GEOLOGICAL SURVEY DEPARTMENT

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SUMMARY REPORT

ON THE

OPERATIONS OF THE GEOLOGICAL SURVEY

FOR THE YEAR 1895

BY

THE DIRECTOR

OTTAWA

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OTTAWA, 1st January, 1896.

The Honourable T. MAYNE DALY, M.P.,
Minister of the Interior.

SIR,—In accordance with the provisions of the Act of Parliament relating to the Geological Survey, I have the honour to submit this Summary Report of the Department for the calendar year 1895. The reduced appropriation made by Parliament for the work of the Geological Survey during the fiscal year 1895-96, has rendered a strict economy necessary. This has particularly affected the nature and amount of the field-work undertaken, for the existence of a number of unpublished reports and maps resulting from the work of previous years, appeared to render it desirable that a considerable proportion of the money actually available should be devoted to printing. The members of the staff, without exception, have, however, exerted themselves to make the best possible use of the means placed at their disposal, and the progress made in 1895 has been satisfactory and important, as the succeeding pages of this report will, I believe, show.

Annua Reports.

During the year, volume VI. of the new series of Annual Reports of the Survey, has been completed and issued. The volume is a small one, of but 534 pages, but as the funds available for the fiscal year 1894-95 did not admit of further printing, it was deemed advisable to give to the public the matter already in type. The printing of volume VII. is now in progress, and it is hoped that this volume also may shortly be ready for publication.

Maps published during the year.

Twenty-six maps have been issued during the past year, including fourteen sheets of the geological map of Nova Scotia on the scale of one mile to an inch, and one sheet on the scale of four miles to an inch; nine plans and one section relating to the auriferous creeks of the Cariboo

district in British Columbia; the north-east quarter-sheet of the "Eastern Townships" map, Quebec; the Rainy River and Seine River sheets in western Ontario. A number of the maps above mentioned had been engraved and printed previous to January 1st, 1895, but had not been distributed. Of the Seine River sheet, a small preliminary edition only has so far been printed, in advance of the forthcoming report on the district, and subject to correction in detail. This course was adopted in order to render the results of surveys immediately useful to prospectors and miners engaged in discovering and developing the gold-bearing veins of the district. This preliminary map has been available since October, although part of the field-work included by it was actually carried out during the past summer.

In addition to the maps above mentioned, two of the Kamloops district, one of the Omenica and Finlay region in British Columbia, and five relating to the surface geology of New Brunswick have been printed and are ready to appear with volume VII.

Other publications.

Other publications include part II. of volume III., Palæozoic Fossils, 84 pages, with 9 plates, and part I. of volume II., Contributions to Canadian Palæontology, 66 pages, with 5 plates. The latter had been printed in separate sheets at different times previous to 1895. A new list of the publications of the Geological Survey of Canada from the beginning of the work, in 1843, to date, making a pamphlet of 52 pages, has also been prepared and printed. This list has been very carefully revised throughout, and now includes no less than 479 official publications (including all maps, plans, etc.) besides a large number of scientific papers bearing upon the work of the Survey or the collections in the museum, of which copies are held on sale for the convenience of the public.

General index.

In order to facilitate reference to the various reports of the Survey, Mr. D. B. Dowling has now been for some months engaged in the preparation of a classified index to the reports published subsequent to the Geology of Canada (1863), which it is proposed to print when completed. The volume prepared by Sir William Logan, under the above title, forms a synopsis of the results of the Survey to the time of its publication; and the collective indexing of subsequent reports may be regarded as a first step towards the production of further synoptical reports.

Mineral specimens sent to Imperial Institute.

In pursuance of the policy of making known to purchasers and consumers, such special products of Canadian mines as find their market at a distance, letters were sent to the various producers of mica in the autumn of 1894, and at a later date to pro-

ducers of asbestus in Canada, inviting them to send commercial samples and price-lists for transmission by the Geological Survey to the museum of the Imperial Institute in London. This invitation was well responded to in both instances, and the series of representative specimens obtained have during the year been placed on exhibition by the curator of the Canadian Section of the Institute, Mr. Harrison Watson. Brief descriptions of the character and mode of occurrence of the minerals were at the same time furnished for insertion in the technical journals, with special reference to the specimens shown, and many inquiries and requests for further particulars and addresses, have since been received both by the Geological Survey and the several exhibitors.

Photographic Exhibition.

In response to an invitation to participate in the special Exhibition of Photography in its application to the Arts, Sciences and Industries, in London, a number of large coloured and framed photographs of geological features and mines, illustrating the use of photography in connection with the work of the Survey, were prepared and transmitted. These photographs where taken and coloured after nature by Mr. H. Topley.

Geographical Congress.

To represent the work of the Geological Survey at the exhibition of the International Geographical Congress, also held in London during the past summer, a typical series of the various classes of maps published by the Survey was mounted and sent to that exhibition.

Both the photographs and maps above referred to, were at the close of the respective exhibitions handed over to the Canadian Section of the Imperial Institute, where they are now permanently displayed.

Educational collections minerals.

Another subsidiary, though not unimportant feature of the work, to which reference may be made, is that of the supply of small typical collections of Canadian minerals and rocks to educational institutions in Canada. This has grown up in consequence of requests received for such illustrative specimens. It was at first possible to make up a few collections from time to time from duplicate material in stock, but of late years it has become necessary to devote a large part of Mr. Willimott's time to the accumulation of suitable material, and the arrangement of such collections. During the year 1895, no less than fifty-nine collections of this kind, embracing 6665 specimens, have been furnished, without any charge beyond that of carriage, to educational institutions in the several provinces, from Nova Scotia to British Columbia. The increasing demand for such collections has rendered it necessary to restrict the supply pretty closely to institutions and schools in which some instruction in natural

science is actually given. In most cases such collections are evidently highly appreciated, as shown by the acknowledgments received, and their value, from an educational point of view is, I believe, very great. It is scarcely possible to overestimate the importance in connection with the development of the resources of the country, of familiarizing the growing generation with even the commoner ores and rocks.

Correspondence.

A large and constantly increasing part of the official correspondence of the Survey, consists of answers to applications for special information on particular mineral products of the Dominion and cognate subjects. Attention is given, in this matter, to placing consumers and producers in connection, in so far as the information at disposal permits. Replies to such inquiries often involve considerable time and trouble, but this their direct importance fully justifies.

Inquiries relating to the geological structure of different parts of the country and the conditions of occurrence of minerals, are also numerous, and during the past year alone, have embraced questions respecting coal, petroleum, gas, salt, water-supply, mineral-waters, stone, clays, lime, cement, peat, fertilizers and many metallic ores. Another large class of applications for information must be made to include the most varied subjects connected with geographical features, heights of summits, or watersheds, elevations of lakes, practicable routes of travel, distribution of forest trees and character of timber, &c., &c. Many of these it is possible to answer to the satisfaction of the inquirers, from the facts included in previous reports, by means of reference to plans or surveys in the office, or from the experience of individual members of the staff.

Examination of specimens.

A very large number of specimens of every kind are also received for identification, determination or description. Many of these are transmitted to the laboratory for examination, and when this appears to be called for, they are there tested, assayed or analysed, the result being communicated to the sender.

It is necessary to mention briefly the work done in the offices under the above heads, as a considerable portion of the time of several members of the staff is thus occupied without any adequate record in the publications of the Survey, although, undoubtedly, to the great advantage of the public at large.

Necessity of a new building.

It is impossible to omit, in this report, a renewed allusion to the entirely insufficient accommodation afforded by the present building for the work of the Geological Survey. Not only are the offices inadequate and inconvenient, but the space available in the museum has become much too restricted, while both offices and museum with all

their valuable accumulations, are subject to danger of loss by fire. The advantage to Canada of having an adequate display of the mineral wealth of the country can scarcely be exaggerated, and that the museum, even in its present state, possesses much interest to the general public, is evidenced by the fact that more than 26,000 visitors have been registered during the year.

Acknowledgments of assistance.

Scarcely a year passes, in which the Geological Survey is not indebted to specialists for important assistance, rendered gratuitously and in the interests of science. At the present time it is appropriate to acknowledge particularly our indebtedness to Professor Charles Lapworth, F.R.S., of Birmingham, who has devoted much time to a study of Canadian graptolites, a work now approaching completion; to Mr. S. H. Scudder of Cambridge, Massachusetts, to whose researches the work on fossil insects already mentioned is due, and to Professor A. Hyatt, of Boston, Massachusetts, for his critical notes on various fossils submitted to him. The acknowledged preëminence of each of these gentlemen in his particular lines of study, is such as to render their contributions of the utmost value.

Work of the Director.

My own time, during the year, has of necessity been employed chiefly in connection with the office and in the rearrangement of some parts of the executive work, as well as in supervising the printing and publication. A few days were, however, spent in the country near the Kingston and Pembroke railway, and about three weeks, in August and September, on a visit of inspection to Athabasca Landing in connection with the boring operations there.

Iron ores in Frontenac, Leeds and Lanark.

Considerable attention has lately been given by the civic authorities and Board of Trade of Kingston, to the possibility of establishing furnaces at that place for the smelting of iron ores found to the northward, chiefly in the counties of Frontenac, Leeds and Lanark. In June last, an influential deputation from Kingston waited upon you, for the purpose of urging that the Geological Survey should undertake at once such an investigation of the quantity and quality of the deposits of ore likely to become tributary to Kingston smelters, as might justify the necessary investment of capital there. It was pointed out, in replying to this request, that a good deal of work had been accomplished by the Geological Survey in the district in question some twenty years ago and at various times since, and I ventured to express the opinion that, taking the iron ore deposits in the aggregate, there could not be any reasonable doubt as to their great available quantity and excellent average quality. Many changes in connection with iron smelting have, however, occurred in late years, and it was

thus considered advisable that such further investigation of the district as might be immediately possible should be undertaken. Mr. E. D. Ingall was consequently entrusted with this work, and with him I visited Kingston early in August, and subsequently looked over a number of the more important iron mines. Mr. Ingall continued and extended the examinations thus begun, with care and in considerable detail. A preliminary report upon his work is given on a later page, and it will be gratifying to those interested, to observe that the favourable conclusions flowing from the results of previous work by the Survey are fully borne out by this report.

Boring at Athabasca Landing.

Experimental boring for petroleum.

At the time of my visit to Athabasca Landing, the boring there had attained a depth of 1500 feet, which has since been increased to 1731 feet. The work of sinking this experimental well has been attended with unlooked-for difficulties and delay, in consequence of the unconsolidated character and the great thickness of Cretaceous shales which has had to be passed through, and the time consumed in communicating with, and meeting the requirements of the work, in a locality situated nearly one hundred miles beyond communication by railway or telegraph. Mr. W. A. Fraser has spared no effort in advancing the progress of the boring, and is entitled to much credit for the manner in which he has been able to overcome the various obstacles met with. A synopsis of his report on the work is given below.

Intention of the work.

It will be remembered, that the object of the experimental boring has been to reach and penetrate the basal sandstone of the Cretaceous formation, which, where it comes to the surface, about 130 miles further north on the Athabasca River, is known as the "tar sands" and is charged with bituminous matter.* In the last Summary, Mr. McConnell's Report on a Portion of the District of Athabasca, is quoted, to the effect that the top of the "tar sands" should be found at Athabasca Landing at a depth of from 1200 to 1500 feet. This statement was based upon the observed dip of the Cretaceous rocks and the relative heights of places along the natural section afforded by the banks of the Athabasca River, and depended upon an estimate, as close as the circumstances admitted, of these factors. It had necessarily to be assumed that the thickness and lithological character of the members of the Cretaceous series remain the same throughout. To a depth of 1090 feet, a continuous mass of shaly beds was penetrated in the

*Annual Report, Geol. Surv. Can., vol. V. (N.S.), Part D.

boring, and it began to appear possible, in consequence, that the Pelican and Grand Rapids sandstones of the observed exposures to the north, had given out where the boring was in progress. When, however, at the above-mentioned depth, a sandstone was encountered, it became probable that this represented one or other of the previously recognised sandstone formations; and before a depth of 1500 feet had been reached, it was clear that this represented the Pelican sandstone, that it was followed beneath by the Pelican shales, and that these in turn were underlain by the Grand Rapids sandstone, the two first-mentioned formations having very nearly the thickness and character presented by them at their natural outcrops.

Information gained as boring progressed.

It became apparent that the La Biche shales had a thickness somewhat exceeding that estimated for them at this place, but that notwithstanding this fact, the Cretaceous series as a whole remained perfectly regular, and that the volume of its underlying members was practically constant. There is thus much reason to believe that the thickness of the Clearwater shales, in which the well is for the present stopped, and that of the underlying "tar sands," will also prove here to vary little from that found at the natural outcrops; in which case the top of the "tar sands" should be reached at about 1800 feet, or less than 100 feet beyond the actual point now attained. Should it prove possible to do so, it is proposed to continue this boring to a depth of 2000 feet, a depth which it is anticipated will pass through the "tar sands" and penetrate, for some distance, the underlying rocks, presumed to be limestones of Devonian age. The bituminous matter with which the "tar sands" are saturated further down the river, has undoubtedly welled into them from the underlying limestones of that vicinity, and it is therefore advisable at this place, to seek for the existence of petroleum in both, if possible.

Regularity of the measures.

Depth to be attained in present boring.

It must be remembered, that the enormous accumulation of bitumen in the sands, where they are seen, has become possible only from the fact that these porous beds lie directly upon the limestones and are themselves covered by impervious shales. It is of course quite possible that impervious shaly layers may occur in the beds representing the "tar sands" beneath Athabasca Landing, and if so, any one of these might prevent the upward flow of petroleum if it exists there. For this reason, the possibly oil-bearing character of the lower beds of the Cretaceous, can not be considered to have been fully tested at the Landing until their whole thickness has been bored through.

It is also necessary to bear in mind that, even in the most productive oil-fields, the occurrence of valuable accumulations of petroleum

A single experiment insufficient.

is confined to certain limited areas or "pools," and that although there can scarcely be any reasonable doubt of the existence of an important oil-field in northern Alberta and Athabasca, the first experimental sinking in an entirely new region, may not prove to be successful as a source of oil. Whatever may be the ultimate result of the first experiment still in progress, it must be admitted that it has already demonstrated a most important fact in respect to the regularity, over a great area, of the members of the Cretaceous formation, and has rendered it possible to estimate within close limits of error, the depth at which the "tar sands" may be looked for along the Athabasca Valley for a distance of about 150 miles.

The great importance of the development of deposits of petroleum in this region, to which allusion is particularly made in my last Summary Report, should, I believe, not only encourage the completion of the present boring, but lead to an even more energetic system of prospecting, under which several experimental wells might be simultaneously progressing, in different parts of the great area which the geological conditions show to be favourable to the occurrence of petroleum in quantities of commercial value.

Plans proposed for further boring.

The depth attained, with the small diameter to which the present boring has now been of necessity reduced, cause its further prosecution to be attended with considerable difficulty, but should no further success be achieved in it, it is proposed in the spring to move the plant down the Athabasca River to the vicinity of the mouth of the Pelican. There, although still more remote from any base of supplies, it should be possible to reach the "tar sands," at the comparatively moderate depth of about 700 feet. If, on the other hand, any petroleum should yet be encountered in the present well, the importance of tracing its existence as far southward as possible, points to the advisability of making a second test somewhere in the North Saskatchewan valley. Should it, however, prove possible to do so, I would strongly advocate the simultaneous sinking of experimental borings at both these places, thereby effecting a saving of a year in the process of testing the great northern field.

Gas and salt water.

The natural gas, met with in quantity and under considerable pressure in the course of the boring at depths less than 1000 feet, and mentioned in the Report for last year, was, at a later stage, almost entirely shut off by the casing. When the Pelican sandstone was penetrated, the hole became filled with salt water, which overflowed at the top, but not in any great volume. When the casing passed this sandstone the flow was reduced, but the water still continued to flow around it into the hole, with, probably, at a later stage,

some additions from the Grand Rapids sandstone. A five-gallon specimen of this water, collected by myself, has been subjected to analysis in the laboratory of the Survey, with results of some interest. They are reported as follows by Dr. Hoffmann :—

Analysis of salt water.

"The water contained a small quantity of suspended matter. This was removed by filtration. The filtered water, which was at first perfectly clear and colourless, became, after standing a short time, turbid, and deposited ferric hydrate, with ultimate complete separation of the iron previously contained in the water.

"Agreeably with the results of an analysis, by Mr. F. G. Wait, an imperial gallon of the water would contain :—

	Grains.
Chloride of potassium	4·32
" sodium	2305·77
" calcium	131·91
" magnesium	79·98
Bicarbonate of lime	1·65
" iron	7·84
Silica	·57
Organic matter	traces
	2532·04
Carbonic acid, free	·65
	2532·69

"The carbonates are calculated as anhydrous bicarbonates and the salts without their water of crystallization.

"The water further contained a very distinct trace of lithium, faint traces of barium and strontium ; also very distinct traces of bromine and a strong trace of iodine."

Geological section developed.

The geological section, as developed in the bore-hole up to the present time, with the addition of that shown in a natural exposure examined by me last summer, near the site of the bore, may I believe be summarized as follows, the zero datum being the top of the bore-hole, ten feet above low-water level of the Athabasca River, or about 1660 feet above sea-level :—

Height.		Thickness of formation.
	TOP OF BANK.	
180 feet.	Yellowish sandstones, thin beds, with some ironstone : *Fox Hill* or *Laramie*	15 feet.
165 "	Probably all gray shales, with some thin sandstone layers ; not well exposed.	

Depth.		Thickness of formation.
0 feet.	Top of bore-hole.	
1090 "	Gray and blackish shales, often very soft, with occasional thin, hard, layers of sandstone or ironstone. Much gas at different levels between 245 feet and 780 feet: *La Biche shales*	1255 feet.
1130 "	Gray sandstone, with a flow of salt water: *Pelican sandstone*	40 "
1233 "	Dark shales, often soft; a little sandstone: *Pelican shales*	103 "
1461 "	Gray sandstones and gray reddish and blackish shales; the sandstone sometimes very hard and probably nodular, as in outcrop at Grand Rapids: *Grand Rapids sandstones.*	228 "
1731 "	Dark and light-gray shales, generally hard, with some sandstone layers, particularly toward the base: *Clearwater shales*	270 " or more.
	Total	1911 feet.

Report on boring operations.

As recorded in the last Summary Report, the boring was suspended on the 26th of October, 1894, at a depth of 1011 feet, it being found impossible to go further without more casing. On the work done in 1895, Mr. Fraser has made a detailed report, from which the following account is extracted or summarized:—

I left Toronto for Athabasca Landing on the 10th April and work was resumed on the boring on the 27th of that month. The 300 feet of 5⅝-inch casing which had been sent up the previous fall, had not arrived in time to be driven however, so, as the first part of the work, we proceeded to try driving it. It was found that the 5⅝-inch casing had parted about 200 feet from the surface, so I deemed it unadvisable to try driving it—in fact it would have led only to disaster. It could not be determined at what exact depth it had parted, for it would not have been safe to attempt to draw it; the walls would have caved in and perhaps covered up the bottom lengths, so that the top lengths could not have been got into them again.

I then had the 4⅝-inch casing put down. We used the under-reamer from the former depth, 825 feet, to the full depth of the bore, 1011 feet.

At the depth of about 1000 feet, the 4⅝-inch casing would go no further, the bottom length became bent, and we could not work through it with safety. I did not consider it advisable to try to straighten it out, for fear it might become so badly damaged that no other smaller casing could be put through it.

Under the circumstances I proceeded to Ottawa for consultation on the 17th May. My suggestion that an additional string of 3⅝-inch casing be procured, and the boring proceeded with, was approved of, and 1500 feet of this sized casing was ordered. A full set of new tools of smaller size had also to be provided and the making of these caused considerable delay. Both casing and tools were,

Report on boring operations—*Cont.*

however, shipped on the 11th June from Petrolia, and arrived in Edmonton on the 24th of the same month. I got back to Edmonton by the same train, and immediately procured teams and had the casing and tools sent to the Landing, where I arrived on the 29th.

One of the skilled men I had taken up from Petrolia, refused to work any longer, owing to a disagreement with the driller while I was away. This occasioned me some inconvenience, but I turned in myself and took his place, and the work proceeded from this time on very rapidly.

The first work was to put in the small casing (always spoken of as four inch) down through the 4§-inch. At 985 feet it struck hard cavings which had been driven up in the 4§-inch by the gas, and would not go any further. We drilled this out, and put it down to the bottom of the bore, 1012 feet.

Drilling was then recommenced, the shale being so soft that the casing followed the bit without any reaming for the next three or four feet. The materials passed through, with notes upon the work, are as follows, in descending order :—

1012–1015 feet, dark soft shale.

At 1015 feet this changed to a hard light-coloured shale.

At 1017 we struck a mud-vein which ran in as fast as we could take it out with the sand-pump. The shale, though hard, still caved badly.

1017–37, still caving. In reaming found it quite hard at 1020 feet.

1037–69, formation dark shale and caving badly. Struck gas at 1055 feet.

1069–84, formation dark shale, caving badly.

1084–90, formation dark shale.

1090, struck sandstone (afterwards proved to be Pelican sandstone) which carried water that flowed over the top of the casing and was strongly saline.

1090–94, sandstone. Put down the casing, but it did not shut off the water, which continued to flow over the top.

1094–1130, still sandstone, water present but in less volume. When the tools were left out of the hole at night, and the water was allowed to find its own hydrostatic level, it stood at about 60 feet below the surface.

1130, reached shale, pretty clearly the Pelican shale of Mr. McConnell.

1130–60, shale, dark in colour and caving badly. The sandstone and shale here mixed in the hole to the consistency of cement, which made the drilling difficult.

1160–70, dark shale—soft.

1170–1207, dark shale with layers of sandstone.

1217–33, dull reddish shale and sandstone.

1233–37, dark gray shale—soft.

1237–42, light gray shale—very hard.

1242–47, light gray shale—soft.

1247–55, dark shale—soft.

1255–60, sandstone—very hard.

1260–67, dark shale—soft.

Up to this time we had been able to pull the casing up and down in the hole, and it worked rather freely. We had moved it up and down almost every day to prevent it becoming fast. At 1267 feet, the bore was caving very badly and the casting became fast. In trying to move it we pulled the derrick down and narrowly escaped a serious accident, particularly to the driller, who was buried underneath the ruins, but unhurt.

Report on boring operations—*Cont.*

Lumber had to be sawn out by hand to rebuild the derrick, and about a week was lost by this mishap. When the repairs had been completed, we were obliged to have recourse to driving. We screwed an iron cap, which had been provided for such a contingency, into the top length and drove on it. From this depth to the bottom the casing required more or less driving.

1267–85, dark shale—soft.
1285–95, sandstone—very hard.
1295–1300, sandstone—hard.
1300–10, sandstone—very hard.
1210–1323, dull reddish shale and sandstone—soft.
1323–38, reddish shale.
1338–50, sandstone and dark shale.
1350–63, dull reddish shale with a little sandstone.
1363–79, dull reddish shale and sandstone.
1379–91, dull reddish shale and a little sandstone.
1391–1425, sandstone, with some layers of dark gray shale.
1425–35, sandstone, medium hardness, shale dark.
1435–48, sandstone, hard with soft streaks.
1448–61, sandstone and dark shale interstratified.
1461–73, dark shale. (Thin streaks of lignite about here.
1473–91, dark shale.
1491–1531, hard shale, light gray colour.
1531–40, shale; not quite so hard.
1540–66.
1566–70, hard sandstone.
1570–76, very hard sandstone.
1576–89, hard shale, drilling very like limestone.
1589–1601, hard shale, light gray in colour.
1601–13, similar, with streaks of soft shale.
1613–26, hard shale.
1626–33, very hard. Iron-stone boulder.
1633–43, hard shale.
1643–55, hard shale, a little gas.
1655–82, hard shale.
1682–89, hard and soft shale alternating.
1689–95, shale and sandstone alternating.
1695–1722, shale and sandstone alternating. Shale very soft and caving in badly.
1722–31, shale with a little sandstone.

At this depth (on October 10th) further drilling became impossible, because of caving-in of the sides of the hole, until the casing should be put down to the full depth. The casing stood at the time at 1473 feet. The under-reamer, which had been gotten new in June, was completely worn out; so I proceeded to Calgary and had a new one made there. I returned on the 25th October, when work was resumed again, and the hole was subsequently enlarged and the casing carried down to a depth of 1668 feet. When this had been accomplished, it became necessary to close operations for the season, owing to the onset of very cold weather.

When it became fully established that the formations were in regular order, as observed by Mr. McConnell on the lower reaches of the Athabasca, it was evident

that the "tar sands" would be encountered at a greater depth than anticipatep, consequently the 1500 feet of 4-inch casing would be insufficient. An additional 300 feet was ordered, and forwarded by the department. No delay was met with, for this casing arrived before it was actually needed, thanks to the prompt manner in which it was forwarded. The quantity of casing on the ground should be sufficient to carry the bore down to 2000 feet. Report on boring operations—*Cont.*

The sinking of the bore during the season of 1895, has been a difficult undertaking. The formation is the very worst that can be encountered, on account of the constant caving, requiring to be cased all the way, and to this the sandstone strata proved a serious obstacle, as they required to be reamed off before the casing could be put down. The under-reamer got for this purpose was quite inadequate to the work, as made in the shops; but, as the result of much experience on this bore, it is now a first-class tool and does its work very satisfactorily.

The price of success has been eternal vigilance. An instance of this may be given which occurred during the reaming, at 1285 feet. We were six days reaming three feet, and when the casing was put down it had only *one-quarter inch clearance*. This was through a very hard sandstone, which wore off the steel as though it were being held on a grindstone driven by steam power. We could not pull up the casing had we let it down, and if it did not go through all work on the bore would have ended there. We made sure of our measurements, and then put the casing down successfully.

Although operations were commenced over a year and a half ago, the drill being first started on August 15th, 1894, only eight months of actual work has been done on the bore, divided as follows:—1894, two months; 1895, six months. The balance of the time had been lost for actual work, owing to the great distance by which the locality is removed from the base of supplies.

The work is of such a nature that machinery and tools cannot be made so that breaks will not occur. Neither would the duplicating of parts overcome this evil, for one particular part may break two, three, or five times, whilst the parts are so numerous, bulky and expensive that one would be forced to spend a small fortune on freight in moving the plant about in such an out-of-the-way place, to say nothing of the first expense of purchase. All that can be done has been done in the past to provide against such delays, having a due consideration for the fact that economy has been carefully and at all times impressed upon me by the department.

The boring at the Landing has been put down as cheaply as possible, and if it had been done by day labour, it is safe to say that it would have cost double the sum it has.

At present the amount of casing in the bore-hole is as follows:—

37 feet of 6⅝-inch diameter; 625 feet of 5⅝-inch diameter; 1000 feet of 4⅝-inch diameter; 1070 feet of 3⅝-inch diameter (probable estimate). Much of this can be recovered for use next year in another bore.

There is above ground:—30 feet of 6⅝-inch diameter; 400 feet of 5⅝-inch diameter; 500 feet of 4⅝-inch diameter.

During the summer, two large boats capable of carrying ten or twelve tons of plant, have been constructed to take the boring outfit down to the Pelican River,

Report on boring operations—*Cont.*

if this should be decided upon. These boats were built by the men while work was interrupted on the boring, as above described.

In conclusion, I beg to call your attention strongly to the value of the information obtained, with regard to the continuance of the rock-formations observed near the outcrop of the "tar sands," at this great distance from the said outcrop. It means that the forecast that they did so extend is now an absolute certainty, and is one of the strongest arguments against the popular fallacy that geological knowledge is of no practical value in determining the extent of a petroleum deposit. We now know that the formations overlying the petroleum-saturated sandstone, extend with almost unvarying regularity at least one hundred and fifty miles to the south and west. That they have been found at a greater depth than anticipated matters very little—in fact, in my opinion, this is rather favourable to the existence of a greater natural reservoir for oil, should it still be there.

The total expenditure in connection with the above operations, during the calendar year 1895, has been $7838.66, of which $6125.50 was paid to the contractor as the work progressed, $1504.31 was paid for casing and transporting the same, and $208.85 represents travelling and minor expenses.

Gold-washing on the Saskatchewan.

While at Edmonton, in connection with my visit to Athabasca Landing, some facts of interest in connection with gold-washing on the North Saskatchewan were learned. This industry has been prosecuted in an irregular manner, at low-water stages of the river, for many years. The principal paying bars are found along the river within a distance of about sixty miles above and a similar distance below Edmonton, but of late, ground has been worked even as far down as Battleford, some 250 miles below Edmonton. A larger number of men than usual were in 1895 engaged in this work on the Saskatchewan, probably about 300 in all, while it was estimated that gold to the value of $30,000 had already been purchased at Edmonton, before the end of August. Simple mechanical appliances of various kinds, worked by hand, are now employed successfully in raising gravel from the submerged bars, a sand-pump has been tried without much success, but this year a large dredge has been constructed for the work. This was about ready for operation at the time of my visit, but no particulars are available respecting its work since.

Distribution of gold.

The occurrence of gold is not, however, limited to the North Saskatchewan. As may be gathered from previous Reports of the Survey, it is found in greater or less abundance, in a similar manner, on portions of the courses of all the rivers east of the Rocky Mountains from the 49th parallel northward. Good returns obtained by individual miners on the corresponding part of the Athabasca River, led last summer to the outfitting of many parties for that river. The results were on the whole disappointing, but it must be added that most of the advent-

urers were not even skilled in the work, or likely to be able to save the gold, which is always very fine.

To the south of the Peace River, at least, the gold thus found in the beds of the rivers of the Great Plains, does not appear to be derived directly from the Rocky Mountain region. The question of its origin has been discussed in several previous Reports, but further investigations appear to be required to settle this definitely.

Gold mines on Lake of the Woods.

On my return journey, a couple of days were spent on the Lake of the Woods, with the purpose of seeing something of the progress of the gold mines there in course of development. Acknowledgments are due to Mr. R. H. Ahn, for his kindness in assisting me in this endeavour; and I had also the pleasure of meeting, at Rat Portage, Mr. A. Blue, Director of the Ontario Bureau of Mines. In company with Mr. Blue, visits were made to several of the locations. The *Sultana* is the only one of these which can be said to have, at the time, passed the experimental stage. The shaft is there down about 200 feet, with levels run out on the vein to the north and south, while a considerable amount of ore has also been taken taken out from the outcrops of the veins. A ten-stamp mill with Frue vanners is in constant operation, the free gold only being obtained at present Pyritous "concentrates" which amount to about one-hundredth of the whole weight of quartz, and are said to carry $50 to $60 worth of gold to the ton, are put aside for future treatment. Through the kindness of Mr. J. F. Caldwell, the owner of the Sultana, I am able to state that the total yield of gold from this mine to date, has been of the value of about $90,000.

At the *Gold Hill* mine, a ten-stamp mill had been put in place and was nearly ready for operation at the time of my visit, while work was actively in progress on the lodes. The *Regina* mine was not visited, but another ten-stamp mill is now at work there, and very excellent specimens of auriferous quartz from the mine were shown to me by General Wilkinson. Projects are on foot for the installation of milling machinery on other properties around the lake, and, generally speaking, an encouraging amount of well-directed activity is being shown, such as to lead to the belief that the gold mining industry is likely to be pursued in future in a business-like manner and with good results.

Auriferous belts.

Taken in connection with the later developments about Rainy Lake, the Seine River and in the Manitou district, of which some particulars will be found in Mr. McInnes's report on a later page, the circumstances are such as to show, more clearly than ever, the auriferous character of the Huronian rocks. Already the prospectors and miners have become

accustomed to recognize this fact, over the whole region, and the geological maps prepared by this department are valued by them as most important guides, while urgent demands are made for the further extension of the work of the Survey.

Metalliferous character of Huronian rocks generally.

From a still wider point of view, embracing the nickel, copper and gold deposits of the vicinity of Sudbury and Sault Ste. Marie, as well as those above particularly referred to, the economic importance and metalliferous character of the rocks of the Huronian system become even more apparent. This fact was recognized and the importance of the geological conditions insisted upon by Sir William Logan, in reports of the Survey made nearly forty years ago, and it is gratifying to observe that the practical miner is now beginning to appreciate the value of a large amount of geological work carried out in the country to the north of the Great Lakes, which, a few years ago, it might have appeared difficult to justify in the light of any economic results up to that time achieved. There can now be very little doubt, that every square mile of the Huronian formation of Canada will sooner or later become an object of interest to the prospector, and that industries of considerable importance may yet be planted upon this formation in districts far to the north, or for other reasons at present regarded as barren and useless.

Distribution of field-parties.

Turning to the operations of the regular field parties of the Geological Survey, the following synopsis of their distribution, by provinces, may in the first place be given :—

British Columbia	2
North-west Territories (boring operations)	1
Manitoba and Keewatin	1
Ontario	4
Quebec	4
Nova Scotia	2
Total	14

Special examinations in the field.

In addition to the above parties, which were engaged in continuous field-work during a great part of the season, several members of the staff were occupied for shorter periods with special investigations in the field. Mr. J. F. Whiteaves, spent a few days in palæontological researches on the Island of Montreal and in its vicinity, and Dr. H. M. Ami was occupied for nearly a month in similar work in Nova Scotia; both in connection with the definition for mapping of the geological formations. Mr. W. F. Ferrier was authorized to visit and examine several localities where ores and minerals of interest had been reported. Mr. J. White spent two weeks in running a line of survey, found to be

necessary for the laying out of one of the Ontario map-sheets. Mr. Willimott also, as noted in the sequel, made a number of short journeys for the purpose of collecting duplicate material to be employed in making up collections for educational institutions. Of the gentlemen not regularly attached to the staff of the Survey, who have in former years carried out geological work, Professor L. W. Bailey of Fredericton, alone was entrusted with any such work during the year, and the funds available restricted his operations to a short period.

Synopsis of field-work.

Before entering with such details as are appropriate repeating the field-work of the season, the following additional general observations may be given, which, in conjunction with the foregoing notes, will serve as a brief outline of the scope and results of the explorations and surveys of the year:—

The work done in British Columbia has been confined to two districts in that extentive province. Its results, given at greater length below, are therefore insufficient to indicate the great general development of mining there is in progress. The facts detailed by Mr. McConnell, however, show the wonderful expansion of mining enterprises taking place in the West Kootanie district and the extent and richness of the deposits carrying silver and gold there. One of the most notable points brought out, is the occurrence, lately ascertained, of ores of exceptional value in parts of the granitic area, which has heretofore been almost disregarded by the miners.

Most of the facts relating to the structural geology and actual survey of the district, are reserved for a detailed report and map, for which much further work is still needed. Ten years ago this district was almost an untrodden wilderness, but it is difficult now, with the means at the disposal of the Geological Survey, to keep pace with the march of discovery. Mr. McEvoy's work in the Shuswap region, has been given principally to obtaining additional data for the map, now approaching completion. The recent discovery of a large deposit of gypsum in this region is noteworthy, as being the first of the kind found in British Columbia.

Mr. Tyrrell's exploration of the country to the east of Lake Winnipeg, has afforded the means of representing that region correctly upon the maps. Although found to be underlain almost exclusively by Archæan gneisses and granites, an unexpected development of superficial silty deposits was met with, such as to afford a large tract of probable agricultural value.

In the Rainy Lake and Thunder Bay districts of Western Ontario, the surveys carried out by Mr. McInnes, of which an interesting

Synopsis of field-work—*Cont.*

summary is given, have been in close connection with the development and definition of the auriferous quartz-veins and the iron ores. The rocks characterizing this country are divisible, in a general way, into Laurentian and Huronian, the former term being applied to the granitoid gneisses and granites of similar composition inclusively, in the absence of criteria such as to enable any distinct line to be drawn between these two classes of rocks, and without necessarily implying the existence of any rocks preserving their originally bedded character, like those of the Grenville series. The Huronian rocks include the Keewatin and Coutchiching of Dr. Lawson, and of these the relations will be more fully explained in Mr. McInnes's forthcoming report. It is in this series that minerals of value are found to occur, and it may be added, that some assays lately made in the laboratory, of quartz from the Manitou and Seine River regions, prove the existence of quartz-veins exceptionally rich in gold, of which it only remains to prove the extent and continuance in depth.

Rocks very similar in character to those above referred to, but even more closely akin lithologically to those of the Sudbury region, of which they are in fact the continuation, characterize the area covered by the Nipissing and Temiscaming sheets. These two maps, with a report relating to their united area, are in process of compilation by Mr. Barlow. Frequent inquiries are already being made for maps of this region, by prospectors anxious to pursue their explorations in it, and it will be endeavoured to publish the sheets referred to as soon as possible. Upon Lake Temiscaming is one of the typical Huronian areas first discovered and named by Sir William Logan, and its close examination has produced results of considerable value from a geological standpoint.

The country in the vicinity of the Ottawa River, from the vicinity of Ste. Scholastique to that of Pembroke, now being laid down in detail for the first time by Dr. Ells, comprises extensive areas of the Grenville series of the Laurentian, with its great crystalline limestones and other characteristic rocks. These, it is hoped, it may be possible to trace into some clear connection with the representatives of the Hastings series of Vennor, of which the relations have remained more or less in doubt. The economic minerals of the region covered by this work comprise iron-ores, mica, graphite, apatite, asbestus, as well as marble and other structural materials.

The map-sheet extending to the south-east of Ottawa and including Cornwall, upon which Mr. Giroux has been engaged, is underlain by little-disturbed Cambro-Silurian rocks. The areas occupied by the various formations comprised within this period are being carefully defined.

No metalliferous deposits are known to occur, but questions relating to building-stones, brick-clays, peat, marl and the existence or otherwise of porous beds capable of yielding potable water, are involved. Synopsis of field-work—*Cont.*

The survey of the Noddaway River in Northern Quebec, by Dr. Bell, and the establishment of the fact that the stream previously known to exist to the north of Grand Lake, on the Ottawa, is one of its principal sources, makes a substantial contribution to the geography of the province. The most important geological discovery made, and one which promises to have results of economic value, appears to be the existence of a great area of the Huronian system to the north of the main watershed. The occurrence of a wide expanse of country characterized by good soil and bearing a considerable growth of forest, is also notable.

Mr. Low's expedition up the Manicuagan River and in the country about the height-of-land between this river and those draining to the northward, had also in part a geographical object. Its geological results are, however, not without importance in connection with the accumulation of material for a more complete map of the rocks of the Dominion. The supposition that the region traversed is in general one of Laurentian rocks has been confirmed, but it has been proved that the Upper Laurentian, or Granville series, is present there, as well as important masses of anorthosite rocks. A remarkable bed of magnetic iron-ore was also discovered, although this is too far from means of transportation to be of any immediate utility.

In the 'Eastern Townships' of Quebec, Mr. Chalmers has begun a critical reëxamination of the auriferous gravels, bringing to bear upon this problem his long experience of the superficial deposits of the neighbouring parts of New Brunswick, and of the events of the glacial period generally. The wide spread of the auriferous drifts beneath the boulder-clay has been demonstrated, while various facts of scientific value have also been noted; such as the probable twofold division of the boulder-clay, the height and continuity of old sea-beaches and the various directions in which the ice flowed over the district during different stages of the glacial period. The discovery of an auriferous conglomerate among the ancient metamorphic rocks of the region, at Dudswell, is also a matter of interest and possibly of importance.

Mr. Fletcher's work, in Cape Breton, has been directed to a reinvestigation of the Sydney coal-field, preparatory to a new issue of the geological map-sheets, of which the previous edition has become exhausted. Since the surveys of Mr. Robb, many years ago, great progress has been made in the working of these coal-fields, rendering

Synopsis of field-work—*Cont.*

necessary such a reconsideration of structural facts as that now in progress. In the counties of Halifax and Hants, Nova Scotia, Mr. Faribault has continued his careful survey of the Cambrian gold-bearing rocks. The facts discovered in regard to the relation of the auriferous veins to the various well-marked anticlines, have rendered necessary a close study of these folded strata, together with their associated granitic masses and the various faults and fractures affecting them. All these features are being laid down with accuracy upon maps on the scale of a mile to the inch, and the interest of the mining population in the work is freely expressed.

The work done by Professor Bailey, of Fredericton, during a few weeks, in the south-west part of Nova Scotia, had reference to a revision of the general geology of that portion of the province, which has not yet been mapped in detail.

Arrangement of following summaries.

In presenting the subjoined preliminary reports on work done in the field, they are arranged, in conformity with previous practice, in order by provinces and districts from west to east. In respect to detail, greater prominence is, as a rule, given to the results of explorations and surveys which are as yet incomplete, and of which it will not be possible to present final reports and maps for some time to come, and greater space is given to those aspects of the work of the year which appear to have immediate importance from an economic point of view.

BRITISH COLUMBIA.

British Columbia.

During the early part of the year, much of Mr. R. G. McConnell's time was occupied in completing for publication a report and map of his exploration on the Finlay River, made in 1893. Work was also in progress on the surveys made in West Kootanie during 1894, and on the rocks and minerals obtained from this district and from the Finlay.

West Kootanie. Work by Mr. McConnell.

On the 11th of June, Mr. McConnell resumed field-work in West Kootanie, assisted, as before, by Mr. H. Y. Russel. The work was brought to a close on October 5th.

The season available for effective geological work on the high mountain ranges of the Kootanie district, judging from the experience of the last two seasons, is practically limited to the two months of July and August, with the first two weeks of September, and even during this short period, operations are often seriously hindered by forest fires and the dense smoke arising from them. The snow seldom

disappears from the high summits before the end of June, and usually re-appears on the mountain tops before the middle of September. The shortness of the season, taken in conjunction with the rough, wooded, pathless character of most of the region, necessarily cause its geological examination to be a lengthy undertaking. British Columbia—*Cont*

Mr. McConnell reports as follows on the progress made in his work, and the condition of mining in the district.—*

"Field-work was commenced with an examination of Slocan Lake and the surrounding country, which occupied about a month. After completing this, work was continued eastward to Kootanie Lake, and southward to Balfour, along the zone of shales and schists bordering the great granite area of the district. A trip from Kootanie Arm to Slocan Lake and back by the Slocan River was contemplated, but had to be abandoned owing to the early appearance of the snow. The work included a rough topographical survey as well as geological survey of the district, the former being conducted by Mr. H. Y. Russel, the latter by myself. Operations of the season.

"Slocan Lake is one of those long, narrow bodies of water which occur so frequently throughout the mountainous districts of British Columbia. It occupies part of a great valley, hewn out of the mountains long before the present drainage-system was inaugurated, extending from Nakusp on the Upper Arrow Lake, to Kootanie River. Slocan Lake.

"The lake has a length of twenty-three miles, and an average width of about a mile. Its depth increases, going southward, from 750 feet near the mouth of Wilson Creek, to 930 feet off Cape Horn. Marginal flats are absent, except at the mouths of the principal feeders; and the high mountains which surround it on all sides, rise either gradually, or in precipitous cliffs, from the water's edge. The slopes of the mountains are covered with a dense coniferous forest, except where forest fires have passed, up to a height of 3000 feet above the lake, and with a scattered growth of pine, spruce and fir, up to a further height, dependant on local conditions, of from 1000 to 2000 feet.

"The region between Slocan Lake and River and Kootanie Lake, partially examined during the season, is covered mainly by granite, fringed on the north and east by a border of slates and schists, and is everywhere of a mountainous character. The granite-mass, originally dome-shaped, has been carved by the drainage-system of the region into bold craggy mountains and mountain ranges, which culminate in a rugged mass of snow-clad peaks, situated between the south-end of Region between Slocan and Kootanie Lakes.

* NOTE.—The bearings given throughout this and the succeeding reports are referred to the true meridian unless otherwise specially stated.

British Columbia—*Cont.*

Slocan Lake and Ainsworth, the highest summits of which approach 9000 feet in height above the sea. The principal streams of the district, including Lemon Creek, Ten-mile Creek (Slocan Lake), the south fork of Kaslo Creek, Woodberry Creek and Coffee Creek, radiate from this group and descend rapidly through deep, steep-sided valleys to the main waterways. A second range of prominent peaks, scarcely inferior in height to the central group, occurs north of the Kaslo-Slocan wagon-road. The Whitewater, Lyell Creek, and other tributaries of Kaslo Creek, head in glaciers which descend from this range.

Boundaries of the granite.

"The principal geological boundary in the district between Slocan Lake and River and Kootanie Lake, is the sinuous line separating the granite area from the bordering slates. Starting from Four-mile Creek on Slocan Lake, this line follows that stream in an easterly direction for ten miles, then bends to the north across the range separating Four-mile Creek from Cody Creek and following the latter stream in a northerly direction for a couple of miles. From Cody Creek, the granite border runs almost directly east to Twelve-mile Creek. After crossing this creek the line becomes more irregular, as several spurs leave the granite area and penetrate for varying distances the group of mountains lying between Ten-mile Creek and the South Fork of Kaslo Creek. At the latter stream, the granite recedes a couple of miles, then bends around a deep embayment of slates, and continues on in an easterly direction towards Kootanie Lake. Four miles from the lake, the line of junction turns abruptly southward, and continues in this direction until near Balfour, where it bends more to the west and crosses the outlet of Kootanie Lake about four miles below its head. Inliers of slate in the granite, occur at the head of Eight-mile Creek (Slocan Lake), on Four-mile Creek and at other places, while bosses of granite, separated from the main area, break through the slates at Paddy's Peak, Reco Mountain, and north-east of New Denver.

Rock-series developed.

"The stratified rocks bordering the granite area are everywhere tilted at high angles, broken by numerous faults, and frequently overturned. They may be divided into four main groups, as follows, in descending order:—A series of dark shales and slates associated with limestones and calcareous quartzites, which may be provisionally named the Slocan slates; a series of greenish, probably mostly diabase-schists, interbedded with some slates (Kaslo schists); a series of dark calc-schists holding occasional bands of limestone and green schists (Nisconlith series); and a basement series of mica-schists, calc-schists, crystalline limestones and gneisses (Shuswap series).*

*Compare Annual Report, Geological Survey of Canada, vol. IV. (N.S.), part B. The Slocan slates are probably the equivalents of the Adams Lake series, but it may be an advantage for the present, at least, to refer to them by a local name.

British Columbia—*Cont.*

Distribution of rocks.

"The Slocan slates occur all around the northern end of Slocan Lake and extend eastward, striking in a north-westerly and south-easterly direction, along the Kaslo-Slocan wagon-road to the Forks of Kaslo Creek. The slates of this group strike into the granite area, and with the exception of a narrow strip which skirts the eastern edge of the granites south to near Balfour, are cut off by it. The Kaslo schists were traced from Balfour north to Kaslo Creek, and then in a north-westerly direction to the edge of the map. These schists are altered in places into serpentine. The Shuswap series occurs in a band of varying width along the shores of Kootanie Lake, and was also found on the western side of Slocan Lake near Saw-mill Creek, where it is inclosed in granite.

"The classification of the rocks of the district as given above, is based entirely on differences in lithological character, as no fossils were found, nor were any unconformities worked out. The three systems appear in places to graduate into each other, and the lines separating them must be drawn, so far as present evidence goes, in a more or less arbitrary manner. The stratified rocks are traversed by two systems of dykes, one apparently contemporaneous with the granites and the other much younger. The former is cut by the fissures holding the mineral lodes of the district, while the latter, in some cases at least, cuts these fissures.

Metalliferous veins.

"Mineral veins occur to some extent in all the formations represented in the district, irrespective of age or origin, but are more numerous and better defined in the Slocan slates than in the older stratified rocks or in the granites. The famous Slocan Star occurs in this formation, and also the Alamo, Idaho, Mountain Chief, Noble Five, Reco, Alpha, Wellington, Payne, Washington, No. 1, Skyline, and dozens of other promising leads. The Eureka and the great Silver King vein, occur in the Kaslo schists, and the Bluebell and Highland in the Shuswap series. As examples of those occurring in the granite, may be mentioned the Fisher-maiden, Enterprise and Arlington.

Rich veins in granite.

"A number of mines and prospects in the district were visited during the progress of the work and brief notes were taken, some of which may be of interest here. The granite area south of the main Slocan mining camp, hitherto somewhat neglected, was prospected pretty thoroughly during the past season, and a large number of claims—some of considerable promise—were staked out. Among those visited in this section were the Arlington, celebrated for the richness of its ore, the Nancy Hanks, Tamarac, Dayton and Enterprise.

"The Arlington, on Springer Creek, located in 1894 by C. E. Fielding, follows a zone of shattered rock, which as shown in the single

British Columbia—*Cont.*

opening so far made, has a width of from six to eight feet. The ore occurs mostly in siliceous stringers, ranging in width up to four or eight inches, which run in an irregular manner through the fissured and altered granite, but is also found disseminated through, or in small bunches, in the granite itself. It consists principally of native silver, galena, gray copper and argentite. The lead strikes in a north-easterly direction and is reported to be traceable all the way to Ten-mile Creek, a distance of over ten miles. Claims have been staked on it for this distance.

"A large boulder of altered granite, holding stringers of ore resembling that of the Arlington, occurs on the Speculator, the third claim north of the Arlington. The Tamarac is situated on Whittaker Creek, a branch of Springer Creek The workings here have exposed a quartz-seam, from twelve to eighteen inches in width, holding grains and bunches of galena, argentite, and ores of copper. The seam is very regular and has been uncovered for a distance of 250 feet. The Dayton and Nancy Hanks are somewhat similar in character.

"The Enterprise, situated on the northern slope of the ridge separating Springer from Ten-mile Creek, was located in 1894 by R. Kirkwood. This claim is crossed by a well-defined fault-fissure, running in a north-easterly direction and dipping to the south-east at an angle of 80°. The fissure has a width of twelve to eighteen inches and is filled partly with ore and partly with a quartz gangue. The ore consists mostly of galena with some gray copper, and in common with other ores in the granite belt is high grade in silver. A large number of claims have been staked out in the vicinity of the Enterprise, but little development work has so far been done on them.

Claims on Eight-mile Creek.

"The claims on Eight-mile Creek, north of Ten-mile Creek, occur mostly in an inlier of hard, rusty slate or schist, several square miles in extent, inclosed in the granite. The L. H., Baby Ruth, Los Vegas, Mountain View, Granite Mountain, Daisy, and a number of others are situated on this strip. The L. H., is a gold claim of a somewhat peculiar character. The slates are fissured along an east-and-west line, and the schistose country-rock adjoining the line of fracture on the south has been altered, silicified, and impregnated in places with ore, along a zone varying in width from 20 to 40 feet. The alteration varies greatly in intensity, in some places being scarcely noticeable, while in others the rock has lost all traces of its original character. The ore appears to consist mostly of native arsenic, mispickel, pyrite, and pyrrhotite, distributed through the vein in an irregular manner. Assays from samples taken at intervals across the whole width of the lead (40 feet) are stated to have averaged $23 in gold to the ton, and others taken

across a selected band seven feet in width, to have averaged $125 to the ton. British Columbia—*Cont.*

"The Baby Ruth, situated on a branch of Eight-mile Creek, about half a mile below the L. H., shows a well defined fault-fissure a couple of feet in width, filled with a quartzose gangue and bands of residual clay. The Granite Mountain and Mountain View leads, appear to consist of narrow tongues of slate penetrating the granite. The slate is partly altered, and mineralized to some extent with pyrite, blende, and galena. The Los Vegas and Daisy, both reported to be valuable claims, were not examined.

"Small inliers of slate occur in the granite in what is known as the Galena Farm, a plateau south-east of Silverton, so called on account of the numerous galena boulders scattered over it. The principal claims examined here were the Noonday and Currie. The workings on the Currie consist of a small shaft and a short tunnel, both inaccessible at the time of my visit, on account of water. The lead where uncovered, has a width at the surface of ten to fifteen feet, and consists of a brecciated mass of quartz and angular fragments of slate, mingled with galena, blende, and pyrite. It appears capable of yielding a large quantity of concentrating ore. The Noonday, situated near the junction of the slate inlier with the granite, is somewhat similar in character. Galena Farm

"The known area of the mineralized granite belt, was greatly enlarged during the latter part of the season, and now includes all the country drained by the various branches of Lemon and Cedar creeks, and probably extends even farther to the south and east. The rough character of the country, and the almost total absence of trails, has prevented much development work being done on the various lodes, beyond that required for assessment work, and it is highly desirable that readier means of access to this promising region should be opened up.

"A short account of some of the principal mines in the main Slocan mining camp, was given in my summary of last year's work. A number of others were visited during the past season, but it will be impossible here to make more than the briefest mention of these. Slocan mining camp.

"This camp has passed the doubtful stage, and is now in a thoroughly prosperous condition. The workings on the older mines have proved the continuity in depth of the lodes in most cases, and new ore-bodies are constantly being opened up. Several tramways and concentrators are in course of construction, and two lines of railway will this winter compete for the rapidly increasing output of ore.

British Columbia—*Cont.*

"The principal mines in the Slocan district, are situated on the slopes of the long irregular ridge separating Four-mile Creek from the South Fork of Carpenter Creek, and on the ridge separating the South Fork of Carpenter Creek from Seaton Creek, or the Middle Fork of Carpenter Creek. The former ridge is known as Silver Mountain, and around it are grouped the Alpha, the Reed and Robertson groups, the Canadian group, the Mountain Chief, the Alamo, Idaho, Cumberland, Yakima, Wonderful, Ruth, Slocan Star, Ivanhoe and many others.

The Alpha.

"The Alpha is situated on the Four-mile slope of the mountain, about two miles east, and 2500 feet above Slocan Lake. The steep slope near the mine, is overcome by a gravity tramway 1600 feet in length, from the foot of which a good wagon-road leads to the lake. The Alpha lead has the character of a crushed zone, 20 to 40 feet in width, running through shales and limestones. The strike is N. 24° E., and the dip is south-easterly at an angle, near the surface, of 35°. The ore occurs mostly in large pockets, one of which yielded 800 tons, and two others about 200 tons each. It consists principally of rich galena, with some blende, and gray copper. Considerable tunnelling has been done at this mine, and at the time of my visit an incline, following the dip of the lead, was being sunk. Farther to the south-east on the same slope, are the Reed and Robertson claims, situated on a strong lead 20 to 30 feet in width, which is stated to be traceable from Four-mile Creek to the summit of the ridge, a distance of over two miles. Still farther east, on the crest of the ridge, are the Chamblet and Britomarte claims.

"Among the more important mines on the northern slope of Silver Mountain, are the Mountain Chief, from which 1000 tons of ore has already been shipped, and the Alamo, Idaho, and Cumberland, on the head of Hauser Creek. The Idaho was idle at the time of my visit, but good forces of men were engaged on both the Alamo and the Cumberland.

The Alamo.

"The Alamo affords a good type of the leads in this vicinity. It shows a well-defined fissured zone from five to ten feet in width, traversing the slates in an easterly direction and filled with crushed and brecciated slate, calc-spar, spathic iron, quartz, and ore. The dip is southerly, at an angle of 75° in the upper levels, but lower down it becomes nearly vertical. The lead is situated on a steep slope, and, like most of the mines in the Slocan district, offers especial facilities for being mined by tunnels, four of which have been driven into it at levels about 100 feet apart, in all of which important bodies of pure and concentrating ore have been exposed. The ore consists principally of galena, with some blende, gray copper, pyrargyrite and pyrite.

British Columbia—*Cont.*

"A concentrator of 100 tons capacity, was erected by the Slocan Mining Company at the mouth of Hauser Creek during the past summer, to treat the concentrating ores from the Alamo and other mines in the vicinity. A tramway a mile and a quarter in length, has also been built up Hauser Creek, from the end of which wagon-roads lead to the different mines.

Mines on north slope of Silver Mtn.

"On the north slope of Silver Mountain ridge, are the Slocan Star, Ruth, Ivanhoe, Wonderful, and other claims. A description of the Slocan Star was given in last year's summary. The fourth tunnel, which was incomplete at the time of my former visit, reached the ledge at a distance of 500 feet. Drifts—mostly in ore—are now being driven along the lead, and an upraise to connect with No. 3 level, 300 feet above, is being made. A concentrator of 100 tons capacity, connected with the workings by a tramway 1900 feet in length, is also in course of construction in connection with this mine.

"The Ruth lead, has a width of from four to ten feet, and strikes S. 70° W., with a dip to the south of 65°. The workings consist of a tunnel 300 feet in length, from near the end of which an upraise has been made to the surface. One hundred and fifty tons of ore, principally galena, stated to carry 120 ounces of silver to the ton, has been shipped from this mine, and considerable bodies of ore are in sight.

"The Ivanhoe, situated high up on the slope of the mountain, shows several nearly parallel veins. Two cross-cut tunnels—the upper 50 feet and the lower 90 feet in length, connected by an upraise of 70 feet—have been driven, and drifts have been extended along the lead from the ends of both tunnels for varying distances. The workings have exposed an ore-chute sixty to seventy feet in length, with a maximum width of five feet of pure and concentrating ore. A contract for a third cross-cut tunnel, 150 feet below No. 2, had been let at the time of my visit.

Mines on Reco Mtn. ridge.

"The leads on the ridge separating the South from the Middle Fork of Carpenter Creek, are crowded even closer together than those on Silver Mountain ridge. On the south slope, among others, are the Noble Five group, Last Chance, Goodenough, Reco, Deadman and Bluebird, and on the north slope the Best, Antelope, Rambler, Surprise, Antoine, R. E. Lee and Washington. The Payne, the first mine staked in the district, is situated on the crest of a spur of the same ridge.

Noble Five Group.

"The Noble Five group, consists of a string of five claims, located on the same lead. The strike is N. 60° E., and the dip is to the north-west at an angle of 45°. The lead has in places the character of a true

British Columbia—*Cont.*

fissure, and in others that of a crushed and fissured zone filled with masses of the slaty country-rock, quartz, calc-spar and spathic iron. It varies in width from a few inches to ten feet or more.

"The Bonanza King and World's Fair, two members of this group, have been worked continuously since the spring of 1892. The workings consist of five tunnels, following the lead at various depths, with a number of upraises and intermediate drifts. The three upper tunnels, which have lengths respectively of 120, 240 and 400 feet, pierce an important ore-chute from 60 to 100 feet in length, and from a few inches to six feet in width. The ore-body widens from No. 1 to No. 2 tunnel and narrows somewhat at No. 3. A fourth tunnel, at a further depth of 350 feet, is now heading towards the chute, but has not yet reached it. The ore consists mostly of galena and blende, with their decomposition-products, classed locally as carbonates, and some gray copper, native silver and a dark earthy mineral which has not yet been examined, but probably consists largely of argentite. A band of the latter in No. 2 tunnel, three to four inches in width, is stated to have averaged 1500 ounces of silver to the ton. A thousand tons of ore stated to have averaged 135 ounces in silver to the ton, has already been shipped from this mine, and the owners expect to ship a second thousand during the coming winter.

The Deadman.

"The Deadman, a parallel lead situated 400 feet east of the Noble Five group, has a somewhat similar character. The ore-body has here a length of 40 to 50 feet and a maximum width of five feet. It has been opened up by two tunnels, each about 200 feet in length, and a third tunnel 135 feet lower down has been started towards it. The ore is very high grade in character. The output of shipping ore up to the present, is stated to have amounted to about 300 tons.

The Goodenough.

"East of the Deadman, on the same slope, are the Reco and the Bluebird, accounts of which were given in last year's Summary. The Goodenough, a small but exceedingly rich lead, adjoins the Reco on the south. The ore-chute, varying in width from traces up to six or seven inches, has been followed for a considerable distance on the neighbouring Reco claim. The ore consists mainly of galena and carbonates with some ruby silver and gray copper. A shipment of ten tons of the undecomposed ore from this mine, is stated to have averaged 776 ounces, and another shipment of five tons 817 ounces of silver to the ton.

The Last Chance.

"The Last Chance, is situated above the Noble Five mine. The surface appearance of this lead was somewhat unpromising, but an incline run down on it to a distance of 80 feet, resulted in the dis-

covery of a chute of ore showing from one to three feet and a half of pure high-grade galena, bordered by several feet of carbonates and concentrating ore. The chute was followed for 40 feet, when work was stopped by water, and a tunnel is now being driven toward it at a lower level. British Columbia—*Cont*

"The claims on the northern slope, occur mostly near the heads of the various tributaries of McGuigan's Creek. The R. E. Lee, is situated above McGuigan's Lake near the crest of the ridge. This lead has a width of about three feet and follows a well-defined fissure which cuts sharply through the hardened quartzose slates and granitic dykes which form the country-rock. The vein-filling is principally broken slate with some quartz. A tunnel has been driven along the lead for a distance of 100 feet. The first 20 feet proved barren, but beyond that, a layer of ore from three to six inches in thickness resting on the foot-wall, was followed all the way. At the breast of the tunnel, ore occurs on both walls. The ore is principally a high-grade galena, shipments averaging 133 ounces to the ton in silver and 75 per cent lead. Claims on north slope of Reco Mtn. ridge.

"North-west of the R. E. Lee is the Washington. This mine has been idle for some time, but will be worked during the present season. The principal openings consist of a tunnel 300 feet in length, from which an upraise of 180 feet leads to a short tunnel above. An ore-body was struck 140 feet in from the mouth of the tunnel, and followed for 120 feet, from which 1500 tons of shipping ore and about 5000 tons of concentrating ore have already been taken. A third tunnel, 146 feet lower down, has been driven in 300 feet, and will be continued to the ore-chute and connected with No. 2 by an upraise, during the present season. A tramway 1500 feet in length and a concentrator of 50 tons capacity are also projected in connection with this mine. The Washington.

"East of the Washington is the Surprise basin, occupied by the Surprise and the Antoine claims, neither of which was examined; and still further east are the Best and Dardanelles basins. The ridge between the last two basins, is formed by a fine-grained granitic boss about half a mile in diameter, on which are situated the Best, Rambler, Antelope and Caribou claims. The granite is traversed by numerous small faults and seamed with irregular quartz-veins of all sizes, which often carry considerable quantities of tetrahedrite rich in silver. A specimen from the Antelope, assayed in the laboratory of the Survey, ran over 3000 ounces of silver to the ton. Besides the tetrahedrite, some galena, iron- and copper-pyrites and blende are also usually present. A number of the ledges in this group have been Best Basin.

British Columbia—*Cont.*

opened up by short tunnels and shafts, but no extensive development work has yet been undertaken.

Dry-ore belt.

"The North Fork of Carpenter Creek runs through what is known as the 'dry-ore' belt. The leads in this district are usually siliceous in character and carry bodies of highly argentiferous tetrahedrite, galena and other silver ores. Most of the claims are situated north of the area examined during the past year. At the Miner Boy, a fairly regular quartz-vein, from a few inches to a couple of feet in width, has been followed over 100 feet by a tunnel, and has also been traced west from the face of the tunnel for an equal distance. Some shipments of rich ore have been made from this mine, but I was unable to obtain statistics of these, as the mine was idle at the time of my visit.

"At the London group, north of the Miner Boy, the slates and associated quartzites are cut by several ore-bearing quartz-seams, ranging in size from stringers up to a foot or more in thickness. The seams have been opened up by a couple of short tunnels, and a long tunnel is now being driven in to intersect them in depth.

Claims east of main Slocan camp.

"East of the main Slocan mining camp, numerous claims have been located, both north and south of Kaslo Creek, all the way to Kootanie Lake, but only a few of these were examined. South-west from Bear Lake, is the Lucky Jim, situated on what appears to be a faulted line of contact between the slates and a brecciated band of limestone. The ore occurs in large pockets and side fissures penetrating the limestone. About fifty tons have been shipped.

Claims on South Fork of Kalso Creek.

"North of Kaslo Creek and east of Murray Creek, is the Wellington. This lead resembles somewhat that of the Alpha, and may be described as a wide crushed zone, traversing the slates in an east-and-west direction and dipping to the north. The crushed slates hold stringers and pockets of quartz, spathic iron and calc-spar. A shaft was sunk near the lead to a depth of seventy-seven feet, but was abandoned on account of the water, and the mine is now worked by tunnels. The upper tunnel cross-cuts the slates for 170 feet, and a drift then follows the lead for 100 feet. The drift has exposed an ore-chute sixty to seventy feet in length, stated to average two feet in width at the bottom of the tunnel. It was covered at the time of my visit. A second cross-cut tunnel from the surface to the lead, 700 feet in length and 160 feet below No. 1, has just been completed. The Wellington ore consists of a fine-grained galena, with blende and gray copper. One hundred and fifty tons, stated to average 250 ounces in silver to the ton, have been shipped.

British Columbia—*Cont.*

"Farther east, near the head of Lyell Creek, is the Eureka, situated on a well-defined fissure cutting the green schists of the Kaslo series. The workings consist of a cross-cut tunnel 150 feet or so in length, from the end of which a drift follows the lead for 300 feet. An ore-chute twenty feet in length, from which some shipments have been made, was passed through, eighty feet from the end of the tunnel.

"On the South Fork of Kaslo Creek are the Montezuma, Daisy and Ben Hur, the first on a tributary and the two latter near the main stream. The Montezuma lead strikes about N. 30° E. At the main showing, the lead divides, one branch continuing on in nearly the same direction, while the other bends more to the south. The southern branch has a width of ten feet. The south-western one is somewhat smaller and soon narrows in. A tunnel, following ore all the way, has been driven in for a distance of about 100 feet. The ore consists principally of argentiferous galena and blende, with their decomposition-products. On the Daisy, two leads are exposed, about 100 feet apart. They strike N. 60° E. with a dip of 80° to the S. E., and are each from seven to eight feet in width. On the upper lead a shaft, following a short ore-chute adjoining the hanging-wall, has been sunk to a depth of twenty-five feet. The ore consists of argentiferous galena, blende, iron- and copper-pyrites, and some native copper. Gold assays up to $4.40 a ton have also been obtained.

"The Ben Hur, situated north-east from the Daisy, shows two leads each eight to ten feet in width, which are supposed to be a continuation of those on the latter claim.

Ainsworth District.

"In the Ainsworth district, the principal mines being worked are the Highland, No. 1 and Skyline. A short description of the Highland mine, which is situated on a well-defined fissure cutting the schists of the Shushap series, was given in last year's summary. The lower tunnel mentioned there, has since been driven in to a distance of 480 feet. Ore was met with 330 feet from the face of the tunnel, and has been followed continuously for 150 feet. An upraise to the surface, along the lead, was also nearly completed at the time of my visit. A large quantity of shipping and concentrating ore is now in sight in the mine.

Character of Skyline and No. 1.

"The Skyline, and No. 1, occur in limestone bands associated with the Slocan slates, and are situated, the former about 200 yards and the latter about half a mile east of the granite area. The deposits worked in these mines are of a somewhat puzzling character, and would require extended study before conclusions of value could be arrived at concerning them. They appear to occupy fractured zones of con-

British Columbia—*Cont.*

siderable but unknown width, traversing the limestones and slates in a nearly north-and-south direction, and dipping to the west. The zones have been silicified, and impregnated with ore in a selective manner, by ascending solutions.

"The ore occurs in flattened ore-bodies, occasionally ten to twelve feet in thickness, which, in the case of the Skyline, according to Mr. Scott MacDonald, the manager, often cross nearly horizontally from the foot- to the hanging-wall. The workings on the Skyline include an incline eighty-seven feet deep sunk on the lead, and a shaft farther to the west, 200 feet deep, from the bottom of which a drift 120 feet in length and an upraise of forty feet lead to the incline, and the chambers of ore at present being worked. The Skyline ore consists of a porous siliceous rock, carrying a dark mineral, probably mostly argentite, native silver and galena, along with some gray copper and iron- and copper-pyrites. It averages from forty-five to fifty ounces in silver per ton. The present output of from ten to fifteen tons per day, is shipped directly to the Pilot Bay smelter, its siliceous character rendering it valuable as a flux for the more basic ores of the district.

"The workings on No. 1, are somewhat irregular, owing to the different managements under which they have been carried out. The ore consists of a siliceous matrix, holding argentiferous iron-pyrites, native silver, galena and several other minerals which have not yet been identified. The pyrite, when separated from the gangue is stated to assay 700 to 800 ounces in silver per ton, and the galena 200 to 300 ounces. A concentrator of seventy-five tons capacity has been built at this mine, and the output, amounting to about fifteen tons daily, is mostly concentrated before shipment.

"Besides the mines mentioned above, some work is also being done in the district on the Highlander, the Lady of the Lake, the claims of the Canadian Pacific Mining and Milling Company at the mouth of Woodberry Creek and at other places.

Hendryx.

"At Hendryx, the Bluebell is in active operation. This mine is situated on a band of crystalline limestone interbedded with the Shuswap schists, which has been fractured in various directions. The ore, consisting mostly of low-grade galena and pyrrhotite with some blende, iron- and copper-pyrites, and their decomposition-products, occurs either pure or disseminated through a calcareous and occasionally a siliceous matrix. It occupies irregular chambers in the limestone, some of which are of huge dimensions. The ore-body being worked at present, including some large horses of limestone, measures approximately 70 feet in width by 200 feet in length and 150 feet in height. Forty thousand

tons of pure and concentrated ores have been shipped from this mine during the year, and prodigious quantities remain in sight. British Columbia—*Cont.*

"The Toad Mountain district was not visited during the season. A Halliday wire-rope tramway, four miles and a half in length, leading from the Silver King mine to a flat near Nelson, has been constructed here by the Hall Mines Company, and a Fraser & Chalmers 100-ton blast furnace will be completed, so I was informed by Mr. Croasdaille, by the end of the present year. (1895.) Toad Mountain.

"Before returning east, a brief visit was made to Trail Creek. A short account of the geology and principal mines in this district was given in last year's report, but since then great progress has been made. The number of working mines has been largely increased, the known area of the mineral belt extended in all directions, a well-built town of 2000 or more inhabitants has sprung up near the mines and a second town is being built near the mouth of Trail Creek. Cursory examinations of some of the working mines were made, but of too general a character to add much to previous knowledge, and as part of the coming season will probably be spent in this district, it would be injudicious here to enter into much detail. The greater part of the mines are situated on an eruptive area, which appears to consist largely of diorites and uralite porphyrites cut by numerous dykes. The eruptive area is traversed, in an approximately east-and-west direction, by lines of fracture dipping to the north and holding ore-bodies ranging in size from mere stringers up to great lodes 30 feet or more in width and from 100 to 200 feet in length. The ore consists mostly of gold-bearing pyrrhotite and chalcopyrite, but mispickel, galena, blende, pyrite and other minerals also occur. Trail Creek.

"Work on the Leroy and War Eagle, the two principal mines of the camp, has been actively prosecuted during the year with highly satisfactory results. The shaft on the Leroy is now down over 380 feet, and the lode followed appears to be strengthening with depth. At the 350-foot level, the ore-chute has a length of 168 feet and a width, at one point, of over 40 feet. The result of the workings on the Leroy, the pioneer mine of the camp, has inspired confidence in the permanency of the numerous other less developed lodes in the district. Principal claims.

"At the War Eagle, which is worked by tunnels, the great yield of the past season, amounting to many thousands of tons of rich ore, has been taken mostly from a stope on the main ore-body between the first level and the surface. A second tunnel over 800 feet in length and about 100 feet below No. 1, is now nearly completed to the chute, and a third one, which when finished will have a length of 1800 feet,

British Columbia—*Cont*

has been started. At the Josie, a tunnel following the lead has been driven in to a distance of 330 feet, and three ore-bodies have been opened up, the further one of which has a length, to the breast of the tunnel, of 128 feet. Considerable work has also been done in this vicinity on the Cliff, the Nickle Plate and the Centre Star, and farther to the east important ore-bodies have been developed on the Iron Horse, the Kootanie, the Columbia and numerous other points.

"South of Trail Creek, development work is being pushed, among other claims, on the Crown Point, where a wide body of rich ore has been followed to a depth of 65 feet, and on the R. E. Lee. West of these are the Homestake, the Deer Park and a number of other important claims.

Machinery employed.

"The large amount of work being done, or in contemplation, in this district, is illustrated to some extent by the following list of machinery, part of which is in active operation and the remainder ordered. This has been kindly furnished me by Mr. J. D. Sword, agent at Rossland for the Ingersoll Rock Drill Company.

"At the Leroy, one 7-drill compressor and eight Ingersoll drills, two hoisting engines, three boilers (100 h.p., 80 h.p. and 40 h.p.) One diamond drill.

"At the War Eagle, one 20-drill compressor, ten Ingersoll drills, two 100-h.p. boilers.

"At the Josie, one 7-drill Ingersoll compressor and drills, also diamond drill and hoisting engine.

"At the Centre Star, one 7-drill Ingersoll compressor and drills, 80-h.p. boiler.

"At the R. E. Lee, one 30-h.p. boiler, Ingersoll hoisting engine and steam drills.

"At the Iron Horse, one 5-drill Ingersoll compressor, drill and pump.

"At the Columbia and Kootanie, one 30-drill Ingersoll compressor and drills.

"At the Nickle Plate, one hoist and Knowles pump.

"Sampling works of 200 tons capacity, and a matting plant of 125 tons capacity, are also being erected by the British Columbia Smelting Company near the mouth of Trail Creek.

Metallic minerals found.

"The following is a list of the metallic minerals which have been recognized so far in the West Kootanie district:—Native gold, native silver, native copper, native arsenic, galena, cerrusite, anglesite, altaite, argentite, pyrargyrite, proustite, chalcopyrite, chalcocite, bornite,

tetrahedrite, malachite, hæmatite, limonite, siderite, blende greenokite, stibnite, jamesonite, mispickel. British Columbia—*Cont.*

"In conclusion, I must express my thanks to the various mine owners and managers in the district for permission to visit the different mines, for information, and for many other courtesies."

In the early part of the year, Mr. J. McEvoy was chiefly occupied in the compilation of parts of the Shuswap map-sheet, British Columbia, employing for that purpose data obtained during the previous summer. Before leaving for the field, about one-half of the area of this sheet had thus been laid down. The field-work of the season was devoted to the area of the same map, in which further surveys and examinations were carried out, such as to nearly complete the required data. There remains, however, some rugged mountain country in the north-east corner of the map, and a geologically complicated tract in the south-west corner, both of which it may be desirable to investigate further before the publication of the sheet. Work by Mr. McEvoy.

Mr. McEvoy left Ottawa for the field on the 6th of June and returned on the 21st of October. The work accomplished is described by him as follows:—

"Leaving Kamloops with pack-horses and supplies, my first work was the examination of Louis Creek valley and adjacent mountains, where the distribution of the Cambrian rocks was investigated. A squeezed serpentinous agglomerate was noticed capping the mountains north of Fadear Creek, which will probably prove to be a local variation of the Tod Mountain rocks. Examination of Shuswap sheet.

"Proceeding to Shuswap and thence northward, the region north of Shuswap Lake was visited and the boundaries of the granite area on Scotch Creek were traced out. The examination of this country was carried on as far as Lee Creek, the next creek above Ross Creek, beyond which the rocks are exposed on the lake shore and were seen by Dr. Dawson last season.

"Salmon River country was next visited, the return being made by way of Shuswap. Some outlying areas of Tertiary volcanic rocks were traced out and the granite boundaries were ascertained.

"On the hillside north of the middle crossing of Salmon River, there is a fine deposit of gypsum, associated with gray schists and white crystalline limestone. The principal deposit, in which a tunnel twenty-five feet long has been made, is one hundred feet and over in thickness. The exact thickness could not be ascertained on account of the heavy cover- Gypsum deposit.

British Columbia—*Cont.*

ing of drift on the hillside. Above this is another deposit, with a thickness of thirty feet or more, still higher up are two more small deposits, one of which shows bedding. The large deposit is massive and perfectly white in some places, showing slight traces of anhydrite. The general strike of the deposits is east-and-west, true, with vertical or high northerly dip.

"At Salmon Arm, the boundaries of the granite composing Granite Mountain and its extension eastward were traced out, and at Canoe Creek a considerable extent of Cambrian rocks was found, running eastward as far as the Spallumcheen Valley.

Region north-east of Vernon.

"Proceeding toward Vernon, a few points were visited to define granite boundaries on the west side of the valley, where the granite is in contact with black argillite. From Vernon, the B. X. Creek was ascended and the mountains crossed over to Trinity Valley. A great thickness of argillites and grauwackes is developed here. The descent to Trinity Valley was through a wind-fall of heavy larch timber necessitating much chopping and making progress slow. Trinity Valley lies north-and-south and is situated, roughly speaking, midway between the valley of Mabel Lake and the Spallumcheen Valley, and approximately parallel to these valleys. The valley is quite wide, over three miles in the widest part, and a number of settlers have lately taken up land in it.

"A trip was made into the foot-hills of the Gold Range on the east side of Mabel Lake, following the watershed between Mabel Lake and the Upper Shuswap River (above Sugar Lake). These mountains proved to be composed of rocks of the Shuswap series.

"The North Fork of Cherry Creek and vicinity was next visited and further evidence as to the extent of the argillite area in that neighbourhood obtained. Harry's Creek and some other points in White Valley were also examined.

Shuswap River.

"Returning to Enderby, the survey of Spallumcheen or Shuswap River from 'the islands' up to Mabel Lake was completed, by means of a canoe. The river is quite shallow in places, being divided by bars and islands. At low water an ordinary log canoe touches bottom on some of the 'riffles.' Two miles below the lake, a portage-route one and a quarter mile long begins. At the head of this a large stream flows into the river from the north.

"Between the northern end of Trinity Valley and Mabel Lake, a new area of Tertiary volcanic rocks, underlain by shales and sandstones, was found and traced out.

"On the return journey to Kamloops, some work was done near Round Lake and Monté Lake. At Campbell's Creek a day was spent in ascertaining the boundaries of the Tertiary rocks and the granite and argillites of that vicinity. British Columbia—*Cont.*

"The amount of agricultural land still unclaimed has frequently been mentioned in previous reports. Much still remains, notably, along the north shore of Shuswap Lake at Lee Creek and Ross Creek. This land has mostly been burned over more than once, and could easily be cleared for cultivation. Irrigation would not be necessary on the greater part of it. Between Enderby and Salmon Arm also there is still unclaimed land which is suitable for settlement. Agricultural lands.

"The Chinese are still engaged on a small scale in placer mining on Scotch Creek and Cherry Creek. During the summer hydraulic mining was commenced on a small stream a mile and a half south of the lower crossing of Salmon River." Placer mining.

MANITOBA AND KEEWATIN.

Mr. J. B. Tyrrell reached Ottawa on 16th January, 1895, after completing a second traverse of the "Barren Grounds," as briefly mentioned in last Summary Report. He was occupied during the remainder of the winter, and until July, in preparing a report on the whole expedition and a map of the route followed. Work by Mr. Tyrrell.

On the 5th July, Mr. Tyrrell left Ottawa for the purpose of examining that portion of Manitoba and Keewatin lying east and north-east of Lake Winnipeg and drained by streams flowing into that lake or into the upper part of the Nelson River. It was considered advisable to ascertain the geographical and geological features of this tract of country, as it is comprised within the area of a map-sheet in course of preparation. This sheet embraces Lake Winnipeg and its vicinity, already geologically surveyed by Mr. Tyrrell and Mr. D. B. Dowling. Mr. Tyrrell returned to the office on the 19th October. Country east of Lake Winnipeg.

He reports on the work done as follows :—

"On Saturday, 13th July, I arrived in West Selkirk, and shortly afterwards engaged as canoemen Roderick Thomas, and John Harper, two of the men who had accompanied me in 1894, down Kazan River, through the Barren Grounds, to the west coast of Hudson Bay. A cedar canoe, ordered from the Peterborough Canoe Company, had not yet arrived, but Sir John Schultz, then Lieutenant-Governor of Manitoba, kindly placed a large bass-wood canoe at my disposal. The Journey north from Winnipeg.

Manitoba and Keewatin—*Cont.*

remainder of that day and Monday, were spent repairing and painting this canoe, and obtaining necessary supplies for the season. On Monday evening, however, word came from Winnipeg that my cedar canoe had reached there, and would be in Selkirk by the next train on Wednesday morning. Fortunately, the steamer 'City of Selkirk' was leaving for the north on the same day. On Wednesday afternoon we left the wharf and started down the Red River, and at five o'clock the next evening, after a quick and pleasant run over Lake Winnipeg, we reached Selkirk Island, twelve miles north-east of the mouth of the Saskatchewan River. On Friday evening, July 19th, we were towed north-west for about twenty miles, after which we paddled our canoe around the north shore of Lake Winnipeg, reaching its outlet into Nelson River, where the exploratory work of the season was to begin, late on Saturday evening.

Great Playgreen Lake.

"During the first half of the following week, a survey of Great Playgreen Lake was made with a boat-log and compass. The north-eastern shore is entirely underlain by Archæan granites and gneisses, while the south-western shore is composed of the stratified post-glacial clays, which form the long, narrow point separating that lake from Lake Winnipeg. Nelson River issues from Great Playgreen Lake in several channels. The most eastern channel we descended and surveyed past the mouth of Gunisao River to Rossville Mission on the latter lake.

Gunisao River.

"Here an Indian was engaged to accompany us up Gunisao River. Near its mouth, it winds without perceptible current through an extensive marsh, with a width of from fifty to one hundred yards. The water is of a dark brown colour and slightly murky. Up to the Forks, a distance of about eighteen miles, the banks are low and but scantily wooded, with a few rounded bosses of gray gneiss rising here and there. The stream is interrupted by four rapids, past two of which are portages, respectively 100 and 185 yards in length.

"Above the Forks, the south branch is the larger. This was in the first place ascended, for six days, through Gunisao Lake, to a small lake above. Many rapids obstruct the stream, up some of which the canoe was hauled with a line, while past twenty-two of the most serious it was necessary to carry the canoe. For about fifty miles above the Forks, the river flows through a clay-covered country sloping gently towards the north-west, and has cut a channel or valley varying in depth from six to twenty-five feet. In places it has cut down to the underlying granite or gneiss, which then usually forms a barrier over which is a fall or rapid. Between these rocky rapids is slack water, and rock-exposures are infrequent, and where seen are constantly of gray or reddish-gray granite.

"The banks are wooded with beautiful, tall, white spruce, apparently forming a magnificent coniferous forest, but how far back from the river this forest extends, was not determined. There is certainly here a large quantity of valuable timber, much more than was seen anywhere else in the country immediately east of Lake Winnipeg, for most of the surface further south has been swept by extensive forest fires within the last decade. Manitoba and Keewatin—*Cont.*

"In the upper half of the river, the banks are low and much less clearly defined. Deep bays, filled with wild rice, extend between the rocky knolls back to swamps, wooded with tamarack and small black spruce, generally killed by fire.

"Gunisao Lake was reached on the first of August. This is a lake of clear cold water, with irregular contour, about thirty-two miles in length, and with steep, almost bare rocky shore of gray granite. The rowan bush was seen growing on some of its many rocky islands. Gunisao Lake.

"On descending the south branch again to the Forks, the Indian hired at Rossville mission refused to accompany us up the north branch, so he was put ashore among some of his friends who happened to be passing, and the river was ascended without his assistance.

"The channel is almost as large as that of the south branch and carries about two-thirds as much water, but the banks, in the lower part at least, are rather more rocky and barren, and almost all the timber has been destroyed by fire.

"The north branch was ascended for three days and a half, to its source in a narrow lake ten miles long, from which there is said to be a good canoe-route across the height-of-land eastward to Island Lake. There are but ten portages on this river, but for long distances the current is very swift, and the river has not yet cut for itself a channel of any considerable depth. Throughout its whole course from the long narrow lake to its mouth, the river flows through a level, clay-covered country, the rock merely rising here and there in knolls and ridges above the general level. North Branch of Gunisao River.

"After the survey of this river was completed, we paddled down the stream to its mouth, and then to Norway House, where we were delayed for several days by heavy winds, but the time was spent in refitting the sail-boat 'Pterodactyl' that had been brought out last year to await our arrival from the north, and was now to be used in travelling southward down the east shore of Lake Winnipeg.

"On the 20th and 21st August, accompanied by Mr. R. Strath, of Rossville mission, we made a survey of Little Playgreen Lake. The Little Playgreen Lake.

Manitoba and Keewatin—*Cont.*

rock is generally a very uniform gray granite, although at one place, near the south end, it is associated with a dark rather coarse-grained massive diorite, and near the north end of the lake, it is cut by veins of red pegmatite containing crystalline aggregates of molybdenite.

Black River.

"From Norway House, where we had been kindly welcomed by Mr. J. K. Macdonald, we sailed southward to the mouth of Little Black River. Here, leaving the sail-boat at anchor, and taking a week's provisions in the canoe, we began the ascent and survey of Little Black River. For twelve miles, up to the first portage, the river is from sixty to one hundred yards wide, with clay banks six to fifteen feet high, wooded with white poplar and small black spruce. A low outcrop of gray granite may be seen here and there. The water is dark-coloured and muddy. Above this portage, the river has a width of from thirty to fifty yards.

"We continued our journey up the river for three days, during which time we made twenty-one portages past as many rapids, besides ascending numerous other rapids with line or paddle. The river was found to rise not far from Gunisao Lake, and there is said to be a practicable canoe-route in high water from it to the lake, but the water was now so low that it was impossible to ascend so far with our canoe. The current was often swift, and the channel crooked and overhung with willows. The banks are everywhere composed of stratified clay or silt, and much of the country had been well wooded, but unfortunately nearly all of the timber has been destroyed by fire in comparatively recent years. Some small trees of Manitoba maple *(Negundo aceroides)* were growing by one of the lower rapids. The rock, wherever seen, was a uniform gray granite.

"From the mouth of Little Black River, we sailed southward to Berens River, but a heavy storm drove us in to Poplar River, and detained us there for several days. At Berens River, we engaged an Indian as steersman, and on Monday, 9th September, we paddled southward to the mouth of Pigeon River, and began the ascent and survey of that river.

Pigeon River.

Pigeon River flows into the lake in a deep channel, a hundred yards wide, between sandy points, above which it opens into a shallow weedy lake. Around the sides of this lake were beds of wild rice, then almost ripe, on which great flocks of wild ducks were feeding. The channel gradually narrows and becomes well defined at a little rapid, where it is about forty yards wide, above which it again expands to a width of from sixty to a hundred yards, with even clay banks, six to ten feet high, wooded with tall white poplars. Low bosses of gray gneiss outcrop here and there, on which are growing small groves of oak.

"The ascent of the stream was continued for six days, and on Saturday evening we reached the Hudson's Bay Company's trading-post at Grand Rapids. The work of ascending the stream had been rather slow and difficult, for the Indians rarely travel on the river, and the twenty-nine portages that we were obliged to make were often through dense burnt forest and over innumerable fallen trees. In its lower part, the banks are chiefly composed of stratified clay or sand, and the channel is even and well defined, but higher up the banks are of gneiss or pebbly till. Manitoba and Keewatin—*Cont.*

"From Grand Rapids Lake, Pigeon and Berens rivers, two streams of about equal size, flow westward towards Lake Winnipeg, the former discharging from the south, and the latter from the west side of the lake. Large pot-holes.

"On Monday morning the return journey to Lake Winnipeg was begun down the Berens River. Just below a little rapid with a drop of thirty inches, at the west end of Long Lake, is a granite hill, on the south-east side of which, facing up the river, is a group of seven large pot-holes, besides several smaller ones. The most perfect is thirty-three inches in diameter and ten feet deep, with the top of the rim eight feet above the water at its base, or five feet and a half above the water of Long Lake. Some of the others have been partly cut away, and the smooth rock faces are strongly scored by glacial marking, showing that the pot-holes are of pre-glacial or inter-glacial age, when the water flowed in a direction more or less opposite to the course of the present river.

"A short distance below Pot-hole Portage, a small sluggish brook flows into Berens River from the north. This brook was ascended to a little shallow lake, almost choked with luxuriant beds of wild rice. Near the east end of this lakelet, we entered a small crooked brook which winds through marsh and willow swamp for about three miles to a rocky barrier eight feet high, over which the water flows in its higher stages earlier in the season. Crossing this rock by a portage fifty yards long, we begin the descent of what is now the Etow'-imā'-mi River. At the next portage, the water runs in a rill a few inches in width. The narrow, winding, but constantly increasing stream was then descended for about thirteen miles, between banks of rock and light gray pebbly till, to a series of heavy rapids, just below which is a well-defined sandy terrace, marking the highest shore-line of the glacial Lake Agassiz seen on the east side of Lake Winnipeg, and the eastern limit of the lacustral deposits. This limit had been determined on several of the other streams flowing into the lake, but nowhere was it so distinctly marked as here. Below this sandy terrace, the Etow'-imā'-mi River.

Manitoba and Keewatin—*Cont.*

river was followed downward for two days, between wooded banks of stratified lacustral sand and clay, to the point where it empties into Berens River seven miles above its mouth. The rocky bosses seen here and there were everywhere of uniform granite and granitoid gneiss.

Blood River.

At the mouth of Berens River, the sail-boat was sold to Mr. William Flett, and we proceeded southward in our canoe to the mouth of Miskowow or Blood River, where an Indian was engaged to accompany us up the river. The ascent of the stream was begun on September 28th. Miskowow River, near its mouth, averages from forty to fifty yards in width, with water of a slight brownish tinge but not dark-brown like most of the other rivers east of Lake Winnipeg, indicating that it is derived chiefly from lakes of considerable size, in which the water has been cleared of its dark colouring matter. The banks are not very high, but are usually rocky, and the water often seems to flow in a preëxisting rocky channel. Between the rocky knolls and ridges, the blue, stratified, lacustral clay that is seen everywhere in the lower country east of Lake Winnipeg, forms well-defined level land, thickly wooded with white poplar, while the rocky knolls are thickly wooded with Banksian pine and oak.

"At the fourth portage up the river, three pot-holes, similar to those on Berens River, occur on the summit and south-west side of a granite knoll, and further up the river, above the ninth portage, and about half-way between the mouths of Mine'go and Little Miskowow rivers, a large pot-hole has been bored in the steep eastern side of a granite hill, the surface of which is now strongly scored by glacial markings. the river was ascended to Kowtinagan (or perch-dish) Lake, and then descended again for a short distance and the north branch ascended to Sasaginigak Lake, an irregular body of clear water lying in the midst of low hills of gray granite. From this lake there is said to be an easy canoe-route northward to Grand Rapids on Berens River.

Return to Selkirk.

"After the survey of this lake was completed, the river was again descended to Lake Winnipeg, which was reached on the 4th of October. On the following day we were taken on board one of the steamers running on the lake and carried to Selkirk, where we arrived on the evening of October 6th, just as a heavy snowstorm set in. The canoe and outfit were stored at the Government fish-hatchery, the men were paid off, and on Tuesday, October 8th, I started for Winnipeg and the east.

General character of country.

"The country explored was found to be almost entirely underlain by granites and granitoid gneisses of Laurentian type. A very interesting feature is the occurrence over a very large area, of massive granites

characterized by plagioclase felspars. These granites and gneisses are generally overlain by stratified clays and silts up to a height of about a hundred and fifty feet above the present level of Lake Winnipeg. Much of this area will undoubtedly prove to be excellent farming land, more especially since the nearness of the great body of water in Lake Winnipeg will largely prevent the occurrence of summer frosts. Much of the timber that once covered the country has, unfortunately, been destroyed by forest fires, but there is still some excellent white spruce on the banks of Gunisao River." Manitoba and Keewatin—*Cont.*

ONTARIO.

(With adjacent parts of Quebec.)

Mr. W. McInnes, after writing a preliminary report on the Lake Nepigon region, explored the previous season, devoted the winter of 1894–95 to getting together the materials for a report on the region covered by the Shebandowan and Seine River sheets, of the series of geological maps now being prepared of Western Algoma. For the geological colouring of a large part of the last-mentioned sheet, the notes and specimens collected by the late W. H. C. Smith, who had the work in hand at the time of his death, had to be carefully gone over, and the report on this section must to a certain extent be based upon these. Work by Mr. McInnes.

On May 24th, or as early in the season as appeared practicable, Mr. McInnes proceeded to the Rainy River and Thunder Bay districts of Ontario, for the purpose of continuing work upon the map-sheets above mentioned, and in other neighbouring areas, to which much attention has lately been attracted in connection with gold mining. He was assisted, as in former years, by Mr. W. Lawson, who attended to a great part of the surveying work. The following preliminary report on the results obtained is given by Mr. McInnes :—

"The early part of the season, until the 10th of July, was spent in the region lying to the east of Rainy Lake. Calm or Nonwatin Lake, on the lower part of the Seine River, was first visited, and the country about it geologically examined for the purpose principally of defining more closely the Keewatin (Huronian) areas in that region. With this object in view, the smaller lakes and streams in the vicinity were surveyed, and additional information was gained of the distribution of the gold-bearing Keewatin rocks. This information has been incorporated in the geological map, of which a preliminary edition has since been published. Region east of Rainy Lake.

Ontario—*Cont.*

"With the same object in view, a track-survey was made of the Little Turtle River to Dovetail Lake and thence to the Seine River. Many gold locations have been taken up in the district, particularly in the region lying immediately to the east of Bad Vermilion Lake, which is included in the Rainy Lake geological sheet, already published. In this neighbourhood two stamp-mills have been erected, but attention was wisely being directed chiefly to sinking on the properties to prove the extent and value of the veins. At Harold Lake, a five-stamp mill was in operation, and the owners report satisfactory results in free gold, with promise of further profits from treatment of the tailings, for the handling of which they are not yet provided with machinery. Development work was being carried on upon a number of veins on this property.

Stamp-mills.

Manitou region.

"The Manitou region was then visited, and surveys were made there which occupied the time until early in September. The eastern shores of Manitou Lake and a number of small lakes adjoining were first surveyed. Rocks of the Keewatin were found to occupy the whole of the immediate shores of the lake, consisting of green chloritic and other schists with areas of massive diorites, etc. A great thickness of conglomerates and agglomerates, with a schistose, felspathic matrix and well-rounded pebbles of quartzite, felsite, banded chert, impure magnetite, quartz and occasionally of gneiss, occupies the eastern shore of of the main lake from Beaver Narrows to the head. Irregular belts of the same conglomerates are interbedded with the schists on many of the islands in the lake. Near the north end of the lake, the gneisses approach within a mile of the eastern shore, trending away from the shore southwards, being distant about four miles opposite the Narrows and approaching the lake again to within two miles opposite Sand Point. A route from Manitou Lake southerly to Rainy Lake by way of Crooked and Round lakes was then surveyed. The north-east branch of Kahopskikamak River was ascended to its headwaters, and surveys made of Eagle Rock, Narrow and Small Trout lakes. Hornblende gneisses were found to occur all along this route. This is the gneiss area above referred to, which comes close to the eastern shore of Manitou Lake near the head.

"A route was next surveyed west of Manitou Lake, from Pipestone Lake northward through Yoke, Route, Arm, Lawrence, Hill and Rowan lakes and back to Pipestone by Bass Lake and a number of smaller lakes. The Keewatin area of Crow and Pipestone lakes was found to extend northwards to the western arms of Lawrence Lake. Rowan and Hill lakes were found to lie entirely within this Keewatin belt. The biotite-gneiss belt which approaches the western shore of

Manitou Lake, occupies almost the whole of the shores of Lawrence Lake, the contact trending north-easterly near its western end. Ontario—*Cont.*

"The remainder of the season was devoted to sheet No. 9 (Lake Shebandowan sheet), where surveys were made of short routes north and south-east of Dog Lake, for the purpose of adding to the topographical details of that region and of gaining a closer knowledge of the structure of the gneisses which occur everywhere about Dog Lake Surveys on Shebandowan sheet.

"Short trips were made by Mr. Lawson from Buda, Kaministiquia, Murillo, and Kakabeka stations, and the line of the Canadian Pacific railway was examined between Carlstad and English River.

"The gold in the region explored seems to be confined, or at least its occurrence in commercial quantities, to the belts of Keewatin (Huronian) rocks, which, with many minor deflections and diverging arms, extend eastward and north-eastward in broad bands inclosed in the Laurentian gneiss. The areas of these rocks open to the prospector, though limited on the United States side to the southern margin of Rainy Lake, are very extensive on the Canadian side of the boundary, extending from Rainy Lake easterly through the districts of Rainy River and Thunder Bay. The occurrence of gold throughout this whole area is now established, and during the past season a discovery of promise was made in rocks of the same class at Jack-fish Bay on the north shore of Lake Superior. The greater part of the actual development and mining work, has been so far confined to the region lying about Bad Vermilion Lake, near the mouth of the Seine River, where the first finds were made on the Canadian side. In this neighbourhood, almost all the land lying between Shoal and Bad Vermilion lakes has been taken up in gold locations. Two mills have been erected in this area, at Hillyer's and at Weigand's, and testing shafts have been sunk on a number of the properties. Work in this direction is still going on and the prospects for the establishment of permanent mines seem good. Gold mining in progress.

"At Rainy Lake, two mills of ten stamps have been built on the United States side, one at the Little American Mine on the outlet of Back Bay and the other at the Lyle Mine on Dryweed Island just south of the boundary line. Neither of these mills were being worked at the time of my visit, but the power was being used for operating drills in the shafts. At the Lyle, a shaft was down 75 feet at that time. It was sunk in a belt of quartz-schist, chloritic and sericitic in layers, and with irregular, small veins, stringers and lenses of quartz, the whole pretty thoroughly impregnated with iron-pyrites and stated to carry gold in good quantity. Nearly opposite, on the Canadian side, a small amount of work had been done on Sand Point Island, on a well Mines and mills near Rainy Lake.

Ontario—*Cont.*

mineralized vein about four feet in thickness, in chloritic schist, cut by a dyke or mass of diorite. The vein was not traced on the strike for any distance.

"The Little Canada, on a small island near by, is a contact deposit, where a coarse diabase with blebs of opalescent quartz cuts chloritic schists. Stringers and lenses of quartz occur near the contact and the general mass of the rock for several feet is well impregnated with iron- and copper-pyrites. Assays giving good returns in gold are reported by the owners of these properties.

Prospecting on Seine River.

"Prospecting work has extended for some distance up the Seine River, though only in a rambling sort of way, indeed the immediate shores of Rainy Lake and the lower Seine River, with the area already referred to about Bad Vermilion Lake, are the only areas which have yet been gone over with any thoroughness. In the vicinity of Sturgeon Falls, on the Seine River, a number of properties have been taken up, as well as further on at Nonwatin or Calm Lake and in the region surrounding it. On most of these properties some preliminary stripping work has been done. Still further to the eastward, prospecting work of an even more scattered character has been carried on, and gold properties have been taken up as far in that direction, on the Seine River belt, as Star Island and Partridge Lake.

"On an arm of this Keewatin belt, stretching north-easterly towards the Canadian Pacific railway and reaching it at Carlstad station, properties have also been taken up at Lynx Falls and Saw-bill Lake, lying to the east of Clearwater Lake. These properties show free gold, and good assays have been obtained from surface specimens. Only preliminary surface stripping has been done on them.

Huronian mine and vicinity.

"On another belt of similar Keewatin rocks, further to the east and south, and separated from the Seine River belt by a band of gneiss about ten miles in width, is situated the Huronian mine and neighbouring properties on the same vein. This was equipped with the necessary buildings and machinery, but operations have been suspended since 1885. Following the opening up of the Huronian mine, upwards of one hundred gold locations were taken up on the belt extending north-easterly from the mine, along the strike of the schists and along both shores of Upper Lake Shebandowan. With the exception of the Huronian, little work has been done on any of the properties recorded at that time. Recently renewed attention has been given to this area, and gold properties have been located as far east as Gold Brook, a tributary of the Matawin River.

"In the region about the easterly end of Rainy Lake and extending up the Seine River, more than five hundred locations had been taken up. Ontario—*Cont.*

"Though extensive deposits of magnetic iron-ore of high percentage have been recorded along the Atikokan River, beyond testing with the diamond drill and some preliminary stripping, no mining work has been done. Iron ores.

"Further east, south of Finmark station on the Canadian Pacific railway and near the Matawin River, are other deposits of iron, which have been stripped and tested pretty thoroughly by the diamond drill, but although the deposits are promising enough, actual mining has not yet begun. Further deposits of iron have been located at various points along the different Keewatin belts, but nowhere else has any considerable work been accomplished.

"The occurrence of gold has now been established over practically the whole district lying between Lake of the Woods and Lake Superior, confined, however, as far as our present experience goes, to the belts of Keewatin (Huronian) rocks. It occurs throughout these belts in impregnations of bands of the country rock, in parallel sets of bedded or interfoliated segregation veins, and in well-defined fissure-veins which cut the containing rocks without regard to the direction of their foliation. Any of these forms of occurrence might under proper conditions constitute good paying properties. General distribution of gold.

"The discovery during the past summer of a gold-bearing vein which promises well, at Jack-fish Bay, on the north shore of Lake Superior, is interesting, as it occurs in rocks which we believe to be practically a continuation of those of the district under consideration."

Mr. E. D. Ingall spent a considerable part of the summer in the investigation in the field of the deposits of iron-ores in the country traversed by the Kingston and Pembroke railway. The circumstances under which this work was taken up have already been explained. In company with Mr. Ingall, I visited Kingston for the purpose of conferring with the gentlemen interesting themselves in the initiation of iron-smelting in that vicinity. We then together visited some of the best known mines, and subsequently Mr. Ingall (on August 13th) began a more detailed examination of the points already visited, as well as of many other known deposits of ore, which was continued until October 28th. On the work accomplished, Mr. Ingall reports as follows:— Work by Mr. Ingall.

"The main questions upon which it was desired to obtain further information were as follows:— Questions to be answered.

Ontario—*Cont.*

"The quantity of available ore from immediately accessible localities?

"The quality of the same?

"The first question, for its solution requires a correct understanding of the nature of the deposits of the district, and, therefore, of their reliability as to continuity in length, depth and thickness. This is more particularly the case owing to there being no mines at present working from which to judge of the behaviour of the deposits in depth. At a number of places extensive openings have been made, but work has been discontinued throughout the district for several years, and, the excavations being now filled with water, nothing but the surface features remain available for the study of the question.

"It is thus evident that, using the term 'ore in sight' in its proper sense, at none of the places visited were the conditions such as to allow of measurements being made of the cubic contents, and therefore of the tonnage of any block of ore, unless one assumed or imagined, at least one of the three dimensions necessary to be ascertained. At some places there was found to be a stock-pile of ore selected from the material mined; but, apart from that, the question of available ore becomes one of judging, in a general way, the possibilities of the supply from deposits already discovered and worked, and of the probability of discovering yet other deposits throughout the district in the future.

Ore deposits visited.

"In order to form an opinion on these points, visits were made to as many as possible of the reported deposits of iron-ore, to the number of over forty, where, besides examining all openings, measuring all ore exposures and collecting illustrative specimens, both of area and rocks, surface surveys were in many places made, as well as readings with the dip-needle. The points visited, including many reported hæmatite occurrences, were as follows:—The Bluff Point and Calabogie mines of the Calabogie Mining Company; the Coe Mine; the Martel, or Wilson; the Culhane; the Williams or Black Bay, and the Lerond mines, all in Bagot township, and within a radius of three miles of Madawaska station on the Kingston and Pembroke railway; the Radenhurst and Caldwell properties in Lavant township and near Flower station, and in the same township the Wilbur mine; the Robertson and Mary mines near Mississippi station in Palmerston township, all situated near the line of the Kingston and Pembroke railway north of Sharbot Lake. Between this point and Kingston, the mines of the Zanesville group were visited, namely, the Zanesville or Glendower mine; the Howe mine and the Black Lake mine. Of the district tributary to Kingston, by way of the Rideau Canal, time only permitted visits to the two chief places, viz., the Chaffey and Yankee mines near Newboro'.

Frontenac county.

"In the south-western corner of Lanark county, the mines visited were the old Foley mine openings with those adjacent to it, and several reported hæmatite occurrences in Bathurst township. In Dalhousie township visits were made to the old Playfair hæmatite mine and to a number of reported indications of the same mineral in that vicinity, as well as to one on the eastern shore of Dalhousie Lake. Ontario—*Cont.* Lanark county.

"In the township of South Sherbrooke, the mines visited were the Christie's Lake; the Bygrove; the Fournier (with the adjacent Allen mine in North Crosby); the Silver Lake and others near Christie's Lake, whilst near Maberly on the Canadian Pacific railway, in the northern part of the township, examination was made of the range of properties, taken up for iron, extending from near the station westward to the property of Mr. Rudd in Ose township. Although somewhat distant from the present railway communications, a trip was made to the Yuill mine near the eastern end of White Lake in Darling township. The above, together with reported hæmatite occurrences in Storrington township on Dog Lake, which connects with the waters of the Rideau canal, on Birch Lake in Bedford township, and some other points of lesser importance, constitute the examples it was found possible to visit in the time at disposal. South Sherbrooke.

"The geology of this part of Ontario has already been reported upon by the Geological Survey. In the Geology of Canada, 1863, and in the Reports of Progress for 1870-71, 1871-72, 1872-73 and 1874-75 particulars will be found of the results of the investigations made by former officers of the staff.

"In a general way the rocks of the district can be described as a series of schistose and gneissic beds with interspersed belts of crystalline limestones, which latter often persist for miles. The schistose rocks may be roughly classed as micaceous and hornblendic, whilst more basic rocks, probably dioritic in nature, are also frequent. A definite opinion as to the relationships of these more basic rocks to the rest of the series could not of course be based upon the present work, so that nothing further can be said as to whether they are merely basic members of the series or intrusive masses in it. The series seems to have a very general dip southward over the parts visited, often at quite low angles. To the south it is overlain unconformably by the basal beds of the Cambro-Silurian formation, represented by the basal conglomerates and false-bedded sandstones of the Potsdam with the overlying limestones at Kingston. Rocks of the region examined.

"Although the ores mined in this district so far, have been almost altogether magnetites, in the past, the Dalhousie or Playfair mine

Ontario—*Cont.*

shipped hæmatite for several years, and at many points in the district similar ore is reported as occurring, although it has nowhere else been developed to any extent.

Nature of ore-deposits.

"*Magnetite.* It would be premature to pass any final opinion upon the exact nature of the deposits, previous to the thorough examination and working out of the specimens and other data collected, but in speaking of the district in general and its probable future ore-producing capacity, a correct judgment could not be formed if one ignored the fact that the deposits are irregular in their nature. It would seem as if, so far, this feature had hardly been recognized sufficiently, and thus we find most observers in the past assuming that the ore occurs in beds and therefrom erroneously inferring the continuity of the ore-bodies between widely separated outcrops, and in some cases forming thus most exaggerated estimates of the amount of ore which could be taken as proved to exist.

Erroneous ideas concerning these.

"Then also in using the dip-needle, this same error would appear to have been frequent. If, for instance, on a given run of rock or direction across country, a few high dip-readings were obtained in a distance of several miles, it would be assumed as proved that a continuous bed of ore exists, only requiring sinking on it to open it up for extraction. In travelling through the country it was pointed out, that by so using the dip-needle comparatively little can be proved when, as in most cases, the observations have not been taken sufficiently close together to justify definite conclusions. Also, that all such conclusions must be modified and interpreted in the light of knowledge acquired by a study of the worked deposits of the nature and habits of the same. For example, it was found that many of the worked deposits consisted of masses of magnetite in compact, dark, basic (dioritic?) rocks, and many of the dips-readings obtained where no outcrops of ore showed were along the strike of similar basic members of the series, leaving one, in the absence of anything to the contrary, to fairly conclude that these isolated dip-readings might be taken as showing the existence of separated masses of magnetite of greater or less extent, rather than of a continuous bed of ore.

"Another feature which has led to misapprehension in many cases, has been the prevalence of outcroppings of rusty rock which have quite generally been taken as indicating the existence of iron-ore below. As a matter of fact, the colour of these rusty parts seems to be almost always due to the decomposition of pyrites plentifully disseminated through the rock.

Aggregate importance.

"Whilst, however, all these points must be taken into account in judging individual deposits, the wide-spread occurrences of ore-bodies

throughout the district as a whole, and the great likelihood of further discovery leading to a large addition to the list of deposits already known, would seem to assure its future as an ore-producer for any smelter of reasonable size that might be erected; just as in the case of the phosphate mining district of the Rivière du Lièvre in Quebec, where, whilst the deposits of that mineral show similar irregularity, the output of the district was considerable and steady for over seventeen years and ceased only because of low prices and in no way because of any failure with regard to its capabilities for yielding the mineral. Ontario—*Cont.*

"Speaking still of the magnetite deposits, their mode of occurrence may be briefly summarized as follows:—

"The chief worked deposits may be classified under three heads, viz.:—First, ore-bodies occurring at the actual contacts of belts of crystalline limestone with the harder gneissic and schistose members of the series. Second, ore-bodies where the magnetite occurs in ribs, or impregnating schistose or gneissic belts, in most of which cases limestone is either absent from the vicinity altogether or only occurs at some little distance from the ore-body. Third, ore-bodies occurring entirely in areas of basic rocks, very much after the manner of the apatite deposits of Ottawa county, Quebec, where these are found in the pyroxenites. Classes of magnetite deposits.

"In the first and second classes, there is a tendency for the ore-bodies to follow along the strike of the formation, either entirely isolated from each other or separated by intervening stretches of rocks either free from magnetite or too poor to pay for extraction. In the third case, the ore shows in detached, irregular occurrences, the rocks being, as at some points opened, reticulated by numerous veins, seams, &c., of magnetite, showing at times vuggy or drusy cavities with crystals of calcite, hornblende and other minerals. The magnetite will thus vary in its occurrence from places where there is a considerable admixture of foreign matter to those where the ore is in considerable mass and comparatively free from admixture.

"Where the ore occurs in the schistose rocks, the magnetite frequently shows as detached grains plentifully disseminated through the substance of the schist, varying in proportion between the extremes of a magnetite-bearing schist, and ore with a small intermixture of bisilicate minerals. In places, in immediate association with the ore, a chloritic schist occurs which probably results from the local alteration of the materials of the inclosing schistose rocks.

"The developments made in the district in the way of proving the deposits, have been comparatively shallow in most instances, being Mining developments

Ontario—*Cont.*

limited to depths under 100 feet; although, in a few cases, by pits and diamond-drill holes the ore has been proved to a depth of 300 feet. Longitudinally, the distance between the extremes of any range of pits would come well within 2000 feet for the most extensive mine in the district, whilst in most instances the known extent in length of any string of ore bodies is covered by a few hundred feet, and frequently the whole development consists of one more or less circular pit.

"As to the width of the ore-deposits, it is extremely variable, even in the more regular belt-like masses. At the same mine it is found to vary from one or two feet to thirty or forty feet; whilst, with regard to the more irregular deposits in the basic rocks, it would be impossible to actually say which dimension of the pit to take as width. At Robertsville, the large pit has surface dimensions of 40x60 feet, with a reported depth of 250 feet, and at the old Chaffey mine are three large pits, separated only by narrow walls of rock, which are said to be about fifty feet deep and would measure, in the case of the two larger, fifty feet by one hundred and fifty feet, and for the smaller about thirty feet by one hundred and fifty feet. At the Yuill mine, is a pit about one hundred by thirty feet, reported sixty feet deep, and this, with the two previous examples, will illustrate the dimensions of some of the largest of the irregular ore-bodies of the district. It is stated that the Robertsville mine shipped over 60,000 tons, which further indicates the size attained by such ore-bodies, and as it is stated that the three diamond-drill holes put down on the hanging-wall side here, went through twenty feet of ore at a depth of 550 feet, the body of ore evidently extends a considerable distance below where work was abandoned.

Characte of the ores.

"The magnetite ore of this district presents the following features. The shipping ore of course represents the best as selected from the general run of the ore mined, and is in general pretty free from sulphur as far as visible pyrites is concerned. The various piles of ore also, with very few exceptions, showed no visible apatite. Beyond this no further statement can be made as to the percentage of sulphur and phosphorus which might be expected in the ores of the district taken as a whole and in large shipments, short of spending considerable time and money in really sampling large piles. That the percentage of these deleterious ingredients does not prevent the use of these ores in the blast furnace under proper conditions, is evidenced by the fact that as long as the prices permitted their exportation, the United States smelters were quite willing to buy and use them.

"The ore-bodies do carry pyrite and often in considerable quantity, but in most cases in such a way that the pyritous parts can be

rejected by hand picking. At some points visited, however, the pyrite was so finely and evenly distributed throughout the ore as to render its elimination by this simple process impossible, and this has also been found to be the case in portions of some of the larger and better known deposits which have elsewhere yielded large quantities of clean shipping ore. Ontario—*Cont.*

"In some cases, nearly the whole of the material taken out has been shipping ore, as evidenced by the smallness of the waste-pile relatively to the size of the excavation, though in most instances the amount of waste has been considerable. In the case especially of some of the isolated occurrences in the basic rocks, apatite occurs associated with the ore.

"As shown by the ore-piles, the foreign matter which would have to be dealt with in smelting would be mostly of a fusible nature, consisting of hornblendic, micaceous, and chloritic material distributed through the mass, as well as in the seams in the ore. Calcite is also a common ingredient, with more rarely quartz. These minerals by proper selection should make a good slagging mixture.

"In grain, the ores at different points show varying characters. Those of the ore-bodies in the basic areas are apt to show a peculiarly vitreous fracture, vuggy structure, and interferent crystalline aggregation of the magnetite; whilst at other points the structure of the ore is schistose, platy or granular, with a coarse or finely crystalline cross-fracture.

"The ore already mined and available, is represented by the stock-piles at some fifteen places, and amounts to about 17,000 tons. It is stated that in the past the total shipments from this district have amounted to some 220,000 tons of magnetite, to which must be added about 30,000 tons from the Dalhousie and McNab hæmatite deposits. Ore in stock.

"The available analyses of these ores are those of hand specimens, which cannot be taken as representing the actual composition or character of bulk lots, such as can be shipped. The examination made of the ore-piles of the district showed a visible admixture of foreign materials, already mentioned, of from five to fifteen per cent, estimated by the eye. This would, of course, bring down the theoretical percentage of iron in magnetite (72·37 per cent) to from 60 to 65 per cent. Analyses of ores.

"A table has been prepared of the several analyses of the ores of the district, made at various times in the laboratory of the Geological Survey and published in the Reports. This it is proposed to publish in connection with a more detailed account of the mines, together with

Ontario—*Cont.*

such additional analyses as may be made of specimens recently collected. Meanwhile, the following general statement, based upon the existing information, may be given :—

"Of the 31 determinations of metallic iron, 22 were of magnetites and 9 of hæmatites, the average of the former being 59·20 per cent, of the latter 59·58 per cent. Of the 15 determinations of phosphorus in the ore, the proportions in 10 magnetites varied from a trace to 0·110, whilst in one specimen small crystals of apatite were visible to the eye, although the proportion of phosphorus was not actually determined in this case. In 5 hæmatites, the phosphorus ranged from 0·010 to 0·235 per cent.

"In 9 magnetites the sulphur ranged from a trace to 1·75 per cent, while in 5 examples of hæmatite it ranged from 0·004 to 0·070 per cent.

"Titanic acid was looked for in two of the hæmatites, but not found. Of 21 magnetites examined for this substance, 11 were free from it, in four other cases it ranged from 1·03 to 5·92 per cent, whilst in the ore from the Yankee and Chaffey mines, it was found in four analyses to range between 5·70 and 16·45 per cent.

General character of ores.

"Thus it may be stated that, in so far as these analyses represent the general character of the ores, the percentage of phosphorus is low, the sulphur is in some cases rather high, while the titanium, with a few exceptions, is inconsiderable in amount. Should it be found advantageous in some cases to do so, the amount of sulphur might no doubt be reduced by roasting.

"It will be observed that the percentage of titanium is high in some cases, but where it is in large proportion, as at the Chaffey and Yankee mines, it is only what one would expect of such irregular bunches of ore in a coarse diabase rock.

"In the absence of determinations based on carefully sampled lots representing large quantities of the ore, it is not possible accurately to determine what proportions of phosphorous, sulphur or titanium would have to be dealt with in furnace charges, or to what extent it might be advantageous to mix these with other ores. The ores of the district have been used already by managers of smelters in the United States, presumably in this way, and lately also the Drummondville smelter in Quebec has purchased these ores for admixture with their own bog ores.

Improvement in steel-making methods.

"The constant improvement in methods of smelting in late years, has of course rendered it possible to utilize more impure ores than formerly, and even in making the best grades of steel a much lower grade

of pig can be used. In this connection it may be useful to quote an article by Mr. H. H. Campbell, on 'Open Hearth Work at Steelton,' in The *Mineral Industry* for 1893, p. 378.* Ontario—*Cont.*

"Speaking of the large open-hearth furnaces, with tilting hearths in use there, with either basic or acid lining, he says:—

"'The ability to remove the slag in such a furnace renders possible the use of an impure stock [pig], and charges have been successfully handled which contained 0·28 per cent sulphur, whilst others have had 3 per cent of phosphorus. For the most common work it may suffice if the phosphorus and sulphur are both brought below 0·10 per cent; but this by no means represents the regular practice. The charges in the basic furnaces generally average from 0·25 to 0·50 per cent in phosphorus and from 0·07 to 0·12 in sulphur. This is reduced to a content of from 0·005 to 0·04 phosphorus, according to requirements, and from 0·015 to 0·06 sulphur in the steel.

"'The large steel castings are made from one of these tilting furnaces, and by careful selection acid metal of 0·015 phosphorus has been produced. The smaller castings are made from a five-ton acid furnace and contain from 0·025 to 0·04 per cent phosphorus. This pure metal gives steel which will compare with the products of any of the celebrated foreign manufactories.'

"*Hæmatite.*—A number of points were examined where deposits of hæmatite were reported to occur, with a view to ascertaining the possibilities of obtaining supplies of this class of ore. Apart, however, from the old Dalhousie or Playfair mine in Dalhousie township, nothing was seen that could be properly described as a hæmatite deposit. In some cases the only indications consisted of pieces of hæmatite, either lean or rich, ploughed up in fields; at others, an ochreous impregnation of the rocks or soil had led to the belief that the prevalence of so much rusty material must indicate the existence of solid hæmatite in depth. In every case, however, a little investigation of the surroundings would demonstrate the connection of the phenomena with the occurrence of outlying patches of the Potsdam sandstone. Where this formation showed distinctly, it would appear as if the supposed hæmatite deposits consisted of shattered portions of the sandstone, the spaces between the broken pieces being filled up with loose ochreous oxide of iron, which had also percolated in and filled the interstices between the grains of the sandstone, thus giving the whole a very rusty appearance. In places, specimens could be obtained of the Hæmatite ores.

* *The Mineral Industry* for 1893, by R. P. Rothwell, 'Scientific Publishing Company, New York.

Ontario—*Cont.*

solid hæmatite; but these, judging from all the appearances, probably owe their condition to a further consolidation of the original loose ochreous form of the oxide. This action, however, at the points studied, has only gone on to a limited extent, nor did it seem likely at any of these points that any large quantity of the richer and more solid material would be obtained. The bulk of the material wherever seen, consisted of sandstone impregnated or stained with ochreous oxide of iron to a greater or less extent, constituting at best a very lean ore.

Hæmatite reported in many places.

"It was found impossible, in the time at disposal, to visit all the reported occurrences of hæmatite, but in most cases, from the description given, it is evident that they are similar to those noted. In the report of the Ontario Mineral Commission, pages 128 to 142, many such places are mentioned, and at one place, viz., Tamworth, a number of shallow pits were put down which proved the superficial nature of the deposit, and that it was underlain by crystalline limestone. The quality of the ore here is stated to have varied also from rich to quite lean.

"The Geological Survey called attention years ago to similar occurrences in the Potsdam at other places, as will be seen by referring to the Geology of Canada, pages 88 and 89, and the dolomitic nature of this formation in places was also alluded to.

"Taking everything into account, it may be assumed that the phenomena observed are the result of the decomposition of ferruginous dolomitic parts of the Potsdam sandstone, with the formation of ochreous oxides of iron and further consolidation of the same in spots into the hæmatitic form, the lean ores consisting of adjacent portions of the sandstone impregnated with the ochreous decomposition product.

"In a few cases, the ore was found apparently passing down into the underlying Archæan rocks, but evidently to a limited depth only and in such a way as to lead to the belief that, these cases resulted from percolation downwards from the overlying rocks into joint-planes and cavities.

Character of the Dalhousie deposit.

"Of those visited, the Dalhousie mine is the only one having any features of a continuous ore-body, for there the ore was followed down into the crystalline limestone to a depth of 100 feet. Ore was taken out for a length of about 500 feet, with an average width of perhaps 10 feet, although it is stated that the ore-body was very irregular, often thinning down very suddenly to two feet or less. The details of this deposit are well shown in the plan of the mine accompanying Mr.

Vennor's description in the Report of Progress of the Geological Survey for 1872-73, pp. 176-77.* Ontario—*Cont.*

"When visited this summer, it was found that the limestone walls had caved in so as to fill the excavation nearly to the top with débris. The ground being free from cover, however, the surface characteristics of the ore-body can be clearly made out. The surrounding area shows frequent outcroppings of rock, which is seen to be crystalline limestone all round. A close examination for some distance in both directions on the run of the ore-body, showed that it did not extend much beyond the present workings, as far as outcropping at the surface is concerned. The extension of the strike of the ore-body westward, would be along the northern bank of the Mississippi River, and for a distance of about a quarter of a mile, considerable trenching and stripping has been done with a view to tracing its continuity, but without success. In most cases no signs of ore seem to have been found, although at two places some ore was obtained, varying in quality from lean ochreous sandstone to rich and solid lumps of hæmatite. From the appearance of the material and the features presented, these would seem to be simply ferruginous outlying patches of the base of the Potsdam, resting as already described, upon the denuded surface of the Archæan rocks.

"The interesting point about the Playfair mine proper, lies in its being a body of ore extending downward for a known depth of 100 feet into the crystalline limestone. It is suggested, however, that it simply represents ferruginous material leached out from the originally-overlying Potsdam sandstones, deposited in a waterworn cavern in the underlying limestone. This view is borne out by several features observed on the spot, and is shown in the plan and sections of the mine already alluded to, viz., the irregular shape of the ore-body; the fact of its continuing eastward underground without outcropping, being in fact entirely over-arched by limestone; the smooth bounding surface between the ore and the limestone; the tendency of the body to show a general lens-shape and to thin out gradually in depth. This thinning out in depth is also mentioned as a feature of the Arnprior deposit in McNab township which occurs similarly in crystalline limestone.† Hæmatite filling cavities in limestone.

"The yield of the Dalhousie mine from the commencement of work to 1873 was about 15,000 tons of ore.

*In reproducing this illustration in the report of the Ontario Mineral Commission, p. 139, figures 21 and 22, the scale as there reduced, has been erroneously given as 600 feet to the inch instead of 200 feet, as it should be, which makes the length of vein developed appear longer than it really is.

†Report of Progress, Geol. Surv. Can., 1873-74, p. 212.

Ontario—*Cont.*

"From the published description of the McNab mine already alluded to, it would seem to be very similar to the Dalhousie mine.

McNab mine.

It is said to have been worked to a depth of about 80 feet, when, according to one account it thinned out and according to another it was cut off by a fault.

Bog ores.

"*Bog Ores.*—No deposits of bog-iron ores were visited, but the existence of these ores is reported at a number of places in the district.

Means of transport.

"*Communications, etc.*—In studying the subject of the available supply of ore for a possible smelter at Kingston, it becomes a question as to what district may be fairly taken as tributary to that centre. With its lake communications ores might undoubtedly be brought from afar, but the scope of this inquiry was understood to be confined to the possibilities of the immediately surrounding district. With the present railway and canal communications, this would probably include the counties of Frontenac, Lanark and Leeds with adjacent portions of Carleton and Renfrew counties. The Kingston and Pembroke railway would be the main feeder, connecting as it does with most of the chief mines, but other deposits would be reached by means of its connections with the Canadian Pacific railway at Sharbot Lake and Pembroke and with the Ottawa and Parry Sound railway, as well as by the Ottawa and Kingston canal. In fact, the means of communication of the district are very good to the north and east, and, were it necessary, ore could undoubtedly be also drawn from the deposits in Hastings, Peterborough and Haliburton counties to the west.

"The question of the local facilities for and of the cost of smelting, as well as the question of the marketing of the product, need not be here dealt with, as it is understood that those interested have thoroughly satisfied themselves on these points.

Summary of conditions.

"*Summary.*—Reviewing the results obtained by the investigation and having in view the answering of the questions propounded, the conclusions arrived as may be stated as follows:—

"There seems no reason to doubt the possibilities of the district in the matter of supplying ore for a smelter of the size contemplated (viz. 100 tons per day), providing exploratory and development work is kept well ahead of the actual work of extraction of the ore, for although the ore-deposits are irregular in their nature, yet the occurrences already known are numerous, and doubtless many others would be located by explorers were a demand to arise for the ore.

"Apart, however, from the general chances, as above set forth, and the 16,000 to 17,000 tons in the stock-piles of the district, the question of ore immediately available must remain in abeyance, as naturally no

measurement of 'ore in sight' could be made with all the mines abandoned and full of water. The ore supply would be almost entirely magnetite, with possibly some hæmatite or bog ore. In the magnetite, careful selection would probably be necessary, in the case of some of the deposits, to keep the proportion of sulphur and phosphorus low." Ontario—*Cont.*

The first part of the year, before the commencement of field operations, was occupied by Mr. A. E. Barlow in plotting the surveys of the previous season and procuring such topographical details as were deemed necessary for the completion of the Nipissing sheet (No. 131, of the Ontario series). Much time was likewise consumed in studying the geological results obtained, while considerable progress was made in writing an accompanying report. In connection with Mr. Ferrier, various petrographical studies were undertaken, which proved of material assistance in the more accurate delineation of the various rock formations exposed in the region under examination. The permanent labelling of the large suite of rock specimens obtained, also occupied some time. The map of the area above named has been completed and is now in the hands of the engravers. Work by Mr. Barlow.

As it was considered advisable to continue the work of previous years on the Temiscaming sheet (No. 138 of the Ontario series), Mr. Barlow was instructed to secure such additional topographical and geological information as seemed essential for a map and report of an approximately final character, covering this district. This sheet adjoins the Nipissing sheet to the north, while its south-western corner abuts on the north-east corner of the Sudbury sheet, already published. The map will include nearly the whole of Lakes Temiscaming and des Quinzes, with the northern portions of Lakes Keepawa and Temagami. All information necessary for this sheet has been collected, and it is hoped to finish the compilation of both map and report during the present winter. In regard to the summer's exploration, Mr. Barlow reports as follows :—

"I left Ottawa for the field on the 31st of May last, and was joined in Mattawa by Mr. A. A. Cole, B.A. Sc., of Montreal, who had been appointed as my assistant for the whole of the season's work. Mr. Cole's previous experience in the field-work of the survey, when acting as assistant to be Mr. A. P. Low and Dr. Adams, better fitted him for the work he was called upon to perform, while his zeal did much to advance the objects of the exploration. Surveys on the Temiscaming sheet.

"By the kindness of Mr. Colin Rankin, of the Hudson's Bay Company, Fort Temiscaming, an abandoned post belonging to this com-

Ontario—*Cont.*

pany, was again made our headquarters for the season. The month of June was taken up in detailed micrometer surveys and geological examinations of Whitefish, Turner, Nonwakamnig, Wakaimika and Muskananing (Lady Evelyn) lakes, in the north-western corner of the sheet, connection being thus made between my survey of Temagami Lake, of 1887, and the Montreal River, which had been surveyed with chain and transit in 1868 by Mr. A. Forrest, P.L.S., of the Crown Lands Department of Ontario. A survey was likewise performed of the route via Mud and Sharp lakes to Lake Temiscaming at Haileybury, as well as of a number of smaller lakes in this neighbourhood. During July, similar measurements, accompanied by a geological examination, were made from Aminipissing Lake via Breeches and Mountain lakes to White-bear Lake, including Thieving Bear and Net lakes. These surveys were continued, and included a chain of lakes which fall into Net Lake, the largest of which is known to the Indians as Waibikaiginaising (rib lake), and which extend to within a short distance of Bay Lake (on the Montreal River). The latter part of July and the first week of August were spent in examinations and surveys of Obascong, Friday and other smaller lakes which empty into the north-eastern bay of White-bear Lake, and of Bear Lake, a narrow sheet of water six miles in length, which flows into the Matabitchouan River below Rabbit Chute. The remainder of August was employed in a geological investigation of the shores and islands of Obabica and Wawiagama lakes, situated to the west of Lake Temagami, and while thus engaged, Mr. Cole was busy making surveys of some lakes to the west of Rabbit Lake.

"This examination being completed, a trip was made through Temagami, Nonwakaming and Lady Evelyn lakes, and the Montreal River was followed as far as Round Lake, the shores and country in the immediate vicinity of this river being closely examined to its mouth, on Lake Temiscaming. During July, Mr. Cole made a survey of all the roads in the townships of Duhamel, Guigues and Laverlochère, on the east or Quebec side of Lake Temiscaming.

Boundaries of Huronian rocks.

"The boundaries between the conglomerates, slates and quartzites, which here constitute the Huronian system, were traced out, as well as the more important line of junction between these Huronian strata and the various granites and gneisses. Great care was taken in the delimitation of the diabases, gabbros and other basic eruptives, which rocks had been found to contain the nickeliferous pyrrhotite and chalcopyrite in the Sudbury district, to the south-west.

Ore deposits.

Extensive deposits of these sulphides were noticed in 1887 and 1888 on the east side of Temagami Island and on the south-east shore of Ver-

milion Lake to the north of the north-east arm of Temagami Lake. The deposits of argentiferous galena at the Mattawapika (outlet of Lady Evelyn Lake) and at Wright's Mine, Lake Temiscaming, have already been noticed in previous reports. In view of the intention to publish the report covering these explorations at an early date, it is unnecessary to go into further details regarding the geological features." Ontario—*Cont.*

The work in connection with the above sheet was completed on August 27th, when Mr. Barlow returned to Ottawa to obtain certain maps and other information necessary for the continuation of the geological and topographical survey of the Haliburton sheet (No. 118 Ontario series). Work in this region was commenced by Dr. F. D Adams, in 1892, by the examination of certain mineral deposits which had attracted considerable attention, and which were situated in the townships of Digby, Dalton, Lutterworth, Somerville and Galway. Work on Haliburton sheet.

A preliminary report in connection with these examinations, accompanied by a brief summary of the rock formations encountered in a general geological reconnaissance of most of the area covered by this sheet, has already appeared.* The position of sheet 118 is there described as "situated to the north of Lake Ontario and south of the River Ottawa, in the counties of Victoria, Peterborough and Hastings. In order to describe its position more accurately, it may be stated that the four corners of the sheet lie in the townships of Digby, Finlayson, Hagarty and Grimsthorpe." The work commenced in 1892 was continued by Dr. Adams for only a few weeks in 1893, when, owing to lack of funds, further work in this district was postponed. Two weeks only in the first part of September were occupied by Mr. Barlow in work properly belonging to this sheet. Owing to the difficulty in fixing the exact latitude and longitude of the map, it was thought expedient to run a tie-line from Gelert, on the Victoria division of the Grand Trunk railway, in the south-western part of the sheet, to Waubaushene, on Georgian Bay, the position of which has been accurately determined by the Hydrographical Survey. This tie-line was run with great care by Mr. James White, chief draughtsman of this department, and it is believed will suffice for the purpose for which it was intended. It is hoped that the work thus begun will be resumed early next year, as it is sure to prove of great interest.

Mr. Barlow returned to Ottawa on October 1st.

*Annual Report, Geol. Surv. Can., vol. VI. (N. S.), part J.

Ontario—*Cont.*

Work by Dr. Ells.

From the beginning of the year 1895, until exploratory work was resumed in the field in the early summer, Dr. R. W. Ells was occupied with the preparation of map-sheets Nos. 121 and 122, extending along the Ottawa Valley from Rigaud Mountain to the Petewawa, and in compiling the notes of surveys by himself and other observers for an explanatory report upon these sheets. His field-work of the year was principally directed to the completion of the same sheets, but it was considered advisable that some part of the time should be given to the completion and revision of data for the geological mapping of the south-west sheet of the "Eastern Townships" map, shortly to be be published. Dr. Ells makes the following preliminary report of the results of his examinations, which extended from May 25th to September 23rd :—

"The field-work of 1895, was principally devoted to the mapping of the Laurentian and overlying formations found on both sides of the Ottawa in the counties of Renfrew and Pontiac. In September, a revision of the area east of the St. Lawrence, including the Phillipsburg and Stanbridge districts, was made. A careful examination of the islands of Montreal and Jesus and of the country along the Lower Ottawa, was also undertaken, in order to ascertain, if possible, the thickness of the several Palæozoic formations in this vicinity, from the Calciferous upward, which might serve as a guide to any subsequent boring operations in the Ottawa and St. Lawrence river valleys.

Examinations in Renfrew and Pontiac.

"Specimens illustrating the many varieties of the crytalline rocks of the Laurentian were collected, not only of the stratified gneiss and limestones, but also of the several kinds of intrusions which are found throughout the entire Laurentian area. Collections were also made of the crystalline dolomites and schists of the Hastings series, for the purpose of study ; the exact position of this division of crystalline rocks not having yet been definitely settled.

"The occurrence of Palæozoic rocks, ranging from the Potsdam sandstone to the top of the Utica formation, was noted at a number of points throughout the area. Their distribution was mapped as carefully as the heavy mantle of drift would permit. In some places, these newer formations were found to be extensive, while in others they are represented by but small patches resting in depressions of the older crystalline rocks.

Post-Archæan granitic intrusions.

"The Laurentian gneiss and limestone, were found to be penetrated at many points by masses of granite, generally reddish, with syenites, diorites and occasionally trappean rocks. Much of the granite is

of the binary variety, composed chiefly of white felspar and quartz, similar to that found so frequently in the Grenville series. That some of the intrusions are comparatively recent, is evident from their action not only on the Laurentian limestones and associated gneiss, which they have penetrated and altered at many points, but also from their relations to the beds of the Calciferous, which at several points have also been broken up by dioritic dykes, apparently projections from the great crystalline series. This peculiarity of some of these intrusives was also noted last year in Nepean township, near Ottawa, where the granites penetrate the Potsdam sandstone. Ontario—*Cont.*

"The Potsdam sandstone was not seen west of the township of Fitzroy, the Calciferous, westward of this, being the oldest of the Palæozoic formations observed. On Allumette Island, the limestone of this formation is well exposed, on the western end, but is overlain eastward by the sandstones and shales of the Chazy which pass upward through the calcareous part of that formation into the highly fossiliferous beds of the Black River limestone at Paquette's Rapid, near the lower end of the island. Cambro-Silurian areas.

"Inland, to the south, the Chazy and lower part of the Trenton formation have a considerable development in the valley of the Bonnechere, at Eganville, whence they extend eastward to Douglas village. The flat-lying limestones occur for some distance on both sides of that river. Another outlier extends from the east side of Lake Dove eastward to Mink Lake, and thence spreads over the flat area between Douglas and Cobden; while yet another considerable area occurs on the lower west half of Muskrat Lake, which is discharged by the Muskrat River at Pembroke. Along this stream the Chazy beds also show, capped in Stafford township by highly fossiliferous strata of Black River age. A small outcrop of Chazy is again seen in a cutting on the Ottawa and Parry Sound railway, about three miles west of Killaloo station, while on Clear Lake, to the south, the Trenton and Utica beds are exposed at the south-west corner. From these a collection of the characteristic fossils of the Utica formation was made by Mr. W. J. Wilson.

"The western limit of our surveys on the south side of the Ottawa, extended from the vicinity of Golden Lake and the township of Brudenell, northward to a point about seven miles west of the mouth of the Petawawa. The southern limit of the sheet extends from near Arnprior westward past Renfrew and Clear Lake in Sebastopol, though our surveys during the past season extended for some distance further south, in order to connect with previous surveys on the Madawaska by Mr. James White.

Ontario—*Cont.*

Surveys north of Ottawa River.

"On the north side of the Ottawa, the work extended westward to the sharp bend at the foot of the Deep River in the township of Sheen, which marks the most westerly of the settlements on the Quebec side. Traverses were made of all roads in the townships of Sheen, Chichester and along the Black and Coulonge rivers for nearly twenty miles, the country being exceedingly hilly and rough. The crystalline limestones and associated rusty quartzitic gneiss, were found to have a considerable development along the Black River, a broad band of the limestone extending for a long way up the valley of the stream with a general strike of a few degrees west of north. The most westerly observed outcrop of the crystalline limestone and of rusty gneiss on the north side of the Ottawa, was about two miles west of the bridge on the post-road over the Black River, the rocks to the west of this being mostly gneiss and intrusive granite, with syenite and diorite.

Crystalline limestones.

"The relations of the cystalline limestone and its associated quartzose, rusty and often garnetiferous gneiss, to the great masses of the lower reddish gneiss or foliated granitic rock are clear, and confirm the conclusions stated in earlier reports, that the oldest known rock of the Archæan is a foliated granite-gneiss, upon which the more regularly stratified gneisses rest. Whether there is here a direct conformity between these two series, or whether they are distinct and unconformable, cannot be definitely ascertained till all the surveys of the areas in question are plotted and mapped. When this is done, and the masses of clearly intrusive newer granite and syenite have also been separated, it is hoped some conclusive data as to structure will be obtained which will facilitate future work among these crystalline rocks.

Limestone conglomerates.

"It is interesting to note the occurrence of unmistakable limestone conglomerates in the Laurentian crystalline rocks of the Grenville series in Renfrew county. These were seen at several widely separated points, as in the township of Westmeath, along the Rocher Fendu channel of the Ottawa, in the townships of Bromley and Stafford, in Sebastopol, and along the Opeongo road. In these conglomerates, which rest upon the rusty gneiss are pebbles of garnetiferous, hornblendic and reddish gneiss, quartzite and rusty gneiss, well rounded and water-worn. The grayish quartzose gneiss, in the lower part of the calcareous series, presents all the aspects of an altered quartzose sandstone, and the whole series at these places looks like a succession of altered sediments.

Hastings series.

"The Hastings series, as seen about Calabogie Lake and on the line of the Kingston and Pembroke railway, as well as generally throughout the townships of Horton, Bagot and MacNab, consists of a very

considerable development of hornblende-schist and diorite, dolomitic limestone and mica-schist, portions of which are garnetiferous. They are cut by masses of granite and syenite, generally reddish in colour. Around Calabogie Lake and at other places, the hornblende-schist overlies directly the rusty gneiss and limestone of the Laurentian or Grenville series. So far as I have yet ascertained, there does not appear to be any decided break between the rusty gneiss and limestone, and the hornblende-schist and dolomite series, but further work in this direction is necessary to settle the relations of these rocks. Ontario—*Cont.*

"Some of the reddish syenite and granite rocks associated with the last, and exposed along the line of the Kingston and Pembroke railway between Renfrew and Calabogie, would furnish beautiful building stones. They would take a fine polish, and can probably be obtained in large blocks. Economic minerals

"Other minerals of economic value were not observed in workable quantity at any point throughout the area included in the season's work, with the exception of the iron deposits near Calabogie Lake. West of Douglas, dykes of pyroxene occur, which carry small quantities of pyrites and mica, with irregular quartz-veins of small size. Shell marl is found in several lakes in considerable quantity and should be of economic importance. Perhaps the most extensive of these deposits is in Mink Lake, Wilberforce township, Renfrew Co. Other lakes holding marl were found in Westmeath, and Ross, in Ontario, and in Masham and Upper Wakefield, west of the Gatineau River.

"Very considerable areas of crystalline limestone occur throughout the counties of Renfrew and Pontiac, some of which constitute useful marbles. Of these, the quarries near Portage du Fort were referred to in last year's summary. At Renfrew, extensive quarries exist, which furnish an excellent quality of stone, both for building and for burning, very similar to the stone from the Arnprior quarries. A new deposit of snow-white marble has been opened up on lot 19, concession 6, Ross, on the property of Mr. Chas. Bilson. This is a beautiful stone, highly crystalline, and yields large blocks for monumental or decorative work.

"A deposit of graphite has recently been exploited to some extent near the Madawaska, in the township of Brougham. The pieces already obtained show the vein to be of considerable size, but the locality was not visited by me.

"Observations on the glacial geology were made throughout the area. The direction of the striæ was taken at many points on both sides of the Ottawa River, and the course was found to vary from S. 60° Glacial geology.

Ontario—*Cont.*

E. or S. 70° E. on the north side, to S. 40° W. in the south-west part of Renfrew county, south of the Ottawa. Along the Ottawa itself, the direction of these ice-markings generally follows the course of the stream, and the movements of the ice seem to have been affected by the local conditions of the surface.

"Kames and deposits of morainic matter occur frequently, with old shore-lines of well-rounded stones. A prominent feature of the surface geology over much of the area, is the distribution of sand and clay. These deposits have a wide extent, and while marine shells are but rarely found, the character of the clays is undoubtedly marine, the presence of organisms at a few widely scattered points, clearly establishing their mode of deposition. They are overlain by extensive sand deposits, especially in the area to the west and south of Pembroke, and in places these are clearly interstratified with the clay. Deposits of Saxicava sand also occur, containing abundance of marine forms.

"During the last part of June and the first half of July, Mr. W. J. Wilson accompanied me and obtained important facts pertaining to the glacial geology of Renfrew county."

QUEBEC.

(With adjacent parts of Ontario.)

Work by Mr. Giroux.

In the office, since the date of the last Summary Report, Mr. N. J. Giroux was employed principally upon the completion of the north-west sheet of the "Eastern Townships" map.

During the summer, Mr. Giroux has been occupied with field-work, chiefly in the area of sheet No. 120 of the Ontario series of geological maps. This comprises the counties of Grenville, Dundas, Stormont, Glengarry and portions of the counties of Carleton, Russell and Prescott, in the province of Ontario, as well as the counties of Huntingdon, Soulanges and part of Vaudreuil, in the province of Quebec.

The general geological structure of this region had been ascertained very early in the history of the Geological Survey, but questions connected with economic problems such as water supply, building materials, &c., now render it desirable that a more detailed and accurate map should be prepared.

Wells bored at Alexandria.

Mr. Giroux was in the first instance instructed to visit the town of Alexandria, for the purpose of ascertaining, as far as possible, the geological conditions there, in connection with a well then being sunk

for water. The well was found to be on the northern bank of the Garry River, a branch of River Delisle, where ledges of grayish fossiliferous Trenton limestone occur, holding crystals of clear white calcite and small partings of black, shiny, very friable shale. These beds lie apparently flat, and extend but a short distance along the stream on which they outcrop. From the information obtained on the spot by Mr. Giroux, combined with that resulting from a careful examination of the samples of drillings received from the well by Dr. H. M. Ami, the subjoined section is drawn up. Quebec—*Cont.*

Depth.	Character of rock.	Formation represented, and thickness.
Feet.		
0	Dark gray impure limestone, holding fossils, among which can be recognized the following: *Rafinesquina alternata*, Emmons; also fragments of what appear to be *Plectambonites sericea*, Sowerby; *Strophomena* cf. *S. incurvata*, Shep.; *Zygospira*, sp.; *Escharopora*, sp.; and *Helopora* or	
470	*Arthroclema*	*Trenton*, 470 feet or more.
570	Dark gray impure limestone, softer than preceding. No fossils detected	*Black River*, 100 feet (assumed thickness).
755	Dark gray impure limestone, underlain by greenish-gray calcareo-arenaceous shales—at times fine-grained, at others coarse and more highly arenaceous. Obscure fossil remains detected in the upper calcareous beds	*Chazy*, 185 feet.
786	Hard, compact, dark, chocolate-coloured limestone, probably magnesian; no fossil remains observed	*Calciferous*, 31 ft. or more.

At 730 feet, in the Chazy, a porous bed about one foot thick was met with, yielding strongly saline and bitter water. More water of the same character was found in the last twenty-five feet, and the undertaking was abandoned at 790 feet.

A specimen of the saline water from the Chazy formation, above noted, was subjected to a qualitative examination in the laboratory of the Survey, and was found to contain a very large quantity of chlorides (sodium and calcium); a rather small quantity of sulphates (magnesia); and a somewhat large quantity of carbonates (lime).

Mr. Giroux writes: "There was altogether but very little water got in this boring, the water standing at about fifteen feet from the surface when the drill was in the hole, and when taken out of it the water would drop down to 100 feet below the surface. Another test was made, not very far from the station, to a depth of about 350 feet, with as little success as on Garry River." Saline water.

Quebec—*Cont.*

Surveys on area of sheet 120.

Of his general field-work for the season, Mr. Giroux gives the following account:—"On the 6th of June I began to survey roads in order to locate as accurately as possible all the rock-exposures, since in a district like this, imperfectly mapped, and so extensively covered with drift, the new roads, and those not much used, generally afforded more exposures than the main roads.

"In order to obtain a general idea of the geological structure, a few sections were made north and south from the River St. Lawrence to the Ottawa River, as well as several east and west, across part of the area to be examined. Starting from Glen Robertson, the road northwardly was surveyed as far as L'Orignal, thence back to St. Isidore de Prescott in a south-westerly direction, and down to Maxville and across Glengarry county to the River St. Lawrence. A very few exposures of Calciferous and Chazy rocks were, however, alone met with. I then surveyed the St. Lawrence shore-road from River Beaudette to Morrisburg, but without finding a single rock-exposure. From this last mentioned village I went as far as Embrun, crossing the township of Dundas and part of Carleton in a south-westerly direction, and from Embrun I travelled eastwardly to Glen Robertson and back to River Beaudette, having seen rocks of the Chazy, Trenton and Utica in this last circuit.

"By making these sections, a district was outlined including part of Soulanges county, almost all Glengarry, all Stormont, half of Dundas, and parts of Carleton, Russell and Prescott counties, forming an area of about 675 square miles, in which roads were surveyed until the 25th of June. Five days were then spent in ascending River Beaudette, in a canoe, as far as Glen Nevis, a distance of about fourteen miles, then descending the River Delisle, and going thence to St. Polycarpe, without seeing any rocks *in situ*. The low state of the water in these streams, compelled us to drag the canoe over sand, gravel and mud banks about half the distance.

Surveys south-east of Lake St. Peter.

"Early in August, the water being then very low in all the streams, an examination was made of the south-east part of the north-west sheet of the 'Eastern Townships' map, as included in your instructions. Leaving Valleyfield on August the 5th, I drove down to St. François du Lac in order to examine the small area attributed to the Medina, to the north-east of St. Francis River, south of Lake St. Peter. All the roads in this district were traversed, but no rocks were found *in situ*, even in the small brooks which ran in rather deep, irregular, clayey ravines. A number of wells have been dug in and about the village of St. Elphège, which is situated in the gore of Upton, and although

these are ten to fifteen feet deep, no solid rock was met with in any of them. Quebec—*Cont.*

"The larger Medina area to the east of the last, extends from the south-west branch of Nicolet River to the north-east, haing a width of about three miles on the north-east branch of the Nicolet River, with a maximum width of seven miles, and running about four miles north-east of the Becancour River. The red shales and sandstone forming this area can be seen in many places, and where not visible, the soil has a marked reddish-brown colour, and is, therefore, very different to the soil derived from the Hudson River rocks, which is gray. A paced survey of part of the north-east branch of the Nicolet River was made, in order to locate on that stream, an anticline in the Hudson River formation. These Hudson River rocks are much twisted, altered and faulted on both sides of the above anticline, and more particularly to the south of it. The disturbance has very probably been caused at the same time as the fault between the Hudson River and the Sillery, which Dr. Ells observed on the Becancour River in 1388. Silurian rocks.

"Rev. Mr. Proulx, director of the Nicolet college, is sinking a well just behind that institution in search of gas, the find made in Beauséjour some years ago at about seven or eight miles from Nicolet village, being the only indication which prompted the above named gentleman to make this trial. No gas has yet been found, although the hole was 1100 feet deep when I was there last, and the record kept gives, in descending order :—120 feet of clay, 10 feet of sand, 970 feet of Hudson River shales, with possibly Utica shales at the base. Boring at Nicolet

"On the 17th of August I returned to Vaudreuil, and from that date to the 21st of October, with the exception of a few days spent with Dr. Ells near Montreal and St. Johns, P. Q., continued work in the area of sheet No. 120, chiefly in the eastern half of that sheet. Return to sheet 120.

"The vicinity of Rigaud Mountain was examined, and the Potsdam sandstones of Como and Hudson, which crop out at about one mile southward of Ste. Anne de Prescott and can be traced for a considerable distance in the direction of St. Redemption village. A hill of this rock to the north-west of Ste. Marthe, extends towards Ste. Justine de Newton in the county of Soulanges. The formation also appears on the shore of the St. Lawrence about nine miles east of Côteau du Lac church and extends thence to the Cascades at the lower entrance to the Soulanges canal. In the eastern and southern part of Huntingdon county, the Potsdam was in part outlined. Potsdam sandstone.

"East of the Potsdam appears the Calciferous, first at the mouth of River Delisle, on the St. Lawrence River, where a quarry has been Calciferous.

Quebec—*Cont.*

opened to furnish material for the construction of the Soulanges canal. It also occurs a short distance east of the Canada Atlantic railway, in the canal excavation, as well as at the Canada Atlantic railway bridge, where ledges of limestone were struck at 30 feet below the actual surface. Rocks of this age appear at Glen Nevis on River Beaudette, in Glengarry county, as well as at Glen Sandfield, in the same county. North of Winchester and at a short distance from Ormond are ledges of brownish-weathering, fine, gray limestone with a greenish hue which very probably belong to the Calciferous formation. To the south of the St. Lawrence, impure limestone of Calciferous age outcrops in a few places in the county of Huntingdon.

Chazy.

"The bluish-black, brittle Chazy limestone, has been, and is still quarried, in several places in the district examined, but apart from these openings but few exposures belonging to this formation could be seen. The characteristic green Chazy shales of the vicinity of Ottawa, have not been met with *in situ*, and débris of the same were seen in one place only. Near Glen Robertson station, there are two quarries in very dark, bluish-gray or blackish Chazy limestone. It is very brittle and hard, contains iron-pyrites in places and holds many brillant specks consisting of small crystals of calcite. At about one mile and a half from Glen Robertson station, there is another quarry in dark bluish-gray or blackish limestone of the same age, thick-bedded, and somewhat more concretionary than that at the above station. This limestone is not as good for building purposes as that of the quarries nearer Glen Robertson station; it has in many places a rough, pitted weathered surface and holds fossils amongst which are fine sections of *Pleurotomaria*. At about four miles and a half north of Cornwall station, there is also a small quarry in blackish, brittle, heavy-bedded and jointed limestone; it has a rough weathering which exhibits in many places a coarse net-work, the meshes being of brownish colour. It holds small inclusions of calcite as well as iron-pyrites finely distributed in thin bands.

Trenton.

"Though my surveys are not yet all plotted, I can safely say that the Trenton formation has a greater extent than any of the others in the eastern part of sheet 120. Limestones belonging to this formation have been seen in many places, among which the following may be particularly noted:—At about one mile and a half south of Vankleek Hill, there is a small quarry in fine, gray, very brittle and bituminous Trenton limestone, with partings filled with bituminous matter and joints coated with white crystallized calcite. The beds here are somewhat folded. At one mile south-east of St. Isidore, in Prescott County, hard, gray limestone contains many crinoid stems and other

well preserved fossils. On the Nation River at Casselman, limestone occurs, very probably of Trenton age. Not very far from Apple Hill station, on the Canadian Pacific railway, in Glengarry county, are ledges of gray fossiliferous Trenton limestone, and a little over one mile to the north-west of these ledges, is a quarry in bluish-gray Trenton limestone, in beds varying from one to three feet in thickness. This limestone is very fine and compact in some bands and fossiliferous in others; it is much jointed, one set of joints being perpendicular to the other. The beds are concretionary in places and separated by thin shaly partings. At about three-quarters of a mile north-east of Lochiel post-office, in Glengarry county, are ledges of gray fossiliferous Trenton limestone containing corals. At Crysler, in the northern part of Stormont county, the beds and banks of the Nation River, for about 350 to 400 feet below the bridge, and up to the dam, about one-quarter of a mile from the bridge, consist of gray, thin-bedded Trenton limestone. The limestones of this formation dip at low angles in various directions, and the non-continuity of exposures renders it almost impossible to determine their thickness. Quebec—*Ont.*

"A small basin of Utica rocks occurs about Maxville on the Canada Atlantic railway; débris of black shales belonging to this formation having been seen in half a dozen places in the neighbourhood of this village. On Mr. M. J. Fisher's property, lot 2, range 6, of the township of Roxborough in Stormont county, these black shales holding *Trilobites*, *Orthoceras*, *Lingula*, &c., form the bed of a small brook for some distance, not far from, and to the south of, the Canada Atlantic railway. These shales appear to lie horizontally. I am told that the same shales were met with in many places about Maxville in digging wells, at depths of 20 to 23 feet. Whether this small area is the continuation of the one to the east of the city of Ottawa, has not yet been ascertained. Utica.

"As a rule, the rocks in this district show glacial striæ comparatively seldom, and these vary considerably in direction from place to place. Courses were in fact observed ranging between S. 41° E. and S. 40° W. Marine shells such as *Macoma fragilis*, *Macoma calcarea*, *Saxicava rugrosa*, &c., have been found in many places in the counties of Soulanges, Glengarry and Stormont, and near Côteau du Lac church, in the excavation of the Soulanges canal, at twenty-two feet below surface, was found a fossil skeleton of the white whale or white porpoise *(Delphinapterus catodon)* but unfortunately only one of the vertebræ could be preserved, as all the rest of the bones fell to pieces. Glacial deposits.

Quebec—*Cont.*

"Fine boulders of labradorite were seen in a couple of places in the county of Glengarry. On the road from Alexandria to Glen Robertson, one of these boulders was blasted, and exhibits large crystals of beautiful iridescent labradorite.

Bog-iron.

"Bog-iron ore, is found in small quantity in the sand-hills of Vaudreuil county, and the same mineral occurs on lot 2, range 6, of Roxborough township, in Stormont county, on a small hill, a short distance to the south of the exposure of black Utica shale.

"In regard to water supply, the following notes may be given:—

Water supply.

"On River Beaudette, at about three-quarters of a mile north of the Grand Trunk railway, is a fine spring of good water. An analysis of this water has been published.* Near the hotel in Maxville, there are two wells very close to one another; the water from one of them is very good, while the other is highly sulphurous.

"Some years ago, a well was sunk in search of oil at a short distance from Bainsville, in Glengarry county. The depth is given at 760 feet, but no oil was found. Excellent water, however, flows continually from this well, to about three feet above the surface, the flow being much greater in the spring than during the summer. In the village of Maxville there is another flowing well, twenty-two feet deep only, which furnishes good water in small quantity. At about one mile east of River Beaudette, to the north of the main road to Côteau Landing, is another flowing well which is about seventy feet deep and gives excellent water. One mile further east, along the St. Thomas concession-road running northward, and between the St. Lawrence shore-road and the Grand Trunk railway, are two more very good flowing wells fifty-five to sixty feet deep only.

Peat.

"There are several peat bogs in this district, which, I think, could be worked profitably. That to the south of the St. Lawrence, in the county of Huntingdon, crossed by the road from Port Lewis to Huntingdon village, has been already worked some years ago and presents many advantages for exploitation.

"Good building material as well as numerous and thick deposits of clays very suitable for brick making are of frequent occurrence.

"During the season I surveyed 1249 miles of roads and rivers, viz., 1242 miles of roads by wheel and seven miles of rivers by pacing."

Work by Dr. Bell.

During the winter months, Dr. R. Bell was engaged in elaborating the results of his field-work on sheets No. 129 and 128, and preparing

*Annual Report, Geol. Surv. Can., vol. I. (N.S.), p. 12 M.

local geological maps to be used in laying down the details of the geology of the region from the Sudbury sheet to the eastern shore of Lake Superior, for publication on a scale of four miles to one inch, as soon as these two sheets shall have been compiled upon a proper projection. Some further progress was also made towards the completion of the Manitoulin sheet, No. 126. Quebec—*Cont.*

In 1887, as recorded in the Summary Report for that year, Dr. Bell was engaged in the geological exploration of the Upper Ottawa River, and in the course of this work, the late Mr. A. S. Cochrane (one of Dr. Bell's assistants at that time) under his directions crossed the watershed to the north of Grand Lake and followed a chain of lakes and river leading northward to Shabogamog Lake. This lake, which proved to be about thirty miles in length, was also surveyed, and the river discharging from it was followed for a further distance of some ten miles, making in all about seventy miles in a straight line from Grand Lake. The existence of an important belt of Huronian rocks was ascertained by Mr. Cochrane, but its limits, as well as the further course of the river, which at this time was supposed to flow into Hannah Bay, remained indeterminate. The river flowing from Shabagamog Lake, evidently, however, offered a route of some kind which has hitherto remained practically unknown, geographically and geologically, from the head-waters of the Ottawa to James Bay. Dr. Bell, having been requested to make a preliminary examination of the country in question, decided to follow the route indicated. He successfully descended and surveyed the whole length of the river, which proved to be the main branch of the Nottaway or Noddawai, discharging in Rupert Bay. Dr. Bell gives the following account of this interesting exploration :— Previous survey in Upper Ottawa region.

"My party consisted of my assistant, Mr. Alexander Barclay, five Indians from the Maniwaki Reserve, and Théophile Michaud, a French Canadian voyageur, who had accompnied me during six previous years. I provided myself with two birch-bark canoes, in which we carried our provisions, outfit and everything necessary while making our measurements during the season. By this means, we proceeded very rapidly, otherwise it would have been impossible to make such an extensive topographical survey, together with various explorations, in so short a time. Party and route.

"In going northward by canoe from Maniwaki, two routes are available, one by the Gatineau River and its tributary the Gens de Terre, and the other by the Désert and its branch the Thomasine. Both are very difficult for loaded canoes. We left Maniwaki village

Quebec—*Cont.*

on the 1st of July, and followed the Désert route to Lac des Rapides. This lake has two outlets, one southward to the Gatineau and the other northward, discharging part of its water into the Upper Ottawa at a place called The Barrière or Dam. From this locality, we followed the Ottawa down-stream, or westward, to Grand Lake.

Previous surveys by Mr. Cochrane.

"Leaving the northern extremity of Twenty-mile Bay, of Grand Lake, by a small brook, we crossed the height-of-land and descended to Shabogamag Lake, (properly, Shibogama, or lake of channels) referred to in connection with Mr. Cochrane's survey of 1887. Mr. Cochrane's map shows every topographical detail, and it was found to be sufficiently accurate for present geological purposes. Mr. Cochrane supposed the river he had been surveying below Shibogama Lake to be one of the branches of a river which ultimately fell into Hannah Bay. This was at that time, and it still is, the opinion of the few Indians who are aware of its existence, and we did not hear of any white man who had ever visited the stream up to that time, although many years ago a part of it may have been used by the Indian voyageurs of the Hudson's Bay Company. In this connection, I may mention that the lower parts of the stream are frequented by only one Indian, and that he came only a few years ago from the Abitibi region. His name is Taibi, and we had the good fortune to meet him at Grand Lake house, when he was on his annual trading trip to that post, and to engage him as guide for the river as far as he might know it. Although this man knew more of this river than any other person, he declared emphatically that it did not discharge into Rupert Bay, but 'somewhere between that bay and Moose River'; but in this he turned out to be quite mistaken. He had obtained his information from other Indians, who were supposed to know the facts.

Map of the Crown Lands Department.

"Before leaving Maniwaki, I had requested and obtained from the Honourable the Commissioner of Crown Lands of Quebec, a tracing of a map by Mr. Henry O'Sullivan, P. L. S., showing the streams to the north-east of Grand Lake and thence northward to Waswanipi Lake. To the north of Grand Lake this map showed the route we were going to follow about thirty miles further than it had been surveyed by Mr. Cochrane in 1887, but without any details, such as were shown with great accuracy on Mr. Cochrane's map; nor had it the notes on soil, timber, etc., which are shown on the map, dated 22nd October, 1895, and published in the report of the Commissioner of Crown Lands, Quebec, for 1895. This was the only information I obtained from the Crown Lands Department in reference to the region explored.

Quebec—*Cont.*

Drainage as shown by maps.

"The existing sketch-maps show a river named Noddawai * entering the head of Rupert Bay and one named Hannah Bay River flowing into the head of the bay of that name. The upward course of both is represented as being south-east, so that the 'Hannah Bay River,' would, if this were correct, intercept the north-flowing river which we were about to descend from the neighbourhood of Grand Lake. Another stream, called West River, is usually represented on the maps as draining Michigami Lake and flowing into Hannah Bay, west of the river of that name. But the stream which drains Michigami Lake is not West River, but one bearing the same name as the lake itself, and it does not flow towards Hannah Bay, but north-eastward into the lower part of the Noddawai, thus crossing, nearly at right-angles, the course assigned to the so-called 'Hannah Bay River.' The stream which enters the head of Hannah Bay is called by the natives Wash-a-how-sipi, or Bay River. It rises to the south-east of Abitibi Lake, and its course lies to the west of Michigami Lake and river.

Course of Noddawai as now ascertained.

"The river which we descended was found to fall into the western part of a lake called Mattakami, or Mattagami, lying nearly at right angles to the general course of the stream. The same lake receives the Waswanipi, which is also a large river, from the east. The name Mattagami means 'lake at the meeting of two rivers.' From the north side of this reservoir the Noddawai, as a very large river, flows out with a northerly course of about 100 miles to Rupert Bay.

"Shibogama Lake, referred to in the report for 1887, is an expansion of the river which we descended to Mattagami Lake. The Migiskun (or fish-hook ?) River flows at right-angles into the east side of this lake, and its source, which is near that of the St. Maurice, is probably further from the sea than that of any of the other branches of the river-system to which it belongs; but the stream which we descended from the height-of-land near Grand Lake, follows the course of what appears to be the central depression, and it also flows through the central part of the area of this river-system. For these and other reasons, the river we followed from the height-of-land to Mattagami Lake may, I believe, properly be considered the trunk stream and the Migiskun a branch. This line

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*This word means the Iroquois Indians, or perhaps more exactly, the Mohawk division of these people, in both the Otchipwé and Cree dialects. It is differently spelled by various authorities, but the pronunciation is intended to be nearly the same in all cases. The following are some examples of the spelling:—Noddawai—Admiralty charts of Hudson Bay. Nottaway and Notaway—Most sketch-maps. Nâdowé (Otchipwé for an Iroquoi Indian)—Bishop Baraga's dictionary. Nâtowew (Cree for Iroquois)—Père Lacombe's dictionary. Nahduwa ("Chippewa" for Iroquois, Mohawk)—Revd. E. F. Wilson's dictionary. Natoowâo (Northern Cree for Iroquois)—Revd. E. A. Watkins dictionary. The first of these is adopted in this report.

Quebec—*Cont.*

of depression is continuous with the straight and narrow Twenty-mile bay of Grand Lake. A low sandy tract now separates the waters of the Upper Ottawa from those flowing north, and forms the watershed at the extremity of the bay just mentioned, but at a recent geological period, the waters of the Upper Ottawa probably flowed down the central stream of the drainage area above referred to. The change to the present conditions has probably been due to the relatively greater uplift of the continent to the north than to the south. This former diversion of the waters of the Upper Ottawa to James Bay, was fully described by me in a paper read before the Royal Society of Canada last May, of which abstracts were published in the *Journal of Geology* and the *Scottish Geographical Magazine* for July, 1895.

Hydrographic basin.

"The hydrographic basin drained mostly by the Noddawai River and its branches, appears to be larger than that of the Moose River or that of the Ottawa. The Wash-a-how, or Bay River, to the west and the Broad-back River to the east of the Noddawai may be properly included in this drainage area, which would thus embrace some 70,000 square miles. The basin, like that of the Moose River, is about as broad as it is long, and, as in the case of the former, the waters flow from all sides towards the northern margin. It lies immediately south-east of James Bay, just as the basin of Moose River lies to the south-west of it, and the one basin is a sort of counterpart of the other.

Wide level country.

"The elevation of the low divide between Grand Lake and the waters flowing north, is probably not much, if anything, over 1000 feet above the sea, and, as the surface of the basin under consideration is mostly level, as far as I could observe or ascertain, the greater part of it is probably under this level. The conditions were very similar throughout the entire distance and the country presented the same general appearance all the way from Grand Lake to James Bay. Isolated hills and ridges were to be seen occasionally from the canoe route. I ascended a number of these and in every case obtained a good view of the surrounding country. It always presented an even or slightly undulating aspect, with a hill or ridge here and there. To the westward of Gull Lake, on the Waswanipi River, the country is more hilly than elsewhere, and a rocky ridge runs along the south side of Mattagami Lake, with one point rising to the height of 670 feet above its level. I was informed by Mr David Baxter, in charge of the Hudson's Bay Company's post at Waswanipi Lake, that along the canoe route from Gull Lake to the Rupert River the country is almost uniformly low and level.

"The immediate banks of both the main river and its branches, are generally low, averaging only from five to fifteen feet, and it is only in places that they exceed thirty feet in height, although the ground usually rises at a short distance back from the water, and often attains an elevation of from 50 to 100 feet, especially below Mattagami Lake. For long distances, the land along the river-margins is very level and the trees grow quite to the water's edge. The higher scarped banks generally expose bouldery till at the bottom, with thinly stratified horizontal brown clay above, but when the banks are lower they show only the brown clay. The solid rock is commonly seen beneath the superficial deposits at the stronger chutes and rapids, and it forms many projecting points in the rivers and lakes. The brown clay appears to be spread over the greater part of the region, as the water of the main river and most of its tributaries is turbid, except that of the Migiskun, Waswanipi and Michigama. It has the same tint as the clay itself, and resembles that of coffee with milk. Marshes of limited extent occur in places along the rivers and around the lakes, but in looking over the country it was only occasionally that swamps could be seen. The slope of the ground and the ramifications of the numerous streams, appear to afford sufficient natural drainage to reach most of the land fit for cultivation. Quebec—*Cont.* Surface and soil.

"*Timber.*—The white and red pine extend from the southward for a short distance beyond the height-of-land. Banksian pine is found, where suitable conditions exist, as far as Mattagami Lake, but its range towards James Bay is not restricted on account of the latitude, but by some other circumstance, for in a slightly more easterly longitude this tree ranges northward to Great Whale River, a distance of about 450 miles in a straight line from Mattagami Lake. Tamarack or larch, is abundant and of fine growth, but unfortunately most of the trees, throughout the whole distance from Grand Lake to James Bay, have been attacked by the grub of the recently imported larch saw-fly. A certain proportion of the trees have been already killed by this pest, and the remainder will probably die also if its attacks are continued for a year or two longer.* Trees.

"White spruce is perhaps the most valuable tree of the district explored. It grows to a great size everywhere along the rivers and lakes, and although, as a rule, it may be larger near their banks, where it often girths upwards of six feet, a considerable proportion of the trees inland also attain a good size. In point of numbers White spruce.

*In 1893 Mr. Low found the tamaracks in the interior of Labrador as far north as the East Main River, all dying from the same cause. Its ravages extend southward to the Gatineau Valley.

Quebec—*Cont.*

of individual trees, the black spruce takes first rank, and a large proportion of them are of a sufficient size for various useful purposes, such as fuel, building, railway-ties and wood for paper-making. Balsam fir grows in perfection, and is abundant throughout the district. White cedar is confined principally to the margins of lakes and rivers. Its northern geographical limit is slightly beyond the region explored, and it becomes scarce as we approach James Bay. White or canoe birch is a thrifty and abundant tree everywhere. Aspen or trembling-leaf poplar is the most common deciduous tree. The balsam poplar was not observed in the southern part of the great river basin, but was plentiful in the northern part. The timber is almost everywhere of mature age, or consists of old second-growths, and it will be of great importance to preserve these extensive forests, as far as possible, against fires, which have wrought such havoc in so many other districts. A few square miles have been destroyed by fire in recent years on the east side of Siskumika Lake, on the Noddawai, but with this exception we noticed only insignificant patches which had been burnt.

Possible agricultural value

"*Climate.*—The greater part of the region under consideration lies between latitudes 48° and 51°, or south of London. While it does not, like Western Europe, enjoy the advantages of an atmosphere warmed by ocean currents, neither does it suffer from the disadvantages of the chilling effect of the Arctic current, like Eastern Labrador. The climate may be considered as normal for the above latitudes. In estimating its probable suitability for agriculture, it may be mentioned that wheat ripens well at Lake St. John, to the eastward, and also, when tried at different times, at New Brunswick House, on the Missinaibi River, and at Newpost, on the Abitibi, to the west, while barley ripens at Rupert's House and Moose Factory, both of which lie to the north of this region. Newpost lies near the western border and to the north of the greater part of the tract in question, but a straight line drawn from it to Lake St. John would pass through the centre of the area.

Flora.

"The flora of the district may naturally be assumed to be identical with that of the adjoining basin of Moose River in the same latitudes. In 1877, I made a tolerably complete collection of the plants of this region, and Professor Macoun, botanist to this department, after carefully identifying the species, said that, judging from this flora, he saw no reason why wheat might not be successfully grown as a crop.

Crops.

"At Waswanipi post, a little to the north-east of the centre of the region, we saw potatoes and a considerable variety of vegetables all

doing well, although the soil at that particular spot is very inferior to the average of the district. Timothy and red and white clover, which had been accidently sown at this post, were also thriving. I did not hear of any experiments in grain-growing having been made at this establishment, but it was said that grain of some kind had been raised many years ago by the North-west Company's agents on land close to the present Hudson's Bay Company's post. Quebec—*Cont.*

"Last summer, we found the rainfall excessive. After the beginning of August, more or less rain fell every day, and often it was heavy and continuous for twelve to thirty-six hours. Thunder storms with heavy rain were also frequent. At Moose Factory we were told that the past summer had been the most rainy one in the memory of the present generation. Although the season was probably an exceptionally rainy one in the region we passed through, several circumstances indicate that a copious rainfall is the normal condition in this district. The ground under the dense coniferous forest is everywhere covered by a thick carpet of yellowish-green moss, and in favourable places along the Noddawai River, peat accumulates to a depth of from five to ten feet, and even more. The number of rivers, brooks and streamlets, full of water in the middle of summer, is unusually large, and the total quantity of water discharged into the sea is also great in proportion to the area. The difference in the amount of the discharge at the high- and low-water levels in the main river and its principal branches did not appear to be greater than the proportion of two to one, if so great. The average height at which the trees are barked by the running ice in the spring, is about ten feet. The conditions all over the drainage area are very favourable for holding back the water and thus regulating or equalizing its outflow. Among them may be mentioned the general level character and moderate slope of the whole region, the thousands of natural dams formed by logs and sticks lying across the smaller branches, and especially the thick coating of moss all over the surface, acting as a sponge saturated with water and draining slowly away. Rainfall.

"Again, the quantity of snow and the conditions under which it melts, must be considered in relation to the water supply of these rivers. Snow lying in the shade of the close evergreen forest, does not melt rapidly in the early spring as it does from among the deciduous trees which are leafless at that season, or, as in a cleared or open country, but is very slowly acted upon, and it lasts for about six weeks longer than it would if exposed to the sun. Mr. Baxter, of Waswanipi, informed me that the average depth of snow in the woods (where it does not drift) was considerably more than four feet. Snowfall.

Quebec—*Cont.*

Climatic irregularities in 1895.

"Notwithstanding the unusually wet summer at Moose Factory, the central and western branches of Moose River were lower in September than I had ever before seen them. But the Abitibi, which lies nearest the basin of the Noddawai, appeared to be moderately full when we passed its mouth about the middle of the month. At Moose Factory, we were told that these conditions had prevailed for some time before we started up the river. In connection with this subject, it may be here remarked that Mr. Low this summer experienced very wet weather in southern central Labrador; also that voyageurs on the Rupert River were troubled by frequent and heavy rains. From all the foregoing and other facts, it would appear that a dry summer prevailed to the south and west of the basin of the Noddawai, while there was an unusually wet one in and eastward of that region.

Storm of exceptional character.

"The extraordinary weather which we experienced at the time of the equinoxes may be worth noting here, as our position was far from any meteorological station, except that of Moose Factory. We were in the neighbourhood of 'The Forks' of Moose River, about fifty miles from Moose Factory. A severe thunder storm, with very dark sky and east wind, occupied most of the forenoon of the 20th of September. In the evening, an extraordinarily warm breeze, for that season, set in from the south-west and continued all night. At 9 p.m. the thermometer stood at 73° Far. The 21st was a fine and warm day, followed by rain at night. At our camp on the Missinaibi River, about twenty miles above 'The Forks,' it rained during the whole twenty-four hours of the 22nd, with a dark sky; distinct thunder was heard at times. Lightning and thunder, with heavy rain, continued throughout the night of the 22nd, and at daylight of the 23rd, a great gale sprang up from the south-west. This continued all day, the force increasing and diminishing at intervals. The water of the river drifted like snow, and it was impossible for us to move. We were obliged to place our canoes in the woods to prevent them from being blown away. The living forest trees were blown down in great numbers. Our camp was about 300 feet above sea-level. The barometer stood at 29·07 at 7 a.m. of the 23rd, and had risen to 29·94 at 7 a.m. on the 24th. On our journey south-westward from this place, we found that the trees had been blown over all along our route as far as the Canadian Pacific railway, a distance of more than 200 miles, but the destruction inflicted appeared to diminish gradually in that direction. For long distances, about half of the trees had been blown over, rendering it it almost impossible to force one's way through the woods. In many places, acres of the forest had been

prostrated bodily. Previous to this destructive gale, most of the trees which had fallen had had time to rot away, which must have required a period of fifty years or more, so that even if at any previous time they had been thrown down in large numers at once, such an occurrence must have been upwards of fifty years ago. Quebec—*Cont.*

"*Fauna.*—In the region explored, fur-bearing animals and game of all kinds were scarcer than might have been expected, and this circumstance probably accounts for the small number of Indians in the district. Caribou are found throughout the whole region, but not usually in any great numbers. Moose and Virginia deer are confined to the southern part. Only a few black bears were seen. The common American hare (or 'rabbit') was rather plentiful, but the chickaree or red squirrel was rare, notwithstanding the abundance of its favourite food, the cones of the balsam fir, and the two kinds of spruce. Fauna.

"The scarcity of ducks is owing partly to the absence of rice, although the conditions for it appear favourable, and it should grow well if introduced. Another reason is the great reduction which has taken place during late years in the number of the water-fowls in general which migrate to James Bay, owing to the drying of the salt marshes, and to their wholesale destruction in their winter resorts.

"Fish are abundant in all the waters. They consist of whitefish, sturgeon, pike, pickerel, gold-eyes, chubs, suckers and dog-fish. Neither speckled nor gray (lake) trout were seen, nor could we hear of their existence in the district, although the former may occur locally in clear cool streams, as in the case of the Upper Ottawa region and the Moose River basin.

"*Geology.*—The rocks along our route from Maniwaki to Grand Lake all belong to the Laurentian series and consist of gneisses with a little crystalline limestone in some places. To the northward of Grand Lake Mr. Cochrane found Huronian rocks, with some gneiss, as far as he went. Gneiss occurs about the outlet of Shibogama Lake, but beyond that, rocks which may, for the most part, be classed as Huronian were found all along our route towards James Bay, till we reached a point about six miles northward of the outlet or the narrows of Mattagami Lake. A considerable proportion of the area, however, consists of granitic rocks, some of which may perhaps, on close investigation, be placed with the Laurentian, while others are probably true intrusives. Granite was almost the only rock observed on Waswanipi River between Gull and Waswanipi lakes. The boundary between the Huronian and Laurentian rocks runs westward from Noddawai River and crosse the north-west bay of Mattagami Lake. From the above-mentioned Huronian and Laurentian rocks.

Quebec—*Cont.*

point (about six miles northward of the narrows or outlet of Mattagami Lake), gneisses with some granitoid patches and occasional bands of micaceous and hornblende schists were the only rocks met with *in situ* all the way to Rupert's House.

"The Huronian rocks, in the region traversed, have a greater development than we had expected, and this circumstance adds to the prospective economic value of the country, since these rocks are more likely to produce valuable minerals than the Laurentian. Towards the southern side of the Huronian area, the general strike is north and north-north-westward; in the central part it is north-west, and towards the north side west-north-west to west. The rocks consist principally of a variety of schists, such as dioritic, chloritic, hornblendic, and micaceous and also slatey arkose, alternating with massive greenstones intersected by red and gray granites.

"Veins of quartz were frequently seen and some of them contained small quantities of iron- and copper-pyrites. As gold (generally in small quantities) frequently occurs in such veins in similar Huronian rocks elsewhere, it is very probable that it may sooner or later be found in this region also.

Glaciation and surface deposits.

"*Superficial Geology.*—The surface of the crystalline rocks is everywhere thoroughly glaciated. The general course of the striæ is south-south-westward, with local variations, but towards the northern part of the district there is also a newer set of grooves running southeasterly and close to Rupert Bay there were several local sets having other courses. From Grand to Mattagami Lake, the drift materials consisted principally of the débris of the local Huronian rocks, with a certain proportion from the Manitounuck and Devonian rocks of James Bay, the percentage of these latter increasing as we went northward. Beyond Mattagami Lake this percentage became very considerable, the remainder of the materials in that region consisting principally of Laurentian gneiss. The Manitounuck and Devonian drift had probably been first carried to the south-westward from James Bay and afterwards south-eastward when a change had taken place in the direction of the glacial movement. As already mentioned, the horizontally stratified clay in the higher cut-banks along the rivers was seen to be underlain by boulder-clay or till.

"In travelling by water through a densely wooded country like this, very little could be done in the way of observing any terraces or other evidences of former water-margins that may exist in the region. The first proof of the former submergence of the land afforded by fossils, was found only when we came near the head of tide-water, where the

clayey banks of the Noddawai are about seventy feet high, and in their upper parts contain the brackish-water varieties of a number of the commoner northern marine mollusca. Quebec—*Cont.*

"Before closing this report, I wish to express my obligations to Mr. Charles Logue, of Maniwaki, and to Messrs. W. K. Broughton, Donald McTavish, David Baxter, Captain Taylor, and other officers of the Hudson's Bay Company whom we met, for assisting me in various ways to carry out the objects of the season's operations."

Mr. R. Chalmers was, during the winter of 1894-95, engaged in working up for publication the results of investigations on the Surface Geology of New Brunswick and adjacent provinces, including part of South-western Quebec. His report, covering a portion of the work above indicated and accompanied by five maps, has since been printed. Work by Mr. Chalmers.

The field-work of the past summer was chiefly directed to the investigation of the auriferous districts of the province of Quebec, but a short visit was also paid to the salt spring at Saline, King's county, New Brunswick, on which a note is appended (p. 97). Mr. Chalmers reports as follows upon the work carried out:—

"On the 25th of May, I left Ottawa for the Eastern Townships of Quebec to begin field-work there for the season. The object of the work as stated by you in letter of instructions, was to ascertain more precisely than has yet been done, the relations of the alluvial deposits containing gold, (1) to the places of their origin, and (2) to the glacial drift of the region. In pursuance of this object, you further stated, 'it would be necessary to investigate the general character and sequence of all the superficial deposits systematically,' etc. Instructions and plan.

"In commencing the work thus outlined, it was considered best to examine the deposits in those districts where alluvial gold mining has hitherto been carried on, and where shafts and other excavations have been opened, the facts thus obtained being considered as more likely to elucidate the problems presented for solution. The gold mining operations have been practically confined, (1) to Beauce county, and principally to the valleys of the Chaudière River and its affluents, (2) to the valley of Little Ditton River, township of Ditton, and (3) to Dudswell Mountain, townships of Dudswell and Westbury. For the sake of brevity these will be called, the Chaudière area, the Ditton area and the Dudswell area. Outside of these areas no profitable gold mining has been carried on, although gold is known to occur, as shown by Dr. R. W. Ells,* in the alluviums, as well as in quartz, in a great

*Annual Report, Geol. Surv. Can., vol. II. (N.S.), pp. 51 J-53 J.

Quebec—*Cont.*

number of localities between the international boundary and the range of mountains nearest the St. Lawrence River, known as the north-easterly extension of the Green Mountains.

"In the investigation of the auriferous gravels and other superficial deposits of these three areas, the principal part of the season was spent; but some weeks were devoted to the study of the glacial phenomena of the region, and to the work of tracing the post-glacial shore-lines along the northern slope of the Notre Dame Range.

Chaudière area.

"*Alluvial gold mining in the Chaudière area.*—Of the three gold-producing areas mentioned, the largest and most important is that of the Chaudière. This area has been worked for alluvial gold since 1846, and the total production in that time is said to be of the value of about two million dollars. For some years, however, very little gold mining has been carried on except in a desultory manner, at intervals, with pick, shovel, and rocker or sluice-box, and a number of locations which might be profitably worked are idle. This condition of things is said to be due to several causes:—First, to a lack of the knowledge and skill necessary to successful alluvial gold mining, as pointed out by Dr. Selwyn in his Report on Gold Mining in Nova Scotia and Quebec;* second, to the extravagance with which the mining has been carried on by those who operated on a larger scale than the local miner; and third, to the fact that large portions of the best mining lands are owned by private individuals and companies, who do not work them themselves, but hold these lands at such high values as to place them altogether beyond the reach of the ordinary miner. Other causes might be specified, one of which is said to be the difficulty of securing good titles in some localities. Taking everything into consideration, the gold mining industry in the Chaudière is heavily handicapped, and capital has very naturally shrank from investment there.

Present activity in mining.

The prospects of some revival are, however, becoming noticeable of late, especially in those portions of the area lying outside the De Lery seigniory, while some work has also been carried on in the latter district, especially in Gilbert River valley, by Mr. F. Wadsworth, of the American Gold Mining Co. of Boston, with Samuel Byrne, an old California miner, in charge. On the Du Loup, Mr. E. B. Haycock of Ottawa, who has a three-stamp quartz mill there, has been doing some good work in prospecting for gold-bearing gravels and testing the quartz found in numerous veins in the lower part of that river. Mr. John Blue, manager of the Eustis Mines, Capelton, and his son, have also been prospecting for gold in the alluviums of the Du Loup, with,

*Report of Progress, Geol. Surv. Can., 1870-71, pp. 275-76.

so far as I have been able to learn, encouraging results. Mr. Louis Gendreau, of Jersey Mills, worked at Chaudière falls for several weeks during the past summer, and extracted gold from the gravels there. Sluicing for gold was also carried on at the Devil's Rapids, Chaudière River, for a short time, but I did not learn the result. Late in the autumn, Mr. J. E. Hardman, the well-known Nova Scotia gold miner, began operations at St. George, Beauce county, and at the time of my leaving the field—October 17th—had started a tunnel from the bank of Chaudière up Slate Creek valley, expecting to reach the pre-glacial gold-bearing gravels in the old bed of that stream. Capt. Geo. Macduff, an experienced alluvial miner, was in charge of the work. Quebec—*Cont.*

"*Alluvial gold mining in the Ditton area.*—The Ditton area is another from which a large amount of alluvial gold is reported to have been taken, it is said, to the value of seventy-five thousand dollars or more. The richest deposits were met with in that part of the area known as the Pope mine, lots 39 and 40, range 9, Ditton. For some years, however, little or no mining has been done there except prospecting and testing for gold some of the numerous quartz-veins which occur in this area. That the alluvial gold of the Little Ditton valley is exhausted, does not seem reasonable to suppose; but the country along both sides is thickly wooded, and exploration difficult, and so far seems to have been carried on in a desultory and unskilful manner. Ditton area.

"*Alluvial gold mining at Dudswell.*—The Dudswell gold area seems to have been yielding satisfactory returns, at least to some of the parties lately operating there. From Kingsey Brook, lot 3, range 4, Dudswell, several thousand dollars worth of alluvial gold are reported to have been extracted within the last three years, and work is still carried on there by Mr. Chas. Rodrigue, and by Messrs. Copal, Mathieu & Co. Messrs. Osgood and Hall have a claim on the upper part of this stream, lot 4, range 4, Dudswell, which has been prospected, and promises well. Operations have also been begun on the first stream to the west of Kingsey Brook, flowing into St. Francis River, called Maynard's Brook, where gold washing was carried on by Mr. Frederick Harrison, on lot 1, range 6, Westbury, with, I am informed, fair success. Latterly, gold has been discovered in quartz there. Dudswell.

"Alluvial gold mining seems capable of being prosecuted at less expense at Dudswell than in the Chaudière, and perhaps, even then in the Ditton area, owing to the thinness of the superficial deposits overlying the gold-bearing gravels, and the narrowness of the valleys

Quebec—*Cont.*
Mode of occurrence of the gold.

"*Mode of occurrence of the alluvial gold.*—The mode of occurrence of the alluvial gold is nearly the same in all the three areas under review. The principal portion of the gold is found in pre-glacial gravels in the old river-beds, as was pointed out by Dr. Selwyn,* or in these gravels eroded and transported along the present river-bottoms by fluviatile action since the ice age. The general succession of the deposits in the areas which yield alluvial gold in the 'Eastern Townships' of Quebec, may be thus stated in descending order:—(1) Surface gravel and sand, stratified, sometimes auriferous in river-terraces, but not containing gold, so far as known, in quantities sufficient to pay for working. (2) Boulder-clay, of greater or less thickness, usually containing traces of gold. (3) Sand, or sometimes gravel, stratified (the 'quicksand' of the miners), containing traces of gold in some places, but not in paying quantities, often absent. (4) Clay, usually fine-grained, stratified and compact (the 'pipe-clay' of the miners), not auriferous, so far as known, often thin or altogether wanting. (5) Gravel, usually yellow or oxidized throughout, stratified, compact, water-worn, containing boulders of all sizes up to two feet in diameter, but none glaciated; all the materials of local origin, evidently deposited in old river-beds; contains most gold. (6) Non-glaciated rock-surfaces, usually ochreous; if slates, the top layers for one to three feet down, often contain gold between the laminæ.

"The intermediate members of the series (3 and 4) are often wanting, but boulder-clay and yellow gravel (5) are generally present, the latter, however, often thin. It is the 'pay-gravel' of the miners, and in the bottom, close to the bed-rock, gold almost always occurs most abundantly. The compact 'pipe-clay' of the miners (4) is regarded by them as indicating gold in the gravels beneath, if any gravels are present.

Section of surface deposits.

"*Pre-glacial rivers and origin of the yellow gravels.*—The pre-glacial rivers appear to have followed channels on one side or the other of the existing river-valleys, somewhat different from those which the rivers now occupy, and the Chaudière and Du Loup, at least, have flowed at lower levels. The present rivers cross the ancient river-beds at various points. In pre-glacial times, however, there would seem to have been a filling up of the river-channels by sediment, in some parts of the valleys, at least, as at the present day, while in others there would probably be erosion. The materials of which these pre-glacial river sediments are composed, are such as have been carried down off the slopes by the sub-aërial and fluviatile agencies which

*Report of Progress, Geol. Surv. Can., 1870-71, pp. 275-76.

were in operation at the time, and brought into the valleys by tributaries. The gold contents would seem also by these means to have been transported greater or less distances from their parent sources, and concentrated in the sediments along certain parts of the ancient river-courses When the ice of the glacial period advanced over the region, it failed to plough up and carry away many of these deposits, especially where they were protected by the inequalities of the surface, and hence their preservation to the present day. The rivers, in excavating their post-glacial channels have, however, cut through the boulder-clay, and also these pre-glacial river-sediments in certain parts of their courses, distributing the materials along the valley below, and again assorting and scattering the gold contents along the river-bottoms. In this case, the gold occurs most abundantly in the lee of protecting reefs and ledges, and as in Kingsey Brook, at Dudswell, of even the large boulders, as referred to later on. Where the yellow pre-glacial gravels have not been altogether denuded, however, and are auriferous, the gold in them, is regarded by the miners as following 'leads,' that is, has originally been concentrated along certain zones or bands by the action of the pre-glacial rivers.

Quebec—*Cont.*

Subsequent changes.

"*Localities where the yellow auriferous gravels were observed in the Chaudière area.*—In the Chaudière area, sections of the superficial deposits were examined in a great number of localities, and auriferous gravels were noted in the old river-beds in the following places:—In the Chaudière Valley at the falls and at the Devil's Rapids; in the Du Loup Valley at the mouth of Gold Stream; at Humphrey's pit, a short distance below that, and at the Star Gold mine near the mouth of the river, where an excellent section is exposed, which will be described presently. In Slate Creek gold-bearing gravels occur, also along the Famine River below the falls, where the St. Onge Bros. tunnelled, and again near the upper falls. In the Gilbert River valley they seem to extend along the old river-bed almost continuously, though in some places apparently as a very thin sheet lying on the bed-rock. In Rivière des Plantes, these deposits were also observed in several places, and on the north bank of Meule Creek, a branch of Mill River, opposite St. Francis village, there seems to be an extensive deposit.

Occurrences of auriferous gravels.

"The remarkable series of superficial deposits occurring on the north bank of Rivière du Loup, about a quarter of a mile from the mouth, in hydraulic pit No. 1, Star Gold Mine, already referred to, may be briefly described, as it affords a section exhibiting the general character and sequence of the pre-glacial and glacial deposits in the Chaudière

Section of Rivière du Loup.

Quebec—*Cont.*

area better than any other known to me. In descending order, the following beds are disclosed:—(1) Surface gravel and sand, 1 to 3 feet. (2) Unstratified boulder-clay, containing glaciated boulders from 5 feet in diameter downwards—some of them foreign to the locality, 37 to 38 feet. (3) Irregularly stratified boulder-clay, apparently in lenticular beds, with glaciated boulders and pebbles, 15 feet. (4) Unstratified boulder-clay, more compact than No. 2—boulders not so large, and a greater number from local sources, 20 feet. (5) Tough, dark-gray stratified clay, with sandy layers which are ochreous in places, 1 to 3 feet. (6) Stratified, gray, ochreous sand, containing a few pebbles, 12 to 14 feet. (7) Compact stratified clay, with variegated bands and an occasional layer of sand; the whole deposit full of joints and breaking into rhomboidal-shaped pieces ('pipe-clay'), 6 feet. Divisions 5, 6 and 7 maintain a strictly horizontal attitude as seen on the west side of the pit, but the bottom of No. 7 rests on the surface of a gravel-bed which slopes slightly to the north, *i. e.*, away from the river, the slope being about 2 feet in 40. (8) Gray stratified gravel, containing numerous pebbles and a few boulders, water-worn. In the bottom lies a sand bed 8 or 9 inches thick, containing scarcely any boulders or pebbles; material local, non-glaciated; strata dipping northward as described above, 5 feet; these gravels and sands slightly auriferous. (9) Yellow, oxidized, hard gravel, stratified, containing numerous worn boulders from 2 feet in diameter downwards, of local origin, non-glaciated; strata dipping as in above division of series. The bottom of this member of the series was not seen, being covered by tailings and *talus*, but it is supposed to rest on ledges which crop out in the river's bed, and to be probably as low as these. It is auriferous; thickness about 28½ feet. The transport of the material of these pre-glacial beds seems to have been in the direction of the flow of the present Rivière du Loup; (10) non-glaciated rock-surfaces near by, jagged and broken, with gold in the crevices.

Conditions of deposition implied.

"This section exhibits several noteworthy features which can only be referred to here. These are:—(1) the bipartite division of the boulder-clay, (2) the great thickness of the pre-glacial beds, about 45 feet, and (3) the change in the character of these from the bottom to the summit, denoting changes in the conditions of deposition and of drainage. The lower coarse beds have apparently been laid down in rapidly flowing and shallow waters; the clay beds in the upper part in deeper and quieter waters, probably in a lake-like expansion of the Du Loup and Chaudière rivers at their confluence. But what caused the supposed deepening of the waters here at that time? The conditions of deposition are probably to be sought for in the changes which seem to have taken place in the attitude of the region just previous to the advent of the ice age.

"*Auriferous gravels of the Ditton gold area.*—Passing to the Ditton gold area, we find the succession of the superficial deposits at the Pope mine, the only place where a section could be seen here, to be about the same as in certain valleys in the Chaudière area, viz., (1) stratified water-worn material; (2) boulder-clay; (3) yellow oxidized pre-glacial beds, thin and irregular,—auriferous, especially in the bottom; (4) decomposing slates, highly ferruginous, surface non-glaciated, open and fissile to a depth of 1 to 3 feet, and containing gold between the laminæ. It is in the latter that the most gold occurs. Quebec—*Cont.* Superficial deposits of Ditton.

"*Auriferous gravels of the Dudswell gold area.*—In the Dudswell area, the yellow pre-glacial gravel was seen in Hall's Stream, where alluvial gold mining was formerly carried on. Work was stopped owing to the difficulty of keeping the shaft and drifts free from water. The superficial deposits at this mine are about 40 feet thick, but I could obtain no exact information respecting the thickness of the constituent beds. The section at Dudswell.

"On Kingsey and Maynard's brooks, to the west, the glacial and pre-glacial deposits which may have formerly occupied their valleys, have been largely denuded and reassorted by fluviatile action since the ice age, and the gold contents scattered about in the bottom of these. In the portions of the valleys thus denuding by the streams, the deposits seldom exceed a thickness of three or four feet. A section of these on Kingsey Brook, in descending order, is as follows:—(1) One to three feet of mould, or alluvial wash, becoming coarser in the bottom. (2) Gravel, brown and ochreous, with angular or slightly worn pebbles, and a few boulders, some of which are from five to ten feet in diameter; there stand up above the surface, and are glaciated; materials of the gravels, local, or transported only short distances by the stream. They contain gold; thickness, one to two feet. (3) Compact ochreous gravel, in detached masses; materials as in No. 2, but so hard that a pick is required to remove them; this is apparently the equivalent of the yellow gravels of other river-valleys,—the remnants which escaped denudation; contains gold; thickness from three inches to two feet. (4) Gray, slaty, or schistose rock, non-glaciated; in the crevices of this and below reefs and ledges, or in the lee of the large boulders, most gold is found in the bottom of the gravels.

"The succession of the deposits and the mode of occurrence of the gold are very much the same in Maynard's Brook as in Kingsey Brook. The valley of the former is rather wider, and the beds rather thicker. The great advantage of alluvial mining in Kingsey and Maynard's brooks, thus far, is that no shafting or tunnelling is required, the

Quebec—*Cont.*

superficial beds not being more than from three to six feet thick, except in the flat ground, where the streams debouch from the mountain upon the plain.

Sources of gold local.

"*Source or sources of the alluvial gold.*—The sources of the alluvial gold are supposed, in view of all the facts thus far obtained, to be mostly, if not altogether, local. The unworn condition of much of the 'coarse gold,' the local character of the materials composing the pre-glacial, auriferous gravels, and the fact that there were no known agencies in the region in pre-glacial times to transport either the gravel or its gold contents, except atmospheric and fluviatile, all tend to support the conclusion that the precious metal cannot have been transported far. While this is true of the gold found in the pre-glacial bottom gravels, and embedded in the rotten rock beneath these, the gold met with in the shallow deposits of the present river-bottoms, also in the boulder-clay and in the post-glacial river-terraces, may have been carried further, the fine 'scale gold,' indeed, considerable distances. The reason of this seems to be that the latter has been subjected to a second transportation since the ice age, either in the boulder-clay, or in the denudation of the river-valleys and slopes.

Circumstances on the Chaudière.

"Though the above view regarding its local origin is generally accepted, the gold has not been traced to its source in the matrix in any part of the 'Eastern Townships,' except, perhaps, at Dudswell. Alluvial gold has been mined in the Chaudière area for fifty years, yet no free visible gold has been found in veins there to this day. Nuggets, with quartz attached, have been picked up in several places, notably at the Devil's Rapids, near St. Francis; and a number of quartz-veins have, on assay, yielded traces of gold, (one of these, at the falls of the Bras River, having a small quantity of felspathic rock associated therewith and carrying some iron-pyrites, showed, on assay in the laboratory of the Survey, a trace of gold); but the true sources of the alluvial gold of the Chaudière have yet to be discovered. The veins from which it is derived probably traverse parts of the area not yet prospected, and though near the deposits of auriferous gravels, are most likely covered with boulder-clay, and perhaps by the forest. The irregular, broken ridge which crosses the Chaudière Valley at the Devil's Rapids, seems to me to be one locality where gold-bearing veins might be looked for, as the rich gold-producing valleys of the Gilbert River and of Meule Creek occur on either side. Both slopes are largely covered with drift. The ridge along the south-eastern side of the Famine River might also be prospected with advantage, as well as a number of other places, more especially where diorites and other intrusive rocks occur. While the quartz-veins along the river have been

repeatedly examined, those upon the higher grounds have been to some extent overlooked. Quebec—*Cont.*

"The source of the gold of the Ditton area is as problematical as that of the Chaudière. Quartz-veins are numerous in the slates, but none have hitherto yielded free gold. The difficulty of prospecting here has already been alluded to. At Ditton.

"The Dudswell area has afforded better results in the search for gold in the matrix than either that of Chaudière or Ditton. The coarse character of much of the gold found there and the comparatively unworn condition of the gravels, show that the source must be in the Dudswell Mountain. The total area of the mountain is limited, and it could easily be examined were it not that it is still forest-clad. The small auriferous quartz-vein discovered on lot 1, range 6, Westbury (Harrison gold mine), cannot be the source of the alluvial gold of this area, being lower, and to the south of its place of occurrence, but proves the existence of gold *in situ* in the vicinity. This vein is only an inch or two wide, but cuts a bed of gray arkose conglomerate, of which specimens showing no free gold were subjected to assay in the laboratory of the Survey and found to contain 0·35 ounces to the ton. It is possible that this deposit may prove to be of a workable character. At Dudswell. Gold in conglomerate.

"*Localities where alluvial gold might be sought for.*—The gold-bearing gravels of the several rivers, within the areas where alluvial mining has been prosecuted, have only been partially worked, mining having been carried on apparently in those parts of the valleys where the deposits are of least depth. The lower parts of the Gilbert and Famine rivers, also Mil River and the great valley of the Chaudière itself, below the Du Loup, have not yet been worked for alluvial gold. The pre-glacial valley of the latter, especially between the falls, or mouth of the Du Loup, and the Devil's Rapids now forms a deep trough occupied with a heavy bed of superficial deposits. Into this trough the Du Loup, Famine, Gilbert, Pozer's stream, etc., must have carried large quantities of gold. Along the western bank of this part of the valley, there must also be considerable deposits of pre-glacial gravels buried beneath the boulder-clay. This seems to be a promising field of investigation, at least, for the practical alluvial miner. Localities deserving examination.

"In Ditton, the north bank of the river at and above the Pope mine, might be more carefully examined and prospected for gold. It seemed to me that there are yellow gravels along that bank beneath the boulder-clay. The heaviest ice passed over that district from north to south, apparently filling in the pre-glacial valley on that side. Thick deposits of superficial materials occur in that vicinity.

Quebec—*Cont.*

"At Dudswell, further exploration would seem to be required on the summit of the mountain, near the sources of the streams along which gold has been found. The terraces or flats along the south-eastern base should also have gold beneath, especially where the streams debouch from the mountain upon them. These streams, flowing as they do rapidly in narrow valleys, must have carried down considerable quantities of gold to places where the currents slackened. Exploration in these terraces had commenced late in the autumn.

"The foregoing brief statement of the results of investigations during the past season, merely touch on a number of the questions relating to the gold-bearing deposits of the region, and many of the facts obtained will have to stand over till a detailed report is written.

Glacial phenomena.

"The following is a synopsis of the more important observations on the glacial phenomena:—

"The courses of striæ given by Dr. Ells in his reports on the geology of the 'Eastern Townships' seem, so far as I have examined the region, to be mainly correct.* The ice-movements have been widely divergent, and the facts relating thereto are extremely perplexing, and appear to be explicable only on the theory of two, if not three, systems of glaciation by land ice, and probably one by floating ice. The chief difficulty lies in the classification of the different sets of striæ. West of the watershed separating the St. Francis waters from those of the Chaudière, our observations are disconnected and incomplete; but in the area to the east of that watershed and of the head-waters of Becancour River, a considerable body of facts has been collected indicating the ice-movements pretty clearly. First there would seem to have been a northward ice-flow, whether entirely independent of the Laurentide glacier or not, remains to be determined. The direction of movement of this ice varied from N. 45° E. to N. 15° W.,† but was principally between N. 15° E. and N. 10° W. The striæ have been traced from the higher grounds near the international boundary down to the border of the marine plain of the St. Lawrence Valley. In many parts of the region they have been effaced by later ice, but where they dominate, as in Tring and Broughton townships, west of the Chaudière Valley, and in Cranbourne, Frampton, the Etchemin River valley and eastward, the subsequent glaciation by ice moving south-eastward and eastward has either been light or wanting. Following this system of glaciation, there seems to have been an invasion of the region by the Laurentide glacier, which brought in boulders and strewed them pro-

First system of striation.

Second system of striation.

* Annual Report, Geol. Surv. Can., vol. II., pp. 46J-48 J, and vol. III., p. 99 K.

†The courses of striæ are all referred to the true meridian.

fusely over some parts of the country up to a height of 1500 or 1600 feet. This ice defaced the earlier striation in most places, and in the valleys of the Chaudière and St. Francis almost entirely obliterated it. The evidence is wanting to show that it overrode the higher summits of the mountain range nearest the St. Lawrence, especially to the east of where the St. Francis River traverses it. Great tongues of the Laurentide glacier have moved up the valleys of the St. Francis and Chaudière, however, and from the latter it seems to have spread out fan-like, south-eastward, eastward and apparently north-eastward. St. Anselme Mountain, about fifteen miles south-east of Quebec, and 650 feet high, presents an abrupt face to the St. Lawrence with *talus* at the base, while its summit is glaciated in the direction of N. 30° E. and N. 40° E. The N. 5° W. and N. 10° W. sets of striæ are also common in this locality. Quebec—*Cont.*

"A portion of the Laurentide glacier, or of the ice which distributed Laurentian boulders, passed over the low divide between the Chaudière and St. John waters, which is only 1200 or 1300 feet high, in the direction of S. 60° E. to S. 75° E. Extent of Laurentid glacier.

"The Laurentide glacier seems to have stossed some portions of the north side of the mountain range nearest the St. Lawrence River, especially that between the Chaudière and St. Francis rivers. My examinations have not yet extended further westward.

"Ice flowing southward to south-eastward, occupied a considerable part of the drainage-basin of the St. Francis and its tributaries, and Laurentian boulders occur in many places. Whether this ice overrode the range along the international boundary has not yet been determined. Other ice-movements are shown to have occurred in this area by Dr. Ells, and the facts relating thereto were also observed by me.

"On the withdrawal of the Laurentide glacier from the 'Eastern Townships' region, many local glaciers seem to have occupied it, flowing in different directions, and producing a great number of divergent courses of striæ. Local glaciers.

"The facts observed respecting the action of floating ice in the St. Lawrence Valley are still meagre and scattered.

"*Boulder-clay and boulders.*—The boulder-clay as seen at Le Rocher, in the Chaudière Valley, and near Dudswell in the valley of the St. Francis, show, as at Rivière du Loup, in the section described on a previous page, a bipartite division. At Le Rocher, the lower division is of a dark gray, or bluish-gray colour. Then occurs a stratified band, overlying which is a gray boulder-clay. The deposit in the bank of the St. Francis Boulder-clay.

Quebec—*Cont.*

appears to be of much the same character. The far-travelled and larger boulders appear to be in the upper part. Owing to the sliding down of the beds a good view of the exposures could not be obtained, and it is not yet known to what extent the division may be of classificatory importance.

"Laurentian boulders are abundant in certain areas, while in others they are entirely wanting, their distribution evidently depending upon the movements of the ice which occupied the region. At St. Odolin, which is 1300 feet high, the Roman Catholic church is built of blocks of Laurentian granite, gneiss, etc., hewn out of boulders collected within a radius of a few miles.

Terraces and beaches.

"*Changes of Level in the Region.*—The evidences relating to changes of level in the region during the post-Tertiary period, were investigated along the south side of the St. Lawrence in several places from Rivière du Loup, Intercolonial railway, westward as far as Ste. Julie and Arthabaska stations, Grand Trunk railway. Within this distance, a number of the highest marine terraces and benches that could be found were levelled by aneroid, working from the railway stations. Facing the open St. Lawrence Valley, as these terraces do, there can be no doubt as to their marine origin.

Height of shore-lines on on north side of Notre Dame Mts.

"South-east of St. Charles Junction, Intercolonial railway, on the road from St. Gervais to St. Lazare, a shore-line occurs at the height of 540 to 550 feet.* Above St. Anselme, on the west side of Etchemin River, another was seen at 620 feet. About two miles south of Ste. Henedine, Quebec Central railway, the highest shore-line is 750 feet. A lower terrace lies nearer Ste. Henedine station at 715 feet. In the Chaudière Valley near Ste. Marie, 740 to 750 feet on the east side, and 760 feet on the west; and near the head of Beaurivage River, 835 feet. From three to four miles south-east of Ste. Julie station, Grand Trunk railway, three terraces, 855, 865 and 895 feet; and on road leading from the same railway to St. Joseph Lake terraces occur at northern base of mountains at 720, 755 to 765 feet and at 860 feet. Denuded gravel hills and mounds rise above these to 885 or 890 feet. This is as far west as I levelled the shore-lines on the north side of the range.

Height on south-east of mountains.

"On the south-east side of Dudswell Mountain, an extensive terrace or beach abutting against it, is 840 to 850 feet high, and at the north end of Lake Memphremagog terraces of stratified gravel and sand were noted 860 to 865 feet high. The two last localities are on the south-east side of the range nearest the St. Lawrence and within the drainage basin of the

*The heights are above mean tide-level.

St. Francis River. Other terraces were observed in the region, but whether they are marine is doubtful. Quebec—*Cont.*

"Evidences of still more local changes of level, and of uplifts and dislocations were seen in some places. At St. Evariste de Forsyth, a ridge of slate shows some remarkable displacements since the surface was glaciated, one band having been pushed up five feet and a half above the a parently undisturbed rocks on the north side. Similar occurrences are frequent in this region, the displacements, however, seldom exceeding a foot or so. The most notable example of local upheavals, is that of the ridge of intrusive rocks which crosses the Chaudière Valley at the Devil's Rapids. The surface of these in the river-channel is higher than any part of the rock-bottom of the Chaudière above the rapids, as far up as the mouth of the Du Loup, as shown by shafts sunk in two places. As there does not appear to be any other course by which the river could have passed, this uplift must have taken place since the channel of the river below the Du Loup was eroded. This rock-rimmed portion of the Chaudière Valley is that to which I have elsewhere alluded as being probably a receptacle for the gold carried into it by the streams on both sides. Evidences of differential elevation.

"The examination of the gold areas occupied the principal part of the season up till the 9th of September, after which I was engaged in the investigation of the glacial phenomena, surface deposits and elevated marine shore-lines of the region on both sides of the Chaudière to the north and east of the gold area, including the drainage basin of the Etchemin and Rivière du Sud, and along the south side of the St. Lawrence Valley to Montmagny and L'Islet. Subsequently, an examination of the country west of the Chaudière Valley was made, crossing and re-crossing the range of mountains nearest the St. Lawrence River as far westward as Wolfstown and South Ham. A further investigation of the Dudswell gold area was then made, after which I returned to St. Francis by the lakes—Weedon, Aylmer and St. Francis—and through Winslow, Forsyth and Tring. A trip to the upper part of the Du Loup River was then undertaken, and the mines on lot 1, range 7, Marlow, examined and some mineral specimens collected. Returning to St. Francis, a number of points were afterwards examined along the railway lines till the close of field-work. Time occupied in the work.

"*The Salt Springs at Salina, Kings Co., N. B.*— Salt springs, New Brunswick.

An examination of the salt springs at this place was made, and samples of material from the bore-hole and of brine from a spring near by, were forwarded to the laboratory of the Survey for analysis. The boring was 330 feet deep at the time of my visit, disclosing: (1) super-

Quebec—*Cont.*

ficial deposits, 64 feet; (2) gypsum, 21 feet; (3) sandstone, 15 feet; (4) gypsum, 220 feet; (5) sandstone, 10 feet. The pre-Carboniferous rocks were apparently not reached.

"As the beds here are nearly vertical, the above measurements do not represent the actual thickness of the several deposits.

"Field-work closed on the 18th of October, and on the 23rd I reached Ottawa."

Work by Mr. Low.

During the early part of the winter, Mr. A. P. Low was engaged in writing a preliminary report on the explorations of the previous two years, and, with the assistance of Mr. D. I. V. Eaton, in preparing a map of the surveys made. The latter part of the winter was occupied in the compilation of a general report embracing the work of the preceding three years' explorations in the Labrador Peninsula.

Labrador Peninsula.

In June, Mr. Low was instructed to undertake an exploration by way of the Manicuagan River, which flows into the Gulf of St. Lawrence from the north, some 220 miles below Quebec, the object being to gain further information on the country near the central watershed of the Labrador Peninsula. Mr. Low was assisted in this expedition by Mr. Eaton, who carried out the necessary topographical work. After his return, in the autumn, Mr. Low was engaged for ten days in the vicinity of Three Rivers in further defining the outcrops of the several Palæozoic formations between the St. Lawrence and the Archæan region to the northward, for the purposes of the north-west sheet of the "Eastern Townships" map.

The subjoined preliminary report on the exploration above alluded to is given by Mr. Low:—

Exploration of Manicuagan River.

"At Quebec, provisions and outfit were obtained, and with four canoemen from Lake St. John, we left on the steamship 'Otter,' and arrived at Bersimis on the 24th. Here two Indian guides were secured, and also six extra canoemen, who were engaged to assist in the transport of provisions to Lake Mouchalagan, some two hundred miles above the mouth of the Manicuagan River.

"On account of head winds, the mouth of that stream was not reached until July 1st. A survey of the river to the head of Lake Mouchalagan had been made by the Crown Lands Department of Quebec, and in consequence no surveys were started until that point was reached; but the geology and natural resources of the intermediate regions were carefully examined, and located on a tracing of the previous survey.

"Fine weather and long hours, enabled the party to reach the outlet of Lake Mouchalagan on the 12th July, or about ten days ahead of the time estimated by the guides at starting. From here, the extra men were sent back to Bersimis, and the whole loads were transported in four canoes to the head of the lake, where the micrometer survey work was commenced. Owing to the rapid current in the river, double loads were made for the first thirty miles, passing over on the way, two miles and a half of portages, where the route leaves the river-valley and rises more than five hundred feet to a chain of small lakes, to avoid a cañon, in which the river, for over six miles, descends between almost vertical walls in a continuous heavy rapid. Labrador Peninsula—*Cont.* Head of Mouchalagan Lake reached.

"This portion of the work was accomplished on July 21st. A câche was now built, and in it were stored all extra baggage and provisions not required for the next six weeks, which was the time estimated by the guide as necessary to explore the head-waters of the main branches of the river.

"The Indians do not ascend the main stream beyond the poin where the câche was made, being unable to do so on account of its rapid character and high rocky banks, which preclude portaging. The hunters of this region generally ascend in their canoes to the neighbourhood of the câche, and there await the snow and ice before journeying further northward, when they haul their canoes and outfits northward on toboggans. In the spring they descend from the heads of the various branches in their light canoes, making only one load over the portages. On this account, the portages of the upper country are exceedingly rough and often hardly marked.

"From the câche, the stream was left, and the best and easiest portage-route to the height-of-land was followed. It passes out of the river-valley on the west side, following a small tributary through a chain of little lakes. The first portage is upwards of one mile and a half long, with a rise of over six hundred feet. The route next leads, in a zigzag manner, through small lakes and ponds and along crooked, small streams, with many connecting portages, in a direction almost due west, to Lake Matonipi. The distance in a straight line from the river is only thirteen miles, but is upwards of twenty miles by the crooked route, the portages numbering thirteen, with a total length of seven miles and a rise of more than one thousand feet. Lake Matonipi is some five miles long, and discharges by a small stream into the Outardes River. Mouchelagan to Matonipi.

"From this lake, the direction of the route changes to nearly due north, and ascends rapidly to the high rolling ground northward of

Labrador Peninsula—*Cont.*

the lake, following the valley of a small tributary to its head, some eight miles away from the lake, and at an elevation of six hundred and eighty feet above it. Of the eight miles of route, only two are water, the remainder being made up by six exceedingly rough portages.

Portage route thence to the height-of-land.

"A portage of a mile next leads across a summit which divides the waters of the Outardes and Manicuagan rivers. Passing through a small lake, a portage of over seven miles leads to and along a small stream, which is then descended some three miles, where it is left by two portages with small lakes, followed by a portage of three miles and a half to another tributary. Next, nine small lakes connected by portages were passed through to another small branch of the Manicuagan, which was followed about three miles and then left by a ten-mile portage-route, which ends in Lake Kichewapistoakan on the south-west branch of the Manicuagan River. The portages along this part of the route are ten in number, and aggregate eight miles in length. Where the south-west branch was reached, it was found flowing with a sluggish current, in a deep channel about fifty yards wide. There is a wide area of swampy land on either side, extending on the north side about ten miles, to the foot of a high range of barren hills, which forms the watershed between streams flowing south into the St. Lawrence and the head-waters of the Big River of Hudson Bay.

"The south-west branch of the Manicuagan River, takes its rise near the sources of the Outardes and Peribonka rivers, some fifty miles to the south-west of where the portage-route reaches it. From its head it skirts the southern base of the high, barren hills, and is fed by many small streams from their southern slopes.

Lakes Attikopi and Attikopis.

"This stream was followed in a winding course for twenty miles, to Lake Attikopi, a body of water about three miles wide and six miles long, full of deep bays and covered with islands. Another large stream flows into this lake from the northward. This last-mentioned stream was then ascended in a general north-easterly course for twenty miles, to Lake Attikopis, where a second câche was made, and everything not required for a week's flying trip left behind.

"A portage-route through small lakes was now followed almost due west, eight miles, to the water-shed dividing the Manicuagan from the Big River. Crossing this height-of-land, a small stream connecting a number of little lakes was descended westward thirty-five miles, until the stream emptied into a large irregular body of water, deeply indented with narrow bays and almost covered with islands of all sizes. This lake is called Naokokan, and it southern shore was traced some thirty miles, to its western end, passing on the way a large stream flowing in

Lake Naokokan and Nichicun.

and said by the guide to be the main branch of the Big River, which rises close to the heads of the Outardes and Peribonka rivers some fifty miles to the southward. Labrador Peninsula—*Cont.*

"A hill of 400 feet, at the west end of the lake, was ascended, from which a fair view of the surrounding country was obtained. The lake was seen stretching to east and north for many miles, but so filled with large islands and broken by long points that it presented the ap pearance of a multitude of small lakes. A high chain of hills bounds the northern and eastern horizon. As five of the seven days allowed for this trip were now past, we were forced to return to Attikopis without reaching Nichicun, which is situated on the discharge of Naokokan, and probably only a few miles from where we turned back; but from our lack of knowledge as to where the discharge might be, and of the irregular shore-line of the lake, several days were likely to be required for its discovery, especially as the weather was at this time very unfavourable, with continuous rain and fog.

"After again reaching Lake Attikopis, a small stream flowing into the lake was ascended in a north-easterly direction, through five small lakes to a portage separating the waters of the Attikopis branch from those of the main stream. Continuing in the same direction through six small lakes, the general bearing of the route changes to east, and in twelve miles reaches Lake Itomamis, after passing through three lakes connected by a considerable stream. A short stretch of rapids connects Itomamis with Summit Lake, which lies almost on the 53rd parallel of north latitude. It is seven miles long and occupies a deep valley between ridges of semi-barren hills that run north-and-south. The lake has two discharges of about equal volume, both sufficiently large for canoe navigation. The northern discharge, with a short rapid, empties into the first of a number of long narrow lakes that fill the northern extension of the valley, and that finally empty into Lake Kaniapiskau, and so reach the Koksoak or Ungava River. The southern discharge forms the chief branch of the Manicuagan River. After surveying Summit Lake, the main stream was followed southward. On leaving Itomamis Lake it has a breadth of thirty feet with an average depth of one foot in rapids, and being joined by many considerable streams from valleys on both sides, it soon becomes a large river. For eight miles below Itomamis Lake, the river is formed of small lake-expansions connected by short rapids. It then contracts and descends in a deep narrow valley, in an almost continuous rapid, for twenty-four miles, to the junction of the Attikopi Branch. A sur- Attikopis to Summit Lake. Descend main branch of Manicuagan.

Labrador Peninsula—*Cont.*

vey was carried some twelve miles up this branch, in order to connect with that of the trip northward.

"Below the forks, the main stream spreads out into a number of shallow channels, separated by long low islands, between which it flows with a swift even current for eight miles. Beyond this, the river again narrows and passes into a deep valley with rocky banks, down which it swiftly flows with almost continuous rapids for forty-five miles, to the place where it was previously left by the portage-route. While descending this portion of the river, owing to the accidental upset of a canoe, one of the Indian guides named Paul Bacon was unfortunately drowned in the heavy waters of the rapids, and although search was made for his body along the river-banks for many miles below, nothing was seen of it, nor of the canoe which was lost at the time of this disaster.

Canoeman drowned.

Return journey.

"The câche was reached on the 25th August; and from there, the river was descended to its mouth, where we arrived on September 1st and then returned to Ottawa on the 5th of September.

Physical features of the region.

"The physical character of the region visited is similar to that of the rest of the Labrador Peninsula. Within a few miles of the coast, the country rises into an irregular, rocky plateau, upwards of one thousand feet in elevation, but having a further gradual rise towards the interior, so that near the central watershed the general level is nearly two thousand feet above the sea.

"From its mouth to the head of Lake Mouchalagan, the Manicuagan River flows in a deep, ancient valley from a quarter of a mile to two miles wide, with steep, rocky walls rising from five hundred to fifteen hundred feet above the water, and usually flanked with high terraces of stratified sands, gravel and clay. The river, especially towards its mouth, is broken by a number of falls and chutes, where the channel narrows greatly and the large volume of water pours in a swirling mass downwards between perpendicular rocky banks. None of these cañons are of great depth or length, nor do they compare in grandeur with those of the Koksoak and Hamilton rivers. They may be of more recent origin than these.

"Lake Mouchalagan is formed by a widening of the valley; it is upwards of forty miles long, and varies from one to two miles wide. Its surface is about nine hundred feet above sea-level, and it is remarkable for its great depth of water, the deepest sounding taken being six hundred and fifty feet, or some two hundred feet deeper than any previously known lake in Labrador.

"Above this lake, the valley of the river continues northward, but, as the river now flows down it with a heavy grade, the walls of the valley gradually become lower, so that at Summit Lake, the water-level is not more than three or four hundred feet below the general level of the country, which is here characterized by barren hills, arranged in roughly parallel ridges, running north-and-south. Labrador Peninsula—*Cont.*

"The country beyond the main river-valley, as seen along the portage-routes followed, rises above two thousand feet, and is broken by long, rounded ridges of hills that stand from two hundred to five hundred feet above the general level. The lower lands are covered with swamps and dotted with small lakes. The higher ground is often rocky, and everywhere the surface is covered with a great thickness of boulders and broken rock, arranged in irregular ridges, and often without any finer material filling the spaces between them. These ridges form the portage-paths, through the innumerable swamps, but are dangerous and difficult roads for travelling with heavy loads.

"In the river-valley, as far as Lake Mouchalagan, many large trees of white spruce are seen, which would make excellent timber. These trees are most numerous along the first hundred miles from the mouth of the river, and many places were noted, in this distance, where the quantity was sufficient for the establishment of lumber camps. The falls at the mouth of the river would furnish much more power than would be necessary for all milling purposes, and the only drawback to successful working, is the shallow water at the sea coast, where the mouth of the river is greatly obstructed by sandy shoals, extending several miles from shore and affording a very dangerous anchorage outside. Trees

"Besides white spruce, in the valley, large quantities of black spruce, fit for superior pulp-wood, grow far inland, together with balsam fir, Banksian pine, larch, aspen, balsam, poplar and white birch; all of which grow to a fair size, for upwards of two hundred miles inland. Below the first forks, or for about fifty miles from the coast, occasional trees of white pine are seen on the rocky sides of the valley, while on the bottom-lands yellow birch and black ash are found in small quantities. The growth of these trees shows that the climate of the lower river-valley is sufficiently moderate for the cultivation of hardy crops, thus affording a considerable area for future settlement. On the uplands of the interior, the country is only partly wooded with small growths of black spruce, larch, and, in places, Banksian pine; these trees rarely exceed eight inches in diameter, and, branching out close to the ground, are unfit for commercial purposes. All the higher hills rise above the tree-line, and as the central watershed is approached. Arable land.

Labrador Peninsula—*Cont.*

more than half the country is barren. From the above description it will be seen, that much, or all of this high interior region, is unfitted for agriculture.

Laurentian rocks,

"Rocks, of Archæan age alone, were met with along the various routes followed. On the river below Lake Mouchalagan, they belong to the Laurentian, and are largely mica granite-gneiss, often garnetiferous, together with hornblende granite-gneiss, and anorthosite. In these rocks there are few indications of metalliferous veins or minerals of economic value. About Lake Mouchalagan, the garnetiferous gneisses predominate, and appear to be associated with thin bands of crystalline limestone.

Crystalline limestones.

"Above the lake, for some thirty miles, these crystalline limestones are developed in great thickness, and are associated with mica-schists, and garnetiferous gneiss. The limestone is often pure, and at times contains tremolite, or mica, of which latter no large crystals, however, were seen. The mica-schists, close to the limestones, often contain large quantities of graphite, and at other times pyrites, or magnetite.

Great band of iron-ore.

There is an extraordinary band of iron-ore, which appears to belong to the beds associated with the limestone. The ore occurs in a gneiss, composed of quartz, felspar and magnetite; and according to the proportion of magnetite present, grades from ferruginous gneiss into an almost pure iron-ore of high grade. This band was seen in places ten miles apart, on the portage-route leading from the river towards Lake Matonipi, on the Outardes River, and in one place had a thickness of over two hundred feet. Numerous scattered blocks in the river valley, below the portage-route, point to an extension of the band to that place; while to the westward, and twenty-five miles beyond where last seen by us, the guide said that the mass of the 'shining mountain' is composed of similar ore. This mountain is referred to in the *Relations des Jésuites* as a burning mountain, and acquires its title from the glistening of the ore-faces in the sun, when they present a most dazzling appearance. From the above it will be seen, that this bed, in great thickness, can be traced along the strike of the rocks for upwards of thirty miles, forming one of the greatest known deposits of iron-ore.

Schists with quartz-veins.

"To the northward of the portage-route, the rocks along the main stream consist of an apparently bedded series of mica-schists, together with hornblende-schists, and decomposed, massive, basic eruptives; the whole cut by large masses of garnetiferous, mica-hornblende granite-gneiss. The schists are full of quartz-veins, often holding a good deal of pyrites. They may yet be found to contain gold, as they somewhat

resemble the Huronian rocks of localities where gold is now known to occur. Labrador Peninsula—*Cont.*

"As Summit Lake is approached, the schists give place to a coarse, hornblende-granite, which extends westward to Nichicun, and is apparently a south-eastern extension of the great area of similar rock, previously met with between the East Main and Ungava rivers."

Nova Scotia.

From the date of the last Summary Report, part of the winter of 1894-95 was spent by Mr. Fletcher in plotting his surveys, in revising those made by his assistants in the district described on pages 91-94 of that report, in correcting proofs of Nos. 35 and 36 of the Nova Scotian series of maps, in colouring geologically sheets photographed by Mr. Topley from the manuscript maps, in reducing, tracing and adding supplementary surveys to these sheets, in studying Sir Wm. Logan's notes and plottings of the Pictou coal-field and in compiling plans by the late Mr. Scott Barlow of part of Cumberland county and cataloguing and arranging others. The greater part of his time was, however, occupied in compiling from these surveys and other sources, maps of Cumberland county from Moose River and Five Islands towards Cape Chignecto and the Joggins and Springhill coal-fields on a scale of one mile to an inch, and of Hants county between the Shubenacadie and Avon Rivers, on a scale of half a mile to an inch. The latter still remains to be reduced to one mile to an inch for publication. Surveys of the Nictaux and Torbrook iron mines in Annapolis county and of the North River and Truro Devonian rocks in Colchester county were also compiled. Work by Mr. Fletcher.

He left Ottawa on June 10th, 1895, to resume field-work in Nova Scotia, with the particular object of obtaining the information necessary for new editions of the Glace Bay, Sydney and New Campbellton map-sheets in the Sydney coal-field, the revision of which it is desirable to make as thorough and complete as possible by adding geological and geographical detail to the original maps. The greater part of the season has, consequently, been spent by Mr. Fletcher in Cape Breton; but before beginning work there he reëxamined (June 14-21) localities in Antigonish and Pictou counties where he hoped to find fossils in the rocks classed as Cambro-Silurian, in the quartz-veins of which at Sutherland River a discovery of gold has recently been reported. This examination was continued (October 6-18), in company with Dr. H. M. Ami, who was collecting fossils to assist in determining certain doubtful points of structure. Silurian fossils were found in small Revision of Sydney coal-field.

Nova Scotia—*Cont.* Investigations in Pictou county.

patches of greatly altered rock previously supposed to be Cambro-Silurian at Dunbar's, Sunnybrae (Report for 1886, part P, p. 32) and Glencoe Brook, while a *Streptelasma*, like that from the Silurian of Beechhill Cove, was subsequently found, near the post-office on Brown's Mountain, in a small outcrop of rocks also previously included with the Cambro-Silurian but which do not resemble those of the typical exposures of that series.

From November 15th, Mr. Fletcher was again in Pictou county, where he obtained a copy of Mr. Poole's geological plan of the coal-field, made a few supplementary surveys in that vicinity and, with the kind coöperation of Mr. F. H. Chambers of Bridegville and Messrs. J. D. Fraser and O. Herting of Ferrona, collected a quantity of specular iron-ore to send to Ottawa for use in collections. Work is being vigorously prosecuted at the iron mines on the East River of Pictou. A new quarry of dark bituminous limestone has been opened at Spring ville. At the old Blackrock quarry, a cave was examined, along the floor of which runs a stream of water, the roof being hung with rough stalactites.

A spring of strongly saline water, not before mentioned, was also visited at Dunmaglass on Knoydart Brook, a quarter of a mile north-west from the road to Eigg Mountain.

Cape Breton. Surveys made.

Respecting the work done in Cape Breton, Mr. Fletcher reports as follows:—"My field assistants were M. H. McLeod and T. S. McLean who were employed for more than four months and surveyed brooks, lakes and roads, principally in the region underlaid by rocks of the Millstone grit, between Mira Bay and Sydney Harbour, near North Sydney and on Boularderie Island. Their work was greatly facilitated by the use of a large map now being constructed for the Dominion Coal Company by Mr. Hiram Donkin, C. E., and his assistants, kindly lent by the manager, Mr. McKeen, M. P., which shows the new lines of road and railway together with chained surveys of most of the sea-coast, lakes and large streams.

"In this district, in the absence of rock-outcrops and pits, useful geological work can be done by tracing certain bands of coherent rock by means of blocks which lie unweathered on the surface, the loose rocks on the surface being for the most part, as was long ago pointed out by Mr. Robb, derived from beds immediately underlying. In some cases, confirmation of results obtained by this method was obtained in pits subsequently sunk.

Hub seam

"The outcrops and water-levels of the coal-seams in the productive measures, were for the most part well defined before 1874, although

the progress of mining admits of their being now delineated with greater precision than on the map of that date. On the Hub seam (Report for 1872-73, p. 260), which has lain idle for twenty years, work has been resumed in an attempt to win the coal from the submarine area. It was found that while wood submerged for that period in the pit-water has remained sound and well preserved, the iron of rails and castings of all kinds has been completely eaten away, a light, porous skeleton, composed of carbon, silica, iron oxides, &c., being left. Wrought iron is also greatly wasted, but steel points have remained unchanged. Nova Scotia—*Cont.*

"At the western workings of the Gowrie mine, a north-and-south fault was met, which threw the coal down thirty-six feet on the west side. From its face, at the level of the shaft-bottom, a stone drift was extended 284 feet, and borings were made to the coal from this drift and also from the surface along the shores of Morrison Lake, which prove that the Martin pit is on the McAulay seam, as indicated on Lyman's map; but which, taken in connection with the underground workings, also proves that, west of the fault, the axis of the basin is deflected further to the north, and that this seam, instead of terminating, probably continues for more than a mile past the Martin pit, in a narrow basin, to the outcrop of the seam, eight to twelve feet thick, discovered by Neville (Report for 1874-75, p. 189). The discrepancy in the size of the two seams is accounted for by the fact that at certain points on the north rise at the Gowrie mine, the coal attains a thickness of eleven feet, though nominally only five. That the Long Beach anticline or fault (Report for 1874-75, pp. 205 and 212) passes the old Louisbourg railway, was proved by a line of pits sunk in 1891 by Mr. E. T. Moseley, in search of the westward extension of the large seam above mentioned, the steep southerly dips of the bottom of the Cow Bay basin, being found also nearly to the fork of the Hines and Cow Bay roads. Gowrie mine

"On the investigation of the lower coal-seams of the Millstone grit, much money has been spent during the last twenty years, in the hope of their proving economically available, and the acquisition by the Dominion Coal Company of nearly all the mining areas of known value east of Sydney Harbour has stimulated prospecting, yet the results have not generally been encouraging, the coal-seams found seldom exceeding three feet in thickness, and being usually much less. One of the areas, on the Morrison road, visited in 1894 in company with Dr. Gilpin, the Inspector of Mines, and the Deputy Inspector, is shown by the former, in the last number of the Transactions of the Nova Scotian Institute of Science, to contain no seams of more than two feet in Search for lower coal-seams.

Nova Scotia—*Cont.*

thickness, and subsequent close examination has not disproved this statement. It is on the line of the Tracy seam and the little seams that accompany it, as given in Mr. Robb's sections and map (Reports for 1874-75, p. 189 ; 1875-76, p. 414).

"Mr. Lewis Stephens and others have continued to search for workable coal on the strike of these seams on the Mira and Morrison roads near Black Brook, but appear to have found none. From one of the seams a few inches of excellent cannel was obtained. Nearer Sydney, prospecting has been carried on intermittently at the Cossitt pits, but with only the disappointing results explained by Mr. Robb (Report for 1874-75, p. 191). The red rocks of Mira Bay extend nearly to these pits before being replaced by the gray strata of Sydney Harbour.

Tracy seam.

"Since 1874 the Tracy mine has not been worked to any extent. An attempt made, some years ago, to cut through False Bay beach and make of False Bay Lake a suitable port of shipment, was, like a similar effort more recently made to convert McIsaac Pond at Broad Cove into a ship harbour, frustrated by the closing of the excavation by the sea.

"Explorations made by Mr. Simon E. Landry and his associates on the supposed extension of the Tracy seam west of False Bay Lake, have cut two little seams apparently overlying it (Report for 1874-75, pp. 177 and 188) near the Back-lands road. Their explorations have been greatly impeded, however, by a great quantity of surface deposits.

"In a pit sunk near the North-west Brook of Bridgeport Basin, at the most southerly of those called 'Macdougall's pits' on the map of 1874, a coal-seam, with a low southerly dip, generally supposed to be the Carroll, has the following section :—

	Ft.	In.
Top coal	2	6
Shale or clay	0	6
Coal	2	0
Clay	0	3
Coal, not well seen	1	9
	7	0

"In other pits of the immediate neighbourhood, however, it is not so thick. These pits are probably, as stated by Mr. Robb (Report for 1874-75, p. 194), on the crown of the anticline, on the north side of which are those at the mouth of the North-west Brook, supposed to be on the same seam. In one opened by the Messrs. Routledge, the dip is N. $< 6°$, and the section as follows :—

Nova Scotia—*Cont.*

	Ft.	In.
Top coal	1	3
Clay	0	2
Coal	1	9
Parting	..	..
Coal	0	11
	4	1

"In other adjoining pits, dug by Messrs. Neville and McVey, the coal is said to be four feet four inches thick. The anticline apparently lies a little south of these pits, but its exact position is still uncertain.

Carroll seam.

"Although the Carroll seam has not yet been positively traced into the Glace Bay basin—unless it be the small pyritous seam known as the Buchanan seam (Report for 1874-75, p. 190,) on which several new openings were made last season—a thorough and systematic search for it was begun last August by Mr. E. T. Moseley, Q.C., and Mr. D. J. Kennelly, formerly manager of the Reserve mines, by means of a series of diamond-drill borings and pits along the old Louisbourg railway. These explorations have tested the strata underlying the Lorway seam far to the south of the crossing of the Hines road, and have discovered a seam of coal, eighteen inches thick, at a little brook three-quarters of a mile north of the Hines road, and another of about the same thickness at that road. The first is, perhaps, the equivalent of a seam, twenty-one inches thick, opened on the south side of Cow Bay basin, in a pit about one mile north-east of the post-office at Cochran's Lake. The average dip north of the Hines road has been shown by these borings to be about one in twelve. It is hoped that a workable seam may yet be found underlying. Apparently near the same horizon, also near the Cow Bay anticline, good exposures including a one-inch seam of coal, have been made on the new Louisbourg railway at the crossing of Sand-lake Brook. They consist chiefly of red and green marly rocks and of bluish-gray shales full of impressions of fossil ferns and other plants, the dip being about N. 6° E. $< 5°$.

District west of Sydney Harbour.

"Little need at present be said of the district west of Sydney Harbour. From the Sydney mines, there is the usual large annual output of coal. On the crop of the Indian Cove seam, a small mine has been opened by Mr. Greener, and a quantity of coal shipped over a short railway to a wharf built in the cove. The shipment of coal from the Cape Breton colliery at New Campbelton, has been affected by the closing of St. Peter's canal for repairs. An adit, driven to the shore at sea-level, now drains the upper workings. The owners, Messrs. Burchell Brothers, have, during the last few months, bored with the diamond drill some twelve or fifteen hundred feet of strata, in various

Nova Scotia—*Cont.*

holes, for the purpose of finding the large seams which lie above and below the equivalent of their main seam in other parts of the field, but which here seem to be scarcely workable. Sections have been made of the borings here as well as on the old Louisbourg railway, which are useful as proving the strata and for comparison with the sections in Mr. Robb's report.

Dolomites used as flux.

"The bed of white, massive, gray-weathering, broadly-crystalline dolomite discovered in the crystalline limestone series by Mr. Robb and analysed by Dr. Hoffmann (Reports for 1873-74, p. 174 ; 1874-75, p. 253), has been to some extent utilized by the Messrs. Burchell, who are shipping sixteen hundred tons for the use of the steel works at Trenton, and are building a short branch from their coal-mines railway to the foot of the mountain at the North Brook, where it occurs in great cliffs. Analyses of this dolomite and of others from similar rocks at George River and Marble Mountain, obtained from Mr. J. D. Fraser, manager of the iron-works at Ferrona, are appended for comparison with that made by Dr. Hoffmann.

Analyses.

	I.	II.	III.	IV.
Silica	1·41	0·73	2·58	2·00
Oxides of iron and alumina	1·92	1·55		0·50
Calcium carbonate	50 19	54·83	88·67	77·47
Magnesium carbonate	42·16	42·95	7·89	20·00
Phosphate of lime		None.		
Sulphate of lime		None.		

I. and II. give the average of a number of samples from the North Brook, tested by different analysts, the first at Ferrona laboratory by Mr. Fraser, the second at Pittsburg. III. is the average of twelve analyses made by Mr. O. Herting at Ferrona, from samples collected at Marble Mountain ; IV., the mean of a large number of pieces taken from different beds in George River district, between Crane Brook and the limestone quarries near the mouth of the river.

Other minerals.

"From the crystalline limestone formation at George River, specimens of chalcocite and chrysotile have been sent to the Geological Survey by Mr. Hugh R. MacKenzie, C.E., of Sydney. Attempts have also been made to work the traces of iron-ore found in this district but without success.

"No use has yet been made of the fire-clay of Coxheath (Reports for 1873-74, p. 173 ; 1875-76, p. 373 ; 1876-77, p. 456) 'suitable for the manufacture of fire-bricks and pottery,' and rendered more accessible by the completion of the Intercolonial railway to Sydney, from the line of which the deposit is distant about three miles.

"A diamond drill is at present at work in a search for coal on the eastern shore of Sydney Harbour, three-quarters of a mile north of Beatty Brook, where, of course, it will cut only the Carboniferous

limestone rocks of the section given in the Report for 1874-75, page 169, and infallibly result in disappointment. In Pictou county, also, money has been uselessly spent during the past few weeks in sinking among the red rocks of the Foxbrook road, which underlie the productive measures, and also among the rocks of the East River below New Glasgow, which overlie them." Nova Scotia—*Cont.*

Mr. E. R. Faribault's office work, since the date of the last Summary Report, has continued to be in connection with the compilation and completion for publication of the results of his surveys in the gold-bearing regions of Nova Scotia. The manuscripts for the nine sheets numbered 39, 40, 41, 42, 48, 49, 50, 51 and 52 have been completed. They cover the area extending along the Atlantic coast from Salmon River to Musquodoboit Harbour, and inland to the Pictou and Stewiacke valleys, and are included in the counties of Halifax, Colchester and Pictou. Structural sections for sheets 39 and 40 have also been made, but similar sections for the remaining seven sheets have still to be prepared. Work by Mr. Faribault.

In addition to the regular map-sheets, on a scale of a mile to the inch, special plans have also been plotted, on a scale of 500 feet to one inch, of the gold-mining districts of Tangier, Mooseland, Moose River, Caribou, Oldham, Montague and Waverley. Some of these plans are not quite completed, and sections still require to be prepared before they will be ready for publication. They are on a sufficiently large scale to show the interesting and important relation of the auriferous quartz-veins to the general structure of the anticlinal folds, with the numerous faults and disturbances affecting them. It is also intended to show upon these plans, the quartz-veins known to occur in the districts, their width and length, the extent to which they have been worked in depth and along their cropping, together with their average richness when this can be ascertained, the direction and dip of pay-streak and that of the anticlinal axes. Special plans.

Mr. Faribault's field-work was in continuation of that accomplished in previous years. His progress report upon it is as follows:—"I left Ottawa on May 30th to resume field-work in Nova Scotia, and continue the mapping and study of the structural geology of the gold-bearing rocks of the Atlantic coast, and to complete as far as possible the surveys required for the sheets numbered 53, 54, 55, 56, 66, 67 and 68. Owing to the limited amount of exploration fund at my disposal, field operations had to be discontinued by the end of August, and consequently the Waverley sheet numbered 67 and the Halifax City sheet numbered 68 have not been completed. Field of operations.

Nova Scotia—*Cont.*

Positions and names of map-sheets.

"The five sheets just enumerated, comprise the gold-bearing region of the central part of the province, extending along the Atlantic coast from Musquodoboit Harbour to Halifax Harbour, and inland to the northern boundary of the gold-bearing rocks, where they are overlaid by Carboniferous strata along the St. Andrews River, the Shubenacadie River, the Nine-mile River, and on the north side of the Rawdon Mountains. Each sheet covers an area of 12 miles by 18 miles, and the five sheets thus cover 1080 square miles and include portions of the counties of Halifax, Colchester, and Hants. Each sheet is well designated by the name of the most important place it contains, which are the following:

No. 53, Lawrencetown sheet,
" 54, Preston sheet,
" 55, Middle Musquodoboit sheet,
" 56, Stewiacke sheet,
" 66, Rawdon sheet.

"The 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. As many as fifteen folds were located across the belt of forty miles of gold-bearing rocks, extending from the Atlantic coast to their northern limits on the north side of the Rawdon Mountain. 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 the importance of these axes in regard to gold occurrence.

Enumeration of anticlines.

"The names given provisionally to the fifteen anticlines, in the order of their occurrence from the shore to the Rawdon Mountain, with notes on the gold mines worked and quartz-veins prospected along their course, are as follows:—

"1. *Three-fathom Harbour Anticline.*—Crosses only some outlying points along the Atlantic coast.

"2. *Lake Catcha Anticline.*—Worked extensively on two or three properties at Lake Catcha gold district, and a few auriferous quartz-veins have been prospected along its course east of Oyster Ponds.

"3. *De Said Lake Anticline.*—A few auriferous quartz-veins have been prospected on this axis in the vicinity of De Said Lake.

"4. *Lawrencetown Anticline.*—Important operations have been prosecuted on two or three properties at various times at Lawrencetown gold district, and a few auriferous quartz-veins have been opened up at Upper Chezzekook.

"5. *Porter's Lake Anticline.*—Promising auriferous quartz-veins have been prospected along this anticline on the east side of Porter's Lake, one mile north of the telegraph road. Nova Scotia *Cont.*

"6. *Montague Anticline.*—Half a dozen properties have been extensively worked at various times for a number of years in Montague gold district. Very promising quartz-veins have been prospected east of Lake Major, where one of the main faults of the region has shoved the anticlinal axis on the west side of the lake, nearly one mile and a half to the north of its normal position. A few quartz-veins have also been tested along this line east of Bedford Basin.

"7. *Waverley Anticline.*—Extensive mining operations have been carried out on one or other of the many properties of the Waverley gold district, almost continuously since its discovery, to depths of over 400 feet. Auriferous quartz-veins were also prospected on this anticline in the vicinity of Karney Lake and south of Goff post-office.

"8. *Caribou Anticline.*—This only brings up the upper black slate group. Quartz-veins have been prospected along its course on Lively Brook, and north of Goff post-office.

"9. *Oldham Anticline.*—The extensive gold mining district of Oldham has been considerably worked since its opening, two or more shafts on an incline of 43°, reaching a depth of 574 feet, on the Dunbrack lead, while some of the leads have been worked, or opened up, for over one mile in length along their course.

"10. *Carroll's Corner Anticline.*—Auriferous quartz-veins have been opened up at Key's Brook and at the Horn settlement.

"11. *South Uniacke Anticline.*—A few quartz-veins are being worked very successfully at the south Uniacke gold mines, to depths of 500 feet, on some very rich and persistent pay-streaks.

"12. *Mount Uniacke and Renfrew Anticline.*—Mining operations have been prosecuted extensively in both gold districts of Renfrew and Mount Uniacke, for a number of years.

"13. *East Rawdon Anticline.*—Considerable mining work has been done in the East Rawdon gold district for some years.

"14. *Rawdon Mountain Anticline.*—A minor anticline in the slate, between the two main synclines of the upper black slate belt of the Rawdon Mountain. Exploratory work has been done recently at the Withrow gold mine, and numerous quartz-veins have been tested on the surface, along this axis, but most of them proved to be barren.

Nova Scotia—*Cont.*

"15. *Gore Anticline.*—Crops out only in a few places along the southern boundary of the Carboniferous rocks of the Kennetcook basin, by which it is mostly covered.

Faults.

"A number of faults, bearing a general north-and-south course, cut the stratification at right angles, and time was taken up in tracing these and working out the magnitude of the displacements. Some of them cut the whole width of the gold-bearing belt from the Atlantic coast to the Carboniferous boundary on the north side of the Rawdon Mountain, a distance of forty miles, with horizontal displacements sometimes as great as one mile and a half.

Detailed surveys.

"During the summer, special detailed surveys were also made of the gold-mining districts of Lake Catcha, Lawrencetown, Renfrew, East Rawdon, Withrow and Central Rawdon, and necessary data taken in the field, in order to prepare plans of these districts, like those already made of the eastern part of the province, on a scale of 500 feet to one inch.

"A topographical survey of the gold-field of Nova Scotia was undertaken jointly by the Geological Survey and the Nova Scotian government in 1881, and W. Bell Dawson, C. E., was entrusted with the work, and made a most accurate map, on a scale of two inches to one mile, representing an area of twelve miles by eighteen miles, including the city of Halifax and its vicinity. He also made a special plan of each of the gold districts of Lawrencetown, Montague and Waverley on a scale of 500 feet to one inch. These topographical surveys were intended to become the basis of a geological map, but were not prosecuted further, the arrangement under which they were undertaken having fallen through. The area covered by the above plans is partly included in the south-western portion of the region surveyed last summer, they were found most useful in the field in working out readily the structure of the rocks and will be a great help in compiling the map of that area.

"I was again ably assisted in the field during the season by Messrs. Archibald Cameron and Jas McG. Cruickshank, who have been my assistants for the last twelve and eleven summers respectively. They were also employed another month plotting their summer's work. Mr. Frank D. Phinney was also one month with me last summer."

Work by Prof. Bailey.

In the Annual Report for 1892-93 (Vol. IV.), a preliminary report, on the Geology of South-western Nova Scotia by Professor L. W. Bailey is printed. The relation of this to a more detailed report by

the author is there stated. It was not found possible to arrange for any lengthened period of field-work in this connection during the past summer, but Professor Bailey having volunteered his services for a portion of the season, about a month was spent upon the work by him. Of the observations made, he writes as follows :— Nova Scotia—*Cont.*

"These observations had, as their primary object, the obtaining of data required to complete a report upon the geology of Yarmouth and Digby counties, materials for which had already been partially obtained in the summers of 1892 and 1893, by the examination of certain sections not at that time visited, and the reëxamination of others. The results relate, therefore, mostly, to minor details of structure. In particular, a minute examination was made of considerable portion of the micaceous and hornblendic belt which stretches inland, along the line of the Dominion Atlantic railway, from the city of Yarmouth to the border of Digby county; and secondly of the section of Cambrian rocks lying between the head of St Mary's Bay and the Grand Joggins on the Annapolis Basin. Objects in view.

"Both examinations fully confirmed the conclusions previously stated in my preliminary report published last year. As regards the former belt, both the sequence and the characteristics of the rocks composing it, and which had at one time been supposed to be of pre-Cambrian (Huronian) age, were, as seen particularly in the vicinity of Brazil Lake, Lake Ausier and Lake George, found to bear the closest resemblance to the rocks exhibited at Jordan Falls and about Shelburne Harbour, in the county of Shelburne, both being clearly of Cambrian age. The rocks of the second section above referred to, which are in character and sequence typical of a large part of Digby county, are as certainly also a portion of the same Cambrian system. This being the case, it had been hoped that from the black slates which here, as in Queen's county, form the upper member of the system, organic remains might be obtained which would place the age of the containing beds beyond all question; but the search for these, though prolonged, proved unavailing. Results.

"It was also hoped that some further light might be thrown upon the doubtful relations of the peculiar beds about Cape St. Mary, to those of the fossiliferous Silurian and Devonian belt previously recognized at Bear River and Mistake settlement; but upon this point also, little of a definite character could be ascertained, the frequent interposition of areas of eruptive rocks, together with accompanying metamorphism, making it very difficult to follow or to recognize the identity of beds, more particularly when separated, as those of Digby county

Nova Scotia—*Cont.*

so frequently are, by wide intervals of drift. Many features of resemblance have been noted between the beds of Cape Cove, near Cape St. Mary, in Yarmouth county, and those of the tract bordering Annapolis Basin between Bear River and the Grand Joggins, but it would still be unsafe, from present data, to assert their identity or to fix their age.

"In addition to the observations on the Cambrian system, referred to above, some time was devoted to a further study of the traps and sandstones of Digby Neck, including the iron deposits of Waterford, etc. Native copper in threads and small nodules was observed near the entrance of Digby Neck, but the quantity was small. No other minerals of economic value were noted."

Chemistry and Mineralogy.

Chemistry and mineralogy.

Reporting on the work of this division, Dr. Hoffmann says:—"The work in the chemical laboratory during the past year has been carried out upon the same lines as those heretofore followed, that is to say, it has been chiefly confined to the examination and analysis of such minerals, etc., etc., as were considered likely to prove of economic value and importance. The ground covered included:—

Analyses.

"1. Analyses of fuels.

"2. Analyses of mineral and other waters and brines.

"3. Analyses of iron-ores.

"4. Analyses of certain ores in regard to nickel content.

"5. Analyses of marls.

"6. Assays, for gold and silver, of ores from the provinces of Nova Scotia, New Brunswick, Quebec, Ontario and British Columbia.

"7. Examination, and in some instances complete analysis, of several minerals not previously identified as occurring in Canada, some of which promise to prove of economic importance.

"8. Miscellaneous examinations. These include the examination and testing of brick and pottery clays; of limestones and other materials, supposed to possess hydraulic properties; of some samples of silt, bog manganese and disseminated graphite, and of other materials not included under the above headings.

Mineral specimens examined.

"During the period in question, five hundred and seventy-three mineral specimens were received for the purpose of identification or the obtaining of information in regard to their economic value. The greater number of these were brought by visitors, and the information

sought in regard to them was not infrequently communicated to them at the time of their calling. In other instances—those where a more than mere cursory examination was called for, or a partial or even complete analysis was deemed desirable, as also in the case of those specimens which had been sent from a distance—the results were communicated by mail. The number of letters written, chiefly in this connection, and generally of the nature of reports, amounted to two hundred and fourteen, and the number of those received to eighty-nine. Chemistry and mineralogy—*Cont.*

"Messrs. R. A. A. Johnston and F. G. Wait, assistants in the laboratory, have both applied themselves diligently to the work in hand, and rendered excellent service. The former has, in addition to the carrying out of a lengthy series of gold and silver assays, also made some important analyses of minerals, and likewise conducted a great variety of miscellaneous examinations; whilst the latter has, as a principal work, been engaged in the analysis of mineral and other waters, marls and iron-ores. Work by assistants.

"In the work connected with the mineralogical section of the museum, I have been ably assisted by Mr. R. L. Broadbent. He has, apart from general museum work, including the maintenance of the collection generally in an orderly condition, been engaged in the permanent labelling of specimens—a work which must of necessity be of a more or less continuous character by reason of frequent additions to the collection; and also prepared the manuscript of over eight hundred labels for the collections illustrating the distribution of iron, copper, lead, antimony and other ores.

"The additions to the museum amounted to one hundred and thirty specimens. Some of these consisted of minerals not previously represented in the collection, the greater number, however, were of minerals already contained in it, but from new localities, and serve to illustrate their distribution. Contributions to museum.

"Amongst the additions just referred to, are the following, of which—

"*(A.)* Were collected by officers on the staff of the Survey:—

Ami, Dr. H. M.:—

Crystals of pyrite from Willards Mill, Castle Brook, west shore of Lake Memphremagog, Brome county, Q.

Barlow, A. E.:—

Cyanite from Snake Creek, (ten miles north of Mattawa) Pontiac county, Q.

Contributions to museum—*Cont.*

Bell, Dr. R.:—

Chalcocite from the Borron location, tp. of Gould, district of Algoma, O.

Chalmers, R.:—

a. Pre-Glacial or Pleiocene clay from the mouth of Rivière du Loup, Beauce county, Q.

b. Auriferous quartz from the Harrison gold mine, lot 1, range VI., Westbury, Compton county, Q.

c. Rock specimens from lot 4, range IV., Dudswell, Wolfe county, Q.

d. Rock specimen from same locality as *b*.

e. Quartz showing native gold from same locality as *b*.

f. Rock specimens from Falls of Bras River, Beauce county, Q.

g. Scheelite, eight specimens from lot 1, range VII., Marlow, Beauce county, Q.

h. Twelve specimens illustrating mineral associations of scheelite from lot 1, range VII. of Marlow, Beauce county, Q.

i. Auriferous quartz from lot 2, range I., Linière, Beauce county, Q.

Dawson, Dr. G. M.:—

a. Chabazite from road at head of Chasm, north of Clinton, B.C.

b. Shale conglomerate constituting bed rock at the Horsefly mine, carrying gold, Cariboo district, B.C.

c. Bornite from the Tenderfoot claim, east side of Copper Creek, Kamloops Lake, B.C.

d. Gypsum occurring in concretionary or nodular masses in 'china-stone' deposit on west side of Fraser River, opp. Spatsum Station, Canadian Pacific Railway, B.C.

e. Cinnabar from Last Chance No. 2 claim, east side of Copper Creek, Kamloops Lake, B.C.

f. Molybdenite from same locality as the preceding.

g. Native copper in serpentine from 'Painted Bluffs,' near Copper Creek, Kamloops Lake, B.C.

h. Cinnabar from Six-mile Point, Kamloops Lake, B.C.

i. Silver ore, five specimens from the Homestake claim, near Adams Lake, B.C.

j. Magnetite from the Glen iron mine, Cherry Bluff, Kamloops Lake, B.C.

k. Selenite from Fort Kipp, Old Man River, district of Alberta, N.W.T.

l. Limestone showing cone-in-cone structure, from Athabasca Landing, district of Alberta, N.W.T.

Contributions to museum—*Cont.*

m. Coal from Holloway's Spring Creek mine, Middle Fork of Old Man River, district of Alberta, N.W.T.

n. Coal from Highwood River, district of Alberta, N.W.T.

o. Auriferous quartz from the Sultana, Winnipeg Consolidated and Gold Hill mines, Lake of the Woods, district of Rainy River, O.

Ells, Dr. R. W.:—

Magnetite from lot 16, con. IX., Bagot, Renfrew county, O.

Faribault, E. R.:—

Stibnite and kermesite, six specimens from West Gore, Hants county, N. S.

Ferrier, W. F.:—

a. Quartz showing native gold from the Ledyard Gold Mines, Belmont, Peterborough county, O.

b. Arsenopyrite from the Gatling mine, Marmora, Hastings county, O.

c. Bismuthinite from lot 34, con. III., Tudor, Hastings county, O.

d. Epidote from lot 8, con. XIX., Tudor, Hastings county, O.

Fletcher, H.:—

a. Hæmatite from Doctor's Brook iron mine, Arisaig, Antigonish county, N. S.

b. Manganite from Morley road, Cape Breton county, N.S.

c. Talc from Kennington Cove, Cape Breton county, N.S.

Giroux, N. J.:—

Allanite from east shore of Lac à Baude (Lake Bouchard), Champlain county, Q.

Ingall, E. D.:—

Crystals of galena from Gold Hill claim, Illecillewaet mines, West Kootanie district, B. C.

Low, A. P.:—

Almandite crystals from mica-schist from Manicuagan River, Saguenay county, Q.

McConnell, R. G.:—

a. Galena, zinc blende and tetrahedrite from the Antelope claim, Slocan mining district, West Kootanie, B.C.

b. Zinc blende with pyrite from the Bluebird mine, Slocan mining district, West Kootanie, B.C.

Contributions to museum—*Cont.*

c. Galena coated with earthy carbonate of lead from the Deadman mine, Slocan mining district, West Kootanie, B. C.

d. Galena from the Reco mine, Slocan mining district, West Kootanie, B.C.

e. Galena with cerussite, from the Reco mine, Slocan mining district, West Kootanie, B.C.

f. A mixture of earthy sulphate and carbonate of lead with quartz, from the Reco mine, Slocan mining district, West Kootanie, B.C.

g. Galena, pyrite, chalcopyrite, and a little mispickel from the Sheep Creek Star claim, Sheep Creek, Trail Creek mining district, West Kootanie, B.C.

h. Quartz with galena, pyrite and chalcopyrite, from the O. K. mine, Sheep Creek, Trail Creek mining district, West Kootanie, B.C.

i. Quartz with pyrite from the Gold Hill claim, Trail Creek mining district, West Kootanie, B.C.

j. Pyrrhotite with chalcopyrite (auriferous and argentiferous) four specimens from the Leroy mine, Trail Creek mining district, West Kootanie, B.C.

k. Pyrrhotite with chalcopyrite from the Great Western claim, Trail Creek mining district, West Kootanie, B.C.

l. Iron pyrites, pyrrhotite and zinc blende, from the Lilly May claim, Trail Creek mining district, West Kootanie, B.C.

m. Iron pyrites, galena and zinc blende from the Lilly May claim, Trail Creek mining district, West Kootanie, B.C.

n. Pyrrhotite with chalcopyrite (auriferous and argentiferous) from the Kootanie claim, Trail Creek mining district, West Kootanie, B.C.

o. Mispickel from the same locality as the preceding.

p. Pyrrhotite with chalcopyrite from the Iron Colt claim, Trail Creek mining district, West Kootanie, B.C.

q. Pyrrhotite with chalcopyrite (auriferous and argentiferous) from the Nickel Plate mine, Trail Creek mining district, West Kootanie, B.C.

r. Pyrrhotite with chalcopyrite (auriferous and argentiferous) from the War Eagle mine, Trail Creek mining district, West Kootanie, B.C.

s. Pyrrhotite with chalcopyrite (auriferous and argentiferous) from the Monte Christo mine, Trail Creek mining district, West Kootanie, B.C.

Contributions to museum—*Cont.*

t. Pyrrhotite with chalcopyrite (auriferous and argentiferous) from the Cliff mine, Trail Creek mining district, West Kootanie, B.C.

u. Mispickel with chalcopyrite and pyrrhotite from the Josie claim, Trail Creek mining district, West Kootanie, B. C.

v. Galena, coated and intermixed with carbonate of lead, ferric hydrate and green carbonate of copper, from the Noble Five claim, Slocan mining district, West Kootanie, B.C.

Tyrrell, J. B. :—

Marcasite from the bank of the Assiniboine River, Manitoba

"(B.) Were received as presentations :—

Abrahamson Brothers, Revelstoke, B.C. :—

Asbestus (chrysotile) and serpentine from Trout Lake City, West Kootanie, B. .

Bell, B. T. A., Ottawa, O.

Muscovite from Tête Jaune Câche, Rocky Mountains, B. C.

Brown, C., per C. W. Willimott :—

Phlogopite from Kingsmere, Hull, Ottawa county, Q.

Brunet, J., Montreal, Q.:—

Granite, three specimens polished, from the Laurentian Granite Co.'s quarry, St. Philippe, Argenteuil county, Q.

Butchard, R. P., Owen Sound, O.:—

Marl from Shallow Lake, township of Keppel, Grey county, O.

Campbell, A. M., Perth, O.:—

Calcite from near the east end of Dalhousie Lake, Dalhousie, Lanark county, O.

Carter, Alfred, Wairau, Blenheim, New Zealand :—

a. Sample of briquettes or tiles composed of magnetite (separated from Taranaki iron sand by Carter and Purser's process) and glue.

b. Sample of ingot-iron smelted, in cupola furnace, from briquettes similar to '*a.*'

c. Cog-wheel cast from ingot iron, similar to '*b.*'

d. Borings from cog-wheel '*c.*'

Chambers, F. H. (Bridgeville, N.S.), New Glasgow Iron, Coal and Railway Co., Limited, Ferrona, Pictou county, N.S.

a. Limonite from Bridgeville, Pictou county, N.S.

b. Manganite " " " "

c. Barite " " " "

d. Göthite " " " "

Contributions to museum—*Cont.*

Costigan, J. R., Calgary, N.W.T.:—

Zinc blende from South Fork of Red Deer River, district of Alberta, N.W.T.

Coursolles, T. G., Ottawa, O.:—

Phlogopite from lots 16*a* and 17*b*, range VIII., Templeton, Ottawa county, Q.

Ferrier, W. F., Ottawa, O.:—

a. Galena from Tudor, Limerick, Elzevir and Hungerford, Hastings county, O.

b. Galena from Nairn and Galbraith, district of Algoma, O.

c. Quartz with chalcopyrite from Craig's gold mine, Tudor, Hastings county, O.

d. Chalcopyrite from the Begley mine, Batchehwahnung Bay, Lake Superior, O.

e. Chalcopyrite from the township of Snider, district of Algoma, O.

Greenshields, Montreal, Q., per Dr. J. Thorburn:—

Asbestus (chrysotile) from the Jeffrey mine, lot 9, range III., Shipton, Richmond county, Q.

Guillim, J. C.:—

Nine specimens of ores and rocks from the West Kootanie district, B.C.

Hall, G. B., Quebec:—

Microcline from the McGie mine, Block 'G,' Bergeronnes, Saguenay county, Q.

Harding, H.:—

Bituminous shale, so-called 'cannelite,' from Baltimore, Albert county, N. B.

Hill, A. J., New Westminster, B.C.:—

a. Bog-iron ore from Campbell River, lot 14, range VII., New Westminster district, B.C.

b. Slag from burnt seam of coal or lignite, near Village Bay, Mayne Island, Gulf of Georgia, B.C.

Hobson, J. B.:—

Barite in lignite from the Horsefly mine, Horsefly River, Cariboo district, B.C.

Jacques, Captain, Victoria, Vancouver Island, B.C.:—

a. Ilvaite with andradite from Uchucklesit Harbour, near head of Barclay Sound, Vancouver Island, B.C.

b. Ilvaite with pyrite, same locality as above.

c. Chalcopyrite with ilvaite, same locality as above.

Contributions to museum—*Cont.*

Laprairie Pressed Brick and Terra Cotta Co., Laprairie, Q., per J. S. Buchan :—

a. Building brick, grade No. 1, colour 7, four specimens.
b. " " 8, "
c. " " 9, "
d. " " 10, six "
e. 'Buff' brick, four specimens.
f. 'Plastic' brick, six specimens.
g. 'Ornamental' brick, three specimens.
h. 'Paving' brick, six specimens.

Ledyard Gold Mines Company, Limited :—

a. Eleven specimens of auriferous quartz from the east half lot 18, concession I., Belmont, Peterborough county, O.
b. Small bottle of concentrates.
c. " tailings.

Legge, Joshua, Gananoque, O. :—

Steatite from lot 5, concession I., Kaladar, Addington county, O.

McKenzie, H. R., Sydney, N. S. :—

Chalcopyrite from Old French road, Gabarous, Cape Breton county, N. S.

McRae, Hector, Ottawa, O. :—

Graphite from lot 12, concession III., Brougham, Renfrew county, O.

Moffatt, C. P., North Sydney, N.S., per H. Fletcher :—

Chrysotile from George River, Cape Breton county, N.S.

Morris, M., per C. W. Willimott :—

Phlogopite from lot 17, range II., Wakefield, Ottawa county, Q.

O'Connor, M., Delora, O., per Dr. R. Bell :—

Mispickel with lepidomelane from lot 11, concession IX., Marmora, Hastings county, O.

Ontario Peat Fuel Company, Toronto, O., per W. A. Allan :—

Peat fuel from peat bed about five miles from Welland, Welland county, O.

Prest, W. H. :—

a. Thirteen specimens representing the mineral associations of the auriferous quartz from Gold River, Lunenburg county, N. S.
b. Crystals of quartz and pyrites from the Lake lead, Caribou, N.S.

Contributions to museum—*Cont.*

Smith, J. F., Kamloops, B.C.:—

Beryl from Tête Jaune Câche mica deposit, Canoe River, B.C.

Sorette, H., Bridgewater, N.S.:—

Granite, polished specimen from Shelburne, Shelburne county, N.S.

Spotswood, G. A., Kingston, O.:—

a. Petroleum from the Strait of Belle Isle, Newfoundland.

b. Piece of contact rock showing impression of overflow of trap from same locality as the preceding.

c. Sillery sandstone from under the trap, charged with bitumen, from the same locality as the two preceding.

d. Bitumen, anthraxolite (?) from the trap of Port au Port Bay, Newfoundland.

Thain, J. H., Vancouver, B.C.:—

Chalcopyrite and pyrrhotite from Queen's Reach, Jervis Inlet, B.C.

Thompson, H. B., Victoria, B.C.:—

Infusorial earth from south side of Fraser River, opposite Mission City, B.C.

Thorburn, Dr. John, Ottawa, Ont.:—

Asbestus (chrysolite) from the Jeffrey mine, lot 9, range III., Shipton, Richmond County, Que.

Trethewey, T. H., per E. D. Ingall:—

Seven specimens of native copper, two specimens of chalcocite and one specimen of bornite, all from the Copper Creek Mining Company's property (Sand Bay and Pancake Bay locations), Mamainse, Lake Superior O.

Wells and Redpath, Messrs., Kamloops, B.C., per J. McEvoy:—

Asbestus (amphibole) from south side of Tulameen River, nearly opposite Bear Creek, Yale District, B.C.

Weston, T. C., Ottawa, O.:—

a. Nodule of magnetite and hæmatite from one of the Magdalen Islands, Q.

b. Agate from Scaumenac Bay, near Campbellton, Restigouche county, N.B.

Educational collections supplied.

"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—*Cont.*

1. Huron College, London, Ont.....	consisting of	135	specimens.
2. Public School, Bloomfield street, Halifax, N.S.....	"	90	"
3. Digby Academy, Digby, N.S	"	90	"
4. Richmond School, Halifax, N.S.....	"	90	"
5. Normal School, Fredericton, N.B....	"	135	"
6. Lunenburg Academy, Lunenburg, N.S.	"	90	"
7. Provincial School of Pedagogy, Toronto, Ont.....	"	135	"
8. Collegiate Institute, Winnipeg, Man.	"	135	"
9. Public School, Medicine Hat, N.W.T.	"	90	"
10. Brébœuf School, Ottawa, Ont.....	"	90	"
11. Prince Street School, Charlottetown, P.E.I.....	"	90	"
12. Public School, Nauwigewauk, N.B..	"	90	"
13. County Academy, Guysborough, N.S.	"	90	"
14. Public School, Chipman, N.S.....	"	90	"
15. Acadia College, Wolfville, N.S.....	"	188	"
16. Amherst Academy, Amherst, N.S....	"	90	"
17. Couvent de Jésus Marie, Lévis, Que..	"	90	"
18. High School, Iroquois, Ont.....	"	135	"
19. " " Hopewell Hill, N.B....	"	135	"
20. " " Keswick Ridge, N.B ...	"	135	"
21. Collegiate Institute, London, Ont....	"	135	"
22. Grammar School, Alma, N.B.....	"	135	"
23. Public School, Breslau, Ont.....	"	90	"
24. Acadia Seminary, Wolfville, N.S	"	90	"
25. Public School, Carpe, Ont.....	"	90	"
26. Holy Cross Convent, Alexandria, Ont.	"	90	"
27. Superior School, Millford, N.B.....	"	135	"
28. Art, Historical and Scientific Association, Vancouver, B.C.....	"	135	"
29. Superior School, Dalhousie, N.B.....	"	135	"
30. " " Hillsborough, N.S..	"	135	"
31. Provincial Normal School, Truro, N.S.	"	135	"
32. Superior School, St. Martin's, N.B...	"	135	"
33. " " Salisbury, N.B.....	"	135	"
34. Public School, Elgin, N.B.....	"	90	"
35. Columbia Methodist College, New Westminster, B.C.....	"	135	"
36. Superior School, Harvey Station, N.B.	"	135	"
37. High School, Douglastown, N.B.....	"	135	"
38. Public School, Petitcodiac, N.B.....	"	80	"
39. Superior School, Hampton, N.B.....	"	135	"
40. Lakeside School, Hampton Station, N. B.....	"	80	"
41. Public School, Maugerville, N.B.....	"	80	"
42. Caledonia High School, Seneca, Haldimand County, Ont.....	"	135	"
43. Public School Inspector, Toronto, Ont.	"	135	"
44. High School, Hagersville, Ont.....	"	135	"

Educational collections supplied—*Cont.*

45. Superior School, Butternut Ridge, N. B.	consisting of	120	specimens.
46. Windsor Academy, Windsor, N.S.	"	120	"
47. Sydney Academy, Sydney, N.S.	"	120	"
48. Public School No. 3, Harvey, N.B.	"	120	"
49. Forest Glen School, Forest Glen, N.B.	"	80	"
50. Grammar School, Chatham, N.B	"	120	"
51. Public School, Rat Portage, Ont.	"	80	"
52. " " Boiestown, N.B.	"	80	"
53. Harkin's Academy, Newcastle, N.B.	"	120	"
54. High School, Newbury, Ont	"	120	"
55. Public School, Shenston, N.B.	"	80	"
56. Albert Public School, Hopewell, N.B.	"	80	"
57. Grammar School, Campbellton, N.B.	"	120	"
58. City Hall, London, Ont.	"	160	"
59. High Commissioner, London, England	"	122	"

"Making a total of 6,665 specimens, aggregating over two tons in weight of material.

Collecting of minerals.

"In addition to the foregoing work, Mr. Willimott visited, in the course of the summer—for the purpose of procuring further material for the making up of collections for educational purposes—the townships of Hull, Templeton, Wakefield, Buckingham and Orford, in the province of Quebec, and those of Bagot, MacNab and Ross, in the province of Ontario.

"Whilst so engaged, he collected a large and varied assortment of minerals, comprising:—

	Specimens.	Weight.
Actinolite	100	
Albite	....	75 pounds.
Amazon stone	100	
Apatite, crystals	100	
" in calcite	100	
" pyroxene in calcite	100	
Baryta	....	150 "
Calcite, crystals	....	150 "
"	100	
Chrome garnet	100	
Diorite—from Bagot	....	200 "
" —from Wakefield	100	
Dolomite, tremolitic	....	100 "
Fluorite	100	
Gneiss	....	100 "
Graphite, disseminated	....	100 "
Hornblende-schist	....	200 "
Idocrase, crystals, loose	150	
" " in gangue	20	
Jasper	....	150 "

Collecting of minerals.

	Specimens.	Weight.
Limestone (marble)	....	150 pounds.
" hydraulic	....	150 "
" serpentine	....	150 "
Microcline	....	75 "
Molybdenite	75	
Ochre	....	30 "
Phlogopite, crystals (amber coloured)	150	
" " (black)	75	
Pyroxene "	300	
" massive	100	
Quartz	....	75 "
Rutile	75	
Sandstone	....	100 "
Titanite	....	100 "
Tourmaline	100	
Tremolite	....	200 "

"The foregoing included some handsome cabinet specimens which have been placed in the Museum.

"Mr. Willimott has also received—

	Weight.
Clay iron-stone, collected by Dr. G. M. Dawson	150 pounds.
Calcareous tufa, collected by Mr. Geo. Stewart, Banff.	150 "
Basalt, collected by Mr. J. McEvoy	200 "
Tufaceous sandstone, collected by Mr. J. McEvoy	200 "
Hornblende, presented by Mr. R. Hamilton	100 "
Tremolite " "	50 "
Talc, received through Mr. W. F. Ferrier	100 "
Mispickel " "	150 "
Selenite, collected by Mr. E. R. Faribault	150 "

LITHOLOGY.

Lithology

Mr. W. F. Ferrier, lithologist, reports on the work of the past year as follows:—

"Labels have been prepared for the stratigraphical collection of rocks, and those for the flat cases are now all placed in position. As the nomenclature of the majority of the rocks is, as yet, of necessity, based largely on their macroscopic characters, and therefore liable to some alterations, written, instead of printed, labels have in the meantime been provided. It is intended to arrange typical local sets of rocks in the large drawers under the museum cases, where they will be readily accessible to those wishing to study the geology of any particular district.

Lithology—*Cont.*

"The microscopical work of the year included the examination of fifteen additional thin sections of rocks from the Kamloops district, British Columbia, also of thirty sections of rocks from Labrador. The results of the former examination have been incorporated in the appendix to Dr. Dawson's report, which is now in the press, whilst those of the latter will form an appendix to Mr. Low's report on the interior of Labrador.

"Much time has been occupied in the study of Mr. Barlow's interesting and important rocks from the Nipissing and Temiscaming sheets, numbering in all some one hundred and fifty specimens, and the work is now nearing completion. One hundred typical rocks of the West Kootanie district, British Columbia, collected by Mr. McConnell, have been sectioned, but, as the field-work is not yet completed, examinations of only a few of the specimens have as yet been made.

"Twenty-four specimens of Archæan rocks were sent to Prof. H. A. Nicholson of the University of Aberdeen, and sixty-one—principally Archæan—to Prof. Groth of Munich, in exchange for specimens received.

"The miscellaneous work carried on during the year, included many macroscopical determinations of rocks and various microscopical or blowpipe examinations of building stones, minerals and miscellaneous materials.

"Two papers were, with the permission of the Director, published in the 'Ottawa Naturalist,' in one of which the occurrence of stilpnomelane *var.* chalcodite and crystallized monazite, at Canadian localities is recorded for the first time.

Examinations in the field.

"Having detected erythrite, the hydrous arsenate of cobalt, and smaltite, the arsenide of that metal (usually containing some nickel) in some samples of ore given to me by Mr. John Stewart, in 1892, from the Dominion Iron Mine, lot 2, concession II., of Madoc township, in the county of Hastings, Ont., it was thought advisable that I should visit the locality in order to ascertain the extent of the deposit of these cobalt minerals. Accordingly, during the summer, I went to Madoc and examined the mine where they occur as carefully as the circumstances would permit. No work has been done at the opening for many years, and consequently it is difficult to make out the precise relations of the cobalt minerals to the main mass of ore, but they appear to occur in bands or seams, one of which was noted dipping at a high angle. The width of these bands, judging from specimens collected on the dumps, must in some instances have been two feet or

more. Blocks of the iron-ore sometimes show surfaces of over nine inches square coated almost completely with thin-bladed crystals and earthy coatings of the erythrite, which still retains its beautiful peach-red and pink tints of colour, although exposed so many years to the action of the weather. Little masses of earthy erythrite also occur filling cavities, and this mineral appears to have been largely derived from the alteration of smaltite, etc. The smaltite, of a tin-white colour on a freshly fractured surface, is distributed through the iron-ore, usually in small but very perfect crystals, mainly cubes and octahedrons, which, when weathered, tarnish, and greatly resemble iron-pyrites. The massive mineral has also been observed. The minute crystals are often thickly aggregated together so as to form small patches in the iron ore. Lithology—*Cont.*

"Several other localities in Hastings county were visited and numerous specimens of rocks and minerals collected, amongst which the fine glassy crystals of epidote from a new locality on lots 10 and 11, concession XIX., of the township of Tudor, are worthy of mention

Mining and Mineral Statistics.

This work has been carried on upon the usual lines under Mr. E. D. Ingall's control. The absence of Mr. H. P. Brunnell on leave, for three months, and his subsequent resignation for the purpose of accepting an engagement in the line of his profession, to some extent interfered with the progress of the work for the time being. Mineral statistic.

The early months of the year were taken up with the work of collecting and compiling statistics of the production of the country for 1894. A summarized statement was prepared as usual in advance of the main report. It was completed on 30th March, and was printed and distributed shortly afterwards. This was earlier than in any previous year.

The manuscript of the report on mineral statistics and mines for 1893, was completed last April, but it was subsequently decided to add to this the figures of mineral production in 1894. The report thus enlarged has since been printed and at the time of writing is nearly ready for distribution.

In the latter part of the year, the usual preparations were made for the collecting of statistics and general information regarding mining operations in the Dominion for 1895.

Mineral statistics—*Cont.*

During the year, various memoranda have been prepared in reply to questions upon special subjects, and in connection with mining and the mineral resources of the country.

Much of Mr. Ingall's time during the summer, was taken with the special investigation of the iron-ore deposits in the vicinity of the Kingston and Pembroke railway, in which work Mr. A. M. Campbell acted as general assistant. A first report upon the results of the investigation has been given on preceding pages, under the heading Ontario, in which province the entire district examined is comprised.

Palæontology and Zoology.

Palæontology and zoology.

Mr. Whiteaves submits the following report upon the work done in these branches of the Survey's operations.—

Publications

"The second part of the third volume of 'Palæozoic Fossils' was published in September, 1895, and has since been distributed. It consists of two papers, the one a 'Revision of the Fauna of the Guelph formation of Ontario, with descriptions of a few new species' and the other a 'Systematic List, with references, of the Fossils of the Hudson River or Cincinnati formation of Stony Mountain, Manitoba.' The first of these papers was written in 1894, but the receipt of an important consignment of additional specimens from Mr. J. Townsend, in January, 1895, necessitated considerable additions to the manuscript and a final revision thereof. The second was written in the early part of 1895.

"Considerable progress has been made with the MS. of the third part of the third volume of 'Palæozoic Fossils.' This part is intended to consist of an illustrated report upon the fossils of the Cambro-Silurian rocks of Lake Winnipeg and its vicinity, based upon the large collections made by various officers of the Survey during the last fifteen years or more. A paper description of eight new species of fossils from these rocks has been published in the 'Canadian Record of Science' for July last.

Fossils from British Columbia.

"Ten boxes of fossils from the Cretaceous rocks of Hornby, Denman and Vancouver islands, have been received from Mr. Walter Harvey, of Comox, B.C., and one box of fossils from the Comox River, B.C., from Mr. J. B. Bennett of Comox. These have been critically examined and most of the species determined. They throw much new light on the fauna of these rocks, and give some new and important information which it is intended to utilize in the preparation of the fourth and

concluding part of the first volume of 'Mesozoic Fossils.' In the mean time, a paper entitled 'Notes on some Fossils from the Cretaceous Rocks of British Columbia, with descriptions of two species that appear to be new,' has been published in the April number of the 'Canadian Record of Science.' This paper consists of a preliminary description, which it is intended to reprint, with such modifications as may be necessary and with illustrations, in the 'Mesozoic Fossils,' of some of the most interesting specimens in Mr. Harvey's collections. These specimens he has generously presented to the museum. No short-tailed decapod crustaceans or fossil crabs had previously been recorded as occurring in the Cretaceous rocks of the Dominion, but in the collections of fossils made by Mr. Harvey in 1891-93 at Hornby Island and the Comox River, there are several specimens of three species. Specimens of each of these, and of an additional species of fossil crab from the Cretaceous rocks of the Queen Charlotte Islands, were sent to Dr. Henry Woodward, F.R.S., president of the Geological Society of London and an authority on fossil crustacea,—who exhibited them at the meeting of the British Association at Ipswich last September, and read a paper upon them, in which all four were described as new to science. Palæontology and zoology—*Cont.*

"In September, also, Dr. C. F. Newcombe, of Victoria, B.C., visited the Queen Charlotte Islands and collected a fine series of the fossils of the Cretaceous rocks at Skidegate and Cumshewa inlets, which he has kindly promised to send to the writer for examination. So far, four consignments of these fossils have been received and most of the species therein have been determined. Dr. Newcombe has also sent, during the year, some additional species of fossils from Hornby and the Sucia islands. The whole of these specimens will be most useful in enabling the writer to complete a revision of the fossil faunæ of the Cretaceous rocks of the Queen Charlotte and Vancouver islands. In the early fall a few days were spent, with Dr. Ells and Mr. Giroux, in the examination of several rock-exposures on the Island of Montreal and its immediate vicinity, and in determining the exact geological horizon of each, upon purely palæontological evidence. At St. Vincent de Paul, on Isle Jésus, the lower beds of the Trenton limestone, with their characteristic fossils, were seen to lie immediately and conformably on the Black River limestone.

"In Zoology, a paper entitled 'Additional notes on Recent Canadian Unionidæ' was published in the April number of the 'Canadian Record of Science,' and another, a 'Note on the occurrence of *Primnoa reseda* on the coast of British Columbia,' was read at the last meeting of the Royal Society of Canada, and has since been Zoology.

Palæontology and zoology—*Cont.*

published in its Transactions. A small series of recent marine shells from Alert Bay, B.C., has been named for Mr. Harvey, in return for favours received, and specimens of eighty-five named species of duplicate shells, mostly from the Vancouver district, have been sent to Mr. Herbert H. Smith, of Brooklyn, New York, in exchange for specimens received last year.

"Several interesting additions to the Survey's collection of native birds, birds' eggs, mammals, etc., have resulted from Professor Macoun's explorations in the North-west Territories during the past summer, (and more particularly a pair of the Sage Grouse, *Centrocercus urophasidnus*, and a fine example of the Yellow-haired Porcupine, *Erethizon dorsatus*, var. *epixanthus*, both from the White-Mud River, Assiniboia) but these will be referred to more in detail in his report. In addition to these, several interesting species of mammals, birds, birds' eggs, etc., have been acquired by presentation, exchange or purchase. Among them are a specimen of the Red-backed Mouse, *Evotomys rutilus*, from Metcalfe, Ontario; two specimens of the Whistling Swan, *Olor Columbianus*, one from St. Clair Flats, Ontario, the other from Manitoba; a fine male of the brown Pelican, *Pelecanus fuscus*, shot on Pictou Island, N.S.; a female Richardson's Merlin, *Falco Richardsonii*, with three downy young ones,—and a female American three-toed Woodpecker, *Picoides Americanus*,—all from the neighbourhood of Calgary, Alberta. The acquisition of these and of other rare specimens for the museum often entails considerable trouble and a more or less lengthy correspondence. Four mammals and 110 specimens of birds have been mounted by Mr. S. Herring during the year, and he has gone over and cleaned, as he does annually, all the mounted vertebrata in the museum. The collection of stuffed birds, mammals, etc., for the museum in connection with the Rocky Mountain Park at Banff, referred to in my last report, was sent there in the spring."

Work of Dr. Ami.

"Dr. H. M. Ami has during the year completed the local lists of fossils to accompany Dr. Ells's report on the Geology of the south-west quarter-sheet of the 'Eastern Townships' map of Quebec. This appendix contains an extensive series of systematic lists of fossil organic remains, arranged chronologically and zoologically, employed in the definition of the different geological formations represented, in so far as these have yielded fossils.

"A similar appendix has been prepared to accompany a report on the geology of the Great Manitoulin and other islands in Lake Huron by Dr. R. Bell, including fossil remains from the Cambro-Silurian formations of that district.

"Systematic lists of fossils have also been prepared and filed, for reference, from collections made by Dr. R. W. Ells, Mr. J. F. Whiteaves, Dr. W. E. Deeks, the late J. Richardson, Mr. T. C. Weston, Mr. N. J. Giroux, the late Scott Barlow, Mr. W. F. Ferrier, Dr. Robert Bell, Mr. A. E. Barlow, Mr. Hugh Fletcher and by himself and others from various places in the provinces of Nova Scotia, New Brunswick, Quebec and Ontario. These lists include collections (1) from twenty-two localities in Nova Scotia; (2) from thirty-four localities in Quebec; (3) from eight localities in New Brunswick and from seven localities in Ontario. A considerable addition of material both new to Canada and new to science was made during the year, and among other valuable additions are several Cambro-Silurian forms which serve to illustrate species described by R. P. Whitfield and Alpheus Hyatt from the 'Fort Cassin Rocks' of Vermont. Palæontology and zoology.—*Cont.*

"The examinations above referred to, comprise in all more than 60 separate collections. Besides these, he has also recorded for reference lists of fossil organic remains from the Cretaceous coal-bearing rocks at Anthracite, Alberta; from the Silurian of Hamilton, Ont., collected by Col. C. C. Grant; from Highgate Springs, Vermont, collected by himself in 1883; from the Shumardia limestone of Point Lévis &c., collected by Mr. T. C. Weston, 1894.

"Work has been continued on the fossils of Lake Temiscaming, where an interesting outlier of the Silurian occurs, and drillings obtained from a couple of borings have been examined and reported upon. In the early part of the year he prepared a provisional catalogue of the species of fossil remains contained in the collection, and began a catalogue of the species of fossils described by the late E. Billings, with exact references.

"Much miscellaneous work of a routine character has also been attended to, such as the reception and cataloguing of specimens, both palæontological and ethnological.

"On the 25th of September, Dr. Ami was instructed to go to Nova Scotia for the purpose of obtaining, if possible, palæontological evidences of the age of certain rocks of Pictou county, in conjunction with work carried on there by Mr. Hugh Fletcher. He spent nearly four weeks there, and obtained a large suite of specimens, which, in many cases, serve to throw considerable light upon the age of the iron-bearing rocks of Pictou county. A few days were also spent in Antigonish county and in Cape Breton with Mr. Fletcher in similar work. Field-work.

"During the year, Dr. Ami has been absent on leave for a period of nearly four months on account of illness.

Palæontology and zoology—*Cont.* Work of Mr. Lambe.

"During the first half of the year, Mr. L. M. Lambe was engaged in a preliminary study of the fossil corals of Canada, with the idea of concentrating later on each group in turn, the object being a revision of this important class. It was necessary at first to ascertain what material was available for study besides the specimens exhibited in the museum cases. To accomplish this end, about ninety boxes, in the outbuildings, containing fossils from different horizons and from many typical localities in several parts of the Dominion, were examined, and any corals that were thought likely to throw light on the structure, etc., of the peculiar group were selected and placed in the basement workroom in the Survey building so as to be readily accessible. From the duplicate specimens in the drawers beneath the museum cases, a series of corals was also selected. These in conjunction with those already mentioned constitute the mass of material now arranged for study.

"Having completed a preliminary examination of the Canadian fossil corals as a whole, Mr. Lambe in the latter half of the year concentrated on a few particular groups, in the hope of adding to the knowledge of their structure and affinities and of their relation to geological horizons in this country. Critical notes relative to certain genera and species have been prepared and it is hoped to have the first of a series of short papers ready for publication shortly.

"In connection with work being carried on by Mr. Whiteaves, Mr. Lambe has also, during the year, prepared drawings of certain fossils from the Cretaceous rocks of the Pacific coast and the Trenton of Lake Winnipeg, to illustrate the papers or reports already mentioned as published or in course of preparation. Drawings were also made of a collection of Tertiary plants from Burrard Inlet, B.C., to be used in illustration of a paper, by Sir J. William Dawson, for the current volume of the Royal Society of Canada. The specimens described and illustrated in this paper are chiefly those collected by officers of the Survey or presented to it. These have now been named and returned to the museum.

"While finishing his studies of the recent marine sponges of the North Pacific, he named for the Smithsonian Institution at Washington, D.C., the remainder of the specimens collected by Dr. Dall some years ago in that region, and received for the museum in return, a first set of duplicates of the collection.

Contributions to museum.

"The following is a list of specimens collected by or received from officers of the Survey during the year 1895, in addition to those collected by Professor Macoun, which will be found enumerated in his report:—

Contributions to museum—*Cont.*

Dr. Robert Bell :—

Several specimens of Devonian fossils from the lower part of Moose River. Bird-skins from Manitoba and Cross Lake, Nelson River.

Dr. R. W. Ells :—

Several specimens of Cambro-Silurian fossils from Montreal and its vicinity.

J. B. Tyrrell :—

About twelve specimens of five species of Cambro-Silurian fossils from Markham Lake, on Telzoa River. About 200 specimens of 20 species of Cambro-Silurian and Silurian fossils from the mouth of Churchill River. Forty specimens of marine shells, from Hudson Bay. About thirty specimens of fresh-water shells from Manitoba and Keewatin.

Dr. H. M. Ami :—

1320 specimens of Palæozoic fossils from various formations in Pictou Co., Nova Scotia.

100 specimens from the productive coal measures of Indian Cove, North Sydney, Cape Breton Co., Nova Scotia.

A. P. Low :—

Fifty specimens of fossils from the Cambro-Silurian rocks at the Radnor Forges, Champlain Co., Que.

L. M. Lambe :—

Three specimens of Trenton fossils from Cap à l'Aigle, Murray Bay, Que.

Wm. McInnes :—

One bone skin-scraper, from Otukamamoan Lake, Rainy River District.

N. J. Giroux :—

One hundred and fifty spe imens of fossils from Glengarry, Prescott, Russell, Stormont and Dundas. Fifteen marine fossils from the Pleistocene deposits of the counties of Soulanges and Glengarry.

James McEvoy :—

One stone pestle from the interior of British Columbia.

W. J. Wilson :—

About forty specimens of Utica fossils from Clear Lake, Renfrew Co., Ont.

Contributions to museum—*Cont.*

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

By presentation:—

(A. *Palæontology.*)

Sir J. W. Dawson, Montreal:—

A series of named specimens of four species of Microsauria, and one specimen of the rare *Anthrapalæmon Hilli*, all from the Coal Measures of the South Joggins, N.S.

J. B. Hobson, Vancouver, B.C.:—

Eight specimens of fossil fishes from the Tertiary rocks of the Horse-fly River, B. C.; three specimens of two species of fossil wood from the auriferous gravels of the same river; and three specimens of two species of fossils (*Monotis* and *Aulacoceras*) from a Triassic boulder at the Horse-fly Hydraulic Mining Company's pit, Cariboo, B.C.

C. Hill-Tout, New Westminster, B.C.:—

Twenty-four specimens of fossil plants from Burrard Inlet, B.C.

Colonel C. C. Grant, Hamilton, Ont.:—

Seven specimens of fossils from the Niagara formation at Hamilton, and one from the Hudson River or Trenton drift.

Alex. Graham, Ottawa:—

Humerus, ulna and part of radius of seal (probably *Phoca Grœnlandica*) from the Pleistocene clay at Graham's brick-yard, near Ottawa.

James Gibbons, Edmonton, Alberta:—

Portion of molar of mammoth found about six miles above Edmonton.

C. A. Magrath, Lethbridge, Alberta:—

Fine large specimen of an Ammonite (*Placenticeras placenta*) from the Cretaceous shales near Lethbridge.

Walter Harvey, Comox, B.C.:—

Fine specimens of *Anisoceras Vancouverense*, and three other rare orunique Cretaceous fossils from Hornby Island, the types of two species recently described in the 'Canadian Record of Science.'

Contributions to museum—*Cont.*

J. B. Bennett, Comox, B.C. :—

Two specimens of a long-tailed decapod *(Podocrates Vancouverensis)* from the Cretaceous rocks of the Comox River, B.C.

The Smithsonian Institution, Washington, D.C. :—

A fine specimen of a fossil coral *(Streptelasma robustum)* from the Galena Trenton of the Red River Valley, Manitoba.

W. H. Porter, Fort Erie, Ont :—

Four specimens of fossils from the Corniferous rocks at Fort Erie.

T. C. Weston, Ottawa :—

Fifteen specimens of rare fossils from the Lévis limestones and shales at Lévis, P.Q.

Dr. H. M. Ami, Ottawa :—

Fifty specimens of fossils from the Montcalm market rocks, Quebec city; fifty specimens of graptolites from the Intercolonial railway cutting at Lévis, P. Q.; 100 specimens of graptolites from lot 5, range XV., Magog Township, Lake Memphremagog, P.Q., and a small collection from the Devonian shales, holding *Spirophyton*, at Sargent's Bay, Lake Memphremagog.

Walter F. Ferrier, Ottawa :—

Eleven species of fossils from the Pleistocene of Montreal, Murray Bay and Rivière du Loup, and twelve specimens of fo sils from the Trenton limestone at Murray Bay.

(B. *Zoology.*)

The Smithsonian Institution, Washington, D.C. :—

Forty specimens of twenty-two species of recent marine sponges from the North Pacific and Arctic Ocean.

Rev. W. Lowndes, Nassau, N.P.:—

Twenty-one species of marine shells from Nassau.

John McMenomy, Metcalfe, Ont. :—

Specimen of the Long-eared or Red-backed mouse *(Evotomys rutilus* var. *Gapperi)*, from Metcalfe.

J. H. Fleming, Toronto, Ont. :—

Egg of the king eider *(Somateria spectabilis)*, from the Cary Islands, Baffin's Bay.

Contributions to museum—*Cont.*

R. A. Fowler, Emerald, Lennox, Ont. :—

Mottled variety of field mouse *(Arvicola riparia ?)*, from Emerald.

R. S. Lake, Grenfell, Assa. :—

Two eggs of Swainson's hawk *(Buteo Swainsonii)*, three of the mallard *(Anas boschas)*, and five of the pintail *(Dafila acuta)*, from Assiniboia.

James Fletcher, Ottawa :—

Seven specimens of *Limnæa ampla*, from Brome Lake, P.Q.

Walter Harvey, Comox, V.I. :—

Five specimens of *Mactra falcata* and three of *Psammobia rubroradiata*, from Denman Island, P.Q.

(C. Ethnology.)

H. B. Munro, Renfrew, Ont. :—

One hundred and forty-two Indian implements from Lytton and Boothroyd's Flat, B.C., and from the vicinity of Pembroke, Ont.

W. H. Porter, Fort Erie, Ont. :—

Three arrow-heads, two sinkers and two fragments of Indian pottery, from Fort Erie.

C. Hill-Tout, Vancouver, B. C.:—

Forty specimens of chipped arrow- and spear-heads from Burrard Inlet, B.C.

James White, jun., Elphin, Ont. :—

One copper spear-head or knife found in Dalhousie township, Lanark, near the shore of Dalhousie Lake.

Mrs. De Hertel, Perth, Ont. :—

Copper spear-head ploughed up about thirty-five years ago near the head-waters of the Mississippi River, Frontenac Co., Ont.

Dr. T. W. Beeman, Perth, Ont. :—

One arrow-head of quartzite and two fragmentary spear-heads from Rideau Lake, Ont. :—

Malcolm McMurchy :—

One stone skin scraper, six fragments of pottery, a fragment of a pipe and a chipped flint, from the township of Collingwood, Ont.

Contributions to museum—*Cont.*

By exchange :—

Eggs of fifteen species of North American birds.

Trumpeter swan *(Olor Americanus)*, from St. Clair Flats, Ont., and females of the following species from western Ontario :— Semipalmated sandpiper, *(Ereunetes pusillus)*; turnstone *(Arenaria interpres)*; meadow lark *(Sturnella magna)*; American goldfinch *(Spinus tristis)*; white-throated sparrow *(Zonotrichia albicollis)*; chipping sparrow *(Spizella socialis)*; red-eyed Vireo *(Vireo olivaceus)*; Nashville warbler *(Helminthophila ruficapilla)*; chestnut-sided warbler *(Dendroica Pennsylvanica)*; and Blackburnian warbler *(Dendroica Blackburniæ)*.

By purchase :—

Brown Pelican *(Pelecanus fuscus)*, adult male shot on Pictou Island, N.S., in 1892.

Richardson's merlin *(Falco Richardsoni)*, adult female, and three downy young, from near Calgary, Alberta.

American three-toed woodpecker *(Picoides Americanus)*, adult female, from near Calgary.

Three eggs of the canvas-back Duck *(Aythya vallisneria)*, from Snake Lake, Alberta.

Twenty-eight bone implements and ten stone implements, of Indian manufacture, from various localities in British Columbia.

One copper implement (gouge or adze) from the township of Canonto, Ont.

Natural History.

Natural History.

Under this head, Prof. Macoun reports as follows upon the work accomplished in the office and museum.—

"After the date of my last summary report, I prepared a complete tabulated list of the birds known to occur in the Dominion of Canada and Alaska, as well as of all stragglers that have been taken on our northern coasts. The total number of forms known to occur in Canada is 624, of which 443 are represented in the museum collection. Our chief desiderata are sea-birds, and stragglers from Europe which are difficult to obtain. After the completion of this work, I began the arrangement of our Lichens. This, and the routine work of the office occupied me until my departure for the field.

Natural History—*Cont.*

"My assistant, Mr. Jas. M. Macoun, has been for the whole year occupied with herbarium work, but has not yet reached the collections of the past season; and the work of distributing exchanges has progressed but slowly, though enough have been labelled by Miss Barry, to balance accounts with those from whom we have received specimens, when time to distribute them is available.

Determination of specimens.

"The number of collections sent to the herbarium for determination increased materially during the year and was especially large during the collecting season. This branch of the work consumes considerable time, but it is a means of adding to our knowledge of distribution as well as a help to collectors. The most important of these collections were received from H. H. Gaetz, Red Deer, Alberta; Rev. H. H. Gowen, New Westminster; Dr. Newcombe and A. J. Pineo, Victoria, B.C.; and R. Cameron, Niagara, Ont. Of the Survey staff Messrs. Bell, Low and McEvoy brought in small collections from the regions in which they had been working.

Specimens distributed.

"Since December 31st, 1894, 4318 sheets of specimens have been sent to scientific institutions and individuals, for the most part in exchange for specimens sent us for our herbarium. The herbaria to which the largest number of specimens were sent, are :—

The British Museum	199
Kew Gardens	724
The Gray Herbarium, Harvard University	458
Botanical Museum, Copenhagen	125
Botanical Museum, Christiania	325
California Academy of Sciences	300
United States National Museum	295
Columbia College	339
University of Minnesota	150
Botanic Gardens, Natal	125
Missouri Botanic Gardens	426

"Specimens have been received during the year from all the institutions mentioned above, with the exception of the British Museum, Kew Gardens and the California Academy of Sciences. The most important collections were from Newfoundland and the state of Washington, both sent from the Gray Herbarium. Of the exchange with collectors, no details need be given here.

Additions to herbarium.

"The most valuable contribution to the herbarium during the year, was a set of the plants collected by Dr. G. M. Dawson, when on the Boundary Commission during the summers of 1873-74, in the vicinity of the forty-ninth parallel between the Lake of the Woods and the Rocky Mountains. This comprises about 400 species.

"During the year 3717 sheets of specimens have been added to our herbarium, as follows:— Natural History—*Cont.*

Canadian	1371
United States	895
European	373
Cryptogams	1078
Total	3717

"The work of the botanical department is at present in a better condition than it has ever been, and, after all the herbarium material has been got out, an attempt will be made to effect further exchanges for desiderata and to work up and describe some of the doubtful and new species in our herbarium. Routine office and herbarium duties have in the past left little time for this most important branch of our work."

The following short report, also by Prof. Macoun, relates to field work carried out by him during the season, in the North-west Territory:—

"In accordance with your instructions, I left Ottawa on May 13th, reaching Moose Jaw three days later. On the morning of the 18th, I started south with two men, a wagon and light cart, and provisions for two months. Our first camp was on Old Wives Creek, fifty miles from Moose Jaw. Field work by Prof. Macoun.

"During the summer and autumn of 1894, there had been no fires between Moose Jaw and the crossing between Old Wives Lakes, yet the old grass was extremely short and the whole surface showed the effects of the long-continued drought, in the seedless grass, the cracked sod, the parched soil and dried-up ponds and grass-marshes. West of the crossing, the prairie had been swept by fire during August of last year, and only the hollows were now green. All the uplands were black, giving little or no response to the warmth of the sun.

"This was the condition of the country when the first rain came on May 24th. It rained, more or less, all day, and the next morning the moisture had penetrated three inches into the soil and by the evening of the 25th was down another inch. The effects of the rain were seen almost immediately, and very soon the black or brown hills had changed to green.

"Formerly Old Wives Creek was well-wooded throughout the lower part of its course, but now the wood is dead, and in a few years there will not be a stick left. The wood consisted of box-elder, with a little green ash and willow. There are still large thickets of shrubs, chief

Natural History—*Cont.*

among which are choke-cherry, cornus, white thorn, willows, saskatoon berry, rose bush and gooseberry.

"While camped on Old Wives Creek, large collections of birds, birds' eggs, small mammals and plants were made. On May 31st, we went south ten miles, to the forks of Old Wives Creek, passing for the whole distance over an undulating plain covered with short grass.

"At 'the forks' we found the skeleton of a turtle and a large dark-coloured water-snake, both of which must be very rare, as no more of them were seen during the season. The turtle is, apparently, the Oregon golden-turtle, *Chrysemys Oregonensis*, which Dr. Coues obtained in the Souris River in 1874. The water-snake was large, dark brown on the back and reddish-yellow beneath, and is probably the red-bellied water-snake, *Tropidonotus erythrogaster*, Shaw.

Rainfall.

"Between May 24th and June 2nd, there were almost daily showers, and by the latter date the moisture had, on the level prairie, got down into the soil nearly six inches, and the grass and flowers feeling its influence, began to grow with vigour.

"A day and a half after leaving the forks of Old Wives Creek, we reached Twelve-mile Lake, near Wood Mountain, and camped on the creek at its head. We saw no fresh water between Old Wives Creek and Twelve-mile Lake, and at Thirty-mile Creek, where we camped for a night, the water was so bad that one of the horses became sick from its effects. Owing to the long-continued drought, there was no water in the country except in running streams, and as this was the case all summer, our drinking water was carried in a barrel on the wagon.

Birds breeding.

"Twelve-mile Creek was found to be almost dried up, but the marsh at its head received the waters of the creek, and in the upper part of it waders and water-birds were still breeding, though in diminished numbers, as both shelter and water were scanty. Fully sixty species of birds were breeding, or preparing to do so, in and around the lake and on the prairie, but mammals of all kinds were very scarce.

"During the early days of June, more or less rain fell every day, and on the 8th there was a severe storm which left the ground whitened with snow until noon the next day. On the 10th we moved to Wood Mountain post, and by this time the rains had penetrated to such a depth that the drought was overcome and the soil thoroughly moistened. So rapid had been the change from brown to green in the covering of the country that men were heard to say that for eleven years grass had never before been so good at this season.

"Wood Mountain may have deserved its name many years ago, but now it is almost treeless and except in the stream-valleys and sides of coulées, there is no wood whatever. Protected by the Mounted Police considerable young wood is growing up around Wood Mountain post, and were fires prevented, the hillsides where snow-drifts form would soon be forest-clad; for the aspen roots are still there, and were groves once started they would increase every year as the drifts would extend and give adequate moisture for tree growth.

Natural History—*Cont.*

Protection of young trees at Wood Mountain.

"From Wood Mountain post we travelled south until we reached the Boundary mound near Rocky Creek, where we camped. For two days we explored the 'Bad-lands' to the north-east of our camp and found the hills cut by the action of rain and frost into a great variety of shapes, but the vegetation about them differed in no respect from that of other alkaline soils. Scarcely a green thing was found on the hills themselves, owing to the waste that is constantly going on. A number of rare birds were breeding in crevices on the hillsides and nests of the arctic blue-bird, rock wren, Parkman' wren, the bald headed eagle and many species of hawks were seen or taken. We hoped here to get specimens of the sage hen, but on account of our ignorance of its habits we failed to secure any. Seven fine males were seen but disappeared before we got within range. We obtained good specimens later, on White Mud River, and learned that they are found the whole length of that river from the Boundary to, and into, the Cypress Hills. They live among the sage brush (*Artemisia cana*) in the river-valley, and lie so close that without a dog it is almost impossible to flush them. The last trace we saw of them was at Farewell Creek in the Cypress Hills.

Bad-lands near Wood Mountain.

"On June 17th we again left Wood Mountain post, with the intention of making our way to Cypress Lake near Fort Walsh on the south side of Cypress Hills. We reached the lake on June 29th and camped on Sucker Creek which enters the lake at its eastern end, where its discharge formerly was. For a number of years the waters of the lake have been drying up, and Sucker Creek now flows into the lake instead of into White Mud River.

"The grass was good, in fact very good, from Wood Mountain post to the crossing of the White Mud River, a distance of seventy miles. Water was found in all the branches of Old Wives Creek, but all ponds and marshes were dry and no water-fowl were seen at any time. Wood was even scarcer than water, for not a bush was seen except at the 'Holes,' where the watershed was crossed. The valley of the White Mud is wide and covered with sage-brush (*Artemisia cana*),

Grass good from Wood Mountain west.

Natural History—*Cont.*

greasewood *(Sarcobatus vermiculatus)* and cactus *(Opuntia Missouriensis)*. These may be said to constitute the great bulk of the vegetation in the river-valley from the boundary up into the Cypress Hills. Only four small trees were observed in the valley, and willow scrub was far from being continuous. Owing to the character of the river-bottom, safe crossings are few and even wading across is not always safe. We kept south of the river for thirty-one miles and in that time saw neither bush nor water. We then crossed to the north side and in a day reached East End post, where the old trail crosses the White Mud River. From there we ascended into the Cypress Hills, crossing over to Frenchman's Creek on which we camped for a day and made extensive collections of plants as well as careful notes on birds and mammals.

"Passing westward twenty-seven miles further, we camped at Sucker Creek for three days, while we communicated with Maple Creek and obtained supplies for our journey to the south. The four days spent here were devoted to collecting specimens of the flora and fauna of the vicinity, and much valuable information was obtained.

"We were now able to compare the fauna and flora of Old Wives Creek and Wood Mountain with that of the Cypress Hills, and found that in their main features there was very little difference. This was particularly true of the vegetation along the water-courses and of the prairies. It may be said here that from Moose Jaw to the foot-hills of the Rocky Mountains, by the course we travelled, the forage plants are practically the same. Locally they may vary slightly, but speaking generally there is no change. On rich and rather moist soil, the herbage and grasses are taller but the species are always the same. My decided opinion, after a summer spent on the open prairie, is that were shelter and water assured, there is no part of the southern prairie where cattle and horses will not fatten as well as along the foot-hills of the Rocky Mountains. Our horses ate only prairie grass all summer, and pulled a heavy wagon 1200 miles over faint trails or the unbroken prairie, reaching Moose Jaw in better condition than when they left in the middle of May. Day after day I watched them eat, and as they were always picketed they had to clean off the grass pretty well. While we were on the open prairie scarcely a blade was left; in the creek- or river-valleys, where the grass was good in our estimation, they were fastidious and ate only a few species. In the Cypress Hills and foot-hills of the Rocky Mountains they invariably left the 'bunch' grasses and turned to the species that formed a sward and grew on the driest ground. While the bunch grasses are therefore not so suitable for pasture, they are spoken of in Southern Alberta as being

Forage plants.

valuable for hay, and are in winter often the only available food when the shorter grasses are covered with snow. The very grass (*Festuca scabrella*) that is cut for hay on the Belly River ranches, grows all over the Cypress Hills and could be made into hay there. The fact that horses and cattle leave the coarser grasses untouched when pasturing, must not be taken as proof that they would not be readily eaten as hay in winter. Our cultivated grasses in the east are neglected in the same way, when shorter, sweeter grasses are to be had. If cut at the proper time, these coarse grasses are just as nutritious as the finer kinds, though perhaps not so pleasant to the taste. All the grasses of the prairie region are nutritious, but all are not suited for pasture, and while horses seem to prefer hay composed of grasses only, cattle will eat with avidity almost any green thing if made into hay. Natural History—*Cont.*

"With an increase in the number of settlers and a wider knowledge of the capabilities of the country, Southern Assiniboia will become a valuable district. As regards its soil and climate, much of it is suited for agriculture, but my purpose now is to draw attention to the numerous small streams traversing it and the ease with which this water could be used for irrigation purposes and the watering of stock. It is not intended to assert that at present this region is in a condition to receive a large influx of settlers, but I do wish to say that the time will surely come when cattle, sheep and horses will be as plentiful in Southern Assiniboia as they now are in Southern Alberta. The settlement of this region will necessarily be slow, as it is almost wholly devoid of trees, and water is at present scarce, especially in the winter; but all these difficulties will in time disappear, as there are no physical disabilities which cannot be overcome by care and patience. As an experiment, a moderate outlay towards the sources of Swift Current Creek, would soon show whether a series of small dams in the region under consideration would not store enough water to irrigate sufficient land to produce hay, and a supply of water for a number of ranches or sheep farms, besides what might be needed for root crops and grain. Cattle and horses quite wild were frequently seen during the summer. They had evidently lived out all winter. Value of Southern Assiniboia. Erection of dams for irrigation purposes recommended.

"The first three days of July were very hot, and they had a marked effect on the grass south of Cypress Lake. On the 4th and 5th, we traversed the driest section seen during the summer, and camped on Spur Creek, a western branch of Willow Creek. Between Cypress Lake and Willow Creek, the grass was short but formed a sward. As we went west, the soil grew drier, and bare patches with more cactus frequent, especially after we crossed Willow Creek. This section had

Natural History—*Cont.*

escaped the June rains, and everything had ceased to grow, so that between Battle Creek and Spur Creek scarcely a plant had produced a flower.

"Very heavy rain fell on the 5th and 6th and saturated the whole country, so that from that date we had no difficulty in finding good water in pools. From Willow Creek to Sage Creek we crossed a cactus and alkaline plain, and owing to the recent rains found it

Cactus plain.

almost impassable. This was the only worthless tract we saw during the summer, and where we crossed it, it was less than sixteen miles wide. A few miles south of Sage Creek we crossed a ridge, and could then look over the valley of Many-berries Creek as well as the Milk River country beyond it. Before we reached the ridge the soil had changed, and henceforth the grass was excellent and no bad-lands or poor pasture were seen again.

"After crossing Many-berries Creek, we turned south and kept down it until we reached the margin of Milk River, and could see the river meandering from side to side of the valley at least 300 feet below

Milk River.

us. We now turned up the Milk River, and for over 100 miles, until we came to Milk River Ridge, always kept it in sight, and occasionally camped near it and descended into its valley and made natural history collections. A trip was made from the 'Castellated Rocks' to the West Butte, and collections and observations were made which showed the flora of the Sweet Grass Hills to be the same with that of the foot-hills of the Rocky Mountains.

"After passing these hills, we noticed a slight change in the vegetation, and although we were assured that the rainfall was light, we were convinced that the air contained more moisture, and hence produced heavier dews and retarded evaporation. Gradually the grass became taller, and a few miles east of the Benton Trail, a geranium (*G. incisum*), that is a real hygrometer, began to appear on the damp slopes of the hillsides and afterwards increased so much that it was a very prominent feature of both thicket and prairie in the foot-hills of the mountains.

Milk River Ridge.

"We were unfortunate in our weather while examining the Milk River Ridge, as it rained a great part of the four days we spent on it. Large collections were, however, made, and many notes taken on the fauna and flora. The 'Ridge' is a plateau with a system of lakes and creeks which contain excellent water and are the home of many species of water-fowl. A large part of the interior produces hay in great abundance, which is cut every year and taken to Lethbridge, the Police posts, and to various ranches in the neighbourhood.

"Late on the evening of July 20th, we descended the north-western face of the Ridge and camped near Pot-hole Creek. This stream is well named as it is nothing but a series of pools of very good water. The next day we reached the St. Mary River and camped in its valley. Extensive collections were made there, as well as in the valley of Lees Creek at Cardston and in the 'big bend' of Belly River. On the evening of July 27th we camped on the shore of Waterton Lake, almost under Sheep Mountain, which rises steeply from the water to an altitude of 7500 feet. Natural History—*Cont.*

"After reaching the St. Mary River, the whole country was covered with tall grass, which, in most places, was fit for hay and the soil was exceptionnally good. South of the Blood Reserve, between the St. Mary and Belly rivers, most of the land has been homesteaded by the Mormons and some very good farming has been done around Cardston and vicinity. All the settlers there expressed themselves as well pleased with the locality and their prospects. Morman settlements.

"Six days were spent collecting around Waterton Lake and on Sheep Mountain, and over 200 species of plants added to the season's list. On August 2nd, we started north, crossed Waterton River at Stand Off on the 3rd and passing by Fort McLeod reached Lethbridge on the 7th. From there I went by train to Medicine Hat, where I made collections of plants, as well as at Maple Creek, Moose Jaw and Indian Head, leaving the latter place on August 16th and reaching Ottawa on the 19th. The outfit in charge of my assistant and the teamster, I sent across the country from Lethbridge to Moose Jaw where they arrived August 28th.

"During the season close attention was given to the distribution of the summer birds of the region traversed and many interesting results were obtained. Besides their distribution, their breeding habits and the structure of their nests was carefully noted, and eggs were collected of at least seventy species during the past two seasons. Up to date the number of species of birds recognized in Assiniboia and Alberta is 226. Nearly all of them are represented in the museum collection. Waterfowl and waders breed in the above districts in enormous numbers, and egging expeditions, along the line of the Canadian Pacific Railway and north of it, should be stopped by the necessary legislation; as from the writer's personal knowledge such expeditions, in which thousands of eggs of game birds are destroyed, have been taking place for the past five years, greatly to the injury of the country. Distribution of birds.

"Botanical collections were made in all parts of the region traversed, and the distribution and occurrence of the species noted, and since my return the plants collected have been examined and determined.

Natural History—*Cont.*

"Perhaps the most important result of the past season's work, as shown by the flora of the region traversed, is that from Western Manitoba to the Milk River Ridge, the plants of Southern Assiniboia are practically identical with those of Southern Alberta. A comparison of these plants with collections made by me in 1879, at and around the Hand Hills, lead me to believe that Northern Assiniboia and Alberta have a warmer climate than the region south of the Missouri water-shed, probably as a result of lower elevation.

Causes of drought.

"Following out your instructions, I made inquiries of every person I met regarding the drought and the alleged drying up of the whole prairie region. Although the reasons given were often diverse, all agreed that lakes, pools and marshes were drying up, and that where water formerly stood, hay was now being cut. At every point visited during the summer, I took notes on the condition of the country, which have been in part embodied in the preceding summary. The conclusion I have reached is that such changes are periodic, throughout the region visited, and that the present dry period will pass and the lakes and ponds fill again.

"This agrees with the opinions expressed by most of the old settlers. If the snowfall is light and evaporates without turning into water, and this is followed by a dry spring, the ponds and marshes dry up, but if there is a heavy fall of snow in April or early May, the ponds will be filled and water plentiful.

"Last August, the drought was broken everywhere, and the ground fairly moist, but no water collected either in ponds or the sites of old lakes. Should this winter be a normal one and the melting snow in spring saturate the ground, I look forward confidently to a quick return of the condition of ten years ago. At any rate, I am satisfied that the permanent drying up of the country is a myth.

"Over 100 skins of birds and about 50 mammals were secured, principally of species collected last season."

Mr. J. Fletcher on Entomological collection.

Mr. James Fletcher, F.R.S.C., Entomologist and Botanist to the Central Experimental Farm, to whom the Geological Survey is greatly indebted for his services as honorary curator, in connection with the entomological collections in the museum furnishes the following report upon these collections:—

"I beg to report that the entomological collections are in good order, and that a few additions have been made during the past year.

The most important additions were contributed by Prof. John Macoun, who brought back a collection of Lepidoptera from seven different localities in the west. Natural History—*Cont.*

"The following rare species are worthy of record :—

Anthocharis Olympia, Walsh's Ranch, Old Wives Creek, 23rd May.
Hypparchia Ridingsii, *Satyrus Œtus*, *Chrysophanus Sirius*, } Milk River, near West Butte, 14th July.

"A small collection was also brought in by Dr. Robert Bell, and another was contributed by Mr. J. C. Gwillim. These consisted of only a few specimens; but as each insect was labelled with the locality and date of capture, they have a scientific value as bearing on the known distribution of species.

"A small collection of Coleoptera was made by Mr. A. P. Low in Labrador, and since I last reported to you, collections were made on the Alaska Boundary survey by Messrs. Ogilvy, St. Cyr and Wolston Small, and have been handed in.

"In accordance with your suggestion, I am preparing for the Museum of the Rocky Mountain Park at Banff a collection of butterflies characteristic of that neighbourhood. This will I think be ready by April next."

MAPS.

Mr. James White reports as follows upon the condition of the mapping work in the office, and upon a connecting line of survey run by him in Ontario for the purpose of establishing the latitude and longitude of points in sheet No. 118 of the Ontario series :— Maps

"The ordinary routine work in connection with the laying down of projections and general supervision of the draughting has been attended to. Considerable time was also given to the preparation of the new list of publications.

"As the position of the townships in sheet 118, Ontario (Haliburton sheet) was somewhat doubtful, you deemed it advisable to connect the south-western part of the sheet with some point whose position had been accurately determined. In accordance with instructions I left Ottawa on the 16th September and proceeded to Gelert Station, where I joined Mr. Barlow. From this point we carried a traverse-line with transit and chain to the village of Waubashene on Georgian Bay, as its position had been determined by Commander Boulton in connection with the Georgian Bay survey. This fixes the position of

Maps—*Cont.* the townships in the south-western part of sheet No. 118 and along the traverse-line through the northern part of sheet No. 114. A few of the results are appended herewith, adopting the position of the Episcopal church at Waubashene (the terminal point of the survey) as given on chart No. 2102, viz., Long. 79° 42′ 24″ W., Lat. 44° 45′ 29″ N.:—

Gelert Station.....Long. 78° 37′ 02″; Lat. 44° 53′ 52″
Kinmount Station.....Long. 77° 35′ 07″; Lat. 44° 46′ 47″
Norland Post Office.....Long. 78° 48′ 39″; Lat. 44° 43′ 34″
Narrows between Lakes Couchiching and Simcoe.....Long. 79° 21′ 44″; Lat. 44° 36′ 16″

"A similar traverse in 1893 from Kingston to Sharbot Lake gave the following result:—

Sharbot Lake Station.....Long. 76° 41′ 29″; Lat. 44° 46′ 18″

"The maps published during the past year and in the course of preparation, are appended herewith.

MAPS PRINTED IN 1895.

	Area in square miles.
556. British Columbia—Kamloops Sheet—Geology.—(Dr. Dawson). Scale 4 miles to 1 inch.....	6,400
557. British Columbia—Kamloops Sheet—Topography, economic minerals and glacial striæ. (Dr. Dawson). Scale 4 miles to 1 inch.....	6,400
567. British Columbia—Sketch-map of the Finlay and Omenica rivers.—(Mr. McConnell). Scale 8 miles to 1 inch.....	7,000
560. Western Ontario—Sheet No. 6—Seine River Sheet.—(Messrs. McInnes and Smith). Scale 4 miles to 1 inch (preliminary edition).....	3,456
558. New Brunswick, Prince Edward Island and Nova Scotia.—Sketch-map showing area occupied by Pleistocene glaciers at their maximum extension.—(Mr. Chalmers). Scale 40 miles to 1 inch.....	132,800
559. New Brunswick, Prince Edward Island and Nova Scotia.—Sketch-map showing striation from local glaciers and floating ice during closing stage of the Pleistocene.—(Mr. Chalmers). Scale 40 miles to 1 inch.....	132,800
561. New Brunswick and Nova Scotia—Sheet 4 N. W.—Cumberland Coal-field Sheet—Surface Geology. (Mr. Chalmers). Scale 4 miles to 1 inch.....	3,456
562. New Brunswick—Sheet 2 S. E.—Richibucto Sheet.—Surface Geology. (Mr. Chalmers). Scale 4 miles to 1 inch.....	3,456

Maps—*Cont.*

563. New Brunswick and Prince Edward Island—Sheet 5 S. W.—Buctouche Sheet.—Surface Geology. (Mr. Chalmers). Scale 4 miles to 1 inch 3,456

387. Nova Scotia—Sheet No. 33—Cape George Sheet.—(Mr. Fletcher). Scale 1 mile to 1 inch 216

388. Nova Scotia—Sheet No. 34—Antigonish Town Sheet.—(Mr. Fletcher). Scale 1 mile to 1 inch 216

389. Nova Scotia—Sheet No. 35—Lochaber Sheet.—(Mr. Fletcher). Scale 1 mile to 1 inch 216

390. Nova Scotia—Sheet No. 36—West River St. Marys Sheet.—(Messrs. Fletcher and Faribault). Scale 1 mile to 1 inch 216

550. Nova Scotia—Sheet No. 37—Liscomb River Sheet.—(Mr. Faribault). Scale 1 mile to 1 inch 216

551. Nova Scotia—Sheet No. 38—Mosers River Sheet.—(Mr. Faribault). Scale 1 mile to 1 inch 216

Maps, Engraving or in Press.

Western Ontario—Sheet No. 9—Lake Shebandowan Sheet.—(Mr. McInnes). Scale 4 miles to 1 inch 3,456

Ontario—Sheet No. 125—French River Sheet.—(Dr. Bell). Scale 4 miles to 1 inch 3,456

Ontario—Sheet No. 126—Manitoulin Island Sheet.—(Dr. Bell). Scale 4 miles to 1 inch 3,456

Ontario—Sheet No. 131—Lake Nipissing Sheet.—(Mr. Barlow). Scale 4 miles to 1 inch 3,456

Quebec—Lièvre River and Templeton Phosphate Mining District. Sheets I. and II.—(Messrs. Ingall and White). Scale 40 chains to 1 inch 220

Quebec—South-west quarter-sheet of the "Eastern Townships" map—Montreal Sheet, Scale 4 miles to 1 inch 7,200

Nova Scotia—Sheet No. 39—Tangier Sheet.—(Mr. Faribault). Scale 1 mile to 1 inch 216

Maps, Compilation Completed.

Athabasca Territory and British Columbia—Sheets I., II. and III. (to illustrate the work of Mr. McConnell, 1889-90, and extending from long. 110° W. to 120° W. and lat. 54° N. to 60° N. Scale 8 miles to 1 inch 150,000

District of Keewatin and Province of Ontario—Vicinity of Red Lake and part of Berens River—(Mr. Dowling). Scale 8 miles to 1 inch 8,240

Ontario—Kingston and Pembroke Mining District.—(Mr. White). Scale 4 miles to 1 inch 1,700

Quebec and North-east Territory, Labrador Peninsula, extending from the Atlantic Ocean to Hudson Bay and from the River St. Lawrence to Hudson Strait, four sheets.—(Mr. Low). Scale 25 miles to 1 inch 525,000

Maps—*Cont.*

Nova Scotia—Sheets Nos. 40 to 42 and 49 to 52.—(Mr. Faribault). Scale 1 mile to 1 inch 1,512

Nova Scotia—Sheets Nos. 43 to 48.—(Mr. Fletcher). Scale 1 mile to 1 inch 1,296

MAPS, COMPILATION INCOMPLETE.

British Columbia—Shuswap Sheet.—(Mr. McEvoy). Scale 4 miles to 1 inch 6,400

British Columbia—West Kootanie Sheet.—(Mr. McConnell). Scale 4 miles to 1 inch 6,400

North-eastern Manitoba—Lake Winnipeg Sheet.—(Messrs. Tyrrell and Dowling). Scale 8 miles to 1 inch 20,000

Ontario—Sheet No. 129—Mississagui River Sheet.—(Dr. Bell). Scale 4 miles to 1 inch 3,456

Ontario—Sheet No. 138—Lake Temiscaming Sheet.—(Mr. Barlow). Scale 4 miles to 1 inch 3,456

Quebec—North-west quarter-sheet of the "Eastern Townships" Map.—(Messrs. Adams, Giroux and Low). Scale 4 miles to 1 inch 7,200

Quebec—Sketch-map of part of Joliette, Terrebonne, Montcalm, Argenteuil and Ottawa counties.—(Dr. Adams). Scale 4 miles to 1 inch 3,620

New Brunswick—Sheet 1 N. W.—Fredericton Sheet.—Surface Geology. (Mr. Chalmers). Scale 4 miles to 1 inch 3,456

New Brunswick—Sheet 2 S. W.—Andover Sheet.—Surface Geology. (Mr. Chalmers). Scale 4 miles to 1 inch 3,456

Nova Scotia—Sheet No. 10A—Cape Dauphin Sheet.—(Mr. Fletcher). Scale 1 mile to 1 inch 216

Nova Scotia—Sheet No. 12A—Sydney Sheet.—(Mr. Fletcher). Scale 1 mile to 1 inch 216

Nova Scotia—Sheet No. 12B—Little Glace Bay Sheet.—(Mr. Fletcher). Scale 1 mile to 1 inch 216

Nova Scotia—Sheets Nos. 53, 54, 55 and 66, 67, 68 and 69.—(Mr. Faribault). Scale 1 mile to 1 inch 1,548

Nova Scotia—Sheets Nos. 56 to 65, 76, 82, 100 and 101.—(Mr. Fletcher). Scale 1 mile to 1 inch 3,024

LIBRARY.

Library.

Dr. Thorburn, Librarian of the Survey, reports that during the past year ended December 31, there were distributed 12,583 copies of the Survey publications, comprising reports, special reports, and maps. Of

these 9,924 were distributed in Canada, the remainder, 3,375, were sent as exchanges to other countries. Library—*Cont.*

There were sold during the year 1,711 publications, consisting of reports and maps, for which the sum of $388.49 was received.

There were received, as exchanges and donations 2,247 publications.

There were purchased 44 publications and the periodicals subscribed for were 31.

The number of volumes bound was 154.

In connection with the library 745 letters were received, in addition to 1,367 acknowledgments.

The number of letters sent out from the library was 553, besides 578 acknowledgments.

It is estimated that there are now in the library about 11,000 volumes besides a large collection of pamphlets. These relate mainly to the various branches of Geology, Mineralogy, Botany and Zoology.

It may be stated that the books in the library are available for consultation by any one wishing to obtain information in regard to any scientific subject in which he is interested, and a number of persons from time to time, take advantage of this provision.

VISITORS.

The number of visitors to the museum continue to increase, notwithstanding the imperfect manner in which a large part of the collections are displayed in the present building. During the year 1895, 26,785 names were registered in the visitors' book. Visitors.

STAFF, APPROPRIATION, EXPENDITURE AND CORRESPONDENCE.

The strength of the staff at present employed is 47. Staff.

During the calendar year the following changes in the staff have taken place:

Dr. A. R. C. Selwyn, superannuated.

Mr. H. P. Brumell, resigned.

Dr. G. M. Dawson, appointed director and deputy head, *vice* Dr. Selwyn.

Mr. D. B. Dowling, appointed to the second class.

Mr. C. O. Sénécal, appointed to the second class.

Mr. James McEvoy, appointed in the technical class.

Mr. R. A. A. Johnston, appointed in the technical class

Appropriation and expenditure.

The funds available for the work, and the expenditure of the Department during the fiscal year ending the 30th June, 1895, including appropriations for boring in Alberta, were:

	Grant.	Expenditure.
	$ cts.	$ cts.
Civil list appropriation	51,925 00	
Geological Survey appropriation	61,129 51	
Artesian boring "	16,000 00	
Civil list, salaries		48,763 39
Exploration and survey		14,767 93
Wages of temporary employees		16,723 88
Boring operations, Deloraine		88 22
" " Athabasca Landing		7,688 82
Printing and lithography		18,424 23
Purchase of books and instruments		1,416 09
" chemicals and chemical apparatus		224 02
" specimens		175 56
Stationery, mapping materials and Queen's Printer		1,640 01
Incidental and other expenses		1,967 41
Unpaid balances, 30th June, 1894		1,142 92
Advances to explorers on account of 1895-96		4,773 87
		117,796 35
Less—Paid in 1893-94 on account 1894-95		214 63
		117,581 72
Unexpended balance Civil list appropriation		3,161 61
" " Artesian boring appropriation		8,311 18
	129,054 51	129,054 51

The correspondence of the Department shows a total of 7999 letters sent, and 8271 received.

I have the honour to be, sir,
Your obedient servant,

GEORGE M. DAWSON,
Deputy Head and Director.