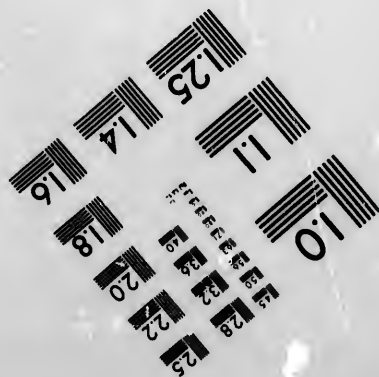
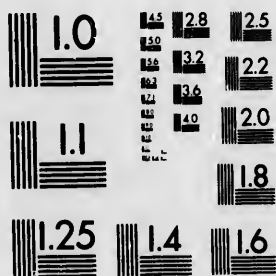


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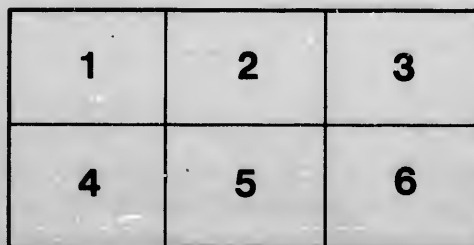
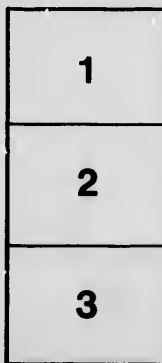
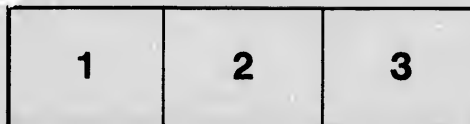
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REPORT

OF

EXPLORATIONS AND SURVEYS

IN PORTIONS OF THE

COUNTIES OF CARLETON,

VICTORIA, YORK AND NORTHUMBERLAND,

NEW BRUNSWICK.

1885.

By **L. W. BAILEY, M.A., Ph.D., F.R.S.C.,**

PROFESSOR OF NATURAL HISTORY IN THE UNIVERSITY OF NEW BRUNSWICK.



PUBLISHED BY AUTHORITY OF PARLIAMENT.

MONTREAL:
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1886.

1883

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A. R. C. SELWYN, Esq., LL.D., F.R.S., &c.,

Director of the Geological and Natural History Survey of Canada.

SIR,

I beg to submit herewith a report of geological investigations made, in accordance with your instructions, chiefly during the summer of 1884, in portions of northern and western New Brunswick.

In addition to my own observations, the report embraces those of my assistants, Mr. Wm. McInnes and Mr. J. W. Bailey, who have also constructed the accompanying map. In this map an attempt has been made to represent the orographic as well as the geological features. It forms Sheet No. 2 S. W. of the general geological map of the province. My acknowledgements are again due to the manager of the New Brunswick Railway Company for facilities afforded both to myself and my assistants; as well as to the officers of the Crown Lands Department in Fredericton.

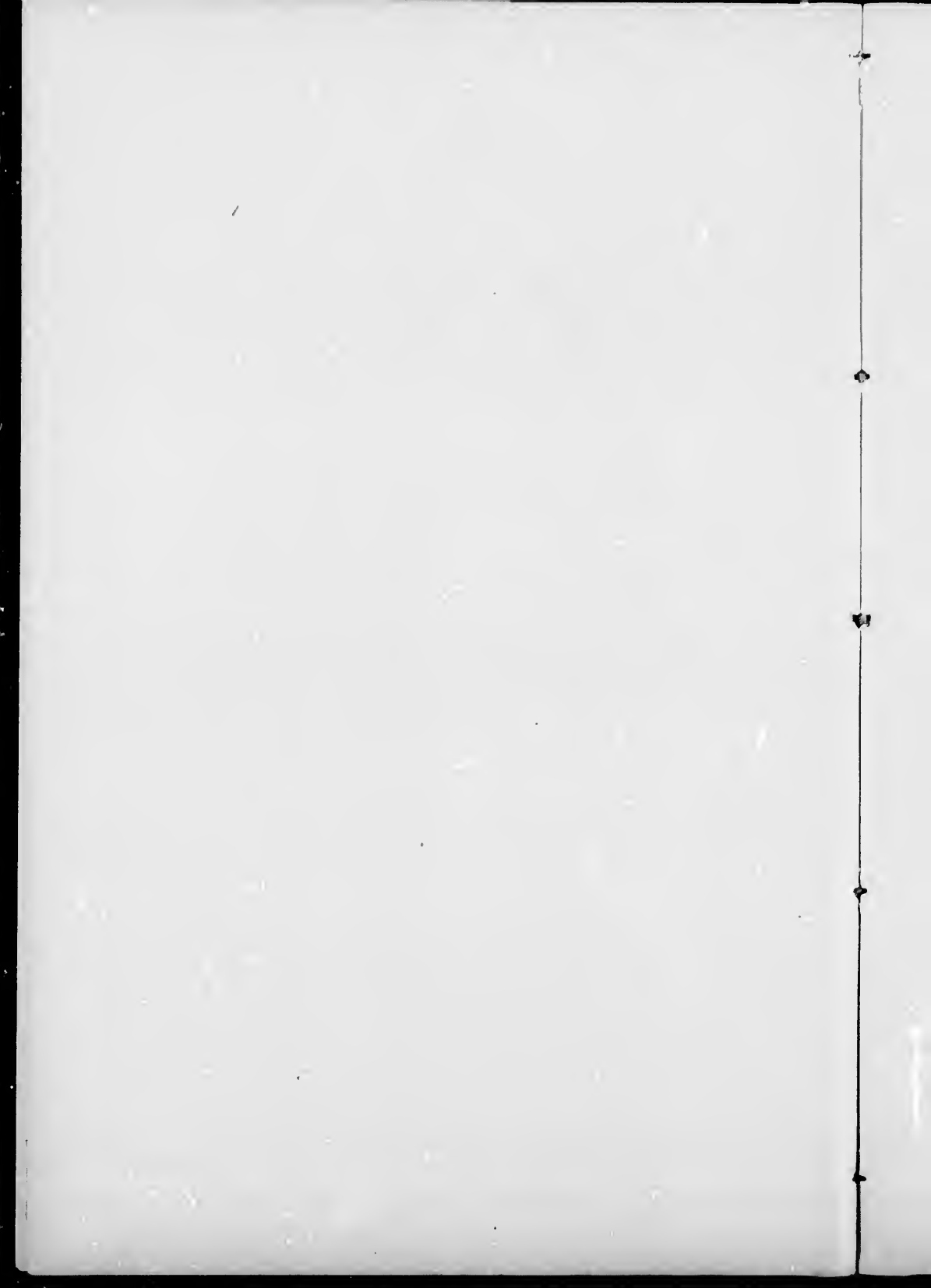
I have the honour to be,

Sir,

Your obedient servant,

L. W. BAILEY.

FREDERICTON, January 11, 1886.



REPORT
OF
EXPLORATIONS AND SURVEYS
IN
PORTIONS OF THE COUNTIES OF CARLETON, VICTORIA,
YORK AND NORTHUMBERLAND,
NEW BRUNSWICK.

The region to which this report relates includes portions of the ^{Region} counties of Carleton, Victoria, York and Northumberland. It lies ^{described.} immediately north of that described in the Report of Progress for 1883, and forms a parallelogram, of which the western and the eastern borders are respectively marked in a general way by the boundary of the State of Maine, and a north-and-south line cutting the Miramichi River about eight miles below Boiestown; while the southern border is an east-and-west line crossing the St. John River two and a-half miles above Woodstock, and the northern border a similar line intersecting the same river four miles north of Aroostook junction. Owing to the approximation of the St. John River to the United States frontier, north of Woodstock, the portion of the area lying to the westward of that stream forms but an inconsiderable part of the whole. It is, however, its most populous portion, the settlements east of the river being comparatively few, while over a large part of the district examined the country is still in unbroken forest.

Topographically, the region is one of much diversity. Portions of ^{Topographical} it, more particularly on the western side of the St. John River, though ^{features.} by no means low, are comparatively flat or gently undulating; but in general the surface is broken by numerous ridges, varying in elevation from 500 to 1,200 feet above the sea level, while between these, the valleys, though sometimes broad and open, are often remarkable for their depth and their abruptness. These depressions are usually occupied by water-courses of greater or less size, and within the district are included, wholly or partly, such important streams as the Tobique, the South-west Miramichi, the Beccaguimic, the Aroostook, the Nashwaak and the Presque Isle. The usual course of the hill ranges is

between N 20° E and N 25° E,* becoming in the northern portion more nearly north and south, but these courses would seem to have had but little influence in determining that of the streams and rivers, which not unfrequently intersect the hill ranges obliquely or even at right angles. In such cases it is usual to find the passage accompanied by more or less considerable rapids or falls, as illustrated in the Grand Falls of the St. John river (74 feet), the Aroostook Falls and the Narrows of the Tobique. Lakes are comparatively few and of small extent.

Elevations.

The following table of elevations above sea level, based on barometric observations, made chiefly by Mr. J. W. Bailey, but including also a few as determined by Mr. Chalmers and the Boundary Commission, is intended as supplementary to the hill sketching as represented upon the map:—

	FEET.
Moose Mountain.....	1,030
Hill on Shiktehawk, north of Glassville Centre	1,255
Ridge north of West Glassville	785
Ridge on Shiktehawk, south of Johnville Road.....	795
Hill, $\frac{1}{4}$ of a mile south of Gordonville Post-office.....	995
Glassville Centre	790
Johnville Church	640
Height of land between Pokiok Bridge on Tobique River and Little River.....	650
Hill on Stickney Brook, 2 miles east of St. John River..	900
Nashwaak Mountain, on South Branch of Miramichi....	855
Height of land between Foreston and McEwen's on S.W. Miramichi	900
Between Foreston and Smith's Corner	875
Hill at Argyle Corner.....	1,135
Ridge opposite Andover.....	590
Hill, $1\frac{3}{4}$ miles below Andover, $1\frac{3}{4}$ miles back from St. John River.....	800
Height of land 3 miles back from Tobique River on Red Rapid settlement road.....	1,190
Mars Hill.....	1,688

The character of the soils and the agricultural capabilities of the region vary with the nature of the rock formations which occupy its several portions. Some remarks upon these subjects will be found in connection with the descriptions of the latter given below, but as they have been made the subject of special examination by Mr. R. Chalmers, it has not been thought necessary to give them extended consideration here.

* These, and all other courses given in this report, are with reference to the true meridian. The variation is about 20° W.

Geologically the region is found to embrace the following systems and divisions:—

G. Carboniferous.

(a) Middle Carboniferous (Millstone Grit.)

(b) Lower Carboniferous.

Geological
formations.

F. Devonian.

E. Silurian.

D. Cambro-Silurian.

A. B. Pre-Cambrian.

Crystalline rocks, including granite.

G. CARBONIFEROUS.

The Carboniferous rocks in the district examined are of comparatively limited extent, and are comprised in three areas, of which one includes a portion of the valley of the Tobique, a second, a part of the district traversed by the Beceagnimic and its tributaries, and the third, portions of north-eastern York county, between Stanley and the Miramichi River.

The Tobique area was somewhat closely examined by Prof. H. Y. Hind in 1865 and again by Mr. Charles Robb in 1868, and in the reports of these gentlemen the more important facts as to its extent and character are given. The present examination has been chiefly directed to a more accurate limitation of its boundaries, effected by ascending and measuring the several streams—the Gulquac, the Odell and Odelloch—which are tributary to the Tobique from the southern side. These measurements, made by Mr. McInnes, give this Carboniferous area a somewhat increased breadth as compared with previous representations. Its southern margin is near the head-waters of the streams named, and distant, at the widest part, about nine miles from the main valley of the Tobique. The total breadth of the area would thus be about twelve miles, and its length, from the Red Rapids to Blue Mountain, about twenty-seven miles.

The rocks appear to belong wholly to the lower or marine division of the Carboniferous system, and as seen along the course of the Tobique, present a succession of low undulations, the dip rarely rising higher than 4° or 5° . The following is a summary of their main sub-divisions in descending order:—

Trappean beds, consisting of grey amygdaloidal dolerite.

Heavy beds of impure gypsum, of pale-green and reddish colours, mostly fibrous but sometimes compact, alternating with thin beds of red shale. Thickness about 350 feet.

Red, grey and green shaly and marly beds, with thin beds of fine-grained grey, red or mottled limestone. Thickness 140 feet.

White, red and variegated calcareous sandstones and grits.

Red and grey conglomerates and sandstones, the former holding pebbles of Silurian slates.

The above succession is, in its main features, similar to that of the Lower Carboniferous formation as seen in Kings, Albert and Westmoreland counties.

The remarkable fertility of this Carboniferous area is attested by the character and the luxuriant growth of its indigenous vegetation, and had attracted attention long before any attempts were made to occupy it for settlement. Now, its fertility and value are fully recognized, and since it has been brought into closer connection with outside markets by the extension of the New Brunswick railway, it has shown a constant and rapid growth in population and productiveness.

The Carboniferous area of the Beccaguimic is considerably smaller as well as more irregular than that of the Tobique. It also presents a somewhat different succession of rocks.

Beccaguimic
area.

Its general form may be described as broadly triangular, with rounded angles and somewhat sinuous and interrupted margins. Two of these margins are coincident, or nearly so, with the two main branches of the Beccaguimic River, but west of the confluence of these streams the area extends to within a few miles of the St. John, where it was probably at one time connected with similar but smaller Carboniferous areas or outliers, occurring along the course of that stream.

Limits.

The highest rocks found in this district are included in the nearly elliptical area embraced by the two streams referred to above. They consist of a series of coarse, grey sandstones, associated with olive-grey freestones, both of which contain vegetable impressions in the form of broken stems. These are too imperfectly preserved to be identified, but the character and relations of the strata leave no doubt that the horizon is that of the millstone grit or base of the Middle Carboniferous. They dip uniformly at a low angle and their surface is consequently nearly flat, but where cut away by the valley of the South Branch they present towards the latter a bold escarpment, (nearly 400 feet in elevation) forming a prominent feature in the landscape. Portions of the flat thus formed are well wooded, but towards its eastern limit it is largely occupied by barrens and small lakes.

Middle
Carboniferous.

While the elliptical area above described, which forms the higher portion of the district, is thus occupied by Middle Carboniferous rocks, the deep valleys traversed by the main branches of the Beccaguimic dis-

close to view other and more ancient strata. These are described below and are in part of Silurian and Cambro-Silurian age, but resting upon the last-named rocks unconformably, and forming several small areas more or less disconnected, is also a series of beds the character and position of which sufficiently show that they are the representatives of the Lower Carboniferous formation. As seen along the valley of the North Branch, at and below Shaw's mill, they are mostly conglomerates of a coarse character, filled with large well-rounded pebbles of the underlying rocks, and possessing a brownish-red colour. Similar conglomerates occur also near the bridge above the Howard brooks, where they form conspicuous and precipitous hills with an elevation, above the valley, of about 300 feet. Still farther up, in the same valley, the highest beds seen are bright red and purple—sometimes mottled—sandstones and shales; but towards the head of the branch, the red rocks are seen to rest upon and apparently to graduate downwards into red somewhat earthy felsites, associated with grey felspathic or doleritic sandstones. These felsites are similar in character to those which occur at Harvey settlement and elsewhere around the border of the central Carboniferous area of the province, and are probably of contemporary origin. Excluding the felsites and associated trappean beds, the dip of the Lower Carboniferous sediments in this valley, like that of the coal measures, is usually low, varying from 5° to 20°. In some of the felspathic sandstones, however, as observed by Mr. Matthew, the dip is as high as 60°.

Owing to the thickly wooded character of most of the region adjoining the Beccaguimic and its branches, and the consequent infrequency of exposures, the determination of the nature of the underlying rocks is often a matter of considerable difficulty, and their boundaries are necessarily somewhat conjectural. Lower Carboniferous sediments, however, in the form of red marls and sandstones, occur along the larger part of the North Branch valley, and again along that of the South Branch, as far as its North Fork near Hamilton brook. The extreme limit of the Carboniferous triangle in this direction is probably about one mile west of South Branch Lake, and but little more from the south-western end of the great granite belt of York and Carleton. Carboniferous rocks also occupy, as has been before stated, a considerable area between the point of confluence of the branches of the Beccaguimic and the St. John River, being well exposed about the summit of the eminence known as Pole Hill, and again in the cuttings along the old track of the New Brunswick railway where this crosses the valley of the Little Pokiok stream. At Pole Hill, the rocks are red and grey conglomerates, resting, with a low dip, on highly tilted Silurian slates.

At the head of the Little Pokiok they are mostly of a finer character, embracing chiefly sandstones and shales of red and maroon colours and containing vegetable impressions. Their dip is also higher, rising to 40° or 45°.

Upper Wood-
stock.

In addition to these Carboniferous strata on the eastern side of the St. John, in Carleton county, one or two small areas, which are believed to be of similar age, are found upon the western side of the same stream, and mark a former extension of the Carboniferous basin in that direction. They are, however, confined to the immediate vicinity of the river, where they appear in the form of long, narrow belts, capping the hills and in part skirting the shore, between Upper Woodstock and Victoria corners. The rocks composing these belts are mostly coarse conglomerates, of a deep brownish-red colour, and often stained with manganese. They include, however, some finer beds. Their dip, like that of the beds on the upper parts of the Little Pokiok, is comparatively high, sometimes as much as 50° or 60°, but varies considerably, and is at all times much less than that of the Silurian slates, upon the upturned edges of which they may at various points be seen to rest.

F. DEVONIAN (?)

Supposed
Devonian rocks

In the description of the Lower Carboniferous of the Beccaguimic region, this age, as being that of the bulk of the sediments there met with, has been assumed, not only on the ground of their evident resemblance in colour, texture and composition, to the rocks of the same age in other parts of the province, but from their equally evident unconformity to the associated rocks, their usually low inclination, and their passage upwards into the ordinary rocks of the coal-measures. Accompanying, however, these Lower Carboniferous deposits, and not always to be easily distinguished from them, there are, in the same region, some other beds in which the relations are less evident, and which have been thought to indicate the presence of Devonian as well as Lower Carboniferous sediments in this portion of Carleton county.

The rocks in question are best exposed at the mouth of Little Pokiok brook, about two miles below Hartland, where their occurrence was first noticed by Mr. Chas. Robb. In texture and composition they are, for the most part, not unlike portions of the Lower Carboniferous rocks, consisting of coarse grey conglomerates, holding large, well-rounded pebbles, chiefly of Cambro-Silurian rocks; but interstratified with these are a few thin beds of finer character, some of which are black and glossy with carbonaceous material, and others are filled with impres-

sions of plants. These latter were determined by Sir Wm. Dawson, in 1871, as being the remains of *Psilophyton princeps*, and it was from their occurrence here that not only the beds more immediately containing them, but all the newer sediments of the Beccagnimic basin were supposed to be of Devonian origin, and regarded as the equivalents of the Gaspé sandstone of the province of Quebec. While, however, this latter view, for reasons above given, is now regarded as untenable, it does seem altogether probable that those plant-bearing strata, together with the conglomerates which enclose them, are of pre-Carboniferous origin, and did they stand alone, might well be regarded as of Devonian age. It is not, however, by any means so certain that they are not really in part pre-Devonian as well as pre-Carboniferous, and form a portion of the Silurian system elsewhere so prominently developed in the neighborhood. Unfortunately, there is nothing either in the character, position or fossils of these beds, at the locality in question, by which this point can be definitely settled. A strong confirmation, however, of the view that they are really Silurian is to be found in the occurrence of very similar remains on the north-east branch of the Beccagnimic, not only in rocks presenting quite a different aspect from those of the Little Pokiok, but among beds of which a portion at least are certainly of this latter age.

These beds occur on the left bank of the stream, about half a mile above Shaw's mill, and consist of dark-grey slaty sandstones or grits, having their surfaces covered with numerous linear and dichotomously branching stems, many of which are longitudinally furrowed and marked by rows of rounded knobs or depressions indicating the attachment of leaves. The associated rocks are rubbly, grey quartzites, which are felspathic and concretionary, and partly dark flinty slates, but their relations are greatly obscured by faults as well as by the smallness of the exposures, and no definite conclusion could be formed regarding them.

E. SILURIAN.

The existence of Silurian (or as then called Upper Silurian) rocks in northern New Brunswick was first announced by Dr. A. Gesner in 1843, organic remains indicative of this horizon having been found by him at various localities in the county of Restigouche, as well as along the valley of the St. John River, in what are now the counties of Carleton, Victoria and Madawaska. This conclusion has since been confirmed, as regards the general character of the district, by the observations of various explorers, among whom may be mentioned, Dr. James Robb, Prof. C. H. Hitchcock, Sir W. E. Logan, Prof. H. Y. Hind, Mr.

Chas Robb, and Mr. R. W. Ells. In the reports of all these gentlemen will be found much valuable information relating to the geological or other features of the region described, while that of Mr. Ells, published in the Report of Progress for 1874-75, is accompanied by a geological map, illustrating particularly the distribution of the iron ores of Carleton county. It was not, however, until the year 1880, that by simultaneous observations made by Mr. G. F. Matthew, on the eastern side of the St. John River, in the Beccaguimic region, and by the writer on the western side of the same stream, a definite physical and geological boundary of the formation was ascertained, and its relations to the other systems clearly established. These relations, as regards the section west of the St. John, from Woodstock to the Maine frontier, are described in the Report of Progress for 1882-84. Those of the eastern section, as made by Mr. Matthew, have also formed the subject of a special report, but as the district to which this relates has since been carefully re-examined and the strata there met with traced and studied over considerably wider areas, the results then obtained are, by permission, here embodied with those of the later and more extended observations.

Area of
Silurian.

The area of Silurian rocks to which this report relates is a very large one. West of the St. John River (where its southern border was described, last year, as extending from Victoria corners, nine miles above Woodstock, to the frontier, at Bull Creek in South Richmond,) the entire area between the river and the boundary, northward to the Grand Falls, is thus occupied. On the eastern side, the same southern border may be described as commencing at Deep Creek, two miles below Hartland, thence extending, north of Pole Hill, to the Beccaguimic River and its tributary, the North-east Branch, up the latter to the Howard brooks, and thence, by a nearly northerly course, through Skedaddle Ridge, to the settlement of Beaufort; beyond which, in the same direction, it is continuous to the eastern edge of the Tobique Carboniferous outlier already described. The country in this direction being thickly wooded, with few exposures, the exact limitation of formations is impossible, but the lines, as laid down, accord with such information as we have been able to obtain. Excepting the outlier referred to, the whole district north and west of the line described, is believed to be referable to the Silurian system.

Physical
features.

The physical features of this extensive area present, as might be expected, considerable diversity, and are worthy of remark from their bearing on the causes which have originated them as well as upon their relations to the agricultural capacity of the district. Speaking broadly, the Silurian area may be described as forming a moderately elevated plateau, having a mean height above the sea level of about 500 or 600 feet. In its western portion the plateau

is intersected through its entire extent, and in a general north-and-south direction, by the deep valley of the St. John, but as the sections thus made are of very unequal extent, so they also present many features of contrast as regards their orographical aspects. Thus, on the western side of the river, from Woodstock northward, at least as far as the boundary of Victoria county, and westward to the Maine frontier, the country, though far from being low or flat, is nowhere hilly, presenting rather a series of gentle undulations, with a drainage embracing numerous but mostly small streams, and not unfrequently diversified by small lakes. On the eastern side, on the contrary, hills and ridges are met with in almost every direction, these often attaining an elevation of over 1,000 feet, while the separating valleys are deep and not unfrequently abrupt, giving passage to such streams as the Beccaguimic* and the Shiktehawk, the Munquart and the Tobique. In most instances these ridges are composed of the same slates as those which occupy the intervening lowlands, and no very obvious connection can be traced between their occurrence and either the composition or structure of the rocks accompanying them. Occasionally, however, where these are of an eruptive character, as in Moose Mountain, (an eminence which, near the boundary between Carleton and Victoria, rises abruptly, from a comparatively level tract to a height of 1,030 feet), it is evidently to the hardness of their constituent minerals and consequent power of resistance that their prominence is to be ascribed. The general course of the slate ridges, like that of the formations composing them, is about N. 10°—20° E.

In the study of the geology of the Silurian district two main difficulties are to be contended with. Of these, one arises from the comparatively slight diversity in the nature of the rocks to be studied, which, as a consequence, present nearly the same aspect over wide areas, and the second, from the profound disturbances which they have everywhere undergone. It is thus well-nigh impossible to determine with anything like certainty, either the order of succession or the relative or total thickness of the several subdivisions of the system. Some aid, however, in this direction is afforded by the organic remains found at different points, as well as by the occurrence of ore deposits, and again by the occasional presence of conglomerates apparently marking the base of the system. From a careful study of these data we have been led to regard the following as representing their probable arrangement, the succession being a descending one:—

* In the case of the first named of these streams, a good illustration is afforded, not only of the extent but of the irregularity of the erosive processes by which these valleys have been formed, its serpentine course being such as to more than double the actual distance between its source and outlet.

Probable succession.

Grey, or greenish-grey (bluish weathering) argillites, with occasional alternating beds of greenish-grey sandstone.

Grey, green and bright-red slates, holding heavy beds of manganese hematite.

Grey, highly calcareous slates, conspicuously banded on weathered surfaces, and including at various points heavy beds of limestone, which are more or less fossiliferous.

Grey, calcareous and buff-weathering sandstones and slates, holding remains of crinoides, corals, brachiopods and graptolites.

Grey, calcareous conglomerates and sandstone, holding pebbles of Cambro-Silurian rocks.

Unconformity.

A description of the argillites which mark the base of the Silurian and their relations to the underlying Cambro-Silurian system, as seen on the western side of the St. John River, is contained in last year's report. It is, however, on the eastern side of the same river, and more particularly about the branches of the Beccagnimic, that their relations, as well as those of the higher beds, are most clearly seen. It has been already stated that considerable portions of the valleys occupied by these streams, as well as the higher lands which they include, are composed of Carboniferous sediments, but in cutting their way down through the latter, the water-courses in question have also exposed beds of considerably greater antiquity. The best exposures are to be found on the North-west Branch, above Shaw's mill. At the mill dam itself may be seen a few ledges of very hard, dark grey silicious slate, having a nearly vertical dip, and capped by nearly flat, brownish-red and rusty-weathering conglomerates, through which ridges of the slate project irregularly. The greater part of these conglomerates have the aspect of Lower Carboniferous sediments, and are apparently continuous with the strata of this age seen further down the valley, but some appear to be older, while the occurrence—a short distance up the stream already noticed—of beds holding the remains of *Psilophyton*, render it probable that both are a repetition of the very similar strata at the mouth of the Little Pokioik. The silicious slates, which again appear beneath the plant-bearing beds, as well as at various points between Shaw's and Campbell's mills, are, as will presently appear, of Cambro-Silurian age. In the hills, however, which overlook the valley on the west, and again along the course of the branch above the mill last named, are other beds which, both by their character and their fossils, show that they belong to the Silurian system. Among these strata are the grey conglomerates or grits, which, according to the tabular view above given, are regarded as forming the base of the Silurian succession. They are largely made

Basal conglomerates.

up of fragments of black, silicious slate and grey quartzite, such as might be derived from the Cambro-Silurian strata near by, imbedded in a grey, calcareous paste, of which portions, as observed by Mr. Matthew, seem to be largely made up of crinoidal fragments. They are also further distinguished from the Lower Carboniferous conglomerates which accompany them by their conformity to the trend of the Silurian system, by their much higher inclination, and in the finer beds, by a slaty cleavage not usually met with in the first-named formation. But the most interesting strata to be found in this vicinity are those which, as is believed, come immediately above these conglomerates in the Silurian succession, and which consist of a series of slates and sandstones abounding in organic remains. The discovery of fossils at this point was first made by Mr. G. F. Matthew in 1880, ^{Fossils.} who also recognized the existence here of two distinct and unconformable formations, but more recent and extended examinations, as well as more ample collections of fossils, have led to the inference that portions of the beds regarded by Mr. Matthew as Cambro-Silurian are really a portion of the overlying Silurian. The rocks in question are first met with, in ascending the stream, near the head of the mill pond above Campbell's mill, and consist of rubbly and somewhat micaceous sandstones or sandy slates, which in places hold pebbles of grey quartzite, ^{Campbell's mills.} and have a westerly dip at an angle of about 80°. Their colour in some parts is grey or dark grey, but more commonly purple or chocolate-brown, and their aspect often not unlike that of Lower Carboniferous sediments; but, apart from the extensive plications which they have undergone and the slaty cleavage by which this is accompanied, the occurrence here and there of such fossils as *Orthocerata*, *Trilobites*, ^{Fossils.} *crinoids* and shells, mingled with the remains of plants, leaves no doubt as to the much greater antiquity of the beds containing them. This is further indicated by the occurrence, a little higher up the stream, but in beds which are evidently part of the same series, of the abundant remains of *Graptolites*. Unfortunately, the majority of these fossils are too fragmentary for specific determination, but their general *facies* is certainly that of the Silurian system, while the comparison of the containing rocks with those met with elsewhere leaves little doubt as to their true position. As regards the graptolites, which are better preserved than the accompanying remains, Mr. Whiteaves furnishes the following note:—

"*Monograptus* sp. This form belongs to a group of monopronidian graptolites, comprising such related forms as *M. priodon* Bronn. and *M. lobuliferus* McCoy. Mr. Ami thinks that it may possibly be identical with *M. Sedgwickii* (the *Graptolithus Sedgwickii* of Portlock),

but the specimens have not yet been studied sufficiently to enable a confident opinion to be given on their specific relations.

"In Europe the genus *Monograptus*, of Goenitz, is regarded as exclusively of Silurian, as opposed to Cambro-Silurian age, and in Canada and the United States ranges as low as the Clinton formation, of which one of the species (*M. Clintonensis*, Hall, sp.) is very characteristic.

"On this evidence it would appear that the rocks in question belong to the Silurian system, as recently restricted in the publications of the Survey."

No other Silurian rocks than those above described are to be found in the North Branch valley, (the last beds visible being the basal conglomerates which, at the bridge above the Howard brooks, pass beneath the Lower Carboniferous outlier), but a few miles to the westward, in Windsor, as well as at various points in the intervening area, facts may be observed which tend to throw further light upon the Silurian succession. The most interesting beds to be found in this interval are undoubtedly the great deposits of limestone which have long formed an important source of lime-supply for all this portion of Carleton county. They are somewhat irregularly distributed, and, owing to the thickly wooded character of the country, rather difficult to trace. They seem, however, to occupy the position of one or more tolerably well defined belts, having a general north-east course, parallel to the border of the Silurian area, and extending from the St. John River near Hartland through the larger part of the parish of Brighton. There are, on the St. John, no workable deposits of limestone, but it is probable that this portion of the system is there represented by the beautifully banded or ribbanded beds which form the western shore at and below Hartland ferry, and which are so highly calcareous as to have led to unsuccessful attempts at their calcination. It was also stated, in the report of last year, that limestones, which have been worked to some extent, are found in what may be regarded as a continuation of the same belt, at Ivy's corner, twenty miles to the south-west, in the parish of Richmond. The largest as well as the purest of these deposits, however, are those which are to be found in the region about the upper waters of the Beecaguimie and its tributaries. One of these deposits, known as Gulliver's, is found at the head of Limestone brook, about a mile and a-half north-west of Pole Hill, but is not now worked. The limestones, which are but a few feet in thickness, occur in slates dipping $W < 40^\circ$, and in both rocks, remains of shells, erinoids and other organisms may be found, but mostly in a bad state of preservation. The next deposits to the eastward, and the most important of all, are those known as Turner's, which are found on the descent of the hill leading down to the North Branch valley about,

Windsor.

Limestones.

half a mile below Shaw's mill. Two quarries have been here opened, in one of which the thickness of the beds exposed is about 30 feet, while in the other, situated about 120 rods to the north, this is increased to about 100 feet, the rock being a compact bluish-grey limestone, with sparry veins and pockets. From both, considerable quantities of rock have been removed, further particulars of which will be found in the sequel. The course of the beds varies from N 30° E at the old, to N 5° E at the new quarry, and their attitude is nearly vertical. We were not able to find any fossils in the limestones, but the beds which accompany them, in the form of buff-weathering sandstones, are evidently, in part at least, a continuation of those already described as occurring along the course of the North-east Branch, and, as in the latter, were found to contain the stems of crinoids, as well as the shell of a large *Orthoceratite*. The course of the beds at Turner's, already given, as well as that at Gulliver's, would indicate an extension of this belt in the direction of the Howard brooks and Skedaddle Ridge, and the accompanying rocks, in the form of grey grits, are actually met with in that direction, but from what is seen a few miles to the north-west, in Henderson settlement, it would appear that there is here a second belt, or, what is more probable, a repetition of the first, by folding or faulting. One bed of limestone belonging to this belt has been recently exposed on the north side of a high hill, around the flanks of which passes the road to Henderson's corner; but other and more considerable beds are to be seen close by the corner itself, where they have been and still are somewhat extensively worked. Their surface breadth at this point is about 200 feet, and their course about N 20° W, while the dips are variable and not easily distinguished. At both localities they are accompanied by grey buff-weathering sandstones or sandy slates, in every way similar to those of the North-east Branch, and at Henderson's these slates, as well as the limestones, are again fossiliferous, containing numerous joints of crinoidal stems, and, more rarely, remains of brachiopods, gasteropods, trilobites and branching corals, but mostly in a fragmentary condition. Among the forms collected by us Mr. Whiteaves has recognized *Pentamerus galeatus*, Dalman, and a *Dalmanites* (sp. indt.) both belonging to the Silurian system, while Mr. Matthew previously obtained from the same locality small individuals of *Atrypa reticularis* and *Strophomena depressa* or allied forms, besides remains of graptolites. At both localities also, as well as in the interval between them, may be seen masses of grit and conglomerate in every way similar to those already described as occurring near Shaw's mills and near the Howard Brooks on the North-east Branch. Like the latter they are conspicuously filled with fragments of black petrosilex and alternate with thin beds of dark

Turner's lime-beds.

Lime-beds.

Henderson's lime-beds.

Fossils.

Conglomerates.

grey slate and sandstone, the whole having a surface breadth of about twenty-five chains, with a nearly vertical dip, and a course about north. In this same direction, but at a distance of six or eight miles, similar beds have been observed crossing the road leading north from the settlement of Knowlesville. It is noticeable that these conglomerates in many respects are not unlike those which, at the mouth of the Little Pokiok, contain remains of *Psilophyton* and have been regarded as Devonian. There can be but little doubt, however, that those here considered are a portion of the Silurian system.

Calcareous
beds.

It has been stated that the limestones of Windsor (Henderson's) are probably a repetition by folding of those upon the Beccaguimic, and as the whole Silurian tract is one of highly disturbed and plicated strata, the reappearance of these beds at still other points to the north is no more than might naturally be expected. While, however, very highly calcareous strata, which nearly resemble those associated with the last-named limestones, occur at a number of points in northern Carleton and in Victoria county, and in several instances have been described as limestones, no beds sufficiently pure to be so called have been anywhere met with by us. In the admirable section afforded by the St. John River, beds of this character are well exposed at the following points, viz.:—along the eastern shore near the mouth of the Shiktehawk, a few miles further up (on the west bank) opposite Bath, at the mouth of the Munquart, at the mouth of the Muniac, about Andover and in the Narrows of the Tobique, and finally in the gorges of the Aroostook and Grand Falls;—they being, in each instance, portions of belts which appear to extend with approximate parallelism and with generally northerly or north-easterly courses, over much of the surrounding country. Like the beds below Hartland ferry, already described, they may usually be recognized, even at a distance, by their conspicuous banding or ribanding, the result both of the different hardness and the different weathering of the calcareous layers, often very delicate, of which they are composed. They are often, also, filled with sparry veins, and it is for the burning of material collected from the latter that most of the small kilns found scattered over the country, but now abandoned, have been erected. We have not been able to find any fossils in these more highly calcareous beds, but in the associated slates and sandstones they are not uncommon, and have been observed at a number of points. Some of these are mentioned in the reports of Dr. Gesner. The best localities, however, with which we are acquainted, are found on the bank of the St. John River, in Perth (just opposite the upper end of the town of Andover), and on the Tobique River, half a mile above the head of the Narrows. The beds on the Tobique are

Fossils in Perth

somewhat more sandy than those on the main river, but the fossils at the two points are very much the same, and as the distance between them is not great (not over two miles), it is not unlikely, notwithstanding a slight difference of strike, that the strata of the two places are continuous. They are especially remarkable for the number of large corals which they contain, the names of which, with other forms, are given in the following list, as determined by Mr. Ami, under Mr. Whiteaves' supervision:—

Halysites catenulatus, Linn.; small variety resembling one from Baie des Chaleurs.

Favosites Gothlandica.

Heliolites. sp. indt.

Syringopora. sp. indt.

Cyathophyllum Pennanti, Billings. [There appear to be connecting processes between the corallites, as in the above species, and a small inner area, through which the radiating lamellæ do not enter, thus resembling the structure of *Diphyphyllum*, Lam.]

Rhynchonella—allied to *R. Wilsoni*. Sby.

Murchisonia. sp.

Atrypa reticularis.

“The horizon of the above is probably not higher than the Lower Helderberg, nor lower than the Niagara.”

In the case of the Silurian beds so far noticed, considerable assistance towards their recognition has been afforded either by their lithological characters or by their contained fossils. The same is to some extent true of the beds which are now to be noticed, which contain the great deposits of iron ore in Carleton county; for although these, so far as known, do not contain any organic remains and are somewhat variable in their distribution, yet they are such, as both by their colour and other characteristics, to readily attract attention. Like the majority of the Silurian strata they are slates, and are also more or less calcareous, but are not conspicuously so, while the grey or dark-grey colour, elsewhere so prevalent, is here, in part at least, replaced by greenish, brownish-red or in some instances blood-red colours, associated not unfrequently with black superficial coatings of manganese. The distribution of the ore deposits has been pretty thoroughly worked out by Mr. R. W. Ellis in 1874, and in his report for that year will also be found many interesting facts relative to their character and work-

ing. To these I have only to add that, so far as I have been able to ascertain, there are, on the eastern side of the river, no deposits which either in extent or value will at all compare with those which have been opened and used west of the river, in Jacksontown. The few additional points at which they have been observed by us will be found indicated in the geological map accompanying this report. It may be added that, while along particular belts, many distinct beds undoubtedly exist, varying from a few inches up to twenty feet in thickness, there is also a recurrence of the belts as a whole along parallel but somewhat widely separated tracts. They thus afford another illustration of the repetition, by folding, which characterizes the entire Silurian area.

One such belt, but of little importance, is indicated by scattered observations as extending from near Hartland, on the St. John River, to the mouth of the Coldstream, a branch of the Beccagnimic, and some beds containing hematite, observed by Mr. Ellis and others near Glassville, may be a continuation of the same; though it is quite probable that these may belong to the next and principal belt, viz., that of Jacksontown, from which the so-called "Woodstock ore" was derived, and which is directly traceable from near Belleville, in the valley of the Meduxnakeag, to Flannigan's Hill on the St. John River. Among the blood-red slates which occur at this point, some were found to contain numerous large but badly preserved casts of shells, while in accompanying grey slates and sandstones were found remains of an *Alveolites*, together with many fragments of erinoids. Fossils were first obtained from this locality by Dr. Gesner. On the eastern side of the river this belt is probably represented, in part at least, by high ridges (800 feet by aneroid) about the sources of Stickney brook, and fragments of the red slate were observed in the hills just south of the Shiktehawk road, midway between Kent station and Gordonville; but the beds exposed on the road are mostly dark blue slates, associated, however, near the settlement last named, with peculiar beds of conglomerate and sandstone. These are referred to, in Prof. Hinds' report to the provincial government, as marking the base and lower limit of the Silurian system in Carleton; but in addition to the fact, as already shown, that the real boundary of the system is situated very much farther to the south, these conglomerates present a somewhat different aspect from those of the Beccagnimic, and are unaccompanied by any evidences by which their true position can be determined. They contain pebbles of slate, quartzite, white quartz and black petrosilex, together with numerous white quartz veins, and are interstratified both with slates and sandstones, the whole dipping N. 65 W. $< 60^\circ$.

No other belt of iron-bearing strata has been observed within the limits to which this report relates, but it may be worth while to notice

Iron-ore belts.

Fossils.

Conglomerate of Shiktehawk.

that another band of precisely similar character extends across the head-waters of the Aroostook, in the State of Maine, and probably approaches the provincial boundary between the latter and the Grand Falls, but, from the infrequency of exposures in this section, it has been impossible to determine whether this is the case or not. The beds upon the Aroostook are described in the report of Prof. Charles T. Jackson on the geology of Maine.

It has been stated that, in the case of the Silurian beds so far described, these usually present some feature, either of composition, colour or contained fossils, by which their recognition is made easy. It is, however, now to be observed that, in addition to these, there are, over various parts of the Silurian area, other beds, of which the precise position is less readily determinable. The larger part of these are argillites, which do not differ greatly from those already noticed, but which are usually less markedly calcareous, and which do not, so far as known, contain any organic remains. Good exposures of such slates may be seen at different points along the banks of the St. John River, as near Florenceville, between Bath and Upper Kent, on the hills about Perth, and at many other localities. They present some variety of colour and texture, including some greenish and purplish as well as grey beds, and both sandstones and slates. The absence, however, of any constant distinctive feature, makes their recognition and comparison at different points a matter of much difficulty. This difficulty is further enhanced by the very general and often highly complicated movements which these rocks, in common with the other Silurian strata, have undergone, and which makes the tracing out of individual beds well nigh impossible. It may even be that among the strata in question there are some which are older as well as others which are more recent than the Silurian system, as has been supposed to be the case in the northern part of the state of Maine, but of this we could here find no distinct evidence. The well known eminence of Mars Hill, along the eastern flank of which runs the International boundary line, and which attains an elevation above the sea level of 1,688 feet, has been thus regarded as in part of Devonian age, but the conglomerates of which it is composed, and which have been described as merely capping its summit, were found by Mr. McInnes, as far as they were seen by him in an ascent of its north-eastern side, to dip N. 75° W. at an angle of about 75°, and to be enclosed in slates not differing from those which elsewhere belong to the Silurian system.

Another set of beds, as to the precise relations of which there is also some doubt, consists, in part at least, of materials which are probably of igneous origin. These consist of diorites and dioritic sandstones, or of hard, felspathic beds, obscurely stratified, and appear to be very

irregularly distributed over the Silurian area. One tract of this kind may be seen about two miles north of the post office in Glassville centre, where are grey-weathering, felspathic quartzites, which are more or less amygdaloidal. Another, forming some prominent ridges, is found on either side of the Little Shikohawk, two miles east of Kent station, and includes heavy masses of dark-green, amygdaloidal diorite, a portion of which is stratified, and (at Lockhard's mill) passes into a curious conglomerate containing dioritic fragments, from one to three feet in diameter, embedded in a matrix of a similar character. Still another occurs near the head-waters of one of the branches of the Munquart, five miles north of Johnville, and attains an elevation of nearly 1,000 feet. But the most marked area possessing this igneous aspect is that of Moose Mountain, in Upper Kent, and close by the boundary line between the counties of Carleton and Victoria. This eminence, which rises with singular abruptness from the comparatively low land about the head-waters of the Munquart, and attains an elevation of 1,030 feet, appears to be chiefly composed of a dark-grey, somewhat red-weathering felsite, porphyritic with small crystals of felspar. It is distinctly stratified, with southerly and south-easterly dips, at angles of 40° to 50° , and probably forms much of the ridge extending easterly from this point along the county line, but as the latter is thickly wooded, its exact limits could not be ascertained.

The rocks in these several belts are often not unlike those which are commonly met with in connection with the Cambro-Silurian system, and it may be that they are in part really of this age, forming bosses which, by denudation, have been left protruding through the more recent strata. As, however, there is no definite proof of this fact, and as the areas which they occupy are comparatively small, we have preferred to represent them merely as volcanic masses connected with the Silurian system.

Intrusive rocks.

It may now be added that over many different parts of the Silurian area, and among rocks which are unquestionably of this age, true eruptive rocks, both in the form of dykes and intercalated masses, are to be met with, and are sometimes very conspicuous. One instance of such occurrence may be seen along the east bank of the St. John, two miles above Hartland, and was referred to in the report of last year. Another was observed near the mill in the settlement of Esdraelon. But the most notable example is that furnished by the Aroostook River. In the remarkable and picturesque gorge through which this stream flows for three quarters of a mile above its falls, such dykes are quite numerous, varying from two or three up to fifty or more feet, and it is chiefly to the presence of a large mass of this kind, transverse to the stratification, that the falls themselves are due. Similar dykes, but

of less conspicuous character, occur also in the gorge below the Grand Falls of the St. John.

The review of the Silurian system now given may be closed by a slight further reference to the nature and extent of the physical movements by which its rock formations have been affected. Probably no features in connection with the latter are more noteworthy than the evidences everywhere afforded of profound movements and displacement. These are found in all portions of the system, but are especially remarkable in connection with the more highly calcareous banded slates, such as are found about Grand Falls and the Aroostook, where the foldings and twistings of the strata could scarcely be exceeded either for variety or complexity. Faults are also innumerable, and, as well exhibited in the last of the localities above named, are intimately connected with the igneous or trappean outflows, to which reference has been made. Yet notwithstanding these local corrugations, it is easy to see that the more comprehensive movements by which the region has been affected exhibit an approximate degree of parallelism, as is evidenced not only by the extension of certain belts, like those of the limestones and iron ores, across a large part of Carleton county, with a nearly uniform trend (about N. 10° E.), but by the general prevalence of dips at right angles to such trends. In most instances these dips are high, but occasionally, as can be seen along the valley of the Shiktehawk, they may be low or the beds may even be horizontal. In such cases, the existence of a well-marked and nearly vertical cleavage makes more than ordinary caution necessary in any observations upon the structure.

Remarks upon the economic minerals of the Silurian will be found in the sequel.

CAMBRO-SILURIAN.

In the report of last year it was stated that to the south of the Silurian rocks, and occupying very considerable portions of York and Carleton counties, is a series of rocks which is unquestionably older, and probably of Cambro-Silurian age. These were further described as consisting of two or more belts of metamorphosed strata which rest upon, or more correctly are penetrated by, great masses of intrusive granite, the alteration increasing in proportion as the latter is approached and being presumably connected with its presence. The same rocks extend into the region to which the present report relates, and present, for the most part, the same features.

Of the several belts to which reference has been made, the more northerly enters the district under review along the valley of the St. John River not far above Woodstock, forming the western shore as far

north as Victoria corners, and the eastern nearly to the Little Pokiook River, two miles south of Hartland. Just east of this line, the same rocks also cover a large area, extending along the southern margin of the map as far eastward as a point nearly midway between the two branches of the Keswick River, a distance of twenty-two miles. This width is maintained, however, for a short distance only; for, a few miles to the north, the belt is not only overlaid by the great Carboniferous outlier of the Beccaquimic, already described, but is met, near Beccaquimic Lake, by great masses of intrusive granite, whereby it is divided into two much narrower belts. Of these the more northerly, beyond the Beccaquimic outlier, extends by the sources of the North Branch of the South-west Miramichi to and beyond the head of the Wapskehegan, one of the southern tributaries of the Tobique, while the other, crossing the granite or rather separating two granite areas, connects, towards the head of Nashwaak, with the second or southern belt of Cambro-Silurian rocks, extending thence to and beyond the South-west Miramichi. On the last-named stream the effects of irregular granite intrusion are again seen in the partial breaking up of the Cambro-Silurian rocks into separate belts, and in the great reduction in their breadth. The main belt, however, continues on, and leaves the limits of the map above the head-waters of the Dungarvon.

The Cambro-Silurian rocks of south-eastern Carleton county, as seen along the valley of the St. John River and again along the line of the New Brunswick railway, were fully described in the report of last year. Over all this tract the prevailing rocks are slates and sandstones which are usually of a grey colour, felspathic and often white-weathering; but some of the slates, as at Acker's Creek, are highly chloritic, with tints of green and red, while at other points they are associated with bedded diorites and felsites. None of the highly metamorphic strata (gneisses, mica-schists, &c.) which are so prominently developed in the south-western extension of the belt (as in Canterbury) have been met with here, but this may be largely due to the infrequency of exposures at the points where these might naturally be looked for. On the other hand there are, in the valley of the Beccaquimic, some beds apparently connected with the above, which are quite different from any elsewhere met with, and which are of special interest as affording the only direct testimony yet obtained as to their geological horizon. These are the black silicious slates and associated quartzites which have been referred to, on a previous page, as occurring in the bed of the last-named stream, a short distance above Shaw's mills. In his examination of these slates in 1880, Mr. G. F. Matthew observed the occurrence of flinty calcareous layers, and from the latter succeeded in obtaining a number of fossils.

Distribution.

Characters.

Silicious slates.

Fossils.

chiefly of small brachiopodous shells, but including also a few encrinural joints and an *Orthoceras*. During the past two seasons more ample collections of these fossils have been made by myself and Mr. McInnes, as well as by Mr. Thomas Reed of Fredericton, and in the material thus obtained, which has been submitted to Mr. Whiteaves, there have been found, not only numerous shells of a species of *Leptæna*, allied to *L. decipiens* of Billings, together with other brachiopoda, resembling *Lingulella*, *Strophomena* and *Discina*, but several trilobites referable to the genus *Harpes*. These last, like the shells, are unfortunately too fragmentary for specific determination, but the mere occurrence of this genus, of which three species, according to Mr. Billings, are found in the Trenton formation of Canada, is sufficient to show that the containing beds are at least Cambro-Silurian, if not possibly even older. The relation of these beds to the Silurian, and the fact that they have contributed material to the Silurian conglomerates, have been already noticed.

Of the more southerly belt of Cambro-Silurian strata, little need here Southern belt. be said. It enters the area to which the present report relates about the head-waters of Tay Creek, and thence extends, in a general north-easterly direction, across the Nashwaak and Taxes rivers, to and beyond the South-west Miramichi. Its lithological characters are much the Characters. same as those of the same belt in its south-western extension, as described in the report of last year, the prevailing rocks being slates and hard sandstones, of greyish, sometimes green or purple colour, between which and the granite there usually intervenes a greater or less mass of more highly altered strata, in the form of fine gnoisses, mica- or staurolite-schists, and black, pyritous slates. Fine exposures of all these beds may be seen upon the Nashwaak, between Stanley and the mouth of the Napudogan, and they are again repeated, with similar relations, both upon the Taxes and the Miramichi, where they have been examined and reported on by Mr. Chas. Robb. As their characters, at all these points, bear the closest resemblance to the rocks of the Cambro-Silurian system as represented in other portions of York and Carleton, it is highly probable that they are in great part referable to this system. It should not, however, be forgotten that it was in connection with this Fossils on Rocky Brook. same belt of rocks that fossils were some years since observed by Mr. Edward Jack, and subsequently collected by Mr. Chas. Robb, which, according to Mr. Billings, appeared to indicate that the containing beds were of about the age of the Lower Helderberg formation, or of the Gaspé limestones. We have made several attempts to obtain additional facts as to the stratigraphical position of this fossil-bearing band, but with little or no success. The locality in which the first discovery was made was on a small branch of the Rocky brook, itself one of the

smaller tributaries of the Nashwaak, and in a region which is still densely covered with forest; but though rocks apparently identical with those containing the fossils were found both here and on the Taxes, neither the thin stratum in which they occur was again met with, nor could any further information be obtained as to their relations. In view of all these facts we must continue for the present to regard the stratum in question as part of an overlying formation, but involved with the Cambro-Silurian in the general system of folding by which the whole region has been affected.

A. B. PRE-CAMBRIAN.

Mr. McInnis furnishes the following description of these rocks:—

Typical rocks. The rocks which have been referred to this division on the accompanying map consist of a series of highly crystalline strata, and include gneisses, syenites, and felsites. They have been thought to form a continuation of the area of Pre-Cambrian rocks recognized by Mr. Ellis as extending south-westerly in a gradually widening belt from the Nepisiguit, across the main North-west and Little South-west Miramichi Rivers, and described by him in the Report of Progress, 1879-80. The typical rocks of the formation as here represented are crystalline felsites, generally, though often obscurely, stratified, and hard, fine grained syenites, which not unfrequently merge almost insensibly into the felsite beds. Although including areas of gneissic rocks, they lack the distinctly schistose aspect which so markedly characterizes them, as described by Mr. Ellis, in their extension to the North-east.

Igneous rocks. Intruded masses of igneous rocks of very considerable extent without doubt occur within the limits here assigned to the Pre-Cambrian. No attempt has been made, however, to represent them on the map, as the inaccessible nature of the greater part of the region has prevented the accurate tracing of their outlines. The dissimilarity of the rocks of this formation to the intruded granites on the one hand, and to the Cambro-Silurian strata on the other is very marked, and is well shown in the section afforded by the Clearwater stream, a tributary from the north of the main South-west Miramichi River, which cuts successively through the Pre-Cambrian, the intruded granites and the Cambro-Silurian rocks.

Clearwater brook. Ascending this stream, ledges of red and grey intrusive granite of coarse texture with large crystals of felspar are first met with. Above, for a distance of about three and a-half miles, almost continuous exposures of hard, banded, felspathic quartzites, often chloritic, purple in colour, and holding iron pyrites, occupy the bed of the

stream, causing the occurrence along this part of its course of numerous falls and rapids.

These rocks are quite similar to the Cambro-Silurian strata seen in other parts of the district. They show the influence of the intrusion of the granite in their alteration in places into schists holding staurolite crystals and in their prevailing purple colour with conspicuous banding. Although much twisted and contorted, they maintain a general northerly dip at an angle of about 70° to $E0^{\circ}$. Alteration.

After passing over a belt of coarse red granite with a width of about six miles, a continuation of that crossing Burnt Hill brook and main South-west Miramichi River, the first rocks of supposed Pre-Cambrian age are met with. They are reddish-grey gneisses, which shew an apparent dip N. 10° W. $< 30^{\circ}$, and are exposed along the stream for about half a mile. These are followed by ledges of hard, fine-grained, red syenite and felsite, obscurely stratified. This syenite, sometimes much coarser and with large crystals of red felspar, is seen along the stream and forms the high bordering hills for a distance of about six miles. A short distance below the crossing of the county line and also extending above the forks for about two miles, are ledges of hard, dark-grey, coarsely crystalline diabase, closely resembling that observed about the lake at the head of South Branch Beccaguimic. Between the county line and the forks are ledges of hard, pinkish, black specked, crystalline felsite dipping S 50° E $< 70^{\circ}$. Clearwater brook.

The southern border of the Pre-Cambrian area is defined on Burnt Hill brook and on the North Branch of South-west Miramichi by the upper edge of the intruded granite. This granite belt, which has on the Clearwater a breadth of about six miles, on the Burnt Hill brook extends from about a mile above the mouth to the confluence of Green brook and South Branch, where it cuts compact red quartz porphyry dipping N. 25° E. $< 70^{\circ}$; and on the Miramichi from just below McDonald's brook to about a mile and a quarter above Bedel Brook on the North Branch. Granite belt.

In an ascent of this branch, the first exposures seen were about nine miles above the forks, and were of reddish-grey granite with black mica. For a short distance above and below Bedel brook, eleven and a-half miles up, ledges of granite were also seen in the stream. About thirteen and a-half miles up a ledge of crystalline, grey felsite, merging into a red syenite, occurs. About a mile below the falls (seventeen miles above the forks) bright-red felsite occurs, followed by grey and black-specked felsite, and hard, greenish-grey syenitic trap. The falls themselves occur over fine, hard, grey and slightly amygdaloidal, felsitic rocks, with specks of iron pyrites. About a quarter of a mile above the falls are ledges of hard, grey, felspathic sandstone, looking very like Cambro- North Branch.

Silurian, and dipping N. 55°, W. < 60°. Then follow greenish traps again, concretionary in structure in places, and having large nodules, like cannon balls, weathering out of the face of the ledge. These are seen to a point about 800 yards above the falls, where the stratified felspathic sandstone again appears, dipping N. 55° W. < 79°, cut by greenish-grey trap. These traps and very hard greenish diorites continue to a point about three-quarters of a mile above the falls. Above this no exposures were seen. A point eighteen miles, or thereabouts, above the forks was reached.

Felsites.

The felspathic sandstones above described have been considered as marking the eastern limit of the Cambro-Silurian belt. Not only do they resemble the rocks of this formation lithologically, but their strike quite accords with the general trend of the band. The other rocks, although they undoubtedly include many of intrusive origin, so closely resemble the succession presented by the Pre-Cambrian rocks in other parts of the district, that they have been thought to probably form a part of this formation, and have been so represented on the accompanying map. Felsites, which may be of a similar age, were described last year as forming a long ridge east of Mapleton, near the southern limit of the map, and have also been observed about Lawrence Peak, and on the branches of the Beccaguimic.

Nashwaak mountain.

In addition to the area above described, Mr. Ells also refers to this division a band of gneiss which shows in low-lying ledges for about two miles along the South-west Miramichi River four miles below the forks.* Coarse granitoid gneiss without apparent bedding, which probably belongs to the same band, forms the high ridge, known as Nashwaak mountain, about three-quarters of a mile to the South-west of the forks above mentioned. As here seen it is in places nearly white from the deficiency or absence of the black mica which gives to it its general grey colour, and in places resembles an agglomerate, quartz, felspar and mica occurring in small rounded pieces like pebbles scattered through it, and encloses large blocks of a hard fine-grained, dark-grey gneiss, quite distinct from the including matrix. As it has been found impossible to separate the gneisses which may be of Pre-Cambrian age from rocks which may be intrusive, the former have been included on the map in the general granitic area.

INTRUSIVE GRANITES.

The character of the granites of York and Carleton counties, with the facts from which their intrusive origin is inferred, having been fully detailed in the report of last year, it only remains to define more par-

* Report of Progress 1879-80, page 32 D.

ticularly the areas which they occupy within the region embraced by the present report.

Of these granitic areas one enters the limits of the map near the middle of its southern margin, being a continuation of a long belt of such rocks extending north-easterly from the St. John River. It was also at one time supposed to be continuous with one or other of the several belts of such rocks found on the South-west Miramichi River, between Rocky brook and the Clearwater. In an examination, however, of the Taxes River and of the Napudogan and other brooks flowing into the Nashwaak from the north, Mr. McInnes found that the Cambro-Silurian sandstones and slates, striking N. to N. 20° E. and dipping at a high angle, extended in a succession of anticlinal and synclinal folds over the whole of this region. It therefore seems probable that the first described area, already narrowed on the Nashwaak, terminates just east of the latter, beyond the Napudogan, while the belts referred to on the South-west Miramichi are also limited to the vicinity of the latter. The main band of granite however, which begins in the Beccaguimic region, widens rapidly and on the Miramichi attains a breadth of not less than fifteen miles, its eastern limit being two and a-half miles above Slate Island brook, while the western is not far removed from the North Branch of the first-named stream.

ECONOMIC MINERALS.

The following economic minerals are, to a greater or less extent, to be found within the area to which this report relates:—

Iron Ores.—These include the hæmatites and limonites of Carleton county, the distribution and relations of which are described in a previous part of this report. Having been at one time the basis of a somewhat extensive and prosperous industry they have received a considerable amount of attention and have been fully described both in the reports of the geological survey and elsewhere. It is now some years since the works were in operation, and with the increased cost of production it is doubtful whether they will be again renewed.

Limestones.—It has been already stated, on a previous page, that the calcareous strata of the Silurian system are in places accompanied by beds of limestone sufficiently pure to be available as sources of lime, and details of their distribution and relations have been given. Quarries have been opened at a number of points and kilns erected, but there are only two at which operations have been carried on upon anything like an extended scale. One of these is that known as Turner's kiln, in

the valley of the Beccaguinie, and the other as Henderson's in Windsor settlement, a few miles to the north of the former. The annual production at Turner's is said to be about 500 casks (2,000 bushels) and to be valued at from \$1.00 to \$1.40 per cask. It is used chiefly for local consumption but is frequently sent as far down the river as Woodstock. The Hendersons first commenced burning lime in 1880, since which time their annual production has averaged about 1,000 bushels.

Gypsum.—The deposits of this mineral accompanying the Lower Carboniferous strata of the Tobique valley, in Victoria county, are extensive and valuable. Their total amount, owing to the horizontal position of the beds and the want of exposures, is not accurately known, but from the length and thickness of the outcrops seen on the main Tobique and its tributary the Wapskehegan, it is certain that the amount is large. On the first named stream the beds form nearly vertical bluffs about 130 feet high, and consist of numerous alternating bands of pale green, and reddish colours, and granular texture, among which are smaller seams of white fibrous gypsum and amorphous alabaster.

This gypsum is employed solely for agricultural purposes and considerable quantities are used in this way not only in Victoria county, but in all those parts of the St. John River valley to which access is given by the New Brunswick railway. Though admirably adapted for this use, it is greatly inferior in purity to that of Hillsboro, and is hardly suited for calcination.

Lead.—Small quantities of galena have been observed in the calcareous slates in the lower portions of the Tobique River, as well as elsewhere over the Silurian area, but in no instance at present known are they of a character to warrant a belief in the existence of workable veins.

Building Stones.—The Carboniferous outlier about the South Branch of the Beccaguinie River, according to Mr. Matthew, is capable of affording good freestones, of even grain, easy to work, and which dress well under the chisel. The outcrops are about seven miles from Woodstock junction on the New Brunswick railway, to which a good road could be had through a comparatively level country.

The slates of Carleton county are usually too much contorted and too calcareous to be available for roofing purposes. There are however among them beds to which these remarks do not apply, and should a greater demand arise, a little search would undoubtedly reveal localities from which suitable rock could be readily and profitably removed.

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