Deposits of Georgia, by Francis P. King, Assistant Geologist. Bull. No. 2, Geol. Surv., Georgia, 1894.

Lithology—*Cont.*

Nature of the mineral.

"Corundum is an oxide of aluminium, the crystallized varieties being essentially pure, whilst the granular variety, to which the name 'emery' is given, contains more or less impurities, chiefly magnetite and hæmatite. The transparent purer kinds of red and blue colours constitute the gems ruby and sapphire. These usually occur as rolled pebbles in river beds, or as crystals embedded in various rocks, such as limestone, as in the famous ruby mines of Burma.

Sources of supply.

"Statistics show that as an abrasive material there is an extensive market for the corundum. The supply of the mineral in the United States comes chiefly from North Carolina and Georgia, small quantities of emery being also obtained in Westchester County, New York State. The finer grades of emery continue to be imported from Turkey and Greece.

Mode of preparation

"Since the present discovery was announced by the Geological Survey, numerous inquiries have been received regarding it, and samples have been furnished to interested parties. Some of these have been tested in the United States, and the corundum pronounced to be of the finest quality. It may be well here, I think, to allude to the proper preparation of the material, essential to its introduction for commercial purposes. It is necessary that it should be completely freed from the gangue and this can only be accomplished by a special process. The corundum-bearing rock is first crushed, and then washed by means of sluice-boxes or revolving barrel-shaped cylinders through which a stream of water passes. But this is not all, for if the fragments of corundum be examined, it will be found that a large proportion of them are coated with a micaceous mineral having in many instances the composition of margarite, and resulting from the alteration of the corundum. This is removed by passing the mineral through another machine, which, in a form used at one of the principal Georgia mines, contains two discs armed with points which are revolved with great rapidity, and soon wear away the soft coating. After undergoing this process the mineral is again washed, crushed, and sifted to the various degrees of fineness required. Great care is necessary to prevent its reduction to 'flour' as this has only a small value compared to that of the coarser grades.

"The purpose of all the manipulation it undergoes is to secure uniformity of hardness in the finished material.

Further discoveries probable.

"Pending further investigation, the lands (which belong to the Crown) on which the corundum occurs in Carlow, have been withdrawn from sale by the Ontario Government, and it is hoped that the deposit will prove as valuable as the surface conditions seem to indicate. It

is more than likely that this is not an isolated occurrence, but that other deposits will be found in the Hastings district, now that attention has been called to it. The very circumstances attending the present discovery show that the mineral is liable to be passed over or mistaken for something else. Lithology—*Cont.*

"As instructed, I visited a number of other localities in Hastings county for the purpose of obtaining minerals, and collected a number of fine specimens for the museum, amongst them being good examples of the stilpnomelane described by me in 1895. Also erythrite, fine crystals of andradite garnet, hæmatite, limonite, hornblende, pyroxene, and various felspars."

Mining and Mineral Statistics.

Mr. E. D. Ingall reports of the work under his control as follows :— Mineral statistics.

"During the year the work of the section was carried on as usual, Mr. L. L. Brophy acting as assistant in connection with the statistical work. Mr. A. A. Cole acted as assistant for a short time in the spring, but for most of the year the technical part of the work has fallen to myself to do.

"The collection of statistics relating to the various mineral industries of the Dominion, together with the necessary compilation and checking of information gained, has occupied much of the time of the diminished staff of the section. The Preliminary Summary of the Mineral Production of Canada for 1895, was completed by 22nd February, 1896, a very much earlier date than ever before attained.

"Beside this, much time has been occupied preparing memoranda covering technical points relating to the mining and smelting of Canadian minerals, and in giving information to many inquirers regarding minerals and mining in Canada.

"Some work was also done in adding to our catalogue and reference system of the mineral deposits of Canada. The object in view in this system is to enable us, when it is completed, to have an entry for each of the mineral deposits in the country with references embodying every available source of information. Thus when information is asked about any mineral deposit, district, or mineral industry, it will be possible at once to get all the data available. To attain to anything like completeness in this matter would, of course, require a larger staff than we have at present

Mineral statistics—*Cont.*

"As opportunity permitted, attention was paid by myself to the detailed report on my field-work of 1895 in the Kingston and Pembroke Railway iron district. This has included examination of specimens and the selection of a certain number for analysis, with a view to determining the contents of the magnetite itself in phosphorus, and titanium in relation to the iron content.

"In October, short trips were made east, through Ontario, to collect outstanding returns regarding mineral production for 1895, which it had been impossible to get in by correspondence, and in the latter months of the year preparations were made toward getting information for the report for 1897.

Asbestos mining.

"The eastern trip was undertaken by myself, and a short visit was made to the asbestos mining centres of Black Lake, Thetford and Danville. In this industry the low prices ruling for the past few years have caused all but the larger producers to suspend operations, and have resulted, in the case of those still operating, in a much larger use of machinery and the extraction of much fibre that used to be considered too short to be worth treatment. The processes in use consist, in a general way, of some method that while crushing the rock frees the fibre without breaking it; followed generally by the passage of the crushed material over travelling picking tables, where the longest fibre is selected out, and then over shaking screens having a slight slope. The effect of these screens is to sort out the remaining shorter fibre into lengths, and also by reason of a funnel with strong up-draft, over-hanging the lower end of the screen, to lift the fibre away from the rock particles, the latter then passing off over the ends of the screens. At Danville this latter material is being stored outside the mill in dump, as it is now coming into use to replace ordinary sand and hair in wall plastering. It is claimed that this 'Asbestic,' as it is called, takes a better finish than ordinary plaster, does not crumble under the action of fire, and that it will not crack or crumble when nails are driven into it."

Of his trip in the peninsula of Ontario, Mr. Brophy reports as follows:—

"Leaving Ottawa on the 8th October, I visited, among other places, Toronto, Windsor, Sarnia, Clinton, Seaforth, Petrolea, London, Buffalo, Caledonia and Hamilton, returning to Ottawa on the 28th of the same month. No difficulty was experienced in obtaining all particulars required, when asked for in person, and the failure of some operators to reply to our circulars and letters is, in most instances, due to oversight and not to a desire to withhold the information. Although the

trip was made almost entirely with a view to acquire the statistical data essential to the completion of the report, yet some general information was incidentally secured. Mineral statistics--*Cont.*

"The following notes on natural gas and on iron smelting may be of some interest at the present time.

"At Windsor, through the courtesy of Mr. S. T. Copus, secretary-treasurer of the Natural Gas and Oil Company of Ontario, Ltd., some interesting particulars were obtained regarding the operations of the company up to date (October 12th, 1896). This company, which succeeded to the business and plant of the Ontario Natural Gas Company some three years ago, now practically controls all the principal wells in the Essex field, and is piping large quantities of gas from their main field in the townships of Gosfield and Mersea, to Walkerville, Windsor and Detroit. Two lines of pipe have been laid into Windsor, a distance of about 32 miles. Some 2000 families in Walkerville and Windsor are now supplied with the gas, while the number of connections in Detroit is in the neighbourhood of 6000. The total number of miles of piping laid is about 130, including all branch lines and connections. The gas, which is used almost entirely for fuel purposes, is sold for twenty cents per thousand (M) cubic feet in summer and twenty-five cents in winter; the extra price in the latter season being due to the increased cost of keeping the regulators, mains, etc., in working order during the cold weather. The total number of wells drilled by both the old and new company, up to the time of my visit, was twenty-six and of these seventeen are still active producers. The rock-pressure at the wells is given at 400 pounds to the square-inch, and their estimated output is about 35,000,000,000 cubic feet per annum. Natural gas at Windsor.

"While no very marked decrease has been noticed in the rock-pressure at the wells in the Essex fields no doubt owing to the comparativ ely recent date at which the consumption became other than of a local character, a very different condition of things prevails in the Welland field, where the wells have been supplying the city of Buffalo with a considerable portion of its fuel for a number of years past. The reason for this statement will become apparent on a perusal of the following information, kindly furnished by Mr. D. Coste, manager of the Provincial Natural Gas and Oil Company, which corporation operates most of the large wells in the Welland peninsula. Their whole output is piped into Buffalo, N.Y., through two large mains running from the field to the Niagara River. The length of pipe laid, including the mains and all connections, is about 120 miles. Up to the 20th of October, 1896, the number of wells drilled by this company and also by the Gas wells in Essex county.

Mineral statistics—*Cont.*

Erie Company, (whose rights were acquired in 1893) was 124, of which 65 are still producing, When the first wells were bored some years ago, the initial rock-pressure was 520 pounds to the square-inch, but the supply of gas in the meantime decreased to such an extent that the average pressure of all the wells is now barely 175 pounds to the inch. The large compressor plant erected near Sherk's Station in the fall of 1893 was in operation for some nine months, but is now seldom used except to pump out a well of which the pressure has fallen below 70 pounds to the square inch. When a well reaches this stage the pumps are put on, the hole is pumped dry and permanently closed down and plugged. This procedure is rendered necessary by reason of the fact that the pressure in the supply mains is so much higher than that in a failing well, that instead of such a well being a source of supply it really becomes a drain on the main pipe-lines and absorbs a large quantity of gas from other wells which would otherwise be available for immediate consumption. Wells which were at one time large producers are sometimes purposely fed in this way, being used as temporary storing chambers for such gas as is not required for immediate use, the reservoirs of these wells being more readily accessible when the gas is really wanted, than in those formerly having but a small producing capacity. According to the opinion expressed by several of the leading authorities on the subject, it would appear to be merely a question of a few years before the gas supply in the Welland field will be exhausted, at least for commercial purposes, though a small flow may still continue for a much longer period which will be of service for domestic uses to farmers and others with wells on their premises and requiring only a very limited daily supply. In support of this opinion, mention may be made of the Provincial Company's well No. 63, drilled in 1893, which yielded when the gas was struck, a flow of over 10,000,000 cubic feet per day. The flow from this well has now decreased to such an extent that it does not produce 400,000 feet in the same time, although it has in the interval been several times fed from the other wells.

Iron smelting at Hamilton.

"While in Hamilton, I was, through the kindness of Mr. Robert Hobson, secretary-treasurer of the Hamilton Blast Furnace Company, enabled to obtain some details as to the company's operations since the completion of the plant. Their furnace was blown in on the 31st of December, 1895, though no pig-iron was made until some weeks later. Production, has, however, been going on continuously ever since. The ore used is derived both from Canada and the United States, the Canadian ore coming from the Wallbridge and other mines in Hastings county; from the north shore of Lake Erie, between

Port Rowan and Port Dover, and also from the district near Smith's Falls and Merrickville. The United States ore is obtained from Escanaba, Mich., and Two Harbours, Minn. The Canadian ore used to the 17th September, 1896, was 9062 tons, producing pig iron to the amount of 5890 tons. The quantity of United States ore charged was, at the same date, 16,781 tons, turning out pig to the amount of 13,247 tons, thus showing the total amount of ore charged to have been 25,843 tons; and producing pig iron amounting to 19,137 tons during a period covering about nine months. The fuel used is entirely coke, which is procured from the Reynoldsville district in Pennsylvania and costs, laid down at the works, about $3.60 per ton. The flux is a limestone obtained from Port Colborne, Ont." Mineral statistics—*Cont.*

Palæontology and Zoology.

Mr. Whiteaves submits the following summary of the palæontological and zoological work accomplished in 1896 :— Palæontology and Zoology.

" The manuscript of the third part of the third volume of *Palæozoic Fossils*, referred to in the last Summary Report as having been commenced, has since been completed and is now ready for the printer. This publication will consist of a descriptive report upon all the fossils from the Galena-Trenton and Black River formations of Lake Winnipeg and the Red River valley, in the museum of the Survey. It will contain identifications, with references, &c., or detailed descriptions of 145 species, and when printed, will make a little more than 100 pages of text, illustrated by seven full-page lithographic plates and by several woodcuts. Its preparation has entailed considerable correspondence with specialists in the United States and Europe. Publications. Galena-Trenton.

" By permission of the Director, a paper on 'Canadian Stromatoporoids' has been prepared and published in the July number of the *Canadian Record of Science*. This paper is essentially a stratigraphical and systematic list, with references, &c., of all the species of *Stromotoporoidea* (about thirty-five in number), that have either been recognized or even supposed to have been recognized in Canada, or described from Canadian localities.

" In the Quarterly Journal of the Geological Society of London for May, 1896, Dr. Henry Woodward, F.R.S., has published descriptions and illustrations of the four species of fossil crabs from the Cretaceous rocks of Vancouver and the Queen Charlotte Islands, sent to him by the writer last year, and a small series of long-tailed decapods

Palæontology and zoology—*Cont.*

or lobster-like crustaceans, from the Nanaimo group of the Vancouver Island Cretaceous, has been forwarded to him this year for identification or description.

Cambro-Silurian fossils.

"Collections of fossils recently made by Mr. J. B. Tyrrell from the Cambro-Silurian rocks near Fort Churchill, Hudson Bay, and at Sturgeon Lake, Wekusko (or Herb) Lake, and Hill Lake on the Mināgo River, Saskatchewan; from the Silurian rocks at Pine Island Lake, Saskatchewan; and from the Cretaceous rocks at seven different localities in the district of Athabasca, have been examined and notes upon the species represented prepared for publication in his reports.

"Several small consignments of fossils from the Guelph formation at Elora and from the Corniferous drift near Kincardine, Ontario, have been named for Mr. R. A. Farquharson of Kincardine.

Triassic fossils.

"Thirteen specimens of fossils from rocks apparently of Triassic age at Texada Island, B.C., and three from the basal beds of the Cretaceous at Lasqueti Island, B.C., collected last summer by Mr. Walter Harvey, of Comox, were sent to the writer for examination, and as much information as possible in regard to them has been furnished to Mr. Harvey.

Cretaceous fossils.

"Six additional consignments of the rarer fossils of the Cretaceous rocks of the Queen Charlotte and Sucia Islands, B.C., have been received from Dr. C. F. Newcombe, of Victoria, who has kindly presented five unique or remarkable specimens from Skidegate Inlet to the museum of the Survey. Some of these fossils have been named and returned, but about one half of them have been retained for further study. A few of the more critical forms among them have been sent to Dr. Franz Kossmat, of Vienna, for comparison with European and Asiatic types, also to Mr. F. W. Stanton, of the U. S. National Museum at Washington, and to Professor John A. Merriam, of the University of California at Berkeley, for comparison with Californian fossils.

"Numerous small boxes of fossils from the Cretaceous rocks on the Comox and Trent rivers, Vancouver Island, and from Hornby and Denman islands, B. C., have been forwarded, for examination, by Messrs. W. Harvey, J. B. Bennett, F. W. Robbins and Dr. G. D. Beadnell. Among these fossils there are some unusually fine specimens and a few species not previously represented in the Survey collection. Most of these have been kindly presented to or acquired for the museum, as will be seen from the list of donations. The remainder have either been named and returned, or kept a little longer for further study and comparison. These specimens, together with those

sent by Dr. Newcombe last year and this year, upon which copious notes have been kept, will enable the writer to make a much more complete revision of the fossil faunæ of the Cretaceous rocks of the Queen Charlotte and Vancouver groups of islands, than would otherwise have been possible. Palæontology and zoology—*Cont.*

"In Zoology every effort has been made to increase and improve the collections in the museum. Fifty-one additional specimens of birds and one mammal have been mounted by Mr. Herring during the year, and 346 birds have been placed upon new and smaller stands in order to economize space. Fine specimens of the Glaucous-winged, Short-billed and Heermann's Gull, a male Black-vented Shearwater and a pair of Tufted Puffins, from Vancouver Island, have been received from Mr. John Fannin, curator of the Provincial Museum at Victoria. A Dusky Shearwater from the Queen Charlotte Islands, and eggs of some of the rarer sea birds of British Columbia, have been presented by Dr. C. F. Newcombe, of Victoria. A female White-fronted Goose, a pair of the White-tailed Ptarmigan in winter plumage and a fine pair of the American Three-toed Woodpecker, from Alberta, have been acquired by purchase. Specimens of about 100 species of shells, mostly from Japan and previously unrepresented in the museum, have been received in exchange for duplicate shells from the coast of British Columbia. Zoological collections.

"An interesting series of small mammals, birds, and the eggs of about thirty-five species of birds from Labrador and Hudson Bay, were collected by Mr. A. P. Low. Among the latter are one egg each of the Long-tailed Jager, Snow Goose, Hutchin's Goose, Gyrfalcon, Labrador Jay, also 'clutches' of eggs of the Old Squaw, Eider, Willow and Rock Ptarmigan, Redpoll, Snowflake, Lapland Longspur, Fox, Tree and White-crowned Sparrows.

"Skins of an adult male Sea Lion and Fur Seal, and of the young of each, with several separate skulls of both, also twenty bird's skins, and eggs of Kotzebue's Gull and of the Least Auk, all from the Pribyloff Islands, in Behring Sea, have been received from Mr. Jas. A. Macoun.

"The space available for the exhibition of mounted mammals and birds in the museum is already overcrowded and there are many large birds which have been recently set up, for which no room can be found in the cases. Want of space in museum.

"Dr. Ami reports that during the past year he has continued the work of determining palæontological collections obtained by officers of Work by Dr. Ami.

Palæontology and zoology—*Cont.*

the Geological Survey, and others, in Ontario, Quebec and the Maritime Provinces.

"To the local lists of fossils prepared to accompany Dr. Ells's report on the geology of the south-western portion of the province of Quebec, referred to in the Summary Report for 1895, he has made several important additions. These are for the most part the result of an examination of numerous fossils from the Cambro-Silurian and Silurian rocks in the vicinity of Montreal, which form part of the collection in the Peter Redpath Museum of McGill University. These completed lists were published early in June and form an appendix to Dr. Ells's report. Systematic lists of fossils, arranged zoologically and chronologically, were also prepared by him with a view of bringing together the palæontological data available for the following geological maps, in course of preparation :—

Sheet No. 119, Quebec and Ontario—Perth sheet.
" 120, Quebec and Ontario—Ottawa City sheet.
" 122, Quebec and Ontario—Pembroke sheet.
" 126, Ontario—Manitoulin Islands sheet.
" 131, Ontario—Lake Nipissing sheet.
" 138, Lake Temiscaming sheet.

Field-work in Pictou county.

"On the 23rd of June, Dr. Ami was instructed to proceed to Nova Scotia, there to continue the palæontological work upon which he had been employed for a short season in the autumn of 1895. The main object of this work was to obtain sufficient palæontological material, from as many localities as possible, to fix the age of the rocks in these localities for mapping. He remained in Nova Scotia until September 14th. Most of his time was spent in the county of Pictou, but some time was also spent examining the Cambro-Silurian and Silurian rocks of Rights River and James River, of Eigg and Brown Mts., and along the I. C. Ry. above and below Marshy Hope, in Antigonish county. At McArras Brook and in other places along the shore of Northumberland Strait, interesting collections were also made.

"Some progress has since been made in determining the palæontological collections obtained in 1895 and 1896 from various horizons in Pictou county, and in preparing local lists of fossils from them. This work necessarily involves a study of all the available material in the possession of the Survey and of the literature on the subject.

"In connection with the work of Dr. L. W. Bailey of Fredericton, who has been examining the geology of the south-western portion of Nova Scotia, Dr. Ami has just completed a preliminary determination of the fossils comprised in twelve new collections from Bear

River, Nictau, Torbrook and other localities in the iron-bearing district of Annapolis county, N.S. Palæontology and zoology–*Cont.*

"Several collections of duplicates far educational institutions have also been prepared, and some time has been devoted to a detailed palæontological and microscopical examination of specimens of drillings, from the gas, petroleum and salt regions of western Ontario.

"Attention has also been given to the determining and classification of other palæontological collections which have come in to the office from time to time, as well as to the preparation of labels for the Devonian fossils from Lake Winnipegosis in the museum cases, and progress has been made in the re-classification of the collections of fossils in the museum drawers. Besides the lists of fossils published with Dr. Ells's report, several papers on Canadian palæontology have been contributed to scientific journals.

"Mr. L. M. Lambe has continued the study of the Canadian fossil corals, and during the year has been engaged, almost continously, in a revision of the *Tabulata*, which is now nearly completed and includes all the genera known to occur in Canada, with the exception of about two, represented by the same number of species. In the revision of this section of the *Actinozoa*, seventeen genera, including about sixty-three species, have been exhaustively studied and descriptions prepared of the different forms giving details of their structure with remarks as to their generic and specific affinities. Drawings of the minute details of structure of some of the species have been completed and it is proposed to prepare further drawings for the illustration of the remaining species with as little delay as possible. Work by Mr. Lambe.

"A short paper entitled 'Description of a supposed new genus of Polyzoa from the Trenton limestone at Ottawa' was written in the early part of the year and published in the April number of the *Canadian Record of Science.*

"In the early part of May, a week was spent by Mr. Lambe in the field with Dr. Ells in the vicinity of Arnprior, Renfrew, Cobden and Eganville, west of Ottawa, examining certain exposures of rock with a view to determining their exact geological horizon. Collections of fossils were made at different localities at or near the above-named places and a list was afterwards prepared of the fossils for a paper by Dr. Ells entitled 'Palæozoic outliers of the Ottawa River' now being published in the Transactions of the Royal Society of Canada for 1896.

"A small collection of fossils, made by Mr. J. B. Tyrrell in 1893, at Markham Lake, Doobaunt River, Lat. 62° 44′, Long. 103°, was also

Palæontology and zoology—*Cont.*

examined; the fossils, principally corals, were named and a list of them was prepared.

"Mr. Lambe also made drawings at various times during the year of a number of fossils from the Cretaceous of the Pacific coast and of some from the Cambro-Silurian rocks of Lake Winnipeg for the illustration of papers or reports by Mr. Whiteaves, already mentioned as published during the year or in course of preparation."

Contributions to museum.

The following is a list of specimens collected by or received from officers of the Survey, during the year 1896, in addition to those already mentioned :—

Dr. R. W. Ells, and L. M. Lambe :—

Specimens of fifty species of fossils from the Black River and Utica formations at Renfrew county, Ont.

R. G. McConnell :—

A few fossils from rocks apparently of Carboniferous age at Grouse and Sophy mountains, near Rossland, B.C.

J. B. Tyrrell :—

About seventy-five fossils from Pine River, Herb and Cumberland lakes in eastern Saskatchewan.

Head of Moose (*Cervus alces*, L.)

A. P. Low :—

Skull of Eskimo.

Model of kyak and umyack (Eskimo boats) from George River, Ungava District.

Specimens of four species of fresh-water mollusca from Ungava.

Donald Gillies, Great Whale River, Hudson Bay; per A. P. Low :—

Collection of birds' eggs, including an egg of the Snow Goose; a stone deer-skin scraper, fish-hook and line, whalebone ptarmigan snare, and ivory implement, all from Great Whale River.

G. B. Boucher, Ungava Bay; per A. P. Low :—

Collection of birds' eggs from Ungava Bay.

John Ford, George River, Ungava district; per A. P. Low :—

Collection of birds' eggs from George River.

— Guy, Rigolet, Labrador; per A. P. Low :—

Collection of birds' eggs from Rigolet.

A. E. Barlow :—

Eggs of three species of birds from Central Ontario.

Contributions to museum—*Cont.*

N. J. Giroux :—

Several hundred Cambro-Silurian and Pleistocene fossils from Eastern Ontario.

Dr. H. M. Ami :—

Extensive collections of fossils from the Silurian, Devonian, and Carboniferous systems at Pictou and Antigonish counties, N.S.

About fifty fossiliferous nodules from the south bank of the Ottawa, near Besserer's grove.

"The additions to the palæontological, zoological and ethnological collections during the year, from other sources and in addition to those previously mentioned, are as follows :—

By presentation :—

(A.—*Palæontology.*)

J. G. S. Hudson, Glace Bay, Cape Breton :—

Fifteen specimens of fossil plants from the Coal Measures at Glace Bay.

Dr. C. F. Newcombe, Victoria, V. I. :—

Fine specimen of a large and undescribed species of *Turrilites*, two specimens of *Olcostephanus cepoides*, one *Phylloceras ramosum* and a new *Cercomya*, all from the Cretaceous rocks of the Queen Charlotte Islands.

The Provincial Museum, Victoria, V. I. (per Mr. John Fannin) :—

The three Ammonites figured on Plates 2 and 3 (Section 4) of the first volume of the Second Series of Transactions of the Royal Society of Canada.

The Harrogate Museum, Yorkshire, England ; per Dr. Beadnell :—

Fine specimen of *Hamites* (*Anisoceras*) *Vancouverensis*, Gabb, from the Cretaceous rocks at Hornby Island.

J. B. Bennett, V. I. :—

Fine specimen each of *Pachydiscus Ootacodensis*, *Desmoceras Gardeni*, *Capulus* (or possibly *Anisomyon Meekii*) *Palæocorystes Harveyi*, and two claws of crustacea, from the Cretaceous rocks of the Comox River, V. I.

F. W. Robbins, Denman Island, B. C. :—

One specimen of *Hamites* (*Anisoceras*) *Vancouverensis*, two specimens of *Phylloceras ramosum*, one *Baculites Chicoensis* with an *Anomia* or young oyster attached, and two *Nucula truncata*, all from the Cretaceous rocks at Hornby Island B. C.

Contributions to museum—*Cont.*

S. J. Cliffe, Comox, B. C. :—

Portion of the vertebral column of a fossil fish from the Tsolum River, Vancouver Island.

L. M. Lambe, Ottawa :—

A small collection of fossil sponges from Metis.

Archibald Stewart, Ottawa :—

Four fossils from the Trenton limestone at Rockland, Ont.

R. N. Slater, Ottawa :—

Two specimens of *Calamites* from a railway cutting between the 'Narrows,' and North Sydney, C. B.

Colonel C. C. Grant, Hamilton, Ont. :—

Two fossils from the Medina sandstone and eighteen from the Niagara limestone at Hamilton. Nine fossils from the Hudson River drift at Winona, Ont., and four from the Iroquois Beach at the Desjardins Canal.

Owen P. Schreiber, Kirkfield, Ont. :—

Thirty-seven fossils from the Trenton shales at Kirkfield.

Adam Brown, Hamilton, Ont. :—

Fossil wood (according to Prof. Penhallow, *Picea nigra*) found in the Erie clay at Hamilton.

T. C. Weston, Ottawa :—

An unusually perfect specimen of *Metoptoma Melissa*, from the Quebec Group at Point Levis.

J. R. Chamberlain, Ottawa :—

Specimen of a species of *Calamites* from the Carboniferous rocks at Springhill, N. S.

J. D. Fraser, Ferrona, N.S. (per Dr. Ami) :—

Thirty specimens of fossils from the Cambrian or Cambro-Silurian rocks at Great Bell Island, Newfoundland.

S. W. Wilkins, Ottawa :—

Fossils from the Cretaceous rocks at the Belly River.

(B.—*Zoology.*)

The Provincial Museum, Victoria, B.C. :—

Two eggs of the Black Oystercatcher and two of the Pigeon Guillemot, collected by Dr. Newcombe, June 1, 1896, at Sea

Contributions to museum—*Cont.*

Bird Islands, Barclay Sound, V.I. Three eggs of the Glaucous-winged Gull collected by Dr. Newcombe, June 18, 1896, at Mittlenatch Island, near Cape Mudge, in the Strait of Georgia.

Dr. C. F. Newcombe, Victoria, B.C. :—

Named specimens of five rare species of Chitonidæ and three specimens of *Chrysodomus tabulatus* from the coast of British Columbia.

Dr. G. D. Beadnell, Denman Island, B.C. :—

Egg of the Black Oystercatcher, from Mittlenatch Island.

Walter Harvey, Comox, V.I. :—

Nest and eggs of the Rusty Song-sparrow from Comox.

Albert J. Hill, New Westminster, B.C. :—

Cocoons and silk of *Bombyx mori* grown at New Westminster.

L. M. Lambe, Ottawa :—

Recent marine shells and starfishes from Metis.

Miss Norah Lewis, Ottawa :—

Five starfishes *(Asterias polare)*, from Little Metis, P.Q.

Rev. J. Lofthouse, Fort Churchill, Hudson Bay :—

Nineteen eggs of seven species of birds, from Fort Churchill.

Louis J. Coursolles, Ottawa :—

Specimen of the Green Heron *(Ardea virescens)*, shot at Billings Bridge.

(C.—*Ethnology.*)

A. M. Campbell, Perth, Ont. :—

Stone spear-head and copper gouge, from the north shore of Mud Lake, Lot 5, Concession VI., township of Bedford, Frontenac county, Ont.

Lieut.-Col. Percy G. B. Lake, Grenfell, Assa :—

Spear-head from Grenfell, Assa.

Matthew Riddell, Moores Corners, near Galetta, Ont. ; (per W. J. Wilson) :—

One flat stone scraper from Lot 19, Concession V., Fitzroy, Carleton county, Ont.

Natural History Society of New Brunswick :—

Fifteen stone implements and seven fragments of Indian pottery, from various localities in New Brunswick.

Contributions to museum—*Cont.*

C. Coutlee :—

Stone gouge from Cascades Point at the lower end of the Soulanges Canal.

James Lusk, Eardley, P.Q. :—

Fragment of pipe bowl, piece of pottery, quartz spear-head and partially chipped quartz implement, from Lot 20, Range XI., Eardley.

By purchase :—

Fifteen rare fossils from the Cretaceous rocks of Vancouver, Hornby and Denman islands, B.C.

Two eggs of the Western Horned Owl, and a clutch of twelve eggs of the Blue-winged Teal, from Alberta.

Stone pestle found at Lot 10, Concession IV., Township of Torbolton, Carleton county., Ont.

Natural History.

Natural History.

The work carried out by Prof. J. Macoun, or under his supervision, in the office and museum, is thus reported on by him :—

"The office-work connected with the Botanical Section continues to increase and at present no little portion of my time is taken up with the determination of obscure species of all classes sent from almost every province of the Dominion. During the year just closed, I find by my letter book that I have named, of difficult forms, no less than 1983 species, chiefly for the collectors mentioned below.

Botanical specimens determined.

"Mr. John McSwain, Charlottetown, P. E. I; Mr. John Moser, Queen's Co., New Brunswick; the authorities of St. Laurent College Que.; Mr. William Scott, of the Toronto Normal School; Mr. Roderick Cameron, Queen Victoria Park, Niagara Falls; Mr. J. M. Dickson, Hamilton, Ont.; and Mrs. A. Hollingworth, Beatrice, Muskoka, Ont. All the above are actively at work and are doing much to promote the knowledge of botany in their respective districts. In Alberta Mr. Willings, of Olds, and Mr. Gaetz, of Red Deer, have contributed many fine specimens, Mr. A. J. Hill, C. E., and Rev. Herbert H. Gowen, New Westminster; Mr. J. Henry, High School, Vancouver, and Mr. A. J. Pineo, of Victoria high school, as well as Mr. J. C. Gwillim, of Slocan City, have sent many hundred specimens.

Collections presented.

"Last winter a fine collection of plants made at the mouth of the Mackenzie River and on Herschel Island in the Arctic Sea, was placed in our hands, by Rev. J. D. Stringer, for determination. These

localities gave together eighty-five species which were entirely Arctic and most interesting on that account. Through the kindness of Mr. Stringer, we have retained a set of his plants for the herbarium. Natural History—*Cont.*

"This autumn another large donation has been made to the herbarium by Charles A. Hamilton, M. D., Mahone Bay, Nova Scotia. This collection consists of over 600 species and contains many duplicates. It is the joint work of himself and his sister Miss Harriet R. Hamilton. The specimens are well preserved and the greater number correctly named. They are a valuable addition to the herbarium and of much interest as they are a representation of the Atlantic coast flora of our most eastern province. The thanks of this Department are certainly due to Dr. Hamilton and his sister for their donation.

"Under your instructions, Mr. A. P. Low took my field-assistant Mr. William Spreadborough, with him to Labrador in connection with his expedition of last season. Besides doing good service for Mr. Low, he made a very fine collection of the plants of Northern Labrador. A partial examination of this material shows that the interior of Labrador has a far higher degree of summer heat than any part of the coast, and further that the Atlantic coast is colder than that bordering on Hudson Bay. Other collections made by Messrs. Low and Spreadborough, are referred to by Mr. Whiteaves. Collections made in Labrador.

"The Catalogue of Lichens and allied forms has been in progress, but has been delayed by want of help in the office, due to the absence of my assistant. Catalogue of Lichens.

"Between January and May, 1896, Mr. James M. Macoun, my assistant, distributed 1559 sheets of botanical specimens, for the most part in exchange for plants sent to our herbarium. Office-work.

"Since my last summary report, 1946 sheets of specimens have been added to the herbarium. Several thousand specimens are ready for mounting, when time may permit.

"During the winter months my assistant, in addition to the routine work of the office, compiled a list of the plants of Labrador Peninsula for Mr. Low's report and contributed to the *Canadian Record of Science* three papers on the distribution of Canadian plants. On the first of May last he was sent on special service to the Behring Sea, and since that time has been working for the Marine and Fisheries Department."

A considerable part of the summer was spent by Prof. Macoun in field-work in Manitoba and the North-west. The results of this are briefly given by him as follows:—

Natural History—*Cont.*

Field-work by Prof. Macoun.

"Acting on your instructions to proceed to Manitoba and the North-west Territories and still further carry on my observations and collections of the Natural History of the region, I left Ottawa on May 27th and reached Winnipeg on the 29th. On the 30th I collected and noted at Victoria Park, near West Selkirk, all the species seen there. June 1st found me at Otterburne, on Rat River. I visited Stonewall on June 3rd, and on the 4th Stony Mountain. On the 5th I examined River and Elm parks of the city of Winnipeg, and in these four days, and an additional five days in August, noted 401 species and collected all that were in flower at the above dates. Owing to the almost incessant rains during May, vegetation was backward and the open prairie all but impassable.

"On the afternoon of the 5th, I went to Brandon, and for the next nine days collected botanical specimens, listed all plants observed growing there, and made observations on the birds breeding in the neighbourhood.

"On June 12th, I visited Sewell and went south to a tamarack swamp about two miles from there. This is the most western tamarack swamp in Manitoba and is the home of numerous species of eastern plants that are seen no more in the prairie regions.

Wind-breaks on the prairie.

"Visits were made to the Experimental Farm at Brandon, for the purpose of seeing the value of shelter belts and the results of tree planting. Having seen these at Indian Head I was prepared for what I found at Brandon. The first day I visited the farm, (June 9th) a heavy north-west gale prevailed, so strong that I was scarcely able to make headway against it. On the west side of the farm where the tree belts were, there was a perfect calm but away from the influence of the trees the severity of the gale began to be felt. I was so satisfied with the value of the experiments that I desire now to place on record my matured opinion as to the great value of tree planting throughout the north-west.

Why trees do not thrive.

"Later in the season I made collections at Prince Albert and in southern Manitoba and was struck with what I shall call the hardiness of the trees and shrubs in these regions. I had seen that the Canadian Pacific Railway gardens at Moose Jaw and Medicine Hat grew trees and shrubs without being winter-killed and that the cause of the want of hardiness must be looked for in other directions than severity of climate. I had long suspected that the trees on the prairie died for the want of nourishment and exposure to biting winds and not from severe cold, and this year I became convinced of it. Were a supply of moisture given to trees, grown from seed,

so that they could mature their wood in July or early August for a couple of years, and the grass allowed to grow around them without being cut or pastured over, enough snow would gather in the winter to give all the moisture needed for the next summer's growth. A study of any thicket on the prairie will prove this. Did the farmer but realize the importance of collecting the snow on his farm, he would begin at once to grow hedges around, say, ten-acre fields. These hedges besides being valuable wind-breaks, would be snow gatherers, and in a very few years belts of trees would spring from the seed sown within the hedge, and while the hedge would protect the young trees it would also gather the snow for the next year's growth. Success in tree planting will only be assured when steps are taken to collect the snow by means of hedges or some other way, and successful tree growing means the settlement of the prairies. Natural History—*Cont.*

"From Brandon I proceeded to Moose Jaw (June 15th) where I remained collecting until June 26th, when I went to Regina and the next day to Prince Albert where I remained until July 17th.

"Before I left Ottawa, you had instructed me to make further observations on the question of rainfall and water supply, and I went to Moose Jaw chiefly for that purpose. In the autumn of 1895, I had noticed that the drought was broken, and on page 148A of the Summary Report for that year I stated my belief that owing to the saturation of the soil there would be a surplus of moisture in the following spring, and that the ponds would fill up. The results were far beyond my expectation. More rain fell then than usual and all the ponds were full, the ground was saturated and as the warm weather began, all vegetables grew vigorously, so that where grass was scarcely three inches high in the spring of 1895, it was from a foot to eighteen inches in 1896. On June 18th, I went to Chaplin on the border of Old Wives Lake and found the water much higher than it was the year before. At Parkbeg where I was on June 23rd, I found all the ponds full and the grass fit to mow. Inquiries, at Moose Jaw, made of farmers and others, brought out the statement that owing to the saturation of the soil they had moisture enough now to insure them two more good crops. The same conditions prevailed at Regina and from there to Saskatoon. The whole prairie was covered with waving grass that by the end of June was all in seed and looked more like a field of grain than a pasture. From my own observations and the accounts of others, I am led to believe that grass produced seed everywhere on the prairie last year, and should the coming spring be fairly moist, in May and June, much of the western prairie will be re-seeded and a great change will take place in the value of the pasture. Rainfall in the North-west Territory.

Natural History—*Cont.*

"A striking effect of the long continued drought was the almost total absence of water-fowl on every part of the prairie. Their disappearance is caused by the absence of cover consequent on the drying up of the ponds and the burning or stunting of the reeds around their borders. Last summer the ponds were full, but there were neither old reeds nor birds. Next spring there will be reeds and water, and I confidently look for the birds as well.

"Between Saskatoon and Duck Lake, the rainfall had been light, and as a consequence the vegetation was sparser and shorter, but from Duck Lake to Prince Albert we passed through a different region, within the poplar belt, and on the prairie the vegetation was more that of the forest than that of the true plains to the south.

Climate indicated by flora

"Very large collections were made in the three weeks I remained at Prince Albert, and enough material was obtained to show what its summer climate is like compared with Moose Jaw and Brandon. Although Prince Albert is more than 200 miles north of Brandon, its climate is about the same, and that of Moose Jaw from five to ten days earlier than either. The real cause of the early season of Moose Jaw is its dry and consequently warmer soil. Prince Albert is almost due north of Moose Jaw, with a less altitude but damper atmosphere, and hence is more subject to summer frosts, but this may be expected to decrease as the subsoil is drained.

"North of Prince Albert is a large muskeg, caused by the springs oozing out of the sand-hills near by. This bog contains at least one hundred species of eastern plants, and it is quite evident that very many of the Atlantic coast and Quebec species pass westward, in the forest region, to, and into the Rocky Mountains; while to the south the prairie now forms, and very likely did in the past, an effective barrier to prevent this.

"During the time I was at Prince Albert, I collected 438 species of flowering plants and ferns, and in the whole collection there were fewer indications of a cool climate than at Wood Mountain, 300 miles to the south. I have noticed this everywhere, and am satisfied that 300 miles north of the boundary the climate is as good if not better (especially to the west), than it is at any point on the 49th parallel. There may be more liability, at present, to local white frosts, owing to the more humid soil and air, but as the ponds are drained and the superfluous wood and brush cleared away, a permanent change for the better will come.

Country best fitted for settlement.

"My three season's experience have convinced me that, while the prairie is even richer and more valuable than we have believed it to be, the brush and aspen district to the north of it is best

suited for immediate settlement, as shelter, which is necessary for comfort, is to be found everywhere, and although more labour is necessary to make a beginning, the settler from the first has more conveniences and needs far less capital. The soil is good, there are no droughts, blizzards cannot prevail, water is good, wood is plentiful and farming just as we have it in Ontario will be the outcome of settlement. Railway communication is a necessity and the settlement of the northern belt must of course depend largely on this being provided. Natural History—*Cont.*

" After leaving Prince Albert, on July 17th, I proceeded to Brandon and made a collection of the flora of that district until July 30th. The collections made in June, added to those made in the latter part of July, gave a list of 514 flowering plants and ferns. Nearly all the plants of the ravines and river-bottoms are of eastern species, but the prairie flora is a mixed one, containing both eastern and western forms with others that have their home to the south. Collections made.

" On the completion of my work in Brandon, I went south-west to Napinka to obtain a more complete knowledge of the flora of the southern district. The first ten days of August were spent at Killarney, Morden and Morris where I made excursions and collections and noted the changes both in the flora and growth of the species.

" A question I had often asked myself and others was why the basswood, elm, grape-vine, wild plum and certain other species, ceased to grow in the river-valleys west of Manitoba. It was supposed that cold and exposure was the probable cause. This may be the cause, and a case in point occurs to me as I write. Last November and December we had very cold weather at Ottawa without snow, and as a result a serious loss of the less hardy trees and shrubs took place at the Experimental Farm. The exposed prairies are always or nearly always bare, and it is this exposure, in my opinion, and not the intensity of the cold that causes the death of the trees. Wherever trees are growing naturally the cold is just as intense as elsewhere, but where they are, snow lies, and where they are not snow does not lie. The conclusion is irresistible that tree planting and the planting of shrubs must go hand in hand with snow gathering and where the snow accumulates and protects the roots there trees will live and thrive. Western limits of certain species.

" Fine basswood trees were found by the brook at Morden, which no doubt had three or four feet of snow around them in winter. One hundred yards from these trees, seedlings from them would not succeed under present conditions. How then can we expect less hardy stock to survive? At Lumsden, twenty miles north of Regina, in the Qu'Appelle River valley, I found the last Elm towering above all the

Natural History—*Cont.*

shrubs and small trees in its vicinity and having a graceful spreading top like the elms of the east. Yet a few hundred yards from where this elm stood, its own seedlings could not grow owing to unfavourable conditions.

"Since my return, I have been engaged working up various collections sent in for determination, and in the intervals in putting in shape my own collections, which amount for the season to over 1200 species, more than 900 of which are from the prairie and the others (fungi) chiefly collected near Ottawa."

Report on Entomological Collection.

Dr. James Fletcher, F.R.S.C., Entomologist and Botanist to the Central Experimental Farm, furnishes the following report upon the Entomological collections in the Geological Survey museum, in connection with which he is kind enough to tender his services as honorary curator :—

"I have the honour to report that the Entomological collections of the Geological Survey Department are in a good state of preservation. Some additions have been made during the past year, the most important being by purchase of a collection made in the Okanagan valley by Mr. C. De Blois Green. Twelve species were previously unrepresented in the museum and nineteen species were insufficiently or poorly represented. A small but very interesting general collection has been presented by Mr. W. Ogilvie, D.L.S., made by him near Fort Cudahy, latitude 64° 26′ longitude 140° 32′. This collection includes Coleoptera, Hymenoptera and some Arachnida and Hemiptera, every one of which is of great scientific interest from the locality. Mr. Ogilvie says : 'I have secured one at least of every kind of insect I have seen. Butterflies seem to be very scarce, only one or two varieties. Notwithstanding the great abundance of mosquitoes and other pests of that kind, dragon-flies are very scarce.'

"A small collection was presented by Mr. J. C. Gwillim, of Slocan City, B. C., consisting of eleven species of Lepidoptera, seven of Coleoptera, and two of Hymenoptera. These were for the most part in poor condition.

"Of collections made by officers of the Geological Survey the most important are : No. 1 by Dr. Robert Bell, in the Nottaway basin, consisting of eighteen species of Lepidoptera with the exact date and locality attached to each specimen.

"No. 2 by Mr. J. McEvoy at Fadear and Louis Creeks in the last week of June, 1895. This collection contained specimen of *Lycœna*

Anna and *Papilio Turnus*, the latter very interesting for the locality. There was a beautiful suffused variety of *Melitœa Whitneyi*. Maps.

"In accordance with your instructions I am preparing for the Banff Park Museum a collection of Rocky Mountain Lepidoptera, which will be placed before the spring opens."

MAPS.

Mr. James White, Geographer and Chief Draughtsman, makes the following report on the progress of mapping work, and on a further measured line run by him in Ontario for the purpose of fixing geographical positions for the geological map-sheets in progress there :— Maps.

"The assignment of work was much the same as in former years. Mr. C. O. Senecal has compiled and drawn, for photo-lithography, the map of Doobaunt and Kazan rivers, and has also drawn, for photo-lithography, the map of the country between Lake Athabasca and Churchill River and the Labrador maps (4 sheets), besides autographing the Red Lake sheet. Mr. L. N. Richard has drawn sheets 43 to 47 inclusive and sheet 51 of the Nova Scotia series, for the engraver, and the map of Argenteuil, Terrebonne, etc., counties for photo-lithography. Mr. W. J. Wilson was engaged in arranging and cataloguing the maps and plans and in reducing and compiling material for the N. W. sheet of the 'Eastern Townships' map and for a general map of Canada. Mr. O. E. Prudhomme drew sheet 138, Ontario, and sheets 40, 41 and 42, of the Nova Scotia series for the engraver, and, since August, has been compiling and tracing material for the general map above mentioned. Mr. D. I. V. Eaton was engaged on the compilation of sheets 122, Ontario, and 12A of the Nova Scotia series from Feb. 9th to the date of his resignation, July 20th. Mr. J. F. E. Johnston was employed to assist in draughting work on Nov. 30th and has since been at work in the office. Mr. Hugh Cameron was employed from Jan. 27th to Feb. 26th, in cataloguing and numbering plans.

"The number of maps published this year is considerably less than usual, in consequence of the commercial embarrassment of one of the contracting firms, which stopped all work, for about two months, on several of the maps.

"At the present time 15 sheets are being engraved on stone and 2 on copper, while 9 are being photo-lithographed. Of the above 26 sheets, about 11 should be ready early in 1897, so that the number of maps published in 1896 and 1897 combined, will be much above the average. The engraving of the Lièvre Phosphate Map is suspended pending the completion of the geological work. Mapping work in progress.

Maps—*Cont.*

"A new map of the Dominion of Canada, on a scale of 50 miles to 1 inch, was commenced in the latter part of August, and the reductions for it are now well advanced. Wherever possible the original plans and surveys have been used, to avoid all errors that may have been introduced in subsequent publication. It will also include a large amount of topographical and geological information hitherto unpublished. The method adopted, viz., that of reducing the original plans by photography to the uniform scale of 40 miles to the inch and then tracing from the photographic reductions, has so far given excellent results, the details of the topography being exactly reproduced. The compilation being on a scale of 40 miles to the inch will require a further reduction by photography to the publication scale of 50 miles. The original will, however, remain available if, at any time, it be deemed advisable to publish on the larger scale. The geographical features of the tract of country between the Nelson and Albany rivers are somewhat doubtful, owing to the uncertainty as to the position of any of the principal points along the coast of Hudson and James bays between York and Albany. The determination of the longitude and latitude of a few of the principal points, such as Capes Smith, Jones and Henrietta Maria and mouths of Richmond Gulf and Severn and Weenisk rivers, by the Hudson Bay expedition in contemplation for next summer, would be very useful geographically.

"The oblique secant cylinder projection has been adopted for the above-mentioned general map, as giving less distortion at all points than any other. The figures used are those calculated by Capt. E. Deville, Surveyor General, for a cylinder cutting the sphere along two small circles perpendicular to the central meridian—in this case 110° W.—and intersecting it in Lat. 51° N. and 67° N., respectively.

Survey made to fix positions in Ontario.

"As the geographical position of the townships in the southern part of Sheet 118 Ontario (Haliburton Sheet), was in doubt, it was arranged that I should, for the purpose of determining this, take over Mr. Barlow's party when he left the field. I accordingly left Ottawa on September 7th and proceeded to L'Amable, where Mr. Cole, Mr. Barlow's assistant, was encamped. From this point a transit and chain line was carried southward by the Hastings road to Ormsby and northwestward by the Hastings and Baptiste Lake roads to the terminus of the Irondale, Bancroft and Ottawa railway at Baptiste Lake station; thence down the railway to my line of 1895, at the Irondale and Grand Trunk Junction. Returning to Ormsby I carried the line down the Central Ontario Railway to Eldorado, where it connected with the northern part of my work of 1886. Resuming the traverse at the southern part of my 1886 work, near Moira Lake, I carried it

via the Grand Trunk Railway to Crookstown, Canadian Pacific railway from Crookstown to Tweed and Kingston, Napanee and Western railway to Enterprise; thence by road to Verona on the Kingston and Pembroke railway, where it intersected my line of 1894 on September 29th. This completes the line from Waubashene on Georgian Bay to Kingston, and fixes the geographical position of the townships in the southern part of Sheet 118, and those along the line through Sheets 112 and 114 and the Madoc and Marmora map. Maps—*Cont.*

"The cataloguing of the maps and plans is suspended at present, as there is no one available for this work. About 4500 out of the 13,000 (estimated) plans have been catalogued in temporary lists and numbered. These include (*A*) charts, (*C*) township plans, Quebec, and (*V*) foreign maps.

"An enumeration of the maps published during the past year or in course of preparation, is appended herewith.

Maps Printed in 1896.

	Area in square miles.
578. Keewatin and Ontario—Vicinity of Red Lake and part of Berens River—Scale 8 miles to 1 inch	8,240
589. Western Ontario—Sheet No. 9—Lake Shebandowan Sheet. Scale 4 miles to 1 inch	3,456
571. Quebec—South-west quarter-sheet of the "Eastern Townships" Map (Montreal Sheet.) Scale 4 miles to 1 inch	7,200
565. Nova Scotia—Sheet 39—Tangier Sheet. Scale 1 mile to 1 inch	216

Maps, Engraving or in Press.

—— Dominion of Canada, 2 sheets each 28 x 34, including the Dominion from the Atlantic to the Pacific and from the International Boundary to Hudson Strait and Great Bear Lake	4,760,000
604. British Columbia—Shuswap Sheet—Scale 4 miles to 1 inch	6,400
594. Athabasca and Peace Rivers—Sheet I—Scale 10 miles to 1 inch	39,700
595. " " " —Sheet II— " "	39,700
596. " " " —Sheet III— " "	41,000
597. North-west Territory — Country between Lake Athabasca and Churchill River—Scale 25 miles to 1 inch	137,100
570. Ontario—Sheet No. 125—French River Sheet—Scale 4 miles to 1 inch	3,456
605. Ontario—Sheet No. 126—Manitoulin Island Sheet—Scale 4 miles to 1 inch	3,456
606. Ontario—Sheet No. 131—Lake Nipissing Sheet—Scale 4 miles to 1 inch	3,456
599. Ontario and Quebec—Sheet No. 138—Lake Temiscaming Sheet—Scale 4 miles to 1 inch	3,456

Maps—*Cont.*

599. Quebec—Lièvre River and Templeton Phosphate District. Sheets 1 and 2. Scale 40 chains to 1 inch..... 220
590. Quebec—Parts of Joliette, Argenteuil, Terrebonne and Montcalm counties—Scale 4 miles to 1 inch 3,350
585. Labrador Peninsula—South-west Sheet—Scale 25 miles to 1 inch. 251,100
586. " " —South-east Sheet— " " 251,100
587. " " —North-west Sheet— " " 251,100
588. " " —North-east Sheet— " " 251,100
592. Nova Scotia—Sheet No. 40—Sheet Harbour Sheet—Scale 1 mile to 1 inch..... 216
607. Nova Scotia—Sheet No. 41—Fifteen-mile Stream Sheet.—Scale 1 mile to 1 inch..... 216
593. Nova Scotia—Sheet No. 42—Trafalgar Sheet.—Scale 1 mile to 1 inch..... 216
598. Nova Scotia—Sheet No. 43—Stellarton Sheet.—Scale 1 mile to 1 inch..... 216
600. Nova Scotia—Sheet No. 44—New Glasgow Sheet.—Scale 1 mile to 1 inch..... 216
608. Nova Scotia—Sheet No. 45—Toney River Sheet.—Scale 1 mile to 1 inch..... 216
609. Nova Scotia—Sheet No. 46—Pictou Sheet.—Scale 1 mile to 1 inch 216
610. Nova Scotia—Sheet No. 47—Westville Sheet—Scale 1 mile to 1 inch..... 216
611. Nova Scotia—Sheet No. 51 (and 52)—Ship Harbour Sheet.—Scale 1 mile to 1 inch..... 256

Maps, Compilation Completed.

603. North-west Territory.—Doobaunt and Kazan Rivers and North-west Coast of Hudson Bay.—Scale 25 miles to 1 inch..... 250,000
Ontario—Kingston and Pembroke Mining District—Scale 4 miles to 1 inch..... 1,700
Ontario—Sheet No. 129—Mississauga River Sheet—Scale 4 miles to 1 inch..... 3,456
Nova Scotia—Sheets Nos. 48, 49, 50, 53, 54, 55 and 56—Scale 1 mile to 1 inch..... 1,512
Nova Scotia—Plans of Goldenville, Wine Harbour, Tangier, Killag, Caribou, Moose River and Mooseland mining districts—Scale 500 feet to 1 inch.

Maps, Compilation Incomplete.

British Columbia—West Kootanie Sheet—Scale 4 miles to 1 inch..... 6,400
North-eastern Manitoba—Lake Winnipeg Sheet—Scale 8 miles to 1 inch. Area about..... 20,000
Quebec—North-west quarter-sheet of the "Eastern Townships" Map—Scale 4 miles to 1 inch..... 7,200
New Brunswick—Sheet 1 N.W.—Fredericton Sheet—Surface Geology. Scale 4 miles to 1 inch..... 3,456
New Brunswick—Sheet 2 S.W.—Andover Sheet—Surface Geology. Scale 4 miles to 1 inch..... 3,456

Maps—*Cont.*

Nova Scotia—Sheet No. 10A—Cape Dauphin Sheet. Scale 1 mile to 1 inch	216
Nova Scotia—Sheet No. 12A.—Sydney Sheet. Scale 1 mile to 1 inch	216
" —Sheet No. 12B—Little Glace Bay Sheet. Scale 1 mile to 1 inch	216
" —Sheets Nos. 56 to 65, 76, 82, 100 and 101 scale 1 mile to 1 inch	3,024
" —Sheets Nos. 66, 67, 68, 69. Scale 1 mile to 1 inch	864

LIBRARY.

Library and publications.

Dr. Thorburn, Librarian, reports that during the year ending 31st December, there were distributed 9833 copies of the Survey publications, comprising reports, special reports and maps, of these 6682 were distributed in Canada, and the balance, 2951 were sent to other countries.

Sales of publications by the Librarian during the year, including reports and maps, numbered 2642, the amount received therefor being $450.28.

During the year 1896, the number of publications received as donations or exchanges was 2559, the number purchased 90, and the periodicals subscribed for 31.

The letters received in connection with the distribution of the publications were 1080, besides 1306 acknowledgments.

The number of letters sent out from the library was 914, and in addition to these 513 acknowledgments were sent to our exchanges and to others from whom publications were received.

The number of books bound during the year was 161.

VISITORS.

Visitors.

The number of visitors to the museum during the past year was 31,595. In 1895 it was 26,785. With a more attractive and commodious building, in which the collections could be properly displayed, there is no doubt that even greater attention would be given to the museum by the public.

STAFF, APPROPRIATION, EXPENDITURE AND CORRESPONDENCE.

Staff.

The strength of the staff at present employed is 46, being one less than at the close of last year, consequent on the death of Mr. N. J. Giroux, of the technical staff, which took place on the 30th November.

Appropriation and expenditure.

The funds available for the work, and the expenditure of the Department during the fiscal year ending 30th June, 1896, including appropriation for boring in Alberta, were:

——	Grant.	Expenditure.
	$ cts.	$ cts.
Civil list appropriation	49,742 50	
Geological Survey appropriation	45,054 25	
Artesian boring "	8,311 18	
Civil list salaries		49,432 38
Exploration and survey		14,903 08
Wages of temporary employees		10,831 69
Boring operations. Deloraine (unsettled claims)		58 50
" Athabasca Landing		6,927 09
Printing and lithography		11,603 99
Purchase of books and instruments		643 56
" chemicals and chemical apparatus		182 06
" specimens		80 27
Stationery, mapping materials and Queen's Printer		881 99
Incidental and other expenses		1,303 17
Advances to explorers on account of 1896-97		9,261 56
		106,109 34
Less—Paid in 1894-95 on account of 1895-96		4,773 87
		101,335 47
Unexpended balance Civil list appropriation		310 12
" Geological Survey appropriation		78 25
" Artesian boring "		1,384 09
	103,107 93	103,107 93

The correspondence of the Department shows a total of 7992 letters sent, and 8110 received.

I have the honour to be, Sir,

Your obedient servant,

GEORGE M. DAWSON,

Deputy Head and Director