CIHM
Microfiche
Series
(Monographs)

ICMH
Collection de
microfiches
(monographies)

Canadian Institute for Historical Microreproductions / Institut canadien de microreproductions historiques

©1996

## Technical and Bibliographic Notes / Notes techniques et bibliographiques

The Institute has attempted to obtain the best original copy available for filming. Features of this copy which may be bibliographically unique, which may alter any of the images in the reproduction, or which may significantly change the usual method of filming are checked below.

L'Institut a microfilmé le meilleur exemplaire qu'il lui a été possible de se procurer. Les détails de cet exemplaire qui sont peut-être uniques du point de vue bibliographique, qui peuvent modifier une image reproduite, ou qui peuvent exiger une modification dans la méthode normale de filmage sont indiqués ci-dessous.

- [x] Coloured covers / Couverture de couleur
- [ ] Covers damaged / Couverture endommagée
- [ ] Covers restored and/or laminated / Couverture restaurée et/ou pelliculée
- [ ] Cover title missing / Le titre de couverture manque
- [ ] Coloured maps / Cartes géographiques en couleur
- [ ] Coloured ink (i.e. other than blue or black) / Encre de couleur (i.e. autre que bleue ou noire)
- [x] Coloured plates and/or illustrations / Planches et/ou illustrations en couleur
- [ ] Bound with other material / Relié avec d'autres documents
- [ ] Only edition available / Seule édition disponible
- [ ] Tight binding may cause shadows or distortion along interior margin / La reliure serrée peut causer de l'ombre ou de la distorsion le long de la marge intérieure.
- [ ] Blank leaves added during restorations may appear within the text. Whenever possible, these have been omitted from filming / Il se peut que certaines pages blanches ajoutées lors d'une restauration apparaissent dans le texte, mais, lorsque cela était possible, ces pages n'ont pas été filmées.
- [ ] Additional comments / Commentaires supplémentaires:

- [ ] Coloured pages / Pages de couleur
- [ ] Pages damaged / Pages endommagées
- [ ] Pages restored and/or laminated / Pages restaurées et/ou pelliculées
- [x] Pages discoloured, stained or foxed / Pages décolorées, tachetées ou piquées
- [ ] Pages detached / Pages détachées
- [x] Showthrough / Transparence
- [ ] Quality of print varies / Qualité inégale de l'impression
- [ ] Includes supplementary material / Comprend du matériel supplémentaire
- [ ] Pages wholly or partially obscured by errata slips, tissues, etc., have been refilmed to ensure the best possible image / Les pages totalement ou partiellement obscurcies par un feuillet d'errata, une pelure, etc., ont été filmées à nouveau de façon à obtenir la meilleure image possible.
- [ ] Opposing pages with varying colouration or discolourations are filmed twice to ensure the best possible image / Les pages s'opposant ayant des colorations variables ou des décolorations sont filmées deux fois afin d'obtenir la meilleure image possible.

**This item is filmed at the reduction ratio checked below /**
**Ce document est filmé au taux de réduction indiqué ci-dessous.**

| 10x | 12x | 14x | 16x | 18x | 20x | 22x | 24x | 26x | 28x | 30x | 32x |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | ✓ | | | | |

The copy filmed here has been reproduced thanks to the generosity of:

National Library of Canada

The images appearing here are the best quality possible considering the condition and legibility of the original copy and in keeping with the filming contract specifications.

Original copies in printed paper covers are filmed beginning with the front cover and ending on the last page with a printed or illustrated impression, or the back cover when appropriate. All other original copies are filmed beginning on the first page with a printed or illustrated impression, and ending on the last page with a printed or illustrated impression.

The last recorded frame on each microfiche shall contain the symbol → (meaning "CONTINUED"), or the symbol ∇ (meaning "END"), whichever applies.

Maps, plates, charts, etc., may be filmed at different reduction ratios. Those too large to be entirely included in one exposure are filmed beginning in the upper left hand corner, left to right and top to bottom, as many frames as required. The following diagrams illustrate the method:

L'exemplaire filmé fut reproduit grâce à la générosité de:

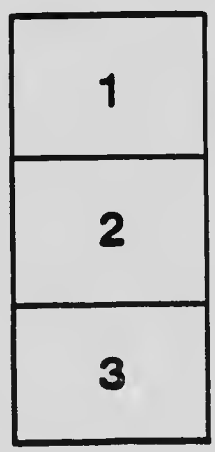
Bibliothèque nationale du Canada

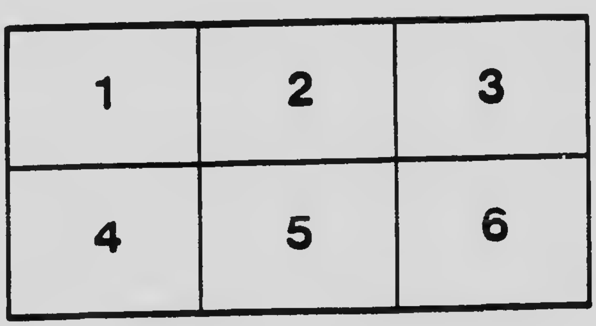
Les images suivantes ont été reproduites avec le plus grand soin, compte tenu de la condition et de la netteté de l'exemplaire filmé, et en conformité avec les conditions du contrat de filmage.

Les exemplaires originaux dont la couverture en papier est imprimée sont filmés en commençant par le premier plat et en terminant soit par la dernière page qui comporte une empreinte d'impression ou d'illustration, soit par le second plat, selon le cas. Tous les autres exemplaires originaux sont filmés en commençant par la première page qui comporte une empreinte d'impression ou d'illustration et en terminant par la dernière page qui comporte une telle empreinte.

Un des symboles suivants apparaîtra sur la dernière image de chaque microfiche, selon le cas: le symbole → signifie "A SUIVRE", le symbole ∇ signifie "FIN".

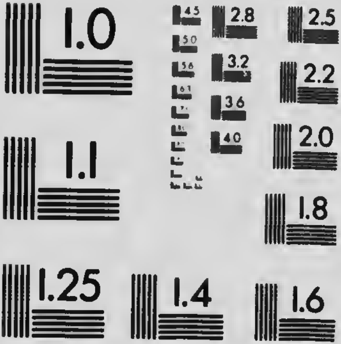
Les cartes, planches, tableaux, etc., peuvent être filmés à des taux de réduction différents. Lorsque le document est trop grand pour être reproduit en un seul cliché, il est filmé à partir de l'angle supérieur gauche, de gauche à droite, et de haut en bas, en prenant le nombre d'images nécessaire. Les diagrammes suivants illustrent la méthode.

**MICROCOPY RESOLUTION TEST CHART**

(ANSI and ISO TEST CHART No. 2)




APPLIED IMAGE Inc
1653 East Main Street
Rochester, New York 14609 USA
(716) 482 - 0300 - Phone
(716) 288 - 5989 - Fax

CANADA
DEPARTMENT OF MINES
GEOLOGICAL SURVEY BRANCH
Hon. W. Templeman, Minister; A. P. Low, Deputy Minister;
R. W. Brock, Director.

MEMOIR No. 18—E

# BATHURST DISTRICT, NEW BRUNSWICK

BY
G. A. YOUNG

OTTAWA
GOVERNMENT PRINTING BUREAU
1911

No. 1165

CANADA

DEPARTMENT OF MINES

GEOLOGICAL SURVEY BRANCH

HON. W. TEMPLEMAN, MINISTER; A. P. LOW, DEPUTY MINISTER;
R. W. BROCK, DIRECTOR.

MEMOIR No. 18-E

# BATHURST DISTRICT, NEW BRUNSWICK

BY

G. A. YOUNG

OTTAWA
GOVERNMENT PRINTING BUREAU
1911

284—1 No. 1165

R. W. BROCK, Esq.,

Director, Geological Survey,

Department of Mines.

SIR,—I beg to submit the following memoir on Bathurst district, New Brunswick, and the Nipisignit iron ore deposit, together with the accompanying maps.

I have the honour to be, sir,

Your obedient servant,

(Signed) **G. A. Young.**

November 5, 1910.

## CONTENTS.

## PART II.



## ILLUSTRATIONS.



## MAPS.

# BATHURST DISTRICT, NEW BRUNSWICK

BY

**G. A. Young.**

## INTRODUCTORY.

The work in connexion with this memoir and the accompanying maps owes its inception to the commencement of development work upon certain comparatively large deposits of iron ore lying near the northern bank of the Nipisiguit river, at a point about 17 miles inland from and to the south of Bathurst, Gloucester county, New Brunswick: a town situated on the sheltered harbour at the mouth of the Nipisiguit, where the river empties into Chaleur bay. Another deposit of iron ore had long been known to occur at a locality about 12 miles northwest of Bathurst, on a small tributary of Millstream river; while a small deposit of galena and zinc blende had been described as occurring farther north on Elmtree river. In order to properly study and describe these various deposits, the writer was instructed to topographically and geologically survey a district, bounded by north-south and east-west lines, whose northern and southern boundaries should fall respectively about 20 miles north and about 15 miles south of Bathurst. By including this comcomparatively large area, it was hoped that the natural rock sections exposed along the sea-coast in the northern portion of the district would afford a clue to the unravelling of the geological structure of the remaining territory.

Field work was continued during the two seasons of 1908 and 1909, but for various reasons it was not found possible to complete the mapping of the whole of the territory originally outlined. The southern boundary of the area covered lies about 8 miles south of Bathurst, and, therefore, the district surveyed does not embrace the large iron ore bodies lying about 7 miles farther south. However, a separate map representing an area of about three-fourths of a square mile in the immediate vicinity of the deposit has been prepared, and the results of the examination of this area are stated in the second part of this memoir.

While in the field many favours were received. Particular mention, however, should be made of the officials of the Bathurst Lumber Company, who generously allowed a line for surveying purposes to be cut through certain of their timber limits, and of Messrs. W. A. C. Parsons and Fulton, of the Canada Iron Corporation, who kindly furnished information and assistance in connexion with the work upon the Nipisiguit iron ore deposit.

Work was carried on during the field seasons of 1908 and 1909. During both seasons, the energy of the whole party was chiefly devoted to topographical work. The main control consisted of a careful survey by chain and transit of the line of the Intercolonial railway southward from the crossing of Belledune river, near the northwestern corner of the area of the map-sheet, to beyond Redpine brook, at the southeastern corner; and of a similar survey run westward along the road south of Tetagouche river to the western confines of the area, and thence, by means of a line cut through the bush, south to the southwestern corner of the sheet. Elevations based on mean sea-level were carried along these various lines.

Secondary traverse lines, run by transit and stadia, or plane-table and stadia, were carried over nearly every road, and also on a number of the principal streams. Subsidiary traverses, run by means of compass and handlevel, compass and chain, etc., were made of various secondary roads, rivers, and portions of the coast line, etc.

Contouring was done by means of meandering traverses, using plane-table, 300-foot tape, and aneroid, and run between various points previously fixed by primary and secondary traverses. The general lack of pronounced vertical relief, and the thickly wooded nature of the greater part of the country, frequently entailed a somewhat diagrammatic representation of the relief, since, except in the comparatively limited areas of cleared land, it was rarely possible to see more than a few yards in any direction.

During the two field seasons, the writer was assisted by undergraduates and graduates of Canadian universities. All of these assistants performed their duties in a highly satisfactory manner. During the field season of 1908, the temporary assistants were: J. S. Bates, R. M. Chalmers, F. A. Huntington, D. S. McIntosh, D. A. Nichels, E. B. Rider, and J. D. Trueman. To J. D. Trueman was entrusted the running of the control lines, while D. A. Nichols took charge of the contouring, and during the succeeding winter months compiled the portion of the map of which the field work had been completed.

During the field season of 1909, the remaining or southern portion of the area was surveyed. During this work the temporary assistants were: A. Boucher, J. L. Cavanagh, H. W. Flemming, W. E. Lawson, N. C. Macrae, A. G. McIntyre, D. A. Nichols, B. Rose, and W. L. Uglow. The running of the control traverses was conducted by W. E. Lawson, while D. A. Nichols carried on the secondary control work, and B. Rose took charge of the contouring. During the following winter months the field work was compiled by W. E. Lawson.

The writer carried out all the geological work, but much time had also to be devoted to topography. The necessity of giving so much time to topographical work, as well as the practical impossibility of correlating the results of the geological examinations as made in the field, was unfortunate in the case of the study of the geology of the district, since, on the whole, save along the few larger waterways, rock exposures are relatively rare, and the geology of the region has proved to be comparatively intricate. Therefore, for the reasons indicated, the results of the geological field work are lacking in detail, and considerable uncertainty with regard to various questions still exists.

## LOCATION, AREA, HISTORY.

The district represented by the accompanying map lies in northeastern New Brunswick, in the county of Gloucester, along the western side and head of Nipisiguit bay, a southward extending expansion of Chaleur bay. The total land area as mapped is about 315 square miles, and within it lies the town of Bathurst, situated at the mouth of Nipisiguit river.

The main line of the Intercolonial railway, from Montreal to Halifax, traverses the district from north to south. From Gloucester Junction, on the Intercolonial just east of the crossing of Nipisiguit river, the Caraquet and North Shore railway runs northerly for a few miles until opposite Bathurst, and from there continues eastward beyond the borders of the area. A railway, nearing completion in

1909, and known as the Northern New Brunswick and Seaboard railway, extends from a point on the line of the Intercolonial south of Bathurst and a short distance west of Nipisiguit river, for about 16 miles southward up the valley of the Nipisiguit to the Nipisiguit iron mines.

The district was originally settled by the French, whose descendants are still in a majority. The first settlement took place as early as 1638 or 1639, but in the earlier days the settlers were several times driven out by Indians, and not until soon after the expulsion of the Acadians from Nova Scotia, in 1755, did the settlements become permanent. At that time, a considerable influx of the French refugees took place, and the village of St. Peters, now known as Bathurst village, was established. It was not until much later, probably about 1820, that the present site of Bathurst was occupied.

In the early part of the nineteenth century, Bathurst was an important ship-building centre. Now it possesses a flourishing lumber trade, its mills, directly or indirectly, giving employment to a large proportion of the population of the town and neighbouring districts. As yet it is only along the coast, or for a few miles inland, that the surrounding country has been settled and partly cleared. An estimate based on the number of dwellings indicates a population of about 10,000 souls.

## PREVIOUS WORK.

Numerous reports and papers bearing directly or indirectly upon the geology of the Bathurst district have been published from time to time, and what is believed to be a fairly complete list is appended.

The district lies within the bounds of a much larger territory, represented by two geological maps, respectively No 3 SE and No. 2 NE, compiled by R. W. Ells, and published, on a scale of 4 miles to 1 inch, with the Report of Progress of the Geological Survey for 1880-81-82. In the preceding Report of Progress for 1879-80, part D, Ells described the geology of the district. The results of the reconnaissance by Ells, as expressed on his maps, have been largely confirmed by the later more detailed work. As is to be expected, the geological formations have been further subdivided, and, in some cases, boundaries have been shifted, or the strata differently grouped.


Fig. 1.—Index Map of Bathurst Iron Ore District, New Brunswick.

## BIBLIOGRAPHY.


Ami, H. M.: Appendix to Summary Report for 1904, of L. W. Bailey; G. S. C. Summary Report for 1904, pp. 289-290, 292.

Bailey, L. W.: Notes on the Geology and Botany of New Brunswick; Can. Nat., 2nd ser., Vol. I., 1864, pp. 80-97.

Bailey, L. W.: Mineral Resources of the Province of New Brunswick; G. S. C. Ann. Rept., 1897, Vol. X, part M, p. 36, and pp. 42-43.

Bailey, L. W.: Summary Report for 1904, G. S. C. Summary Report for 1904, pp. 282-283.

Chalmers, R.: On the Glacial Phenomena of the Chaleur Bay regions; Can. Nat., Vol. 10, 1881, pp. 37-54.

Chalmers, R.: Preliminary Report on the Surface Geology of New Brunswick; G. S. C. Ann. Rept., 1885, Vol. I, part GG.

Chalmers, R.: Surface Geology of Northern New Brunswick and Southeastern Quebec; G.S.C. Ann. Rept., 1886, Vol. II, part M, with accompanying maps No. 3 SE and No. 2 NE, Surface Geology.

Chalmers, R.: Surface Geology of Eastern New Brunswick, Northwestern Nova Scotia, etc.; G.S.C. Ann. Rept., 1893-94, Vol. VII, part M.

Chalmers, R.: The Raised Shorelines of the Province of New Brunswick; Proc. Miramichi Natural History Ass., No. 4, 1905, pp. 6-7.

Clarke, John M.: Early Devonic History of New York and Eastern North America; N.Y. State Mus. Memoir 9, 1908, pp. 92-96.

Dawson, Sir J. W.: Synopsis of the Flora of the Carboniferous period in Nova Scotia; Can. Nat. Vol. 8, 1863, pp. 431-457.

Ells, R. W.: Geology of Northern New Brunswick; G.S.C., Report of Progress for 1879-80, part D.

Ells, R. W.: Northern and Eastern New Brunswick and the north side of Chaleur bay; G.S.C., Report of Progress for 1880-81-82, part D; accompanied by maps No. 3 SE and 2 NE.

Ells, R. W.: Geology and Mineral Resources of New Brunswick; Dept. of Mines, Geol. Surv., 1907.

Gesner, A.: Report on the Geological Survey of the Province of New Brunswick; Saint John, 1843.

Gesner, A.: New Brunswick; London, 1847.

Hardman, J. E.: A New Iron Ore Field in the Province of New

Brunswick; Jour. Can. Mining Inst., 1908, Vol. II, pp. 156-164.
Henwood, W. J.: Notes to accompany a series of specimens from Chaleur bay and the Restigouche river in New Brunswick; Proc. Geol. Soc. Lon., Vol. 13, 1842, pp. 454-6.
Hind, H. Y.: Preliminary Report on the Geology of New Brunswick; Fredericton, 1865.
Hoffmann, G. C.: Chemical Contributions to Geology of Canada; G.S.C., Report of Progress for 1880-81-82, part H, p. 13; G.S.C., Annual Report, 1890-91, Vol. V, part R, pp. 49-50; G.S.C., Annual Report, 1892-93, Vol VI, part R, pp. 44-45.
Ingall, E. D.: Mineral Statistics and Mines; G.S.C., Ann. Rept., 1890-91, Vol. V, part S, pp. 82-83; G.S.C., Ann. Report, 1890-91, Vol. V, part SS, p. 81 and p. 148; G.S.C., Ann Rept., 1892-93, Vol. VI, part S, p. 142.
Lindeman, E Iron Ore Deposits, Austin brook, N.B.; Dept. of Interior, Rept. of the Superintendent of Mines (for year ending March 31, 1907), pp. 33-37.
Lindeman, E.: Dept. of Mines, Mines Branch, Summary Report, 1908.
Lindeman, E.: Map, Magnetic Survey Austin brook; Dept. of Mines, Mines Branch.
Logan, Sir W. E.: G.S.C., Geology of Canada, 1863, pp. 404-5, pp. 437-453.
Paisley, C.H .: Notes on the Marine Clays Occurring at the Railway Cutting on the Left Bank of the Tetagouche river: Can. Nat., Vol. 7 (N.S.), 1875, pp. 41-43.
Paisley, C. H.: On the Post-Pliocene formation near Bathurst, New Brunswick; Can. Nat., Vol. 7, (N.S.), 1875, pp. 268-70.
Young, G. A.: Dept. of Mines, Geol. Survey, Summary Report for 1908, pp. 129-131.
Young, G. A.: Dept. of Mines, Geol. Survey, Summary Report for 1909, pp. 217-224.

## SUMMARY AND CONCLUSIONS.

### Bathurst District.

*Physical Features.*—The Bathurst district lies along the eastern border of the broken, elevated, northwestern portion of New Brunswick.

The district may be described as a tilted plain, rising from the sea to heights of between 600 feet and 750 feet in a distance of from 7½ miles to 10 miles, and traversed by a few larger waterways, having, in many parts, trench-like forms.

*General Geology.*—Geologically the district is a portion of the northwestern geological province of New Brunswick, being underlain, except for a narrow strip of horizontal Carboniferous strata along the eastern edge of the district, by usually much disturbed, pre-Carboniferous strata, and bodies of igneous rocks. In general the formations occur in east-west bands.

The oldest formation recognized is the Tetagouche series, composed of black slates with sandstone bands. The strata are closely folded along east-west axes, and generally dip at high angles; they are cut and metamorphosed along the zone of contact by a granite batholith, and are penetrated by numerous, roughly parallel diabase dykes. The Tetagouche slates, as indicated by a graptolite fauna found at one locality, are of lower Trenton age, being homotaxial with the Normanskill shales of New York state.

The Millstream series, believed to conformably succeed the Tetagouche slates, and to be also of Ordovician age, consists principally of light coloured, tufaceous rocks varying in appearance from slates to fine conglomerates. The strata are closely folded along east-west axes, and, generally, dip at high angles.

The Ordovician strata are mainly confined to the southern part of the district. In the northern part Silurian measures occur. The Silurian is divided into three formations, which, in order of age from oldest to youngest, are the Turgeon formation, the Belledune group, and the Elmtree slates.

The Turgeon formation consists of coarse conglomerates, sandstones, and shales, all generally red in colour. The beds are much faulted, and commonly dip at high angles. The formation is believed to form the base of the Silurian system as developed in the district.

The Belledune group probably conformably succeeds the Turgeon formation. The measures are largely calcareous—red, grey, and black limestones, often impure—but shales of various colours, sandstones, and fine conglomerates also occur. The strata are closely folded and greatly faulted. Poorly preserved fossils occur at a number of localities; they indicate that the measures range in age from Clinton to Niagara, and possibly Guelph.

The Elmtree slates probably conformably succeed the higher beds of the Belledune group. The Elmtree formation consists mainly of black slates, with, in one area, beds of fine conglomerate. The strata are usually steeply inclined, and are cut by many basic dykes. The presence of a single species of coral indicates a Guelph age for the formation.

The Ordovician strata, and the Elmtree slates, are cut by numerous dykes of diabase, and diabase porphyrite. Acid dyke rocks—aplite, granite porphyry, syenite porphyry—and diorite porphyrite occur, but are less common. The dykes are thought to be of Devonian age.

A coarse, semi-porphyritic, biotite granite, the Nipisiguit granite, occurs in the southern portion of the district, occupying an area about 11 miles long by 7 miles broad. The granite cuts Ordovician strata along the western edge of the body, while on the eastern side it is overlain by Carboniferous beds. The granite is supposed to be of Devonian age.

Within the district five areas have been mapped, as occupied by the Fournier group. The term has been introduced only for convenience in description, since it embraces rocks of various ages and unrelated types. One area is principally occupied by quartz diorite; a second is underlain by a confused assemblage of tuffs, slates, sandstones, diabase porphyrite, and various types of schists derived from these rocks; and also gabbro, granite, and diorite, in places forming small stock-like bodies, and, at other localities, intricately associated with various rock types. An area lying between Peters brook and Grants brook is underlain by diabase and altered, amygdaloidal, volcanic rocks, tuffs, etc. These are thought to represent a volcanic series, possibly of Ordovician age, penetrated by bodies of later diabase.

Small detached areas, of nearly horizontal, red, conglomerate, sandstone, and shale, and grey limestone, occur at intervals along the coast. These beds are correlated with the Bonaventure formation of Gaspé. The age of the Bonaventure formation, in previous reports of the Geological Survey, has been given as lower Carboniferous, but the formation is now assigned to the latest Devonian, for reasons set forth by John M. Clarke as a result of his study of the Gaspé region. Certain red beds occurring along the Nipisiguit river, correlated by earlier writers with the Bonaventure formation, are,

in this memoir, considered to be younger, and are separately de-
scribed as the Bathurst formation.

The beds of the Bathurst formation outcrop in a nearly horizontal
attitude along the western border of the district, and consist princi-
pally of red shale and sandstone, with a maximum thickness of at
least 125 feet, resting on the Nipisignit granite. They appear to be
conformably succeeded by the Millstone Grit, and, therefore, are con-
sidered to be of mid-Carboniferous age. It is suggested that the
beds are at least partly of æolian origin.

The district is largely drift-covered, the drift consisting mainly
of glacially transported boulders that in various places form low
hills. In the neighbourhood of Bathurst, boulder clay occurs, over-
lain by stratified clays, capped by stratified sands. Both the clays
and sands are fossiliferous.

Glacial striæ, with directions varying between N 40° E—S 40° W
and S 25° E—N 25° W, were observed, and are believed to indicate
two main directions of ice movement, one eastward down Chaleur bay,
the other northward, from the interior of the Province.

Terraces were observed as high as 350 feet above the sea; whether
they were due to wave or stream action was not determined.

*Structural Geology.*—The main period of orogenic movements is
believed to have been in late Silurian or early Devonian time, but
prior to the deposition of the Silurian the Ordovician may have
been at least gently folded.

Except by the uplift or depression of wide areas as a whole, the
strata of the district appear to have been undisturbed from the Bona-
venture stage of late Devonian, or very early Carboniferous time,
onwards.

*Historical Geology.*—The Tetagouche slates were deposited in a
sea of lower Trenton time. At the close of this stage, or somewhat
later, as a result of volcanic activity, the tufaceous Millstream
series was laid down. Prior to Silurian time volcanic activity ceased,
the region emerged from the sea, and the strata were gently folded
and subjected to erosion.

In the opening stage of Silurian time the sea again advanced, and
the Turgeon formation was laid down. Later, in Clinton time, in a
shallow sea, strata largely calcareous were deposited. Calcareous and
argillaceous beds continued to form during the Niagara epoch, and

until the Guelph, when, under changed conditions, the black slates of the Elmtree formation were formed.

In late Silurian, or early Devonian time, the region was uplifted, and the strata closely folded and much faulted; small bodies of acid and basic plutonics invaded them, and the formation of the Nipisiguit granite batholith took place.

Before the close of the Devonian time, igneous activity ceased, and, after a period of pronounced erosion, the sea again advanced, and the Bonaventure formation was laid down.

At the close of the Bonaventure stage, the district was again above the sea, and continued so until mid-Carboniferous time, when the territory to the east became an area of deposition, and, perhaps under the conditions of an arid or semi-arid climate, the beds of the Bathurst formation were formed.

There are grounds for believing that in Bonaventure time the land had already begun to assume the configuration of the present day; that since that time the greater part of the district has been subjected to erosion, and free from pronounced orogenic disturbances. To explain the often gorge-like character of the present waterways it is suggested that the district, after having been eroded to the condition of a low plain, was tilted in late Tertiary time.

The present waterways are largely of pre-glacial origin, and in places glacial material fills portions of old channels, having forced the streams to cut out new courses.

During the glacial period the district was covered by an ice sheet, or perhaps a succession of them. Through their agency a widespread mantle of boulders, etc., was formed.

After the glacial period, the sea encroached upon the land to an unknown height, and marine clays and sands were deposited. Since then the sea has again retreated.

*Economic Geology.*—Within the Bathurst district the most important ore deposit appears to be that known as the Millstream iron ore deposit, situated on a small tributary of Millstream river, at a point about 8 miles inland. The ore is banded, consisting chiefly of streaks and bands mainly of magnetite alternating with similar areas largely of garnet. A small, variable amount of chalcopyrite occurs with the iron ore.

About a dozen outcrops of ore occur along a nearly straight line slightly over a mile long. The maximum width of mineralized rock visible is about 40 feet, of which one-half might be termed ore. A says of the ore are reported to have indicated an iron content rang ing from above 60 per cent to below 40 per cent. Assays of dri cores are reported to have given 6 per cent copper, for a width o several inches. The character of the surface exposures indicate rather rapid variations in the amount of ore and its character.

The deposit is classed as a contact metamorphic deposit. Save for banded garnetiferous, epidotic, and hornblende rocks, forming the walls of the deposit, rock exposures are wanting. A single exposure of granite aplite may indicate the presence nearby of a granite body.

Narrow seams and veins of hematite, in much altered volcanic rocks, occur over a limited district lying between Peters brook and Grants brook.

A 6 foot vein of galena, zinc blende, pyrite, country rock, etc., outcrops in the bed of Elmtree river, about 5 miles from its mouth. The vein or zone is nearly perpendicular, and cuts black slates of the Elmtree formation. An assay of a sample of ore gave 7·197 ounces of silver per ton.

Throughout the district in general quartz veins are common. They are generally quite barren, but in places carry a little pyrite, and in some cases, specks of galena, zinc blende, mispickel, etc. Assays from certain localities have been reported yielding as high as 40 ounces of silver per ton, but such assays were probably made from picked specimens. No ore body or group of veins warranting mining have yet been disclosed.

A nearly perpendicular vein of quartz about 13 feet wide, carrying manganite in narrow seams and small patches, cuts Tetagouche slates on the south bank of Tetagouche river about 8 miles inland. Manganese ore was at one time shipped from this locality, but mining ceased many years ago.

## Nipisiguit Iron Ore Deposit.

The Nipisiguit iron ore deposit lies outside the area of the Bathurst sheet, close to the Nipisiguit river, about 17 miles SSW of Bathurst.

The rocks exposed in the neighbourhood of the ore bodies are quartz porphyry, quartz-free porphyry, diabase, and schistose rocks derived from these types. The relations existing between the three rock formations are unknown. In the neighbourhood of the mine the diabase, either in the form of dykes or comparatively large bodies, outcrops along a western band. The quartz porphyry occurs in a band lying betwen the diabase and an area of quartz-free porphyry on the east. The ore bodies occur in the quartz porphyry, or along the boundaries with the diabase or quartz-free porphyry.

The ore is chiefly magnetite, and is distinctly banded parallel to the walls of the deposits and to the planes of schistosity in the neighbouring rocks. The banding is made apparent by the presence of finely granular quartz and feldspar. Pyrite is present, in the main confined to narrow bands parallel to the walls; quartz in veins and vugs shows a similar distribution.

As shown by a magnetometric survey, by the results obtained from various diamond drill holes, and by the examination of the ore outcrops, the ore occurs in three deposits, each having the form of a steeply inclined, abruptly ending bed, with very sharp, distinct walls. Number 1 deposit is about 2,000 feet long, and at its northern end has a thickness at the surface of about 105 feet. Number 2 deposit has a length of about 1,200 feet, but is probably divided in two; at its southern end it has a thickness of 40 feet. Number 3 deposit may have a length of one-half mile or more, and at one point has a thickness of 100 feet.

The results of a large number of assays of diamond drill cores indicate that the iron contents average between 47 per cent and 51 per cent, with a range of from 39·6 per cent to 58·7 per cent. Sulphur averages between 0·17 per cent and 0·27 per cent, and phosphorus between 0·77 per cent and 0·89 per cent.

It is concluded that the ore has formed by the replacement of a schistose rock. It is suggested that the quartz veins, and possibly the sulphide now occurring in the ore, were present in the rock prior to its replacement by ore.

# PART I.

## BATHURST DISTRICT.

### PHYSICAL FEATURES.

The Province of New Brunswick, together with Nova Scotia, and that part of Quebec lying south of the St. Lawrence river, represent in Canada a portion of a broken, in many parts mountainous region, that forms the eastern part of the North American continent from Newfoundland in the north to not far from the Gulf of Mexico in the south. To this hilly and mountainous tract the term Appalachian region has been applied, the Appalachians being a system of mountain ranges extending southwestward from New York state.

The Appalachian mountain[illegible] tend from Alabama northeastward into New York state. Fa[illegible]er northward they are continued by the Green mountains of Vermont, the White mountains of New Hampshire, and the mountainous country of the State of Maine. In Canada they are represented by the Notre Dame mountains in the Eastern Townships of Quebec, and by the Shickshock mountains of Gaspé peninsula. In New Brunswick and Nova Scotia, on the other hand, though portions of the two provinces are much broken and relatively elevated, they can scarcely be termed mountainous, and the propriety of including the Maritime Provinces within the Appalachian region is to be justified by the general northeasterly trend of the major physiographical features, and the general geological structure and history of the two provinces.

The Bathurst district lies along the junction of the two major physiographical and geological provinces into which New Brunswick may be divided. Extending eastward, southward, and southwestward from Bathurst is a large, triangular area of some 10,000 square miles, of low, flat-lying country, floored with nearly horizontal Carboniferous and younger strata. West of this flat country is a region of approximately the same area, extending west to the State of Maine and northwest into Quebec, which, in comparison with the eastern region, may be termed mountainous, though the elevations of the highest points probably fall short of 3,000 feet.

The underlying strata of this rugged country are usually much folded, frequently much metamorphosed, include both igneous and sedimentary formations, and are, in the main, of pre-Devonian age.

Within the area of the Bathurst map-sheet, the course of the Nipisiguit river almost exactly marks the boundary between the above-mentioned two physiographical provinces. East of the Nipisiguit the country rises slowly from the sea, but otherwise is like a low, gently rolling plain; west of the river the land rises more rapidly, and broad hills or ridges are common, but lying, as it does, along the border of the two provinces, the country still partakes of many of the features of the level region of the east.

The narrow strip of the level country east of the Nipisiguit, enclosed within the area of the map-sheet, rises above the sea to a maximum height of a little over 250 feet, and borders the river with a steep front 25 feet, to 50 feet high.

West of the northward flowing river, and the northward trending western shore of Nipisiguit bay, the country rises along the western border of the area of the map-sheet, in a distance from the sea of from 7½ to 10 miles, to elevations of between 600 feet and 750 feet. Broadly viewed the district is like a tilted plain gradually rising from the sea coast; examined in more detail it is found to consist of a series of east and west ridges broken into and separated by the comparatively deeply trenched valleys of the easterly flowing drainage system. Superimposed on the broader forms are numerous local hills and short ridges, often rising quite sharply for 50 feet or more.

The comparatively deeply incised valleys of the major streams are the most characteristic features of the district. The general course of these valleys is approximately at right angles to the sea-coast. In the case of the Nipisiguit the valley trends north and south, the first streams to the northward flow in a northeasterly direction, while those farther north flow more nearly eastward, entering the sea along the northerly stretching coast of Nipisiguit bay. Farther north the coast line swings around to the west, and there, beyond the limits of the map-sheet, the rivers run in a northerly direction.

The valley of the Nipisiguit, befitting the volume of the river, is comparatively broad, and its bounding slopes are gentle, but farther up stream, south of the limits of the sheet, the river valley for long distances forms a comparatively narrow depression with steep sides. Within the area of the map-sheet, and north of the Nipisiguit, the main streams which, enumerating them in order, are known as, Little, Middle, Tetagouche, Grants brook, Millstream, Nigadu, and Elmtree, all possess, for at least portions of their courses, comparatively deep valleys, in places but little wider than the stream bed. The streams are all swift, with average gradients varying from 25 feet to 60 feet per mile, each waterway being an almost continuous succession of little rapids, with occasional falls or cascades with drops varying from a few feet to fifty. These streams are not large; the Tetagouche, the largest, having a total length, in a straight line, of only 35 miles, and in mid-summer the volume of water usually so shrinks that for long stretches the boulder-strewn channels are partially bare. In times of high water, in the spring of the year, the [illegible]rs are torrential, and during the summer a heavy rain will cause the water to rise a foot or more in a few hours.

The Tetagouche has the most marked trench-like valley or cañon. For long distances the channel is bounded by steep, often precipitous walls of rock, in places rising 75 to 100 feet. So sharp is the drop from the general level to the stream bed, that, in places where the partly cleared country permits a general view across the river valley, the eye does not detect the presence of the narrow cañon of the water course. The remaining streams do not possess this feature to the same extent, or only along certain stretches, but, in general, the river valleys are abrupt depressions in an otherwise fairly level surface.

One lake, and a few small ponds occur within the area. The lake, Pigeon lake, with a major axis about a half a mile long, lies west of the Nipisiguit, towards the southern margin of the district. Its elevation is slightly under 350 feet above the sea, it is shallow, without a visible outlet save at high water, and is partially enclo[illegible] by two narrow ridges of glacial drift to which its origin is due. The lake receives but little drainage, since on all sides except the south, the land in a very short distance drops beneath the level of the lake. Even on the south the territory tributary to the lake is small, probably less than a square mile in area.

The coast line of the district mapped, neglecting minor irregularities, is very even. Starting in the north with a trend nearly due east, it gradually sweeps around to an almost due south course, which it follows until nearing the head of Nipisignit bay it bends to the east, and at the mouth of the estuary of the Nipisignit turns and runs northeast beyond the eastern border of the district examined.

Along its whole course the shore is low, beaches with low banks a few feet high alternating with rocky stretches where minor points and small open bays are frequent, and where occasional hills or cut banks and cliffs rise to heights of from 25 feet to 40 feet.

Towards the north, where the coast line begins to distinctly bend to the south, there is a good example of what may be termed a cuspate foreland; a triangular projection having a base slightly under a mile long, composed of sand and enclosing an irregular, shallow salt water pond.

At the mouths of the various rivers bars occur, a notable example being the one fronting the mouths of Millstream river and Grants brook. This bar, and its continuation beyond the opening through which the waters of the streams reach [illegible] is over 2 miles in length, quite regular in form and averaging about 250 feet in breadth. The same bar is prolonged for several miles southward by a long sand beach, ending in a sand spit, which, with a corresponding spit from the south, separated by a gap of about 1,000 feet, encloses Bathurst harbour, a shallow bay with a total area of approximately 5 square miles, into which the Nipisiguit, Little, Middle, and Tetagouche rivers empty. No rocks are exposed along the shores of the harbour, nothing but drifted sand or stratified marine sands and clays. On the western side, the deposits, cut into by numerous gullies, extend inland for several miles, while unconsolidated material, forming the northern shores of the harbour and fronting on it with cut banks sometimes 50 feet high, probably extends northward in a gradually narrowing area to the bar at the mouth of Grants brook and Millstream river.

## GENERAL GEOLOGY.

As already stated, the district lies along the border of the two main topographical provinces into which New Brunswick may be divided. These two physiographical provinces are equally distinct as regards their geology. The low, comparatively flat country, triangular in shape, with an eastern boundary formed by the Gulf of St. Lawrence and Northumberland strait, and a western boundary running in a southwest direction inland from Bathurst, is floored with nearly horizontal strata of Carboniferous, and, probably, Permian age. In general these measures vary from arenaceous shales to coarse sandstones and grits. West of this upper Palæozoic region, the hilly or semi-mountainous country is in the main underlain by Silurian or older strata, penetrated and accompanied by great volumes of igneous material of plutonic and volcanic origin.

In the eastern flat country the measures are unaltered, and though possibly cut by minor faults, are comparatively undisturbed, with low angles of dip, seldom higher than 10°. In the western region the strata are not infrequently highly metamorphosed, high angles of dip and close folding are characteristic, and, judging by the conditions obtaining in the Bathurst district, faulting is a dominant feature.

In the eastern province, the same formations monotonously extend over many square miles of country. In the western division, the close folding, the heavy faulting, and the widespread occurrence of igneous material of different ages and characters, all combine to produce a complicated geological structure, and, in general, rapid changes from place to place in the character and age of outcropping formations.

The area of the Bathurst map-sheet almost wholly belongs to the western of the two main geological provinces of New Brunswick. The flat-lying Carboniferous occupies a narrow strip only, extending from the Nipisiguit to the eastern border of the area. West and north of the Nipisiguit, the country is underlain by pre-Carboniferous strata believed to be chiefly of Ordovician and Silurian age, accompanied by considerable volumes of plutonic and volcanic rocks. In general the formations occur in westerly extending, band-like areas, the strata appearing to be closely folded along axes following east and west courses. Faulting is prevalent, and there is much indirect evidence that many of the faults have heavy throws.

In the south, along the course of the Nipisiguit, there appears from beneath the easterly extending, flat-lying Carboniferous sandstones and shales, a coarse, semi-porphyritic biotite granite. that is also displayed to the west on two of the smaller rivers. Though exposures are wanting over the areas between the rivers, it is probable that the granite outcropping along them belongs to the northern portion of one batholith whose eastern part is hidden by the younger, overlying Carboniferous.

West and north of the granite body is a large area extending northward 10 to 15 miles, that is occupied largely by black slates and grey or greenish tuffs or tufaceous sand-tones, which from the evidence of fossils found in black slates at one locality only, have been assigned to the Ordovician. The black slates and the light coloured tuffs each occupy large areas to the exclusion of the other type. The strata appear to be closely folded along axes striking approximately east and west, and, in the neighbourhood of the granite, are much metamorphosed.

Within this zone, occupied by Ordovician strata, there are numerous, usually narrow, diabase dykes, apparently having roughly parallel courses trending east and west. Besides these dykes there is at least one area in which a similar diabase occurs in rather large bodies associated with partly deformed volcanics, possibly of Ordovician age. The dykes are post-Silurian.

North of the Ordovician area occurs a band running west from the coast, and approximately 4 miles broad, in which, except for numerous dykes, it appears that the strata are almost wholly of Silurian age. North of this zone there lies another band of rocks —largely of igneous origin—including diabase, diorite, granite, schists, and gneisses, as well as tuffs and true sediments. These rocks have been classed together as the Fournier group, since under the natural conditions obtaining it did not appear practicable to attempt to separately map different divisions, although, for instance, some of the included tuffs are precisely like those of the Ordovician area farther south, and probably are their equivalents. The mass of the igneous rock is post-Silurian in age, and the granitic types, at least, are possibly late Devonian.

North of the district occupied by the above complex group, bordering the westward trending coast, and extending inland for distances up to 2 miles, is a fourth band, occupied by Silurian strata. Within the two Silurian areas lying respectively north and south of the zone occupied by the Fournier group the formations are essentially alike. The strata are much faulted and folded, and though fossiliferous localities are not rare, the succession has not been completely established. The base of the Silurian is apparently of coarse conglomerates, holding pebbles similar to Ordovician rocks. Overlying the conglomerates is a succession of red sandstones and semi-argillaceous beds, followed by impure limestones, calcareous shales, etc., from which were recovered fossils both of Clinton and Niagara affinities. Younger than these lower calcareous measures is a series of black slates, that, as indicated at one point by a few imperfect corals, may belong to the horizon of the Guelph.

Besides the above formations, there occur at intervals along almost of the whole of the coast line, small patches of nearly horizontal conglomerate, sandstone, and dolomitic limestone of upper Devonian or lower Carboniferous age.

As a whole the district is drift covered and rock exposures are relatively rare, being, in the main, confined to certain portions of the coast, or to the banks and channels of the few larger waterways. In general the drift appears to be largely an accumulation of boulders, and though these are of glacial origin, boulder clay is but rarely seen. Over the lower portion of the valley of the Nipisiguit, in the neighbourhood of Bathurst, there are extensive areas occupied by stratified sands, gravels, and clays, in places holding marine shells.

## TABLE OF FORMATIONS.

| | | |
|---|---|---|
| Quaternary :— | | Drift. |
| | | Stratified sands and clays. |
| | | Glacial drift. |
| Palæozoic :— | Carboniferous | Bathurst formation. |
| | Devonian (?) | Bonaventure formation. |
| | | Nipisiguit granite. |
| | | Dyke rocks. |
| | Silurian | Elmtree slates (Guelph ?). |
| | | Belledune group (Clinton and Niagara). |
| | | Turgeon formation. |
| | Ordovician | Millstream series. |
| | | Tetagouche series (lower Trenton). |
| | Ordovician to Devonian (?) | Fournier group. |

## DESCRIPTION OF FORMATIONS.

### ORDOVICIAN: TETAGOUCHE SERIES.

*Distribution.*—Strata assigned to the Ordovician occupy a large part of the district, forming a band running west from the coast for from 8 to 10 miles completely across the district, and extending from the border of the Silurian area north of Niagara river, south for from 10 to 15 miles to the borders of the granite batholith which appears on the lower portions of Middle, Little, and Nipisiguit rivers. The northern part of this band is almost exclusively occupied by the tufaceous strata of the Millstream series, while the southern portion is chiefly underlain by the black slates of the Tetagouche series.

The northern boundary of the Tetagouche series strikes a little south of east, crossing Millstream river near the western border of the district, and Grants brook near its mouth. The measures extend southward beyond the limits of the district examined, forming there the western boundary of a granite batholith. The dark slates of which the series is chiefly composed are well exposed along the upper part of Millstream river; to the south they may be seen along Grants brook, the Tetagouche, and the upper reaches of Middle and Little rivers. Though exposures are wanting over a greater part of the areas between the above-mentioned streams, it seems very probable that the slates underlie most of this part of the district, but not all of it, since towards the coast, between Grants brook and Tetagouche river, there is a considerable area occupied by igneous rocks mapped under the heading of the Fournier group, while on each of the southern streams there are one or more bands of rocks correlated with the Millstream series.

*Lithological Characters.*—The Tetagouche series consists of dark slates with occasional beds and bands of sandstone and narrow zones of red slates. The dark slates are commonly very dark greyish, nearly or decidedly black, but are sometimes slightly greenish. Bedding is usually distinctly shown by slight variations in grain, colour, and composition, and in some cases a prominent banding is apparent. While often dull, the slates are perhaps more commonly lustrous, apparently as the result of movements along the planes of cleavage. In many cases the slates may be seen to be finely micaceous. They frequently carry so much pyrite as to show a very prominent rusty-weathering. The pyrite is not evenly distributed; often the slates are almost free from this mineral, while when it is present it may occur very finely disseminated, or in coarser grains, or in tiny thread-like areas. The planes of the slaty cleavage, or its equivalent, almost always cut the bedding planes. Frequently the parting planes are hackly, or quite irregular, with a fibrous-like surface

Everywhere with the slates occur beds from a few inches up to a foot or more thick, of dark, fine-grained sandstone, composed of tiny quartz grains, embedded in a dark matrix not unlike the material composing the slates. Some of these beds are much more quartzose than others, and in some instances are comparatively coarse. Less frequently beds of fine conglomerate, or of feldspathic sandstone probably of tufaceous origin, occur with the slates. The sandstone beds, while usually occurring in groups of two, three, or more beds separated by layers of slate, are, in a number of places, much more abundant, and in certain instances they begin to rival in total volume the interbedded black slates.

At one locality on the Tetagouche about one-fourth of a mile east of the most westerly bridge, there is a narrow band of impure limestone, and sandstone, and fine conglomerate having a calcareous matrix. These measures, only seen at one spot, possibly belong to a younger formation infolded with the Ordovician strata.

An apparently characteristic feature of the formation, as seen on three of the rivers, is the occasional occurrence in it of bands, varying from 10 feet to several hundred feet in width, of red rocks which in places closely resemble the ordinary black slates, except for their colour, which is not very prominent and seems at least partly due to finely disseminated hematite. In other cases the colour, a rather light brick red, is very marked, and while in places these red rocks are moderately soft and slate-like; in other places they are hard, almost flint-like, and, in some instances at least, they are slightly manganiferous.

*Structural Characters.*—The Tetagouche slates in the south-western portion of the district strike in a northerly direction, but farther north, over the greater part of the area occupied by them, the general strike is a little north of east. The angle of dip is usually high, often 90°, and is seldom less than 45°. The direction of dip constantly changes, while local variations in the direction of the strike are common. The strata apparently are closely folded, probably often overturned.

Faulting is common, and it is evident that the beds have suffered from severe stresses, as shown by the fractured and torn condition of many of the sandstone beds, which are so disrupted in places that the resultant fragments, embedded in the more plastic slates, give to them the appearance of coarse conglomerates. The slates are often corrugated, or minutely crenulated along the plane of strike.

*Relations to Other Formations.*—The Tetagouche slates are believed to be the oldest rocks in the district. It is assumed that they underlie the tufaceous measures of the Millstream formation, this arrangement being indicated on Middle river by a synclinal structure of one of the bands of volcanic rocks supposed to belong to the Millstream formation. No indications were seen of any want of conformity between the two divisions of the Ordovician, though it cannot be positively stated that they are conformable. Though not seen in contact with the Nipisiguit granite batholith, there is little room for doubting that the granite is much the younger. Diabase dykes are everywhere numerous; other basic and acid types occur, but less commonly.

*Age and Palæontological Evidence.*—The Tetagouche slates have been assigned to the Ordovician, on the evidence of graptolites occurring in black slates on the northern bank of the Tetagouche just above the Intercolonial Railway bridge. The slates are less altered there than elsewhere in the district, and the planes of cleavage and bedding are parallel. The slates elsewhere were fairly closely examined for fossils, but none were found.

The occurrence of graptolites at the above locality on the Tetagouche is mentioned by Ells[1], and he remarks that they 'probably mark the upper portion of the Cambro-Silurian system at this point.' In the marginal notes of map No. 3 SE, Ells states that the graptolites strongly resemble Utica forms. Later, Ami[2] named a collection of graptolites from this locality. The results of Ami's determinations are as follows:—

*Diplograptus foliaceus*, Murchison.

*Diplograptus truncatus*, Lapworth (or a very nearly related form.)

? *Lasiograptus, sp. indt.*

*Climacograptus bicornis*, Hall.

*Cryptograptus tricornis*, Carruthers.

*Dicellograptus anceps*, Hall.

*Orthograptus quadrimucronatus*, Hall.

? *Didymograptus superstes*, Hall.

Besides the above graptolites there was associated with them the following brachiopod:—

*Leptobolus, sp.*

---

[1] Ells, R. W.; G.S.C. Report of Progress for 1879-80, part D, p. 24.
[2] Ami, H. M.; G.S.C. Summary Report for 1904, pp. 289-290.

Regarding the geological horizon indicated by the above assemblage, Ami makes the following statement:—

'These black and at times pyritiferous shales appear to be synchronous or homotaxial with the shales of Normanskill, near Albany, N.Y.; of the city of Quebec; of the north shore of the Island of Orleans; of the Marsouin river, and of numerous other localities in Gaspé peninsula.' The Normanskill shales are regarded as being of lower Trenton age.

Ami[1] also adds the following note:—

'List of species of graptolites determined by Professor Lapworth from the collection sent him by the writer some years ago, obtained along the Tetagouche river, Gloucester county, New Brunswick, by Dr. R. W. Ells:—

*Lasiograptus mucronatus*, Hall.
*Climacograptus bicornis*, H., with branch of *Dicranograptus*.
*Cryptograptus tricornis*, Carruthers.
*Diplograptus aculeatus*, Lapworth, or *D. Whitfieldi*, Hall.
" cf *D. Whitfieldi*, Hall.
" allied to *D. quadrimucronatus* H.
" *foliaceus*, Murchison.
" ?

ORDOVICIAN: MILLSTREAM SERIES.

*Distribution.*—The Millstream series is largely composed of tufaceous measures, and occupies, almost exclusively, a westerly extending band, from 4 to 5 miles wide, bounded on the south by the area of the Tetagouche slates, and on the north by Silurian measures. Four bands of rocks occurring on the rivers to the south within the main area of the black slates of the Tetagouche formation, have been correlated with the Millstream series, though on somewhat doubtful grounds.

*Lithological Characters.*—The rocks of the large northern area occupied by the Millstream series appear to be of tufaceous origin; in colour they vary from light greenish grey to dark grey, and in grain, from fine, slate-like varieties to others resembling fine conglomerate or grit. The finer grained types are the more abundant, and usually display a prominent banding—very narrow, light grey, more

[1] Loc. cit., p. 292.

arenaceous bands, in many cases showing false bedding, alternating with equally narrow, darker, denser bands. The coarser varieties, commonly of a dark greenish hue, are composed of imperfectly rounded, tiny quartz grains, many minute, angular feldspar fragments, and, not uncommonly, very small particles of jasper, etc. These rocks are nowhere soft, and in places are considerably indurated, or finely micaceous. With the tufaceous beds there were seen, rarely, narrow beds, varying in character from an impure calcareous slate to a fairly pure limestone.

On Grants brook, near the railway, occurs a band of rocks that have been correlated with the Millstream formation. The beds, in part, are soft, micaceous, light green in colour, mottled and speckled red. Rocks in part like these occur in a band on the lower portion of Tetagouche river, but as a rule are greatly deformed and schistose.

On Little river two bands of rocks correlated with the Millstream formation occur within the area of the Tetagouche slates. The rocks of the more westerly band are largely tuffs and coarse fragmental rocks, quite different in general appearance from those of the broad area of the Millstream series to the north. One example is dull, dark greenish, fine-grained, with a hackly fracture, and apparently is a sheared tuff, composed of angular feldspar fragments and tiny quartz grains embedded in a dense ground of minute, angular feldspars and secondary minerals. Much finely disseminated pyrite is present. Other rock varieties are much coarser, with foreign fragments varying in size from very small up to many with diameters of half an inch or more. Associated with these fragmental rocks occur others that possibly represent much altered, highly sheared, volcanics.

On Middle river a band of rocks, somewhat like those of Little river just mentioned, has also been mapped as belonging to the Millstream series. At this locality the rocks are generally well-banded and vary from fine tuffs to coarse feldspathic (tufaceous) sandstones.

*Structural Characters.*—The fragmental rocks of the Millstream formation exhibit ge[illegible]ructures similar to those of the Tetagouche formation. In [illegible]e isolated bands crossing the southern streams, the general strike of the rocks is about ENE. while in the main area farther north, it is more nearly east and west. The angles of dip are usually high, and the direction of dip continually varies, indicating close folding. In several cases, where short portions of the streams follow anticlinal axes, the folds were observed to be overturned, a condition that is probably general throughout the Ordovician area. The measures at many points are corrugated along the strike, and a slaty cleavage is usually present. In certain areas the rocks are sheared, and partly schistose in character. A great many small faults and slips were encountered, and probably there are many major faults, but the relatively limited number of exposures prevented their exact determination.

*Relations to Other Formations.*—The Millstream measures are believed to be younger than those of the Tetagouche formation. On Little and Middle rivers there are indications that the volcanic beds lie in synclinal basins, and that the two formations are conformable. The boundary between the Tetagouche slates and the main area of the Millstream beds appears to follow a fairly straight course, possibly a fault plane.

The main area of the Millstream measures is limited on the north by Silurian strata, and the boundary appears to follow a very irregular course; its position could not be even approximately determined, since it lies within an exposureless zone. The Ordovician measures are apparently in contact with various divisions of the Silurian, probably, in part at least, brought into their present positions by faulting, though possibly there may be an overlap of the Silurian. Ells[1] was of the opinion that, along the course of Nigadu river, the Ordovician 'appears to merge gradually into the lower beds of the Silurian'; the results of the more detailed, recent work, negative this view; the presence, amongst Silurian measures, of coarse conglomerates holding fragments of rocks precisely like those of Ordovician strata, indicating that the two systems are unconformable.

As in the case of the lower division of the Ordovician, the Millstream beds are cut by numerous diabase dykes, and, less frequently, by dykes of other types of igneous rocks, both basic and acid.

*Age.*—No direct evidence bearing upon the age of the Millstream series relative to that of the Tetagouche slates was obtained, and the conclusions reached on this point are largely a matter of opinion. Since, for various reasons, it seemed advisable to adopt some definite view regarding the relative ages of the two formations,

[1] Ells, R. W.; G.S.C. Map-Sheet, No. 3, SE, marginal notes.

the Millstream series has been described and mapped as being of Ordovician age, and younger than the Tetagouche slates. The main factors governing this decision are set forth below.

As stated on a previous page, it is assumed, on stratigraphical grounds, that the measures of the three bands of the Millstream series that occur respectively on Tetagouche, Middle, and Little rivers, form synclinal basins within the Tetagouche slates, and are younger than them. No evidence of unconformity between the two formations was obtained.

The strata of the above-mentioned three bands have been correlated with the measures of the wide area of Millstream strata lying north of the Tetagouche slates. This correlation is directly supported only by the fact that the strata of the two districts are of volcanic origin, otherwise they possess but few common lithological features.

No stratigraphical evidence was obtained that the strata of the northern, main area of the Millstream series should be considered younger or older than the Tetagouche slates.

From the occurrence within the early Silurian, Turgeon conglomerates, of pebbles of rocks similar to varieties found within the northern area of the Millstream series, it is definitely concluded that the beds of this northern area of Millstream strata are older than the Turgeon conglomerates and that in age they are separated from the Turgeon formation by a considerable period of erosion. Since the Turgeon formation underlies fossiliferous measures of Clinton age, it seems logical to infer that the Millstream beds are of pre-Silurian age.

If the correlation of the strata of the northern area of Millstream rocks with those forming the three bands crossing the southern rivers is correct, then, on the grounds set forth above, the Millstream series is of middle or upper Ordovician age, since it is younger than the Tetagouche slates, which are, in part at least, of lower Trenton age.

### ORDOVICIAN: METAMORPHOSED ORDOVICIAN.

Along the course of Middle river, approaching the borders of the batholith of Nipisiguit granite, there is a section about 4 miles long of highly metamorphosed rocks, believed to represent members of one or both of the two Ordovician formations already described.

These metamorphosed rocks are nearly all heavily charged with brown biotite, and very frequently contain much pyrite, either finely and uniformly disseminated, or occurring very abundantly along certain lines and bands. The rocks vary from dense hornstones to coarse forms of biotite schists, and even gneisses. In some cases the beds seem to have been dark slates, but the metamorphism is usually of such an advanced type as to prevent a satisfactory determination of their original characters, and exposures were lacking at places where the forms transitional in character between the altered and unaltered types might be expected to occur.

At several points the strata are cut by aplite and granite dykes. At one place the contact with the main body of the granite is exposed. The contact is quite sharp, though angular; veins of the granite penetrate the schist, and angular blocks of schist lie in the granite, separated by only an inch or so from the parent rock, and still retaining their original outlines so perfectly as to give the impression that if it were possible to replace them they would exactly fit their original positions.

These metamorphosed rocks were seen only on Middle river, where they doubtless represent a portion of a contact zone surrounding, or partly surrounding the granite area, but not expos[illegible] where.

### SILURIAN: TURGEON FORMATION.

*Distribution.*—To the north of the broad band of Ordovician measures already described, the district is underlain by two westerly trending zones of Silurian strata, separated by a wide irregular band of igneous and other rocks classed with the Fournier group. The more southerly zone of the Silurian, bounded on the south by the main area occupied by the Millstream formation (Ordovician), and on the north by the large mass of the Fournier group, has a maximum width of about 6 miles, and occupies most of the country between the Nigadu and Elmtree rivers. The northern of the two Silurian zones, extending north from the area underlain by the Fournier group to the westerly trending coast, has a maximum width of about 2½ miles.

The Turgeon formation is thought to be the oldest of three groups into which the Silurian has been divided. Outcrops are confined to the coast or its immediate neighbourhood; in the northern Silurian area, it outcrops along the shore in two areas respectively near Turgeon and Belledune post-offices. In the southern Silurian area the formation is not present in as great volume, being limited to a few outcrops along the coast between Elmtree and Petit Rocher, and a few along a curving east-west line extending inland for about 3 miles.

*Lithological Characters.*—The rocks of the Turgeon formation are of various types, ranging in texture from coarse conglomerate to argillite, and in colour generally from red to grey, the red varieties predominating. The conglomerates have a dark reddish or brownish matrix, and form, in places, massive beds or zones perhaps 100 feet or more thick, that are quite devoid of any appearance of stratification, and in which many of the contained pebbles and boulders have a maximum diameter of 1 foot or more. In other cases the conglomerate is interbanded with lense-like bodies of coarse, red sandstone, while in many instances it occurs in distinct beds, a few feet in thickness, holding pebbles, generally less than one-half inch in diameter, and alternating with reddish beds of grit, sandstone, or argillite.

Pebbles of white quartz are common in all phases of the conglomerate, and at many places are dominant. In certain localities, pebbles of red or green jasper are numerous; tufaceous sandstones and variously deformed volcanics comprise the remaining varieties of pebbles and boulders.

Along considerable portions of the sections of the Turgeon formation, conglomerate is the chief rock type, but along many stretches, coarse, generally red, though in places grey, sandstones and grits predominate, but beds or bands of conglomerate are always common. The individual arenaceous and argillaceous beds are usually a foot or more thick.

*Thickness.*—As indicated by measuring a number of imperfect sections, the total thickness of the Turgeon formation must be considerable, perhaps reaching a thousand feet or more, but no reliable estimate could be formed, since it did not appear that either the base or summit of the formation was exposed, and it was evident that the formation was much faulted. Possibly the faulting has led to an exaggerated idea of the total thickness.

*Structural Characters.*—The strata are usually inclined at high angles, a vertical attitude being common and the angle of dip seldom less than 40°. The direction of strike varies, and abrupt changes in dip and strike are common.

*Relations to Other Formations.*—Scarcely any direct evidence bearing upon the relationship of the Turgeon formation to the other formations of the district was available. Except in the case of certain igneous bodies, it was possible at only a few points to determine the position of the boundaries of the areas even approximately, and at these places the contact seemed to follow fault planes.

Many of the pebbles of the conglomerate are apparently of rock types precisely similar to various tufaceous members classed with the Millstream series (Ordovician), while others closely resemble varieties that have been included in the Fournier group.

Near Belledune, towards the mouth of Hendry river, it appeared possible that grey sandstones classed with the Turgeon formation were conformably overlain by limestones holding fossils of Clinton and Niagara types.

On the lower part of Elmtree river, Turgeon conglomerates are cut by a stock-like body of gabbro mapped as a portion of the Fournier group; farther north, along the coast south of Hendry river, the formation is cut by a body of granodiorite.

At a number of points along the northern coast the members of the Turgeon formation are directly overlain by conglomerates of the Bonaventure (Devonian) formation.

*Age.*—No fossils were recovered from the measures, but from a consideration of their probable relationships to the other geological divisions of the district, it has been concluded that the Turgeon formation is of Silurian age, forming the basal portion of the Silurian system as developed in the Bathurst district.

### SILURIAN: BELLEDUNE GROUP.

*Distribution.*—The Belledune group, the second of the three divisions into which the Silurian of the district has been divided, is largely calcareous in composition—limestones, calcareous shales, shales, etc. The strata are exposed along the coast from a point a short distance north of Elmtree river to south of the mouth of Nigadu river; they occur on the lower part of Elmtree river, and over a small area some 3 miles inland from Petit Rocher; while, in the northern Silurian area, they outcrop at a number of points in the vicinity of Belledune and elsewhere. A small, isolated outcrop occurs some 5½ miles inland on a tributary of Millstream river, on the border of an area underlain by Ordovician strata.

*Lithological Characters.*—The Belledune group, as indicated by the results of the study by Lawrence M. Lambe, of the Geological Survey, of a few collections of fossils, includes horizons ranging in age from Clinton to Niagara, and perhaps Guelph. Measures of the oldest of these horizons are displayed in the vicinity of Hendry river, within the area of the northern band of Silurian strata. At this locality the strata are mainly calcareous, and generally are reddish in colour. In many places the rocks show a very pronounced banding, narrow bands of fine, red, impure limestone alternating with equally narrow bands or beds of coarsely crystalline limestone having a fainter red colour. In places the beds are of the nature of calcareous shales. Dark limestones and shales occur more sparingly, and occasionally grey sandstones are present.

Within the southern band of Silurian strata, at Limestone point, just north of the mouth of Elmtree river, fossiliferous measures of Niagara, and perhaps Guelph age occur. The beds are grey in colour and consist of alternations of thin beds of grey, crystalline limestones, and fine grey sandstones, with occasional bands of fine conglomerate.

Along the shore south of Elmtree river occur dark limestones, in places verging on calcareous shales, black slates, red and green shales, in part calcareous, and light grey and greenish arenaceous beds, the different varieties alternating in bands and zones varying in width from 10 or 15 feet to 300 feet or more. A somewhat similar assemblage, but with a larger proportion of greenish and reddish shales and slates, is exposed along the shore from Petit Rocher south to beyond the mouth of Nigadu river.

*Structural Characters.*—Over the various areas occupied by the strata of the Belledune group the rocks are much disturbed. Though in different areas the direction of strike is often fairly constant, the angles of dip show great variation. The measures appear to be lying in a series of close folds, whose axes frequently appear to be less than a hundred yards apart. Faults are common, and in many cases their throws must be considerable.

The limited number of exposures and the much folded and faulted condition of the strata, has prevented the obtaining of a complete section, and there is considerable doubt as to the relative ages of various assemblages. Probably the calcareous measures found near Belledune conformably succeed the sandstones of the Turgeon formation, since the strata of the two divisions in neighbouring exposures have approximately the same attitudes. Probably this same horizon is exposed near Petit Rocher, and elsewhere. The fossiliferous measures of Limestone point, as indicated by fossils recovered from them, are of a higher horizon, and may conformably succeed the beds of the horizon of Belledune. The possibility of an unconformity existing within the Belledune group is indicated, however, by occasional outcrops of comparatively coarse conglomerate lithologically unlike the Turgeon conglomerates, and which, as far as their situation relative to neighbouring outcrops of Belledune strata are concerned, seem to occur within the Belledune group. An exposure of such a conglomerate may be seen a few rods west of Petit Rocher church.

Except in the case of some of the igneous bodies mapped with the Fournier group, the contact of the Belledune measures and the surrounding formations was nowhere observed, an exposureless area, often of considerable breadth, always intervening. Various divisions of the Silurian are bordered by the Ordovician in such a manner as to suggest that the strata of the two divisions are in contact along fault planes.

In places the Belledune measures are cut out by dykes, but in general such bodies are almost completely absent.

*Age and Palæontological Evidence.*—Fossils are not uncommon in the limestone measures, but are usually poorly preserved. Several collections of fossils were submitted to Mr. Lawrence M. Lambe of the Geological Survey, and his report upon them is as follows:—

'The fossils collected by G. A. Young, in 1908, in the northeastern part of New Brunswick, in the neighbourhood of the Bay of Chaleur, are from two main localities, viz., from near Belledune, and from Limestone point. The faunas represented indicate a Silurian age for the rocks of the included area, those of Belledune being older or lower in the geological scale than those to the southeast at Limestone point. The fossils occur in impure limestone, and are, as a whole, poorly preserved; many of the specimens are deficient in those structures most necessary for an exact determination. The greater part of the collection consists of corals, but two species of brachiopods are present, as well as remains of bryozoan and crinoids. A single lamellibranch, not sufficiently well preserved for definite determination, was also collected.

The following is a list of the fossils obtained, arranged according to localities:—

I. Near Belledune:—

1. Foot of dam, Hendry river, 70 feet below shore road.
   *Palæocyclus rotuloides*, Hall.
   Rings of crinoid stalks.
2. On beach, 400 feet east of Hendry river.
   A simple Cyathophylloid coral (three specimens); not sufficiently well preserved for determination.
   *Halysites catenularia*, L.; fragment.
   Rings of stalks of crinoids.
3. On Hendry river, 40 feet above bridge.
   *Cyathophyllum* cfr. *thoroldense*, Lambe.
   *Aulopora*, sp., small fragmentary.
   *Syringopora dalmani*, Billings; fragments.
   *Favosites gothlandica*, Lamarck.
   *Cladopora multipora*, Hall; fragments.
   ? *Monticulipora;* zoaria small, poorly preserved.
   *Dalmanella elegantula* (Dalman); immature.
4. 475 feet east of mouth of Hendry river.
   *Streptelasma bilateralis* (Hall).
5. Hendry river, 90 feet above main road.
   *Favosites gothlandica*, Lamarck.
6. On shore, 650 feet east of Hendry river.
   *Palæocyclus rotuloides*, Hall; one specimen showing the basal surface only.
   *Cyathophyllum thoroldense?* Lambe.
7. Hendry river, 105 feet below bridge.
   Portions of stalks of crinoids.
   *Anoplotheca hemispherica* (Sowerby); dorsal valves.

8. Hendry river, 130 feet below bridge.
   *Syringopora dalmani*, Billings.
   *Favosites gothlandica*, Lamarck.
   Favositoid coral (*?Favosites niagarensis*, Hall).
   Parts of stems of crinoids.
9. Hendry river, above bridge.
   Fragment of a rugosa coral *?Streptelasma*.
   *?Dalmanella elegantula* (Dalman); poorly preserved.
10. Hendry river, below bridge.
   Small rugosa coral, *?Streptelasma*.
   *Palæocyclus rotuloides*, Hall.
   *Cyathophyllum* sp.; not sufficiently well preserved for identification.
   *Syringopora dalmani*, Billings.
   Favositoid coral (*?Favosites niagarensis*, Hall).
   Rings of crinoidal stalks.
   *?Monticulipora*; poorly preserved.
11. Limestone point, near Elmtree river.
   *Streptelasma caliculus*, Hall.
   *?Streptelasma*.
   *?Streptelasma caliculus*, Hall; cast of calyces.
   *Syringopora compacta*, Billings.
   *Favosites niagarensis*, Hall.
   *Favosites aspera*, d'Orbigny; one specimen.
   *Halysites catenularia*, L.; large form.
   *Halysites catenularia*, var. *micropora*, Whitfield.
   Portions of crinoid stalks.
   *?Orthis*, strongly ribbed.
   Brachiopod; cast of valve with strong mesial fold; somewhat resembling *Hyatella*.
   Lamellibranch; suggestion of *Anadontopsis*.

Considering first the Belledune fauna, seven species of corals and two of brachiopods, can with more or less certainty be identified. Of the corals the most satisfactory one as a horizon marker is *Palæocyclus rotuloides*, of which a number of specimens is present. This species has a limited range and is characteristic of the Clinton formation as developed in the State of New York. *Streptelasma bilateralis* has also been described from the same horizon. The other species of corals cannot be regarded as indicating a very definite horizon in the Silurian, but are on the whole somewhat distinctive of slightly higher beds. Of the brachiopods *Anoplotheca heimspherica* is another Clinton form, originally described from New York, and later recognized in rocks of the same age over a large area in the United States. This species is also known from the Arisaig beds of Nova Scotia, and from division 3 of the Anticosti group.

'The Belledune limestones may, therefore, be regarded as of Clinton age, with the probability of their including beds which pass up into the Niagara. They appear to be synchronous with the lower part of the Arisaig series of Nova Scotia, and to be slightly older than the beds of the Chaleur group, which occur to the northwest of Belledune across the Bay of Chaleur, in the neighbourhood of Port Daniel.

'The fossils of Limestone point are nearly all corals. *Streptelasma caliculus* is a definite Niagaran form, as is also *Favosites niagarensis*. *Favosites aspera* occurs in the Niagara formation, but is also known from earlier rocks. The chain coral (*Halysites catenularia*) with large corallites, and its variety *micropora*, are found in both the Niagara and Guelph formations, whilst *Syringopora compacta*, described originally from Anse à la Vieille, Bay of Chaleur, is from a horizon nearly equivalent to that of the Guelph formation of Ontario. The remains of the brachiopods and of the lamellibranch are not sufficiently well preserved to be relied on.

It would appear, therefore, that the Limestone Point beds are of later age than the Clinton, viz., of the age of the Niagara, and that they probably include some as new as the Guelph. They would find their equivalents in the beds towards the upper part of the Arisaig series, and would approach in age the limestones of Anse à la Barbe, and Anse à la Vieille.'

### SILURIAN; ELMTREE SLATES.

*Distribution*.—The Elmtree formation consists very largely of dark slates. These rocks are, in the southern Silurian area, widely displayed along the course of Elmtree river and its tributaries, on the upper portion of Nigadu river, and over a small area a couple of miles inland from Petit Rocher. A small area of similar rocks occurs on Fournier brook, within the body of rocks of the Fournier group. In the northern Silurian area supposedly equivalent mea-

stures outcrop along the border of the area occupied by the Fourni
group.

*Lithological Characters.*—On Elmtree river these dark slates m
frequently micaceous. In general they show distinct bedding, lin
and narrow bands of dull black regularly alternating with oth
lines and beds of dark grey. The slates frequently are highly in
pregnated with pyrite, and in places are cut by zones of quart
veins. Occasionally small lenses, a few inches in diameter, of lime
stone occur along bands in the slates, while interbanded with th
slates occasionally occur beds of fine, dark sandstone.

The slates of the upper Nigadu are similar to those found o
Elmtree river, but in the northern Silurian area the slates seldom
present any evidence of bedding, and they regularly alternate with
beds of dark conglomerate, having a dense, greenish, quartzose matri
charged with quartz pebbles sometimes as large as three-fourths o
an inch in diameter. With the slates and conglomerates of th
northern area also occur beds of sandstone and quartzite.

*Structural Characters.*—The Elmtree slates usually are steeply
inclined, and as indicated by frequent reversals of dip, are probably
rather closely folded. In many places the beds are corrugated or
brecciated. The sandstone beds frequently may be seen to have been
broken into fragments, and these se[illegible]d from one another so as
to give to the rocks the appearance o[illegible] a conglomerate.

*Dykes.*—The formation is cut by numerous diabase and diabase
porphyrite dykes.

*Age and Palæontological Evidence.*—In the southern Silurian
area, the stratigraphical evidence available indicates that the Elm-
tree slates conformably succeed certain of the limestone members of
the Belledune group. This succession is also indicated by the find-
ing in them, on Nigadu river, of the coral *Favosites gaspensis*, con-
cerning which Lambe has furnished the following note:—

'Nigadu river, about 6 miles above mouth.

'*Favosites ?gaspensis*, Lambe.

'The single coral from Nigadu river is a branching Favosites,
regarded as probably referable to *F. gaspensis*, a species described
from Anse au Gascon, Bay of Chaleur, from rocks of about the age
of the Guelph formation.

The age of the Nigadu beds would appear, therefore, to be about the same as those of Limestone point in their later development."

### DEVONIAN (?): DYKE ROCKS.

Dykes of diabase are common throughout the district, especially over the areas occupied by the Ordovician strata and those of the Elmtree formation. No such dykes were found cutting the Carboniferous, the Bonaventure formation, nor the Nipisiguit granite. They occur, but only rarely, cutting the Targeon formation and the Belledune group. In general the dykes follow nearly parallel courses, about ENE and WSW.

Besides those of diabase, dykes of diabase porphyrite, aplite, granite porphyry, syenite porphyry, and diorite porphyrite were also noticed.

The acid dykes, as indicated by their mineralogical composition, may be of about the same age as that of the Nipisiguit granite, that is, Devonian. Those of diabase and diabase porphyrite, since they do not cut the granite, are likely of an earlier date; but as they appear to have cut the strata after the main period of folding in which the Silurian was involved, it s[illegible] that they too are of Devonian age.

### DEVONIAN (?): NIPISIGUIT GRANITE.

*Distribution.*—A coarse, semi-porphyritic granite is exposed in the southern portion of the district, along stretches of the Nipisiguit, Little, and Middle rivers. Exposures are wanting over the areas between these rivers, though it is fairly certain that all the country in the neighbourhood is underlain by the granite body.

*Lithological Characters.*—Along the Nipisiguit, and the lower portions of Little and Middle rivers, the granite has a fairly uniform appearance, the major differences being mainly of texture, as between coarsely granular and semi-porphyritic. Typically the rock has a light pinkish tinge, due to the presence of numerous large, rectangular crystals of feldspar (orthoclase). These large feldspars, quite often as much as an inch in length, lie in a medium to fine and rather even, grained ground of pale pink feldspar and glassy quartz, with innumerable small flakes of dark mica (biotite).

When examined under a microscope the granite is seen to be of normal, acid type, with both orthoclase and acid plagioclase amon the feldspars. Frequently the individuals of quartz have rud crystalline outlines.

Pale pink, fine-grained, aplite dykes may frequently be seen c ting the granite, but no pegmatite dykes were found. Several dyk of granite were noticed cutting bordering formations; in such ca the granite was coarsely granular, not semi-porphyritic.

On Little river there are a number of exposures of granitic typ somewhat different in general appearance from the widespread vari ty already described. One variety is a pale, greyish white, fi rather even grained granite porphyry, composed of abundant qua in small, angular and crystalline forms, very abundant white fel spar in rectangular grains, and numerous flakes of dark biotite gi ing the rock a speckled appearance.

Viewed under the microscope this rock is seen to be compos of larger individuals of quartz, plagioclase, and orthoclase, wi slender tables of biotite lying in a finely granular ground, parts which suggest a granophyric intergrowth of quartz and feldspar.

Other varieties were seen of character intermediate between t above granite porphyry and the normal, semi-porphyritic types fi described.

The relations existing between the finer grained types and t coarse, semi-porphyritic granite so widely displayed along the Nip siguit and elsewhere, were not established. At several points t coarse, pink variety was found to contain small, rounded inclusio of a fine grey rock, closely resembling some of the fine-graine granites and granite porphyry of Little river.

Exposures of the finer grained, grey types were practically co fined to certain courses of Little river, and it seems entirely probab that the granite mass is preponderatingly composed of the coars pink type.

*Form of Granite Body.*—The exposures of granite evidently a belong to the northeastern part of a batholith of considerable siz bounded on the north and west by Ordovician strata, but hidde over its eastern portion by the younger, Carboniferous strata lyin east of Nipisiguit river. The granite body as exposed has a majo axis following a north-south direction, and of a length of about 1 miles, of which about 7 miles lie within the district mapped; the maximum exposed width is about 4 or 5 miles.

*Relations to Other Formations.*—Along its western edge the granite body is in contact with rocks considered to be the metamorphosed equivalents of the Ordovician, Tetagouche slates into which it sends occasional granite dykes. The eastern edge of the granite area follows the course of the Nipisiguit, and there the rock is capped by the beds of the Bathurst formation of Carboniferous age.

*Age.*—The Nipisiguit granite is probably of Devonian age. It was intruded after the folding of the neighbouring Ordovician strata, and also of the Silurian measures farther north, for the two systems seem to have been affected by the same earth movements. On the other hand, its intrusion seems to have taken place before the period of erosion preceding the deposition of the Bonaventure formation of very late Devonian age. The granite is of the same general type as that displayed elsewhere in Quebec, New Brunswick, and Nova Scotia, and where, in some cases, the plutonic rock cuts Devonian strata.

## ORDOVICIAN TO DEVONIAN: FOURNIER GROUP.

*Distribution.*—Rocks of various types and ages classed with the Fournier group outcrop at a number of localities. The largest area occurs in the northern part of the district, forming a band about 3 miles wide extending westward from the coast to the borders of the district. A second area lies along the coast to the north; a third is traversed by the lower portion of Millstream river; a fourth area of considerable size lies towards the coast between the valleys of Grants brook and Tetagouche river; and a fifth occurs some distance inland and just south of the Tetagouche. These areas are indicated on the map. A portion of the district towards the western boundary, just north of Millstream river, may be largely occupied by rocks that would be classed with the Fournier group, but since only a very few, isolated rock exposures occur over this area it was necessary to map it as being drift covered.

*Significance of Term, Fournier Group.*—The term, Fournier group, has been introduced for the purposes of mapping and describing various, often quite unrelated rock assemblages. The necessity for so doing arose from the fact that over considerable areas having relatively few rock exposures, igneous rocks have been so intricately intruded, and perhaps extruded, amongst stratified beds, that under the conditions of field work it was found impossible to determine the mutual relationships of the various types, or to map their boundaries. The term, Fournier group, therefore, lacks any real geological meaning other than that the rock types embraced are largely igneous.

*First Area.*—Of the various areas occupied by the Fournier group, that one stretching in a narrow band about 1½ miles long, along the coast south of Belledune, is the only one primarily occupied by a single rock body. The prevailing type is a quartz-biotite-diorite, a medium to fine-grained rock, granitic in appearance, when fresh of a light grey colour, but generally tinged red as a result of decomposition. The rock is largely composed of quartz and plagioclase feldspar, and is flecked with specks of chloritic material resulting from the alteration of biotite. The quartz diorite is cut by many dark diabase dykes, and one dyke of fine-grained diorite aplite was observed.

This body of quartz diorite is bordered on the landward side by strata of the Turgeon formation, which it probably cuts. The igneous rock is much fractured, and in places slickensided.

The quartz-diorite is very similar to certain rock types occurring within the main area of the Fournier group just to the south. Possibly in both areas, these plutonic rocks are related to and of about the same age as the Nipisiguit granite, but from the fact that they are frequently cut by diabase dykes that are absent from the Nipisiguit granite, and from the fact that they have been fractured, slickensided, etc., by dynamic forces that the granite has escaped, it is thought that they are older than the Nipisiguit granite, though probably of Devonian age.

*Second Area.*—The broad area occupied by the Fournier group that extends from the shore between Limestone point and Fournier brook inland to the western boundary of the district, is occupied by a complex assemblage of rocks, plutonic, volcanic, and stratified, that in places are variously altered, schists and gneisses being common. Exposures are numerous towards the coast, but inland they are only occasionally met with, and it is chiefly because of the rough, broken nature of the country—a feature that is taken to indicate the presence of igneous bodies—that the greater part of the area has been mapped as being occupied by the rocks of this group.

Along a portion of the course of Fournier brook, well within the area of Fournier rocks, there are, as indicated on the map, exposures of dark slates that have been classed with the Silurian. It is not improbable that there is a considerable development of such rocks elsewhere within the area, but if so they are hidden by the drift. While it is probable that these slates are older than most of the igneous rocks of the Fournier group, this relationship was not definitely established.

Along the shore, between Fournier brook and Limestone point, considerable stretches are occupied by tufaceous sandstones, fine tuffs, red and green shales and slates, and greenish sandstones. These measures, often twisted and brecciated, are in places intricately associated with fine-grained, much altered volcanics, apparently diabase porphyrites. These igneous rocks are usually fine to dense in grain, varying in colour from nearly black to pale green. As a rule they are much altered, being generally chloritic and somewhat schistose.

Other areas along the shore are occupied by dark basic rocks, such as, moderately coarse gabbros, granites, and diorites, as well as hornblende schists, and gneisses. In such areas, the different types, as a rule, rapidly alternate, and are so confusedly arranged and have been so much affected by shearing and crushing, that no clear idea could be gained of their mutual relationships.

Certain small areas along the coast and inland are underlain almost exclusively by coarse-grained igneous types, granite, diorite, or gabbro. One such area occurs on the lower portion of Elmtree river in the neighbourhood of the railway crossing. The area, the largest seen, is elliptical in outline, with a maximum diameter of about three-fourths of a mile. The rocks occupying it vary from moderately fine-grained diabase to coarse gabbro having cleavage faces of feldspar and augite as much as an inch in breadth. Towards one edge the rocks consist of regular alternations of coarse and fine-grained types, elsewhere the rock mass is more homogeneous. It is cut by dykes of diabase.

In the neighbourhood of Greenpoint station, coarse-grained rocks occur, which over one small area are of the nature of crushed granites, while elsewhere they consist of alternating bands or areas of diorite, coarse and fine gabbro, and diabase.

Various exposures along the shore, between Fournier brook and Limestone point, seemed to indicate that the hornblende schists were derived from the diabase porphyrites that, in a less altered state, occur interbanded with the tuffs and sediments. The gneisses appear to have formed from the porphyrites as a result of the injection of granite along roughly parallel planes. The rocks of somo exposures consist almost entirely of the less altered volcanics, at others these are much more schistose, and are cut by distinct veins of granite; other outcrops show granite veins in greater abundance, and present all stages up to a perfectly banded gneiss, consisting of rapid alternations of dark hornblende schist, and light coloured, crushed granite.

For a mile or more inland from the coast between Fournier brook and Limestone point, numerous exposures of dark and light green schistose rocks occur; in many cases these schists seem to have been derived from tuffs. Various types of mica schists, and partly altered slates and sandstones, are also present.

The sediments, with the associated tuffs and volcanics of the main area of the Fournier group, have furnished pebbles to the Turgeon conglomerates, and, therefore, are pre-Silurian in age. Many of the rock types are like those found in the main Ordovician area to the south, and for this reason are considered to be of contemporaneous age.

A careful examination of the exposures of the Turgeon conglomerate failed to reveal the presence of any pebbles of the coarser igneous rocks placed in the Fournier group, and, therefore, it has been concluded that the granites, diorites, and gabbros are younger than the Turgeon formation, and if not of Devonian age are at least of late Silurian. More direct evidence of the relative ages of the coarse igneous types is given by the stock-like body of gabbro and diabaso cut through by Elmtree river. There the dark basic rocks, along their eastern margin may be seen to cut the Turgeon conglomerate, and on their western side to cut members of the Belleduno group, proving that their age is at least late Silurian.

An upper limit to the age of the igneous rocks is fixed by considerations based on the occurrence nearby of measures of the Bonaventure formation. Since the beds of the Bonaventure formation nearby are horizontal and undisturbed, it is deduced that the intrusion of the granite, gabbro, etc., of the Fournier group, took place prior to the formation of the Bonaventure beds; and since the Bonaventure beds are of late Devonian or very early Carboniferous age, the Fournier intrusives must be Devonian, or older.

The relative ages of the various acid and basic plutonics could not be definitely determined, but the impression was obtained that the basic types are younger than the granite.

*Third Area.*—Proceeding southward, a third area of Fournier measures occurs along th[illegible]er portion of Millstream river. The rocks include various dark tufaceous sandstones and fine-grained beds, probably tuffs, also fine sandstones, and argillites, chloritic schists, etc., besides numerous dykes. The rocks, on the whole, are considerably altered and disturbed. In a general way, the assemblage resembles the group of tuffs, sediments, and associated volcanics occurring on the coast near the mouth of Fournier brook.

*Fourth Area.*—Farther south, a considerable area lying near the coast, between Grants brook and Tetagouche river, seems to be predominately occupied by igneous rocks. In this area there are a number of isolated exposures of a diabase precisely like that forming the numerous dykes of the district. Possibly the rock occurs in dykes, but an impression is given that the bodies are of larger dimensions, possibly stock-like.

Other types of rocks encountered in the same area are volcanics of andesitic habit. One example is a very dark greenish rock, fine-grained, with small irregular or ovoid amygdules of calcite, quartz, etc. In some cases the amygdules have diameters as large as one-half inch. With the above types there occur, but less commonly, fine-grained rocks, chloritic and schistose, that possibly represent tuffs. Occasional exposures were apparently of agglomerates, though possibly these are, in reality, of autoclastic origin.

This area between Grants brook and Tetagouche river has been described by Ells[1] as being occupied by a volcanic series. So far as can be judged from the few widely scattered exposures this view is correct, viz., that the area is underlain by a volcanic series, probably of Ordovician age, but penetrated by dykes and larger bodies of later diabase.

*Fifth Area.*—One other area, lying south of Tetagouche river, and about 7½ miles from its mouth, has been mapped as being occupied by members of the Fournier group. At this locality, over a

---

[1] Ells, R. W.; G.S.C. Report of Progress for 1879-80, part D, page 40.

very small area, there are a few exposures of diabase, and one very limited exposure of much altered, quartz diorite, cut by diorite porphyrite.

*Sixth Area (?).*—Towards the western border of the sheet, north of Millstream river, in an otherwise nearly exposureless region, are several detached outcrops of serpentine, in one instance associated with dark, silicified slates. Nothing was found to definitely indicate the relative ages of the serpentine, nor could the form of the body or bodies be determined. Possibly the area is underlain by a complex such as that appearing on the shore between Fournier brook and Limestone point.

### DEVONIAN: BONAVENTURE FORMATION.

*Distribution.*—The Bonaventure formation consists of conglomerates, sandstones, shales, and limestone, and, with one exception, occupies no extensive area, but occurs in small isolated patches along the coast from the mouth of Belledune river southward to Fournier brook. On Millstream river, west of the railway crossing, a comparatively large area, extending along the river for about half a mile, is underlain by these beds. A few isolated outcrops were also noted at other points.

*Lithological Characters.*—The Bonaventure conglomerates, sandstones, and shales are invariably of a red colour, and contain much calcite in the form of white specks and grains rather uniformly distributed. The conglomerates are coarse, the pebbles and boulders well rounded. The dolomitic limestones form massive beds unlike ordinary sedimentary limestones, and probably of the nature of chemical precipitates.

The strata are always nearly horizontal, and nowhere is a thickness of more than 40 feet displayed. The lower beds are usually conglomerates, with a sandy matrix, holding fragments of the immediately underlying rocks. The conglomerates are generally overlain by beds of sandstone, with which occur the dolomitic beds. At various places the ordinary conglomerates are wanting, and the calcareous beds rest directly on the older formations, and the lower portion of the dolomitic beds is then of the nature of a conglomerate, holding fragments of the underlying Silurian or older rocks.

*Correlation and Age.*—The Bonaventure beds are not cut by igneous bodies, and since the sedimentary formation still lies in a nearly horizontal, unfaulted position, close to and at about the same elevation as exposures of granite, diorite, etc., of the Fournier group, it is apparently of a later date than the period of intrusion of the plutonic rocks mapped with the Fournier group.

The Bonaventure beds, as displayed within the area mapped, form small, detached exposures, often lying in hollows in the underlying formations, and evidently are erosion remnants of a once continuous formation. Farther north along the coast of Chaleur bay, they occupy much larger areas, and the formation was seen by both Logan and Ells at intervals along the New Brunswick shores westward to the head of Chaleur bay, and thence eastward along the northern Quebec shores of the same body of water to the extremity of Gaspé peninsula, where it consists essentially of conglomerates, sandstones, and shales, and attains a total thickness of several thousand feet.

Logan[1], who first described the Bonaventure formation from its development in Gaspé, considered that it there formed the base of the Carboniferous system, and that in the Bathurst district it was represented by various isolated outcrops of strata found along the coast, and by certain red beds that outcrop along the course of Nipisiguit river, and are, apparently, conformably succeeded by grey beds of the Millstone Grit. This view was also shared by Ells[2].

The red beds occurring on the Nipisiguit are in later pages of this memoir described as composing the Bathurst formation, and are not believed to be the equivalents of the Bonaventure formation as developed along the coast. If the Bathurst beds and the Bonaventure formation are not the same, part of the argument put forward by Logan and Ells in favour of a Carboniferous age for the Bonaventure beds is destroyed.

John M. Clarke, in recent years, has studied the geology of the Gaspé region, and has presented certain lines of evidence tending to show that the Bonaventure formation is of late Devonian age, or, possibly, was deposited during a period stretching from late Devonian into early Carboniferous time. Clarke[3] states that he was unable to find evidence, as described by Ells, of an unconformity in the sec-

---

[1] Logan, Sir W. E.; G.S.C., Geology of Canada, 1863, pp. 404-405 and pp. 437-453.

[2] Ells, R. W.; G.S.C., Report of Progress for 1879-80, part D, p. 10.

[3] Clarke, John M.; N.Y. State Museum, Bulletin 80, p. 169.

tion of conglomerate strata of Mt. St. Anne, and, therefore, that in his opinion, there was nothing to warrant the dividing of the strata into two, the assigning of the higher beds to the Bonaventure formation with a Carboniferous age, and the placing of the lower beds in the Devonian.

In a later publication, Clarke[1] states that conglomerate beds, in every respect similar to those of the typical Bonaventure strata of Percé mountain and Bonaventure island, occur within the Gaspé sandstone series, whose Devonian age (Hamilton?) is fixed on palæontological grounds. Clarke points out that the earlier geologists seem to have separated the inclined Gaspé sandstone series, with the included conglomerates, from the nearly horizontal Bonaventure beds of Bonaventure island and Percé mountain, because of the difference in attitude of the beds at the several localities, and the thus implied break. While admitting that the present conditions appear to strongly warrant such a conclusion, Clarke states that he is strongly convinced that the appearance is due to faulting, and that no such break occurs between the two series as their present relative attitudes would seem to indicate.

To sum up: Clarke fails to find evidence of a break between the Gaspé sandstone series of Devonian age and the Bonaventure formation, and is strongly impressed by the similarity existing between the conglomerate measures in the Gaspé sandstone series and the Bonaventure conglomerates. The conclusion is, that the Bonaventure beds are of upper Devonian age, or else were formed during an epoch stretching from late Devonian into early Carboniferous time. In the legend of the geological map accompanying Clarke's[2] report, the Bonaventure beds are mapped as Devono-Carbonic.

In the Bathurst district, if the Bonaventure beds are not considered the equivalents of the Bathurst formation described on the following pages, there is no direct evidence bearing upon the question whether they should be considered as Devonian or Carboniferous. If the Bonaventure strata are correlated with the Bathurst formation, as Logan and Ells correlated them, then, since the Bathurst beds, as far as available outcrops show, are conformably succeeded by the Millstone Grit. the age of the Bonaventure would be mid-Carboniferous, an age in accord with neither Logan's nor Clarke's

---

[1] Clarke, John M.; N.Y. State Museum, Memoir 9, pp. 93. 95.
[2] N. Y. State Museum, Memoir 9.

views. As already stated, the Bathurst formation is not considered to be the equivalent of the Bonaventure.

Since in the Bathurst district there is nothing to indicate whether the Bonaventure beds should be classed as late Devonian or early Carboniferous, Clarke's views relative to the age of the beds have been followed, but the strata are classed with the Devonian in preference to using the term Devono-Carboniferous.

### CARBONIFEROUS: BATHURST FORMATION.

*Distribution.*—The measures of the Bathurst formation are displayed along the banks of the Nipisiguit river from near its mouth to beyond the southern boundary of the district. The same beds may be seen on Redpine brook, a tributary of the Nipisiguit, as far eastward as the railway track, and doubtless underlie most if not all of the narrow strip of country between the Nipisiguit and the eastern boundary of the map-sheet.

*Lithological Characters.*—The Bathurst beds range in character from shales to fine conglomerates, and except for occasional, thin, nearly black shaly beds, have a prominent red colour. The various types are usually soft and crumbling, but harden after thorough drying. Sandstones and shales predominate; they are distinctly stratified and usually show marked cross bedding. Many of the sandstones contain much calcite, either in the form of slightly reddish grains or in larger plate-like masses enclosing the grains of sand. Thin, non-continuous beds of conglomerate occur at various horizons, holding pebbles, chiefly of quartz, that only rarely have diameters as large as 2 inches.

*Structural Characters and Thickness.*—The strata are almost horizontal and lie in broad, very low domes, with perhaps a general dip to the east of from 5° to 10°. The beds are practically undisturbed, without any signs of faulting or slipping. Within the district they appear, as indicated by the section along Redpine brook, to have a maximum thickness of at least 125 feet, but the summit of the formation was not observed, though it cannot lie far to the east, as is indicated by exposures of the overlying, probably conformable, grey beds of Millstone Grit found along the coast.

*Mode of Origin.*—Within the area of the district the Bathurst formation was found in contact only with the Nipisiguit granite, which it overlies, and from which at least a portion of the material of the beds has been derived. Contacts between the Bathurst beds and the granite are exposed at a number of points along the Nipisiguit. Only rarely did the basal bed of the sedimentary series consist of conglomerate, and in such cases the conglomerate bed was essentially like the narrow beds of the same rock type occurring at various horizons in the sections. The lowest bed was, in general, of the nature of a fine-grained arkose, composed of material derived from the breaking down of the underlying granite. In some places the division between arkose and granite was not very sharply marked, since the granite was generally much decomposed and in a friable condition.

At a number of points the old granite floor has been revealed by the wasting away of the overlying sediments. In such instances the surface of the granite forms low, gentle domes, while the rock itself is traversed by a series of parting planes concentric with the mamillary surface.

'The absence of basal conglomerates, the presence of an arkose apparently derived from the granite directly below, the mamillary outline of the contact plane, and the concentric partings in the granite so like exfoliation planes, all suggest an æolian origin for at least a part of the Bathurst formation. The presence of fine shales, and the occasional beds of conglomerate, seem to negative this supposition. As the district in question seems to be about on the last shore line of the advancing sea of Carboniferous time, possibly æolian and aqueous deposits may have irregularly alternated with one another[1].'

*Correlation and Age.*—The measures of the Bathurst formation were correlated by Logan[2] with the Bonaventure formation, and this view was accepted by Ells.[3] To the present writer it seems, however, that the measures displayed along the banks of Nipisiguit river are lithologically quite unlike the Bonaventure beds found farther north along the coast. A further difficulty in the way of such a correlation is that, as far as the few exposures available show, the Bathurst beds are conformably succeeded to the eastward by measures of Millstone Grit age, and, therefore, the Bathurst formation is in age but

[1] Young, G. A.; Dept. Mines Geol. Sur., Summary Report for 1909, p. 221.

[2] Logan, Sir W. E.; G.S.C., Geology of Canada, 1863, p. 451

[3] Ells, R. W.; G.S.C., Report of Progress for 1879-80, part D, p. 7 et seq.

little older than the Millstone Grit, *i.e.*, of middle Carboniferous age, whereas, as pointed out by Clarke, the Bonaventure is either very late Devonian or very early Carboniferous. Therefore, the red beds underlying the Millstone Grit have, on the present map, been separated from the Bonaventure beds, and called the Bathurst formation.

### QUATERNARY.

*Stratified Deposits and Boulder Clay.*—The Bathurst district, as a whole, is drift covered. Over the greater part of the region, the covering, save for the superficial soil, seemingly consists largely of boulders that have been glacially transported. Possibly boulder clay is wide-spread, but it is rarely exposed. The country immediately around Bathurst forms an exception to the above general statement, for over a considerable area bordering Bathurst harbour there is a thick covering of stratified clays, sands, and gravels, in places resting on boulder clay. These unconsolidated clays, sands, etc., have been the subject of several papers by C. H. Paisley[1], at one time a resident of Bathurst, and the following presents his descriptions in an abstracted form. In all cases the determinations of the fossils were made by Sir J. W. Dawson.

The deposits are grouped in three divisions, which, from oldest to youngest, are: boulder clay, Leda clay, and Saxicava sand; of these tho upper part of the Leda clay and the lower part of the Saxicava sand are generally fossiliferous.

The boulder clay is usually banded, red bands alternating with bluish bands. In somo places obscure stratification is visible, and the clay occasionally contains valves of *Mya arenaria, Natica, etc.* In some outcrops boulders are numerous. It is stated that the formation was seldom observed abovo a height of 150 feet above sea-level.

The Leda clay is reddish, but on drying becomes darker. It varies greatly in thickness, and where seen contains layers of sand at three horizons.

The Saxicava sand is also very irregular in thickness, and in most cases lies on an uneven surface of Leda clay as though the clay had been partly eroded. Rarely, the two formations were found to grade into one another.

[1] Paisley, C. H.; Can. Nat., Vol. 7 (N.S.) 1875, pp. 41-43 and pp. 238-270.

The following section was measured at a railway cutting just north of the crossing of Tetagouche river:—

| | Feet. |
|---|---|
| 1. Soil.. .. .. .. .. .. .. .. .. .. .. .. .. | 1-2 |
| 2. Coarse gravel.. .. .. .. .. .. .. .. .. .. | 6-8 |
| 3. Sand with an occasional layer of reddish clay.. .. .. .. .. .. .. .. .. .. .. .. .. | 10-12 |
| 4. Yellowish clay.. .. .. .. .. .. .. .. .. .. | ¾ |
| 5. Reddish sand.. .. .. .. .. .. .. .. .. .. | 1½ |
| 6. Reddish-yellow clay with threads of sand.. | 1¾ |
| 7. Greenish sand with an occasional valve of *Mya* and innumerable shell fragments.. .. | 1¾ |
| 8. Course sand and reddish clay intermingled, in some places without evident stratification; occasional small angular rock fragments; very fossiliferous.. .. .. .. .. .. .. .. .. .. | 0-2 |
| 9. Reddish, sandy clay; fossiliferous.. .. .. | 2½ |
| 10. Interstratified red and blue clays; an occasional *Mya* and *Natica*.. .. .. .. .. .. | 6 |

From bed No. 8 were recovered the following fossils:—

*Saxicava rugosa.*
*Mya arenaria.*
*M. trun.*
*Leda p... la.*
*L. glac...is.*
*Nucula tenuis (expansa).*
*Aphrodite Grœnlandica.*
*Me..ome calcarea.*
*M. Grœnlandica.*
*Cryptodon Gouldii (?).*
*Natica clausa (affinis).*
*Buccinum undatum.*
*Balanus crenatus.*
*B. Hameri.*
*Mytilus edulis.*

From bed No. 9 were recovered the following fossils:—

*Mya arenaria.*
*M. truncata.*

*Nucula tenuis.*
*Balanus crenatus.*
*B. Hameri.*
*Mya* (young).

The precise locality from which the fossils of the following list were obtained is not stated, but it is presumably the same as the foregoing:—

*Euryechinus Drobachiensis.*
*Nucula expansa.*
*Leda minuta.*
*L. limatula.*
*Bela turricula.*
*Trophon scalariforme.*
*Buccinum cyaneum.*
*B. Groenlandicum.*
*B. tenue.*
*Fusus tornatus.*

Two species of *Spirorbis.*

Plants:—

*Zostera marina.*
*Rhizomata* of *Equisetum*, and fragments of grasses.

Such beds as those described by Paisley occur occasionally along the coast, and were seen in a few instances inland. Their maximum thickness must be considerable, since partial, imperfectly exposed sections have a thickness of at least 100 feet. At one locality, outside of the district, in the valley of the Nipisiguit, about 17 miles above the mouth of the river, a thickness of about 25 feet of cross-bedded sands was observed lying between two beds of boulder clay.

*Morainic Material.*—Over the greater part of the district stratified sands and clays, boulder clay, etc., seem to be absent. In general the covering is of loose boulders, which, as laid bare at a few localities, formed a fairly even floor. Most of the boulders are large, and blocks with diameters of 10, 15, and 20 feet are common. In some cases accumulations of similar glacial material form small hills, including among others Blue mountain, situated towards the southern boundary of the sheet. Several east and west ridges lying north of Elmtree river are also of glacial origin, being apparently composed of a tumultuous aggregate of boulders and large blocks of rock.

*Glacial Striæ and Ice Movements.*—Though the whole district has been glaciated, glacial striæ were observed only along the coast, or within a few miles of it. Their apparent absence elsewhere is seemingly due to the fact that rock exposures are largely confined to stream beds or their steep valley sides, and other places unfavourable for the preservation of striæ. The direction of the striæ seen varied between N 40° E—S 40° W, and S 25° E—N 25° W. Though the evidence was not very satisfactory, the appearances of the weather-worn glacial surfaces seem to indicate that the ice movements varied in direction between N 40° E and S 25° W, and marked two general ice movements, one paralleling the coast as though made by a sheet advancing down the basin of Chaleur bay, and the second from the land outwards as though made by a glacier heading in the higher, central portion of the Province.

Chalmers[1] has recorded a number of observations of striæ from the district, and has stated[2] that they belong to two main sets, an earlier one indicating eastward movement and ranging in direction from N 22° E to S 88° E, and a later one varying from N 3° W to N 77° E. He also concluded[3] that a third, still younger set of striæ, with directions varying between S 45° W and S 45° E, was confined to a zone between the 60 foot and 150 foot contour lines, and that these were made by floating ice when the shore stood at a level 60 feet to 150 feet lower than that of the present. The same author stated[4] that the western part of Chaleur bay, from its head eastward to opposite Belledune point, was once occupied by an eastward flowing glacier, which he named the Baie des Chaleur glacier.

*Terraces.*—Terraces were noted along several of the river valleys. On that of Grants brook they were observed to heights of 350 feet above sea-level; the highest of a series along Nigadu river also attained approximately the same level. At both these places, 350 feet was practically the highest point at which a terrace could form. Terraces masked by the forest growth may occur at higher elevations elsewhere in the district; many occur at lower levels. No attempt was made to determine whether any or all of the higher terraces were formed by the sea and not by streams.

[1] Chalmers, R.; G.S.C. Ann. Rept., 1885, Vol. 1, part GG, pp. 20-21.
[2] Chalmers, R.; G.S.C., Ann. Rept. 1892-94, Vol. 7, part M, p. 35.
[3] Op. cit., p. 80.
[4] Op. cit., p. 90.

## STRUCTURAL GEOLOGY.

Most of the details bearing on the structural geology of the region have already been presented in connexion with the descriptions of the various formations, but are here recapitulated. It is regretted that the general scarcity of rock exposures, and the conditions under which field work was conducted, have prevented the accumulation of sufficient precise data to have largely freed the discussion of the topic from the use of inferences.

A large part of the region is underlain by formations belonging to the Ordovician and Silurian systems. From an inspection of the strikes and angles of dip as plotted on a map, it might be inferred that the rocks of the two systems had been subjected to the same deforming forces of Silurian or later date, had yielded the same movements, and that, as recorded by an earlier observer the two systems were conformable. Yet, as has been pointed out on preceding pages, the basal member of the Silurian, the Turgeon formation, consists of heavy beds of conglomerate, with a considerable volume of sandstone, and the pebbles of the conglomerates are of various kinds, some of which are similar to the Ordovician rocks. These lithological characters indicate that prior to the deposition of the Silurian the Ordovician strata had been elevated and subjected to a considerable amount of deformation, whereby different divisions of the system had, in various places, been exposed to erosion. Since, in spite of this pre-Silurian deformation, the present attitudes of the two systems, broadly speaking, are alike, it seems necessary to suppose that the disturbing forces of the two periods acted from the same general direction, or else that the effects of an earlier and different series of disturbances have been masked by those that later involved both the Silurian and Ordovician strata; from the lack of any evidence to confirm it, the later supposition has been rejected.

The main period of orogenic movements in the Bathurst district seems to have followed the deposition of the Silurian, and probably took place in Devonian times. After the laying down of the Bonaventure beds in late Devonian time, save for the uplifting or depressing of wide areas as a whole, the strata have in nowise been disturbed.

The Ordovician and Silurian strata have a general east and west strike, though there are innumerable, local exceptions to this rule. This general parallelism of the direction of strike is best shown over the wide Ordovician area extending from the Nigadu to the Tetagouche river. In this area the direction of dip shows many sudden changes, thus indicating a close folding of the strata along axes following, as shown by the strike, general east and west courses. In a few instances, where the crowns of such folds are exposed, it is apparent that the folds were overturned to the south. The strata at the top of the arches are tightly compressed, indicating that the folding took place under load.

The strata are frequently corrugated along the strike. The resulting plication is, in some places, visible on a fine scale, in others on a comparatively coarse one. Further evidence of the profound nature of the deforming forces is furnished by the disruption of bands of sandstone, which, interbedded with argillaceous beds, yielded by rupture to the deforming forces, while the more plastic enclosing shales were bent and twisted.

Minor faults were observed at many places, and over considerable areas the strata seem to have readjusted themselves by wholesale slipping along parallel planes of shearing. Major faults probably occur, but no direct evidence of such an occurrence was obtained, though it is possible that the contact between the Tetagouche slates and the Millstream formation may be along a fault plane.

The present attitudes of the Ordovician strata are believed to have mainly resulted from post-Silurian forces of deformation. It is believed that the earlier stresses of pre-Silurian age differed from the latter, mainly in intensity, and that they threw the strata into a series of broad, comparatively gentle folds.

In the southern portion of the Ordovician area, the strike of the strata is more nearly north than south, or, in a general way, parallel to the boundary of the Nipisiguit granite batholith. This divergence of the strike from the general direction held farther north, may have been caused during the time of the granite invasion.

The Silurian strata of the two bands of these rocks occurring in the northern portion of the district are as much disturbed as the Ordovician strata to the south, or even more so. The measures show the same local twisting, corrugation, and rupturing, and frequent reversals of direction of dip, and abrupt changes in strike are common. The apparently greater structural complexity of the Silurian area as compared with the Ordovician, may be due to the fact that the larger number of lithologically different horizons composing the Silurian emphasizes the presence in it of faults, though they may be equally common in the area of the more monotonous Ordovician. On the other hand, if, as supposed, the Ordovician had already been gently folded, and the post-Silurian forces acted in the same manner as the earlier ones, then it is reasonable to suppose that the Ordovician strata would continue to yield mainly by folding, especially as they would be buried under the whole thickness of the Silurian; while the Silurian measures, under less load, and lithologically less homogeneous, would yield by faulting.

Faults were seen at many points in the Silurian, or their existence was established by inference, and it was apparent that at least some of them were of considerable magnitude. Owing to the scattered positions of the relatively few outcrops, the direction of the major fault planes could not be definitely determined; though based on a consideration of the relative positions of the outcrops of various horizons, it seems probable that the main faults follow two general directions, one approximately a little south of east, and the other roughly north and south. A combination of major faults following these directions would, for instance, furnish an explanation of the course of the boundary between the main body of Ordovician and the Silurian.

Possibly a greater part of the faulting of the Silurian measures may have taken place after the main period of folding of the strata. Throughout the large Ordovician area to the south, basic dykes, chiefly of diabase, are very common, and, in a rather remarkable manner, follow a general course about ENE. Such dykes are also very common in the large area of the Elmtree slates exposed over the basin of Elmtree river. It is to be noted that this area of Elmtree slates is the only comparatively large area of Silurian strata that does not show the abrupt changes of formations that in other areas indicate the presence of numerous major faults. Elsewhere dykes are only rarely seen cutting Silurian strata. It may be, then, that during the formation of the dykes which took place after the folding of the district, the underlying formations of the greater portion of the district were dyked, whereas, in the remaining areas, the strata were faulted.

As indicated on preceding pages, the geological structure of the northern area occupied by the Fournier group is very complicated. This area was apparently once underlain by Ordovician rocks that were folded, probably faulted, and afterwards invaded by numerous igneous bodies whose true extent and characters are masked by the general covering of drift. In some cases the igneous rocks appear in stock-like bodies, *e.g.* the gabbro stock traversed by the lower portion of Elmtree river and an analagous body of quartz-diorite cutting Silurian strata along the shore to the north. The acid intrusives—the granites—in places were injected in a most complicated fashion, so that they produced banded gneisses.

## HISTORICAL GEOLOGY.

The oldest strata in the district, the Tetagouche slates, are of Ordovician age, and probably were formed in lower Trenton times. Whether they are underlain by still older Ordovician strata, or repose on Cambrian or Pre-Cambrian formations, is in nowise apparent.

The dark slates and associated sandstones of the Tetagouche series are believed to have been deposited in a widespread sea, that doubtless submerged all of the Bathurst district in common with most of eastern Quebec and the Maritime Provinces. Towards the close of the lower Trenton stage, or somewhat later, the period of quiet accumulation of argillaceous matter was succeeded by a period of volcanic activity, as a result of which a considerable thickness of tufaceous material, forming the Millstream series, with a varying quantity of erosion products from neighbouring lands, was deposited on the sea bottom, while locally basic lavas were extruded.

The volcanic activity, and the consequent upbuilding of strata, ceased before Clinton time, and the region emerged from the sea. During the interval of emergence, the strata were probably thrown into a series of east and west folds, and were subjected to erosion. Later, in the opening epochs of Silurian time, the region was again depressed, and as the sea advanced, the Turgeon conglomerates and sandstones were formed. During the Clinton stage, as the shoreline retreated and the waters cleared, coral reefs formed and limestone strata were built up.

In the Bathurst district the Silurian sea apparently was comparatively shallow, with land not far away, and probably the region as a whole was repeatedly relatively elevated and depressed. That such was the case appears to be indicated by the nature of the Belledune Silurian group, in which narrow beds of fairly pure limestone rich in coral fragments alternate with impure limestones, shales, sandstones, and even conglomerates.

The intermittent formation of limestones continued through Niagara time, when the deposition of calcareous measures largely ceased, and the dark slates of the Elmtree formation were deposited. Even during this stage, the sea occasionally cleared and became suitable for the growth of corals, as attested by the finding of fossils in remnants of limestone bands amongst the slates.

The Elmtree slates are the youngest Silurian strata now displayed in the district, and are probably of Guelph age. The interstratification of fine conglomerates with the Elmtree slates in the northern Silurian area may be taken as indicating a shoaling of the Silurian sea prior to a retreat of the waters, which perhaps was only temporary, and in late Silurian, or early Devonian time, sedimentation may have been resumed, though no strata of ages intermediate between Guelph and latest Devonian are now present in the district.

Sometime during late Silurian or early Devonian time, the region was uplifted, the strata closely folded, and over certain areas at least, much faulted, and the processes of erosion became active. Towards the close of the interval of orogenic disturbances the strata locally were invaded by various acid and basic rocks. At this time took place the intrusion of the masses of gabbro, quartz-diorite, granite, etc., now exposed in the northern part of the district. Some of the bodies may have reached the then surface of the land and made themselves manifest as volcanoes. During, or about the same time, the strata of the district in general were fractured, and the material of the diabase dykes injected into the fissures. Later than this took place the comparatively quiet intrusion of the mass of the Nipisiguit granite batholith.

During this Devonian epoch of emergence, of deformation of the strata, and of its penetration by deep-seated igneous masses, denudation was in progress, and continued after the cessation of orogenic movements and the intrusions of igneous bodies, until eventually the once buried granites, diorites, etc., were partially laid bare. Finally, in very late Devonian time, the seas again began to advance over the land, and the measures of the Bonaventure formation were laid down.

There are some grounds for believing that prior to the advance of the Bonaventure sea, the land had already begun to assume the configuration of the present day. The distribution of the Bonaventure beds about the whole length of the shores of Chaleur bay seems to show that this basin was already outlined in late Devonian time, and consequently that the drainage system, at least as far as the Bathurst district is concerned, would then be of approximately the same general plan as now. Indeed there is some reason to believe that at least portions of certain broad valley forms of Bonaventure time are still in existence. The largest area of the Bonaventure formation in the district lies towards the seaward end of a comparatively wide depression traversed by the lower courses of Millstream river and Grants brook. Millstream river cuts through the Bonaventure area, and at this place its rock bed is just at the level of the base of the Bonaventure beds. It seems logical to suppose that the low lying land between the lower courses of Grants brook and Millstream river, and now in part occupied by the Bonaventure beds, had approximately the same outline in Bonaventure time.

The maximum extent of the Bonaventure sea is unknown—it may only have submerged the borders of the Bathurst district. With the ordinary sediments of the Bonaventure sea occur beds of compact limestone, apparently of the nature of chemical precipitates, and their occurrence seems to indicate that the Bonaventure sea was subjected to excessive evaporation.

At the close of the Bonaventure stage the district was again freed from the sea, and continued so until about mid-Carboniferous time, when the territory to the east became an area of deposition, and perhaps under the conditions of an arid or semi-arid climate the beds of the Bathurst formation (Carboniferous) were laid down.

There is nothing to indicate that the Carboniferous measures were ever continuous over the whole of the Bathurst district. It seems highly probable that they never extended much farther eastward or northward than now, that is, that the Nipisiguit river, which at present approximately marks the boundary in this district, between the high, rugged country of northwestern New Brunswick and the low, nearly level southeastern portion of the Province, about follows the line of the old sea-coast. There are no traces of Mesozoic or Tertiary strata, nor is there any reason for inferring that they ever occurred in the Bathurst district.

Based on the grounds outlined in the preceding paragraphs, the conclusion is reached that the Bathurst district, as a whole, has been, at least intermittently, subjected to erosion from late Devonian time onward to the present day; and as shown by the horizontal, undisturbed position of the Bonaventure and nearby Carboniferous strata, the region during this lengthy interval has been free from pronounced orogenic disturbances. It would seem that the only movements of importance that have affected the region have been of uplifts or depressions affecting wide districts as units.

The immunity of the Bathurst district from the effects of the deforming forces of the Appalachian revolution which affected so much of eastern North America at the close of the Palæozoic era, was shared by southeastern New Brunswick and Prince Edward Island, as is indicated by the nearly horizontal, very gently folded Carboniferous and younger strata of these regions. Elsewhere in the Maritime Provinces the effects of the Appalachian revolution are reflected in the locally folded and much faulted condition of Carboniferous and later strata.

A region such as the Bathurst district, subjected to erosion for so long a period and lying for considerable lengths of time, if not for most of the time, close to the sea, would, other things being equal, be reduced to the condition of a low plain. Most of the Bathurst district is essentially a plain, but instead of being practically horizontal, it is tilted, rising gradually from the sea and from the Carboniferous area to the east. (*See* profiles on map-sheet). The present tilted condition of the otherwise plain-like surface of the land has, probably, resulted from a regional uplift of late Tertiary date, though it is somewhat difficult to imagine how this was accomplished without its effects being visible over the region of Carboniferous strata to the east.

Such a differential uplift would afford an explanation for the comparatively deep, often gorge-like character of the present waterways, the pronounced cutting of their channels having resulted from the uplift of their watersheds.

The deep-cut channels of the present waterways are of pre-glacial age, as shown by the occurrence in them of glacial deposits, which in places still occupy portions of the old channels, having forced the streams to cut out new courses.

An example of the deflection of a river by the filling up of its valley by glacial deposits is afforded by the Nigadu river, at a locality just below a small fall at a point about 2½ miles from its mouth. Below the fall the river flows through a gorge whose rock sides rise steeply for from 30 to 50 feet. A short distance below the fall the river flows for a few hundred yards in a direction of about ESE, and at the head of this course, the end of a filled-in valley, with rock sides and floor, is visible, the floor being about 5 feet above the present stream bed. The filled-in valley is apparently the direct continuation up stream of the ESE course. The present stream joins the ESE course at the mouth of the filled-in valley at right angles, coming from the south after a fall and cascade of about 30 feet. The structure at once suggests that the main stream at one time occupied the now blocked valley at the head of the ESE course, and that the present waterway, with its rapid fall, was forced on the river as a result of the filling in of the older valley.

The Millstream, at a point about 7 miles inland, affords another example of related phenomena, though at this point the changes are less simple, apparently the local drainage system having been completely modified, though possibly not altogether as the result of the simple filling in of the old channel and the failure to re-excavate it.

At the locality referred to on the Millstream, the river, after flowing in a comparatively shallow valley, drops 40 or 50 feet into a narrow gorge. At the lower mouth of the gorge several small streams flowing from the north join the main river. The tributaries occupy a deep, rock-walled, branching valley, whose size and depth are quite out of proportion to the volume of water flowing through it. The present topography suggests that at one time this tributary valley was occupied by the main stream of the river.

During the glacial period the whole district was covered by an ice-sheet, or perhaps a succession of them. Through their agency the district was buried under an accumulation of boulders, boulder clay, etc., that filled in the already existing waterways. Besides the main ice sheet which moved from the land outwards and was doubtless responsible for most of the glacial debris, a second ice sheet, occupying the basin of Chaleur bay, covered at least the coast.

After the final disappearance of the ice, the sea encroached upon the land, and the marine Leda clay and Saxicava sands were deposited. The height to which the sea rose is not known, it was undoubtedly greater than 100 feet, and may have been sufficient to submerge most or all of the district. Terraces were observed to heights of 350 feet, but in the case of these higher terraces it is possible that they were formed by streams during the processes of readjustment of the drainage system following the disappearance of the ice sheet.

At a later date the sea retreated, and since then the major waterways have almost completely re-excavated their ancient channels, and in places apparently have deepened them, since in a few instances, remnants of older rock-beds of the streams were observed, into which the present streams had cut to a depth of a few feet—in the case of Elmtree river about 5 feet.

## ECONOMIC GEOLOGY.

At present no mining operations are being carried on within the area of tho Bathurst map-sheet, though one of the first attempts at mining within the Province of New Brunswick was made in tho vicinity of Bathurst. Various mineral deposits of widely varying relative importance occur in the district. The most important deposit appears to be one of iron ore, lying near a small tributary of Millstream river, and extending beyond the western border of the area of the map-sheet. Of secondary importance is an occurrence of galena and zinc blende on Elmtree river, and a deposit of manganese ores on Tetagouche river.

### Iron.

#### MILLSTREAM IRON ORE DEPOSIT.

*Situation.*—The Millstream iron ore deposit lies on the side of the valley of a small stream entering Millstream river at a point about 8 miles inland. The deposit occurs along a nearly straight zone stretching east and west, and of which only the eastern portion lies within the limits of the map-sheet. An additional map showing the extent of the deposit, as far as it could be traced on the surface, has been prepared and accompanies this report.

*General Geology.*—The district is heavily drift covered so that rock exposures are almost completely wanting, except in the immediate neighbourhood of the ore body. Their presence there is apparently due to the fact that during the formation of the deposits the neighbouring rocks were changed to types that afterwards resisted erosion to a greater extent than the unaltered rocks of the neighbourhood, and as a result of the action of the ordinary processes of erosion, the more resistant rocks immediately connected with the ore have formed a step-like slope, with exposures of rock, and ore along its face and [illegible].

Since, with the exception of exposures of ore and highly altered wall rocks, rock outcrops are wanting, littlo could be learned of the geological relationships of the deposit. In all only thirty-six exposures were seen, distributed along a narrow zono about 1½ miles long.

A considerable distance to the westward, limestone strata, probably of Silurian age, were seen; to the south, the country appears to be occupied by the dark Tetagouche slates (Ordovician), cut by numerous diabase dykes, and these rocks extend eastward down the valley of Millstream river, until at a point almost due east of the deposit, and less than 2 miles distant, the dark slates are succeeded by the tufaceous measures of the Millstream series. To the east of the deposit, between it and the exposures along the Millstream, there are several widely separated exposures of serpentine. North of the deposit, the country for a considerable distance appears to be void of rock exposures; possibly a portion of this area may be underlain by granite, since boulders of this rock are, locally, abundant.

The boundary between the Tetagouche slates and the Millstream series is believed to follow a nearly due east and west course. If this boundary is projected westward through the exposureless area, it will be found to pass through, or very close to the ore deposit. Possibly, then, the body lies along or very close to the boundary of the two formations.

*Description of Ore.*—Ore is visible at less than a dozen places along a nearly straight, east-west course of slightly over one mile in length. The ore consists essentially of magnetite in a gangue of garnet, and has a very prominent banded appearance, fairly pure lines, streaks, and thin irregular bands or lenticles of magnetite alternating with similar areas of garnet. Pyroxene, epidote, chalcopyrite, and pyrite also occur in the ore.

As determined by Mr. R. A. A. Johnston of the Geological Survey, the garnet is the calcium-iron variety, andradite. It commonly occurs in a compact, finely granular form, of a pale grey or white colour, tinged brownish or reddish. Occasionally the mineral, along partly open seams and cavities, occurs in crystal forms, the crystals varying in size from that of small shot to others with diameters of one-fourth inch and more, and in different spots are of various colours, ranging from a pale reddish to a very dark brown.

The magnetite is usually finely granular, many of the grains showing crystal forms. The chalcopyrite and the associated pyrite commonly occur in comparatively coarse grains and imperfect crystal forms, grouped either in small or comparatively large aggregates.

Small prisms of pyroxene in places occur embedded in the magnetite, and are locally very abundant. Green epidote occurs, though not abundantly, along seams, etc.

The banded appearance of the ore is very striking. In general, the gangue, which is predominantly of garnet, is greatly in excess towards the boundaries of the deposit, while towards the centre the magnetite is often in greater bulk. The garnet and magnetite each tend to predominate in alternate lines, streaks, and narrow bands running parallel to the strike of the body. The magnetite when most abundant occurs, in places, in bands a foot or perhaps more wide, chiefly of the iron oxide, but containing considerable garnet in rather evenly distributed grains, streaks, and narrow discontinuous bands.

The chalcopyrite, which is rather abundant, and the associated pyrite, which is not very plentiful, are also more or less segregated. Although no considerable mass of the ore and gangue is entirely free from sulphides, yet these minerals are much more conspicuous over some exposures than others, and when at all abundant occur mostly in lenticular areas along a given zone.

The mineralogical composition of the ore body or bodies changes along the strike. At some of the dozen or so outcrops, the magnetite is very abundant, at others it is overshadowed in amount by garnet. At certain outcrops there is but little sulphide, while in others it is abundant. At the most westerly exposure seen along the line of the ore body or zone, only a narrow zone of sulphide-impregnated rock, with a few streaks of magnetite, was visible.

*Description of Country Rock.*—The country rock exposed at a limited number of points, never more than a few hundred feet away from the ore body, is much altered. It has a general banded structure paralleling the ore body. The bands, sometimes almost microscopic in dimensions, sometimes a yard or more wide, consist principally of alternations of garnet, epidote, augite, and hornblende.

A common rock variety consists of alternations of irregular streaks and layers of pale reddish grey, fine-grained, siliceous-looking garnet, and very dense, pale green epidote. Rocks of this type are everywhere common along the north side of the ore body. More rarely found are outcrops of nearly black rocks, indistinctly foliated, and very fine-grained, but frequently showing the small, glistening cleavage faces of some mineral constituent. In some cases these dark types are composed largely of fibrous green hornblende, in some instances impregnated with a considerable amount of fine magnetite. Other dark types are largely composed of finely granular augite embedded in chlorite or serpentine.

The only unaltered rock seen is a light pink aplite forming a dyke cutting the banded garnet rocks.

The lighter coloured, banded, largely garnetiferous rocks probably have been derived from sediments. The dark varieties may represent basic dykes, since such rocks are very common in the neighbourhood. Possibly they may have resulted from the alteration of calcareous bands. Mr. W. Parks, the driller in charge of the diamond drill by which four or five holes were sunk in the ore body, stated that dark rocks formed the southern or hanging wall of the deposit.

*Form of Ore Body.*—The ore body where seen did not have definite walls. The outer edges are marked only by the final disappearance of the streaks and lenses of magnetite. The body, as a whole, appears to be nearly vertical, dipping northwards at angles above 75°.

The full width of the ore body was seen at only one place, where the distance between the first streak of magnetite on one side and the last streak on the other side, was about 40 feet; of the total width perhaps only one-half might reasonably be termed ore. Nowhere else was the whole width of the deposit laid bare, but the impression received was that the above measurements represent the maximum width.

The length of the zone of ore could not be determined with certainty owing to the lack of exposures. About a dozen outcrops were seen along a fairly straight east and west line a little over one mile long. As already stated, the most westerly of these outcrops was merely a sulphide impregnated rock. Ore probably lies east of the most easterly exposure, for though no ore was seen in this direction, there were exposures of banded garnetiferous rocks such as elsewhere form the walls of the deposit.

Since so few exposures are available, it is not established that the ore extends continuously between the few outcrops distributed over a total length of above one mile. But all the outcrops lie along a very gently curving, east and west line, and it seems likely that the garnet gangue is everywhere present along this zone, and that magnetite always occurs with it, but in rather widely varying amounts, as indicated by the variations visible in the different exposures. It may be that the western end of the zone is indicated by the narrow exposure of sulphide impregnated rock; this exposure is the most westerly one indicated on the accompanying map.

Several drill holes have been sunk by diamond drill on the property, and it is understood that the ore at such places has been proved to extend in depth for several hundred feet, without any indications of a downward limit.

*Assay Value of Ore.*—Various assays of the ore from the surface and from diamond drill cores have been made. While the results of these assays are not available, it is understood that they showed a considerable variation of the amount of iron, from above 60 per cent to below 40 per cent, and that in some places, for a few inches, the copper content in the drill cores rose as high as 6 per cent.

From the appearance of the various outcrops, wide variations in the amounts of iron, and other contents, are to be expected. To the writer, it seems that the most practicable way of determining the value of the deposit would be by stripping the ore at a number of points and taking careful samples. The variations in assay values should be of the same nature and about of the same degree along the ore outcrop as they would be in a vertical direction to such depths as it would be practicable to prospect by diamond drilling.

*Origin.*—The ore body or bodies apparently belong to that class known as contact metamorphic ore deposits. Such mineral deposits usually occur along or near the contact of an igneous body with an older group of rocks that have been metamorphosed by mineralizing agents accompanying the intruding igneous mass. In the present instance there is no direct evidence of the presence of such an igneous body, except for the single occurrence of the granite aplite dyke, which may be taken as indicating that a body of acid igneous rock, possibly a granite, is present somewhere near, either hidden by the drift or lying at some depth beneath a covering of older rocks.

The situation of the outcrops along a nearly straight line of above a mile in length, and the limited width of the ore, are two features suggesting that the deposit is located along what was once a plane of weakness, perhaps a fault plane, by which mineral bearing solutions ascended. It is significant that the deposit lies on, or very close to the continuation of the boundary between the Elmtree and Millstream formations, and that it is quite probable that this boundary represents an east-west fault.

### PETERS BROOK IRON BEARING AREA.

Narrow seams or veins of hematite a few inches in width, occur at various points within the area of Fournier rocks lying towards the coast between Tetagouche river and Grants brook. These occurrences were noted by Ells[1], who stated that they did not appear to be of economic value. During 1910, some prospecting by means of a diamond drill was done in connexion with certain of the hematite veins visible at the surface. The results obtained from this work have not been made public.

The rocks of this area are largely of igneous origin, and many of the varieties are much altered, containing secondary calcite, chlorite, etc. The occurrence of seams and small bodies of hematite, with such partly or largely altered igneous rocks, is not uncommon throughout the Maritime Provinces, but, as a general rule, such deposits have not proved to be of economic importance.

### ARGENTIFEROUS GALENA, [illegible]

A vein, principally of zinc blende, [illegible] pyrite, pyrite, and country rock, with a width [illegible] osed in the bed of Elmtree river, about 5 miles [illegible] vein, with a general direction of about NNW [illegible] right angles to its course. It is nearly perpendicular [illegible] slates of the Elmtree formation. On the upstream [illegible] a rather distinct wall, and there the enclosing slates are but little altered. On the downstream side the slates are considerably altered (silicified?), penetrated by calcite stringers, and partly mineralized so that the boundary of the vein is not distinct.

As seen in the bed of the stream, the vein, or, since much altered country rock is present, more accurately speaking, the mineralized zone, contains much pyrite and chalcopyrite in narrow, discontinuous veins, some of which are 4 inches or more in width. The sulphides also occur in scattered grains and small aggregates.

On the eastern bank of the stream there is a small pit now filled with water. The dump is of altered wall rock and ore, and it is

---

[1] Ells, R. W.; G.S.C., Report of Progress for 1879-80, part D, page 24.

noticeable that pyrite is less abundantly developed than in the vein as seen in the river bed. The ore consists chiefly of coarsely crystalline, dark zinc blende, coarse galena, coarse pyrite in grains and aggregates, and a relatively small amount of calcite and quartz. The various constituents tend to occur in large and small aggregates, often vein-like, interbanded and intermixed with altered country rock. The relative amounts of zinc blende and galena vary widely, but, in general, the zinc blende predominates.

An assay of one sample collected a number of years ago[1] gave a trace of gold, and 7·197 ounces of silver per ton.

Traces of galena, blende, etc., were seen at a few other localities in the district. On a branch of Elmtree river, about two-thirds of a mile south of the exposure on the main stream, traces of galena, with much pyrite, occur in a narrow, rusty-weathered zone of slates.

On Elmtree river, a short distance above the point at which the vein of sulphides occurs, there is a zone of slates roughly 10 to 15 feet wide, cut by innumerable quartz veins and stringers, usually very narrow, but sometimes several inches in width. Calcite occurs in many of the veins, particularly in such as were partly open. The veins frequently carry a small amount of pyrite, and a few grains of galena were occasionally visible.

This zone of quartz veins had been opened up many years ago, by means of a shaft. It was stated that gold was the metal sought, but that the project proved a failure, little or no gold having been recovered.

Everywhere along the upper portions of Elmtree river, and the streams to the south, quartz veins are common. They generally occur in zones varying in width from a few feet up to 100 yards and more, and not infrequently the country rock is very rusty weathering from the presence of finely disseminated pyrite both in the veins and wall rocks. While many of the veins carry minute quantities of pyrite, the majority are quite barren.

Such a zone of quartz veins occurs at a point west of the limits of the map-sheet, on Rocky brook, a tributary of Millstream river. At this place the veins carry pyrite, chalcopyrite, galena, blende, etc., and assays have been reported yielding as high as 40 ounces of silver per ton[2].

[1] G.S.C.: Report of Progress for 1880-81-82, part H, p. 6
[2] G.S.C. Ann. Rept. Vol. V. 1890-91, part SS, p. 118.

On a small tributary of Millstream river, east of the Millstream iron deposit, in a rusty zone in black slates near serpentine, occur irregular veins and stringers of quartz, holding, besides the more usual sulphides, mispickel.

While the total amount of mineralization represented by the veins and impregnations throughout the district must be enormous, it seems unlikely that any of these exposed zones of quartz veins, etc., will ever pay to mine for their lead, zinc, silver, or problematical gold values. Wherever assays have indicated the presence in commercial quantity of the more valuable minerals, it has generally been found that only very small specimens, rather than fair samples, have been tested. No ore body of dimensions warranting mining has yet been disclosed, and the values are always pockety.

## MANGANESE.

One of the earliest attempts, if not the first, at mining in New Brunswick, was made in connexion with the manganese deposit lying on the south bank of Tetagouche river just below the falls, at a point about 8 miles inland. Writing, in 1843, Gesner[1] states that the deposit had already been opened, and 125 tons, valued at $1,000, shipped.

It is now many years since mining ceased, and the tunnel leading into the old workings has caved in. The deposit appears to consist of a nearly vertical quartz vein, carrying manganite, that cuts a zone of red slates interstratified with the black Tetagouche slates. At its outcrop on the steep river bank, the vein is seen, in places, to be at least 13 feet wide, to be nearly vertical, and to be accompanied by roughly parallel, narrow veins. The quartz is coarse, and white in colour; it forms most of the vein, the manganite occurring in narrow seams, and small patches or aggregates of plates, or in semi-detached, imperfect crystals or fine grains. The vein is irregular in outline, holds inclusions of country rock, and is much fractured. From information gained from nearby residents, it is believed that during mining operations solid or nearly solid ore was found to occur in pockets. At a point several hundred yards farther down stream, manganite in small quantities occurs in the dump of several shallow trenches sunk a short distance back from the river.

---

[1] Gesner, A.: Report on Geol. Survey of N.B., Saint John, 1843, p. 81.

# PART II.

## NIPISIGUIT IRON ORE DEPOSIT.

### INTRODUCTORY.

The magnetite bodies of the Nipisiguit iron deposit lie within the county of Gloucester, N.B., about 17 miles SSW of the town of Bathurst. The ore bodies lie close to the Nipisiguit river, on both sides of Austin brook, a small, southward flowing tributary of the main river.

The deposit was discovered in 1902 by William Hussey, of Bathurst. In 1907 it was acquired from the original owners by Drummond Mines, Limited, and on the reorganization and merging of this Company became the property of the Canada Iron Corporation. The deposit is now being actively developed. A line of railway, some 16 miles long, from Nipisiguit junction, on the Intercolonial railway, south to the deposit, has been constructed by the Canada Iron Corporation, and the first shipment of ore by way of the branch line and the Intercolonial railway, to the port of Newcastle, is to be made in the fall of 1910.

A topographical and geological map representing an area of about three-fourths of a square mile in the immediate vicinity of the ore bodies. accompanies this report. The field work in connexion with this map was carried out in September, 1909, before the completion of the railway and the commencement of actual mining. The map, therefore, fails to show various buildings, railway switches, etc., since constructed, as the result of the active policy of development and mining pursued by the owners of the property.

### PHYSICAL FEATURES.

The country in the neighbourhood of the ore deposit appears to be broadly rolling, with a general elevation of 450 feet to 500 feet above the sea. The Nipisiguit river traverses the country in a narrow valley sunk about 150 feet below the general level, and having steep slopes rapidly rising for from 100 feet to 120 feet above the river bottom. The larger tributaries, and even many comparatively small streams, also have pronounced valleys, and thus modify the otherwise rather level surface of the country.

In the immediate vicinity of the ore deposits, the Nipisiguit river, after having flowed for some miles along a general northerly course, turns to the east. South of the river the land rises abruptly for about 120 feet, after which the rise is more gradual. On the northern side of the river the comparatively steep valley walls are broken by the depression occupied by Austin brook, a southeastward flowing tributary of the main river.

On both sides of Austin Brook valley the walls rise sharply to heights of from 60 feet to 100 feet above the stream bed, while beyond this the general rise is a very gradual one. The surface of this higher, nearly level country is marked by many very low, comparatively insignificant ridges, running, in a general way, north and south. Southwest of Austin brook, towards the western boundary of the local area that has been mapped, the higher lying, level country is broken by the rather pronounced valley of a minor tributary of the Nipisiguit, flowing in a direction parallel to that of Austin brook.

## GENERAL GEOLOGY.

Very little is known of the geology of the district in which the ore deposits occur, for while there are a number of rock exposures in the area about the mine represented on the accompanying map, these are so attributed that the mutual relations of the different rock types are still a matter of doubt. In all, four distinct rock types, namely, quartz porphyry, quartz-free porphyry, diabase, and black slate, were recognized. Some light on the structural relations of these rock formations was obtained, as a result of a hasty traverse made along the Nipisiguit from the southern boundary of the area of the Bathurst map-sheet to Austin brook.

From the southern boundary of the Nipisiguit granite batholith to near the Great falls on Nipisiguit river, the exposed strata are apparently of Ordovician age, wide bands of dark slates like those of the Tetagouche series alternating with others of green, probably tufaceous rocks regarded as the equivalent of the Millstream series.

A short distance below the falls sheared quartz porphyries outcrop, and extend up the river for a mile or more, to and beyond the neighbourhood of the iron deposits. The quartz porphyry is separated from the slates by a narrow band a foot or two wide, of quartz-free porphyry. The contact between the igneous rocks and the sediments is along a plane, dipping WSW at an angle of about 45°. On the downstream side of the contact are exposed the dark slates, with a strike and dip conformable with the plane of contact so that the slates dip under and appear to be conformably succeeded by the quartz porphyry, but separated from it by the narrow band of quartz-free porphyry.

In the neighbourhood of the Great falls, a 15 foot dyke of diabase cuts coarse, quartz porphyry. This diabase dyke, and a similar diabase exposed at a number of points within the area mapped, appear to be genetically connected. In the country about the mine the diabase was never found in contact with other rocks, its exposures are confined to one area, and it is assumed that the basic rock is younger than the quartz porphyry, and that it occurs either as a single, rather large body, or as a series of parallel dykes.

The relative ages of the quartz-free porphyry and quartz porphyry are not known; the two types are regarded as being about contemporaneous and as younger than the black slates. They are thought to be intrusives rather than extrusives.

The rocks of all the exposures show the results of shearing in a varying degree. On a former page, evidence has been cited to show that all such forces as would tend to shear rocks had ceased acting in the Bathurst district before the opening of Carboniferous times. It is, therefore, concluded that the igneous rocks of the Nipisiguit iron area are pre-Devonian in age, since they have been affected by the shearing, and post-Ordovician, since they are held to be younger than the black slates of the Tetagouche series.

## DESCRIPTION OF ROCK TYPES.

In the neighbourhood of the ore bodies there are exposed four types of rocks; arranged in their probable order of age, these are:—

*Post-Ordovician (?).*—Diabase.
Quartz porphyry.
Quartz-free porphyry.

*Ordovician.*— Tetagouche slates.

*Tetagouche Slates.*—Two exposures only of black slates were seen in the northeastern portion of the area. The slates have evidently suffered from shearing, the parting planes being lustrous, and having hackly, fibrous-appearing surfaces. The slates are to all appearance exactly like those exposed along the Tetagouche river, and elsewhere in the Bathurst district.

*Quartz-free Porphyry.*—A number of exposures of quartz-free porphyry occur along the eastern side of the area, and a few are present towards the southwest corner. The rock is usually of a dark, greyish black colour, but in not a few instances green; it is usually very fine-grained, dense, but showing scattered tiny cleavage faces. In most cases the rock has at least an irregular schistose parting, and in many instances has been sheared to a glistening or dull sericite and chlorite schist.

Examined in thin section, the quartz-free porphyry consists of a very finely crystalline base, holding a few, very small phenocrysts of plagioclase. In some instances, the fine-grained base consists largely of minute laths of plagioclase, but more commonly the ground is finely granular, with much quartz present. At times the general structure suggests that the rock is a tuff, but this could not be definitely decided. Various secondary minerals, chlorite, sericite, calcite, etc., occur in varying quantities, apparently directly proportional to the amount of shearing the rock has suffered.

*Quartz Porphyry.*—Quartz porphyry is exposed over a northward trending band, bounded on the east by an area of quartz-free porphyry, and on the west by a zone in which, with one or two exceptions, only diabase was seen.

The quartz porphyry always has a hackly parting plane, and varies in colour from nearly black to dark, greenish grey, the lighter colours being characteristic of the more schistose varieties, which grade into sericite schists. The rock, when not too much sheared, is crowded with crystal fragments of glassy quartz and white feldspar, that lie in a dense base. The crystal fragments, or phenocrysts, vary widely in size from exposure to exposure, though fairly uniform over considerable areas. In many instances the feldspar individuals measure over one-half inch in length, in others they are not above the size of small shot.

In thin sections, the quartz porphyries are seen to be composed of angular individuals of quartz, orthoclase, and acid plagioclase, crowded together in a finely granular ground of quartz and orthoclase. In most cases the phenocrysts are broken, and other results of shearing are usually visible. In the more schistose varieties, sericite, biotite, etc., are plentifully developed.

As in the case of the quartz-free porphyry, the general structure at times suggested a tufaceous origin for the rock, the shearing to which the rocks have been subjected masking their true origin. Their appearance in hand specimens, and in the field, however, does not support this idea of a possible fragmental origin.

*Diabase.*—A number of exposures of diabase, altered in a varying degree, occur over the western part of the area. The rock is finely granular, in some cases nearly black, in others pale greenish, and then has a rather pronounced schistosity.

Examined in thin sections, the rock is seen to occasionally retain most of its original characters, with broad plates of colourless pyroxene partly enclosing laths of plagioclase. More commonly the rock is much altered, and in such cases the feldspars have usually been destroyed, while the pyroxene remains largely unaltered. In some cases, what appears to have been a diabase is now a mass of finely granular pyroxene embedded in chlorite.

## ECONOMIC GEOLOGY.

### DESCRIPTION OF ORE AND ORE BODIES.

The field is not a favourable one for the study of the mode of formation and shape of the ore bodies, which consist largely of magnetite in a siliceous gangue. In all, only seven exposures or groups of exposures of ore were seen. A number of diamond drill holes have been sunk, but these, while indicating the width and general composition of the ore at such points, and proving that the bodies extend to a depth of at least 400 feet, do not furnish evidence of the longitudinal extent of the deposits. The results of the magnetometric survey of the deposits by Lindeman[1], however, indicate the extent of the ore at the surface, and show that a large mass of ore is present.

According to the plan of the magnetometric survey, the ore occurs in three main bodies or groups of bodies, the longer axes of which, at the surface, run about north and south. Of these three separate deposits, one, known as No. 1 deposit, outcrops on the southwest side of the valley of Austin brook at a point about 500 yards from the mouth of the brook, and extends southerly for several thousand feet, nearly to the Nipisiguit. A second group, known as

[1] Lindeman, E.: Dept. of Mines, Mines Branch, Map, Magnetic Survey of Austin brook.

No. 3 deposit, lies nearly due north of No. 1, at a distance of about 800 yards. The third group outcrops on the northeast side of Austin brook, about 300 yards eastward of No. 1, and extends in a northward direction.

*Description of Ore.*—While variations in the character of the ore may be seen from exposure to exposure, it seems necessary here only to describe the ore of No. 1 body, as it is exposed towards its northern end where some stripping has been done. The body at this point outcrops on the southeast side of the valley of Austin brook, forming a steep face about 65 feet high. Sufficient of the eastern and western sides of the body are visible to show that it has clean-cut walls, that it dips westerly at an angle of 45°, and has a true thickness of about 105 feet; the mass thus has the appearance of a bed whose boundaries are conformable with the planes of schistosity in the surrounding rocks.

The whole ore body has a very marked banded structure, parallel in dip and strike to the containing walls. The ore, as a rule, parts with some degree of readiness along planes also parallel to the walls. The banding varies in degree from microscopic to very broadly developed, being indicated, when coarse, by the occurrence of various impurities along certain bands.

The ore, in general, has a prominent slaty cleavage, is fine grained, and is composed largely of finely granular magnetite, the minute cleavage faces of which often give an imperfect sheen to the ore. Slight variations in grain are visible along regularly alternating bands. The ore has a general black colour, tinged greyish from the presence of minute, pale grey minerals (quartz and feldspar) which in some bands are finely and uniformly distributed, while in others they occur in lines, narrow streaks, and minute lenticular areas.

Towards the foot-wall, which is itself heavily impregnated with sulphide, the ore contains considerable pyrite, while, more particularly towards the centre of the mass, considerable quartz is present in veins and stringers. Within the ore body, at several horizons, occur narrow bands of green schist, usually traceable for some yards, but with widths varying from a few inches to several feet.

The ore body is cut by many planes of slipping, following directions transverse to the strike of the body. The faults apparently all have very small throws, usually amounting to only a few inches or less.

At one point, within 6 feet of the wall, the ore for a width of 6 inches is heavily charged with pyrite in fine grains and in minute parallel lines and streaks, usually very short, but in some cases an inch or so in length. In other cases, near the foot-wall the pyrite was less uniformly distributed, and tended to occur in very narrow, distinct, vein-like masses of comparatively large grains showing distinct crystal faces.

At a distance of about 8 feet from the foot-wall, much pyrite was seen along a zone traceable for 30 or 40 feet. In places along this zone, considerable quartz was also present. At one point in the zone there was a mass of nearly pure sulphide 15 inches wide and considerably longer. The boundary between this lense of sulphide and the iron ore, while minutely irregular, was very sharp, the sulphide being almost completely free of iron oxide, and the magnetite of pyrite. In some places along the zone, ore and sulphide were regularly interbanded, the ore dense, the sulphide comparatively coarse-grained.

At various horizons occur bands of dark green schist. These bands, usually less than 2 feet wide, were frequently traceable for a number of yards. They strike and dip conformably with the boundaries of the ore body and the banding within it. The green schists are thickly studded with small, distinct octahedra of magnetite.

Quartz veins occur at various points in the cross section of the ore body, and more especially towards the centre, in places at least, are very abundant. They vary in size from mere threads up to others 3 inches and more thick. While many of the veins at least roughly parallel the walls of the deposit, others ramify through the ore in all directions, sometimes with minutely crenulated courses. The quartz of the veins and vugs is white, finely granular, and usually remarkably pure.

A number of thin sections of ore were examined, and the finely banded appearance of the body was seen to be due to alternations of rather minute, band-like streaks of magnetite, quartz, and feldspar, with varying, much smaller amounts of calcite, chlorite, biotite, sericite, and hornblende. The bulk of the ore consisted of quartz and magnetite, both in a finely granular state. Feldspar (orthoclase?) is also abundant, and occurs in a finely granular form.

On the whole, the ore is composed of minute, rapidly alternating bands of nearly pure magnetite, or magnetite with considerable finely granular quartz or feldspar, or both minerals; and other bands of nearly pure quartz, or quartz with varying proportions of feldspar, magnetite, etc. The calcite is irregularly developed, being, perhaps, of secondary origin.

In the case of one section, cut from a specimen traversed by countless quartz veinlets that often followed very sinuous, crenulated courses, it was found that the bands richer and poorer in magnetite also were crenulated, and the veins of quartz, though distinctly of the nature of veins, appeared otherwise as alternating bands of pure quartz.

*Description of Wall Rock and Boundaries of Deposits.*—The foot-wall of No. 1 deposit is exposed for a short distance. The rock, probably a much altered schistose quartz porphyry, is very heavily charged with pyrite. It has a pronounced schistose parting, along which occur seams and veins of quartz. On the hanging wall side, rock is exposed at one point, and seems to be a schistose form of diabase, practically free from sulphide.

At both walls the boundary of the ore body is remarkably sharp. The ore seems to end abruptly along a plane corresponding to that of the slaty parting and banding in the ore, and of the schistose partings in the wall rocks. On the foot-wall side, it was possible to trace the boundary for a number of yards, and, save for a few feet, the boundary plane and the plane of schistosity in country rock and ore were conformable.

In the case of No. 2 body, lying about 300 yards east of No. 1, a portion of its southern end and east and west walls is visible. The greatest width of the body where stripped is a little over 4 feet. The containing walls are sharply defined, and the body appears to dip to the west at angles varying between 60° and 80°.

The ore has the same banded appearance as in No. 1 body. Some quartz is present in comparatively large irregular veins, but little or no pyrite was seen except immediately along the walls.

On the hanging wall side, at a distance of about [illegible] feet from the ore, ordinary schistose quartz porphyry crowded with large phenocrysts of quartz and orthoclase is visible. At exposures intermediate between this and the ore body, the rock may be seen gradually assuming a more schistose habit. Very close to the ore boundary, the rock is still recognizable as a sheared quartz porphyry, but the phenocrysts have been largely destroyed, being represented by thin lense-like bands of finely granular quartz and feldspar. Immediately at the contact, the rock is still more schistose, and holds considerable pyrite; at one place, the country rock, for a few inches from the contact, holds streaks of magnetite.

On the foot-wall side an analogous set of phenomena is visible, but the rock there appears to be a quartz-free porphyry.

The southern termination of No. 2 body has been laid bare. The mass of ore ends in a number of angular, finger-like projections extending a few feet into country rock and associated with considerable quartz.

The ore, and its relations to country rock as exposed elsewhere over No. 2 and No. 3 bodies, is essentially the same as at the points described above.

*Form and Size of Ore Bodies.*—The bounding walls of No. 1 deposit indicate that the body strikes in a direction of about N 7° W. (true). The outcrops of No. 2 deposit give a strike for that body of about N 23° E, and in the case of No. 3, about N 10° E.

No. 1 body outcrops for a distance of about 500 feet along the strike. The results of the magnetometric survey by Lindeman indicate that the body has a total length of about 2,000 feet. At the northern end of the outcrop, and according to the magnetometric survey this point is close to the north end of the body, the exposure has a breadth of about 150 feet. Since the walls dip at an angle of about 45°, this indicates a true thickness of about 105 feet. A vertical diamond drill hole sunk in the hanging wall near this point entered ore at a depth of about 40 feet, and indicated a true thickness of about 90 feet. A second vertical drill hole bored at a point about 700 feet farther south, intersected ore at a depth of 50 feet, and yielded a calculated thickness of nearly 80 feet. A third drill hole, started at a place about 500 feet west of the last, and inclined towards the east at an angle of 20°, cut ore at an equivalent vertical depth of 410 feet, and where the ore body appeared to be about 65 feet thick.

In the case of No. 2 body, the south end is exposed, and close to it the deposit has a width of about 40 feet, with nearly vertical walls. Northwards, ore outcrops at a few points over a distance of about

1,200 feet, and the indications are that the body remains at about a constant width, forming a comparatively narrow band. The results of the magnetometric survey indicate an ore zone of practically the same length, but containing two ore bodies following one another along the strike.

Four diamond drill holes were sunk in connexion with No. 3 body. Of these the results of one are at present available. The log of this drill hole, together with the position of surrounding exposures, indicates a body of ore about 100 feet thick, dipping west at an angle of about 75°. In this instance the drill passed through ore from a point about 20 feet below the surface to one 350 feet beneath it. Exposures of ore occur at the surface over a length of only 300 feet, but the magnetometric survey of Lindeman, supplemented by one carried out by Mr. Fulton, of the Canada Iron Corporation, indicates an ore-bearing horizon of much greater length; perhaps totalling in the neighbourhood of two-thirds of a mile. It is possible that over this distance the ore may occur in more than one distinct body, and the magnetometric survey seems to indicate the existence—along a parallel line a few hundred feet west—of other bodies.

All the information available seems to indicate that the ore bodies have the forms of abruptly terminating beds or bands, with, in each case, a fairly constant thickness. The walls, where seen, were always sharply defined, and dipped westward at angles varying from 45° to nearly 90°.

*Assay Values of Ore.*—At the surface the ore seemed always to be of magnetite, except, as in some cases, for a thin film of limonite, or perhaps hematite. It has been stated, however, that the diamond drill cores indicated the presence of considerable hematite along bands or zones.

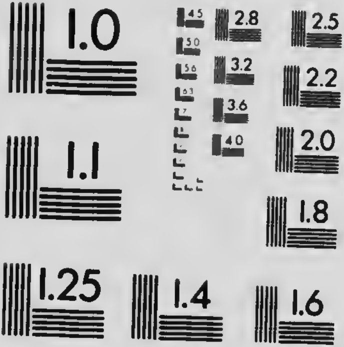
A general sample taken by Lindeman across the whole width of No. 1 deposit, about 230 feet from its northern end, gave[1]:—

| | Per cent. |
|---|---|
| Silica | 26·30 |
| Iron | 47·30 |
| Manganese | 1·00 |
| Phosphorus | 0·64 |
| Sulphur | 0·05 |

[1] Lindeman, E.: Ann. Rept. Dept. Interior, July 1, 1906, to March 31, 1907, Part 8, Report of Superintendent of Mines, p. 31.

MICROCOPY RESOLUTION TEST CHART

(ANSI and ISO TEST CHART No. 2)




APPLIED IMAGE Inc
1653 East Main Street
Rochester, New York 14609 USA
(716) 482 - 0300 - Phone
(716) 288 - 5989 - Fax

In the case of two of the diamond drill holes sunk on No. 1 body, the ore as sampled from the drill cores gave respectively[1]:—

| | Per cent. |
|---|---|
| *Hole No. 1—* | |
| Iron | 49·00 |
| Silica | 16·60 |
| Phosphorus | 0·79 |
| *Hole No. 2—* | |
| Iron | 49·00 |
| Silica | 16·10 |
| Phosphorus | 0·74 |

The character of the ore is also indicated by the following figures, derived from the results of nearly 70 analyses of samples, taken over intervals of 10 feet, from the cores of four diamond drill holes. The logs of the drill holes, and the accompanying analyses, were very kindly placed at the disposal of the writer by Mr. Fulton, the local manager of the mining company.

Iron: Average between 47 and 51 per cent; range, 39·6 per cent to 58·7 per cent.

Sulphur: Average between 0·17 per cent and 0·27 per cent; range, 0·009 per cent to 2·433 per cent.

Phosphorus: Average between 0·77 per cent and 0·89 per cent; range, 0·385 per cent, and 1·222 per cent.

### MODE OF ORIGIN OF DEPOSITS.

On the preceding pages has been set forth all of the information available bearing on the character of the ore deposit, and, indirectly, on its mode of origin.

Though the so-called quartz porphyry may in reality be a tuff, there does not appear to be any ground for supposing the ore bodies to be of the nature of sediments or chemical precipitates, and if the quartz porphyry is indeed a massive rock, it would appear to be altogether impossible that the ore could be of sedimentary or an analogous origin.

In all cases the deposits appear to have sharply defined walls, and there does not appear to be any evidence indicating that the ores are to be considered as directly connected in origin with any of the rock types with which they are associated. Number 1 ore body ap-

[1] Loc. cit., p. 37.

pears to lie along or close to the contact between diabase and quartz porphyry; in the case of No. 2, the deposit seems to lie at or near the contact of quartz porphyry and quartz-free porphyry; in the case of No. 3, the deposit seems to be wholly within quartz porphyry, but near diabase.

The prominent banding of the ore, sometimes on a coarse scale, sometimes microscopic in its fineness, is, when seen in thin sections under the microscope, very regular, and gives the impression of being an original structure, not a secondary one in some way imparted to the ore after its formation.

The parallelism of the banding of the ore (seemingly an original structure) and its attendant slaty cleavage, with the walls of the ore bodies and with the planes of schistosity in the neighbouring rocks, forcibly suggest that the ore has replaced a schistose rock, and has partly preserved the original schistose structure.

The finely granular quartz present throughout the ore, as well as the less abundant granular feldspar, may readily be regarded as representing original constituents of the replaced, schistose rock, possibly sheared quartz porphyry. That the original rock was schistose is supported by the fact that in all cases where observations were possible, the country rock, as it neared the ore bodies, was found to be progressively more schistose.

Under the above hypothesis, the occasional narrow bands of dark green schist seen in No. 1 body may represent a rock variety that more strongly resisted the replacing action of the ore bearing solutions. The apparently basic composition of these bands, and the occurrence of schistose diabase along the western walls of the ore body, suggest that they may represent dykes of diabase.

The localization of pyrite and quartz along certain zones or bands paralleling the walls, may indicate that these minerals were present in the rock prior to its replacement by ore, and in support of this view the following observations are offered.

It is noticeable that, in a number of cases, the magnetite close to the larger masses of pyrite is much finer grained than elsewhere, as though the mode of deposition of the magnetite had been in some way influenced by the presence of the sulphide. It might indeed be possible that the magnetite has been, in part at least, derived from pre-existing sulphide.

As regards the quartz veins, in the case of a thin section of ore charged with small reticulated and crenulated quartz veins, it was seen that the alternating microscopically fine lines and extremely narrow bands of quartz, quartz impregnated with magnetite, and nearly pure magnetite, conformed as nearly as possible to the intricate folding exhibited by the quartz veins. On the assumption that the ore and its structure are due to the replacement of a schistose rock, the minute corrugated forms exhibited by the ore represent a corrugated structure previously existing in the now replaced schist.

The appearance of the ore in thin section did not seem to indicate that the ore would fracture along the old corrugation planes, and so permit of the forming of later quartz veins following similar crenulated courses, and, therefore, it is concluded that the veins did not originate after the formation of the ore.

The appearance of the thin sections of the band or zone of quartz veins, and the ore body as a whole, does not warrant any supposition that the quartz veins were bent after the formation of the ore.

It is true that the veins might have been formed contemporaneously with the ore, but, on the other hand, the puckering and bending of the veins in the ore is duplicated over a part of the exposures of country rock on the foot-wall of No. 1 body. This would indicate that the original rock had been twisted and bent, that quartz veins were introduced either before, during, or after the folding, and that after this the rock had been replaced by ore that still retains many indications of the original crenulations, as well as many or all of the quartz veins.

The results of Lindeman's magnetometric surveys indicate that all the bodies end abruptly. This is actually seen to be so in the case of the southern end of No. 2 deposit. The appearance in this instance forbids the supposition that the body ends along a fault plane, and that, for instance, No. 1 deposit is the continuation of the same body shifted westward by faulting. It is possible, in the absence of any direct evidence to the contrary, that No. 1 and No. 2 bodies or the containing zones of rock may once have been situated in a line, and owe their present relative positions to faulting.

The conclusion then is, that the ore bodies have formed through the partial replacement of schistose quartz porphyry by magnetite, along sharply defined zones. It seems reasonable to suppose that, directly or indirectly, the ore is of igneous origin, but otherwise the origin of the magnetite and its solvent, the reasons for the localization of the bodies, except in so far as this seems to have been along zones of shearing, and the causes that produced their sharp walls and abrupt endings, are unknown.

MINING, ETC.

The Canada Iron Corporation has built some 16 miles of railway to connect the deposit with the Intercolonial railway. The first shipment of ore for export via the Intercolonial railway to Newcastle, was to be made early in October.

When the property was visited for a second time, in September, 1910, mining operations had been commenced upon the 60 foot to 70 foot face of ore, at the north end of No. 1 deposit. The ore, after having been blasted down, was conveyed in trucks to and up an incline, and dumped into a crusher. From a crusher the ore was discharged upon a belt, hand picked as it was being elevated, and then emptied into ore bins.

It was stated that the iron content of the hand picked, shipping ore, ran a little above 50 per cent.

FUTURE POSSIBILITIES.

It is to be expected that other bodies of iron ore besides those described are present in the immediate neighbourhood of the Nipisiguit iron ore deposit. One such body was noticed on the sides of a railway cutting not far from the mine.

It also seems reasonable to expect that, in the future, other deposits of iron ore will be located over a considerable extent of territory. The Millstream deposit, described in Part I of this memoir, lies about 20 miles north of that of Austin brook. While the Nipisiguit and Millstream deposits are unlike in many respects, they are similar in that they both appear to be of igneous origin. The occurrence of the two deposits at the ends of a strip of country 20 miles long may be taken as indicating that at least over this distance, and for some distance to the west, the conditions are favourable to the possible occurrence of other iron ore bodies, and that this district is one in which it has been possible for certain processes of igneous origin to produce ore bodies.

It cannot be stated that ore bodies will *probably* be found, only that *possibly* they do occur, and that in the writer's opinion the district is worthy of careful prospecting. Unfortunately the country as a whole being forested, and heavily drift covered, outcrops are comparatively rare, and it would appear that prospecting should be done by methods based on the magnetic properties of the ores. The use of a dip needle for this purpose does not need to be described.

As an alternative to the use of the dip needle it is suggested that prospecting might be done by determining the local variation of the compass. This would entail the use of a transit or solar compass. During the field work in connexion with the preparation of the small map of the Nipisiguit iron ore property, it was found that the ore bodies there existing exerted a very marked influence on the compass needle up to a distance of one-fourth mile and that distinct deflections were easily detected at distances as great as one-half mile. With the aid of a couple of axemen it proved to be comparatively easy to run a meandering transit line along any general given direction. If other iron ore bodies are present in the district, and if they too are magnetic, it thus would appear that their presence would be detected by observing for local deflections of the compass along a system of meandering traverses so run that each would be about one-half mile from its neighbours.

# INDEX.

## A



## B



## C



## D



## E

V



Z

# CANADA
# DEPARTMENT OF MINES
## GEOLOGICAL SURVEY BRANCH

Hon. W. Templeman, Minister; A. P. Low, Deputy Minister;
R. W. Brock, Director

# SELECTED LIST OF REPORTS AND MAPS
## (SINCE 1885)
## OF SPECIAL ECONOMIC INTEREST

PUBLISHED BY

## THE GEOLOGICAL SURVEY.

**Report of the Mines Section:—**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| No. 245. | Report of Mines Section, | 1886 | No. 662. | Report of Mines Section | 1897 |
| 272 | " | " | 1887. | 698 | " | " | 1898. |
| *300 | " | " | 1888. | 718 | " | " | 1899. |
| 301 | " | " | 1889. | 741 | " | " | 1900. |
| 334 | " | " | 1890. | 800 | " | " | 1901. |
| 335 | " | " | 1891. | 835 | " | " | 1902. |
| 360 | " | " | 1892. | 893 | " | " | 1903. |
| 572 | " | " | 1893-4. | *928 | " | " | 1904. |
| 602 | " | " | 1895. | 971 | " | " | 1905. |
| 625 | " | " | 1896. | | | | |

**Mineral Production of Canada:—**

| | | | | | |
|---|---|---|---|---|---|
| No. *414. | Year 1886. | No. *422. | Year 1893. | No. 719. | Year 1900. |
| *415 | " 1887. | *555 | " 1894 | 719a | " 1901. |
| *416 | " 1888. | *577 | " 1895 | 813 | " 1902. |
| *417 | " 1889. | *612 | " 1896. | 861 | " 1903. |
| *418 | " 1890. | *623 | " 1886-96 | 896 | " 1904. |
| *419 | " 1891. | *640 | " 1897. | 921 | " 19[illegible] |
| *420 | " 1886-91 | *671 | " 1898. | 981 | " 1906. |
| *421 | " 1892. | *686 | " 1899. | | |

**Mineral Resources Bu[illegible]n:—**

| | | |
|---|---|---|
| No. *818. Platinum. | No. 860. Zinc. | No. 881. Phosphate. |
| 851. Coal. | 869. Mica. | 882. Copper. |
| *854. Asbestos. | 872. Molybdenum and Tungsten. | 913. Mineral Pigments. |
| 857. Infusorial Earth. | *877. Graphite. | 953. Barytes. |
| 858. Manganese. | 880. Peat. | 984. Mineral Pigments (French). |
| 859 Salt. | | |

**Report of the Section of Chemistry and Mineralogy:—**

| | | | | | |
|---|---|---|---|---|---|
| No. *102 | Year 1874-5. | No. *169. | Year 1882-3-4. | No. 580. | Year 1894. |
| *110 | " 1875-6. | 222 | " 1885. | 616 | " 1895. |
| *119 | " 1876-7. | 246 | " 1886. | 651 | " 1896. |
| *126 | " 1877-8. | 273 | " 1887-8 | 695 | " 1898. |
| *138 | " 1878-9. | 299 | " 1888-9. | 724 | " 1899. |
| *148 | " 1879-80. | 333 | " 1890-1. | 821 | " 1900. |
| *156 | " 1880-1-2. | 359 | " 1892-3. | *958 | " 1906. |

*Publications marked thus are out of print.

284—7

## REPORTS.

### GENERAL.

745. Altitudes of Canada, by J. White. 1899.
*972. Descriptive Catalogue of Minerals and Rocks, by R. A. A. Johnston and G. A. Young.
1073. Catalogue of Publications: Reports and Maps (1843-1909).
1085. Descriptive Sketch of the Geology and Economic Minerals of Canada, by G. A. Young, and Introductory by R. W. Brock. Maps No. 1084; No. 1042 (second edition), scale 100 m. = 1 in.
1086. French translation of Descriptive Sketch of the Geology and Economic Minerals of Canada, by G. A. Young, and Introductory by R. W. Brock. Maps No. 1084; No. 1042 (second edition), scale 100 m. = 1 in.
1107. Part II. Geological position and character of the oil-shale deposits of Canada, by R. W. Ells.
1146. Notes on Canada, by R. W. Brock.

### YUKON.

*260. Yukon district, by G. M. Dawson. 1887. Maps No. 274, scale 60 m. = 1 in.; Nos. 275 and 277, scale 8 m. = 1 in.
*295. Yukon and Mackenzie basins, by R. G. McConnell. 1889. Map No. 304, scale 48 m. = 1 in.
687. Klondike gold fields (preliminary), by R. G. McConnell. 1900. Map No. 688, scale 2 m. = 1 in.
884. Klondike gold fields, by R. G. McConnell. 1901. Map No. 772, scale 2 m. = 1 in.
*909. Windy Arm, Tagish lake, by R. G. McConnell. 1906. Map No. 916, scale 2 m. = 1 in.
943. Upper Stewart river, by J. Keele. Map No. 938, scale 8 m. = 1 in. } Bound together.
951. Peel and Wind rivers, by Chas. Camsell. Map No. 942, scale 8 m. = 1 in. } Bound together.
979. Klondike gravels, by R. G. McConnell. Map No. 1011, scale 40 ch. = 1 in.
982. Conrad and Whitehorse mining districts, by D. D. Cairnes. 1901. Map No. 990, scale 2 m. = 1 in.
1016. Klondike Creek and Hill gravels, by R. G. McConnell. (French.) Map No. 1011, scale 40 ch. = 1 in.
1050. Whitehorse Copper Belt, by R. G. McConnell. Maps Nos. 1,026, 1,041, 1,044-1,049.
1097. Reconnaissance across the Mackenzie mountains on the Pelly, Ross, and Gravel rivers, Yukon, and North West Territories, by Joseph Keele. Map No. 1099, scale 8 m. = 1 in.
1011. Memoir No. 5 (Preliminary): on the Lewes and Nordenskiöld Rivers coal field, Yukon, by D. D. Cairnes. Maps Nos. 1103 and 1104, scale 2 m. = 1 in.

### BRITISH COLUMBIA.

212. The Rocky mountains (between latitudes 49° and 51° 30'), by G. M. Dawson. 1885. Map No. 223, scale 6 m. = 1 in. Map No. 224, scale 1½ m. = 1 in.
*235. Vancouver Island, by G. M. Dawson. 1886. Map No. 247, scale 8 m. = 1 in.
236. The Rocky mountains, geological structure, by R. G. McConnell. 1886. Map No. 248, scale 2 m. = 1 in.
263. Cariboo mining district, by A. Bowman. 1887. Maps Nos. 278-281.
*271. Mineral wealth, by G. M. Dawson.
*294. West Kootenay district, by G. M. Dawson. 1888-9. Map No. 303, scale 8 m. = 1 in.
*573. Kamloops district, by G. M. Dawson. 1894. Maps Nos. 556 and 557, scale 4 m. = 1 in.
574. Finlay and Omineca rivers, by R. G. McConnell. 1894. Map No. 567 scale 8 m. = 1 in.

---

* Publications marked thus are out of print.

743. Atlin Lake mining division, by J. C. Gwillim. 1899. Map No. 742, scale 4 m. =1 in.
939. Rossland district, by R. W. Brock. Map No. 941, scale 1,600 ft. =1 in.
*940. Graham Island, by R. W. Ells. 1905. Maps No. 921, scale 4 m. =1 in.; No. 922, scale 1 m. =1 in.
988. Similkameen district, by Chas. Camsell. Map No. 987, scale 400 ch. =1 in.
988. Telkwa river and vicinity, by W. W. Leach. Map No. 989, scale 2 m. =1 in.
996. Nanaimo and New Westminster districts, by O. E. LeRoy. 1907. Map No. 997, scale 4 m. =1 in.
1035. Coal-fields of Manitoba, Saskatchewan, Alberta, and Eastern British Columbia, by D. B. Dowling.
1093. Geology, and Ore Deposits of Hedley Mining district, British Columbia, by Charles Camsell. Maps Nos. 1095 and 1096, scale 1,000 ft. =1 in.; No. 1105, scale 600 ft. =1 in.; No. 1106, scale 800 ft. =1 in.; No. 1125, scale 1,000 ft. =1 in.

## ALBERTA

*237. Central portion, by J. B. Tyrrell. 1886. Maps Nos. 249 and 250, scale 8 m. =1 in.
324. Peace and Athabaska Rivers district, by R. G. McConnell. 1890-1. Map No. 336, scale 48 m. =1 in.
703. Yellowhead Pass route, by J. McEvoy. 1898. Map No. 676, scale 8 m. =1 in.
*949. Cascade coal-fields, by D. B. Dowling. Maps (8 sheets) Nos. 929-936, scale 1 m. =1 in.
968. Moose Mountain district, by D. D. Cairnes. Maps No. 963, scale 2 m. =1 in.; No. 966, scale 1 m. =1 in.
1035. Coal-fields of Manitoba, Saskatchewan, Alberta, and Eastern British Columbia, by D. B. Dowling. Map No. 1010, scale 35 m. =1 in.
1035a. French translation of coal-fields of Manitoba, Saskatchewan, Alberta, and Eastern British Columbia, by D. B. Dowling. Map No. 1010, scale 35 m. =1 in.
1115. Memoir No. 8-E: Edmonton coal-field, by D. B. Dowling. Maps Nos. 1117-5A and 1118-6A, scale 2640 ft. =1 in.
1130. Memoir No. 9-E: Bighorn coal basin, Alta., by G. S. Malloch. Map No. 1132, scale 2 m. =1 in.

## SASKATCHEWAN.

213. Cypress hills and Wood mountain, by R. G. McConnell. 1885. Maps Nos. 225 and 226, scale 8 m. =1 in.
601. Country between Athabaska lake and Churchill river, by J. B. Tyrrell and D. B. Dowling. 1895. Map No. 957, scale 25 m. =1
868. Souris River coal-field, by D. B. Dowling. 1902.
1035. Coal-fields of Manitoba, Saskatchewan, Alberta, and Eastern British Columbia, by D. B. Dowling. Map No. 1010, scale 35 m. =1 in.

## MANITOBA.

264. Duck and Riding mountains, by J. B. Tyrrell. 1887-8. Map No. 282, scale 8 m. =1 in.
296. Glacial Lake Agassiz, by W. Upham. 1889. Maps Nos. 314, 315, 316.
325. Northwestern portion, by J. B. Tyrrell. 1890-1. Maps Nos. 339 and 350, scale 8 m. =1 in.
704. Lake Winnipeg (west shore), by D. B. Dowling. 1898. Map No. 664, scale 8 m. =1 in. } Bound together.
705. Lake Winnipeg (east shore), by J. B. Tyrrell. 1898. Map No. 664, scale 8 m. =1 in.
1035. Coal-fields of Manitoba, Saskatchewan, Alberta, and Eastern British Columbia, by D. B. Dowling. Map No. 1010, scale 35 m. =1 in.

## NORTH WEST TERRITORIES.

217. Hudson bay and strait, by R. Bell. 1885. Map No. 220, scale 4 m. =1 in.

*Publications marked thus are out of print.

238. Hudson bay, south of, by A. P. Low. 1886.
239. Attawapiskat and Albany rivers, by R. Bell. 1886.
244. Northern portion of the Dominion, by G. M. Dawson. 1886. Map No. 255, scale 200 m. = 1 in.
267. James bay and country east of Hudson bay, by A. P. Low.
578. Red lake and part of Berens river, by D. B. Dowling. 1894. Map No. 576, scale 8 m. = 1 in.
*584. Labrador peninsula, by A. P. Low. 1895. Maps Nos. 585-588, scale 25 m. = 1 in.
618. Dubawnt, Kazan, and Ferguson rivers, by J. B. Tyrrell. 1896. Map No. 603, scale 25 m. = 1 in.
657. Northern portion of the Labrador peninsula, by A. P. Low.
680. South Shore Hudson strait and Ungava bay, by A. P. Low. Map No. 699, scale 25 m. = 1 in. } Bound together.
713. North Shore Hudson strait and Ungava bay, by R. Bell. Map No. 699, scale 25 m. = 1 in. } Bound together.
725. Great Bear lake to Great Slave lake, by J. M. Bell. 1900.
778. East coast Hudson bay, by A. P. Low. 1900. Maps Nos. 779, 780, 781, scale 8 m. = 1 in.
786-787 Grass River region, by J. B. Tyrrell and D. B. Dowling. 1900.
815. Ekwan river and Sutton lakes, by D. B. Dowling. 1901. Map No. 751, scale 50 m. = 1 in.
819. Nastapoka islands, Hudson bay, by A. P. Low. 1900.
905. The Cruise of the *Neptune*, by A. P. Low. 1905.
1006. Report of a Traverse through the Southern Part of the North West Territories, from Lac Seul to Cat lake, 1902, by A. W. G. Wilson. } Bound together.
1080. Report on a Part of the North West Territories, drained by the Winisk and Upper Attawapiskat rivers, by W. McInnes. Map No. 1089, scale 8 m. = 1 in. } Bound together.
1069. French translation report on an exploration of the East coast of Hudson bay, from Cape Wolstenholme to the south end of James bay, by A. P. Low. Maps Nos. 779, 780, 781, scale 8 m. = 1 in.; No. 785, scale 50 m. = 1 in.
1097. Reconnaissance across the Mackenzie mountains on the Pelly, Ross, and Gravel rivers, Yukon, and North West Territories, by Joseph Keele. Map No. 1099, scale 8 m. = 1 in.

## ONTARIO.

215. Lake of the Woods region, by A. C. Lawson. 1885. Map No. 227, scale 2 m. = 1 in.
*265. Rainy Lake region, by A. C. Lawson. 1887. Map No. 283, scale 4 m. = 1 in.
266. Lake Superior, mines and mining, by E. D. Ingall. 1888. Maps No. 285, scale 4 m. = 1 in.; No. 286, scale 20 ch. = 1 in.
326. Sudbury mining district, by R. Bell. 1890-1. Map No. 343, scale 4 m. = 1 in.
327. Hunter island, by W. H. C. Smith. 1890-1. Map No. 342, scale 4 m. = 1 in.
332. Natural Gas and Petroleum, by H. P. H. Brumell. 1890-1. Maps Nos. 344-349.
357. Victoria, Peterborough, and Hastings counties, by F. D. Adams. 1892-3.
627. On the French River sheet, by R. Bell. 1896. Map No. 570, scale 4 m. = 1 in.
678. Seine river and Lake Shebandowan map-sheets, by W. McInnes. 1897. Maps Nos. 589 and 560, scale 4 m. = 1 in.
723. Iron deposits along the Kingston and Pembroke railway, by E. D. Ingall. 1900. Map No. 626, scale 2 m. = 1 in.; and plans of 13 mines.
*739. Carleton, Russell, and Prescott counties, by R. W. Ells. 1899. (*See* No. 739, Quebec.)
741. Ottawa and vicinity, by R. W. Ells. 1900.
790. Perth sheet, by R. W. Ells. 1900. Map No. 789, scale 4 m. = 1 in.
961. Sudbury Nickel and Copper deposits, by A. E. Barlow. (Reprint.) Maps Nos. 775, 820, scale 1 m. = 1 in.; Nos. 824, 825, 864, scale 400 ft. = 1 in.

———

*Publications marked thus are out of print.

962. Nipissing and Timiskaming map-sheets, by A. E. Barlow. (Reprint). Maps Nos. 599, 606 scale 4 m. = 1 in.; No. 914, scale 4 m. = 1 in.
965. Sudbury Nickel and Copper deposits, by A. E. Barlow. (French.)
970. Report on Niagara Falls, by J. W. Spencer. Maps Nos. 926, 967.
977. Report on Pembroke sheet, by R. W. Ells. Map No 660, scale 4 m. = 4 in.
980. Geological reconnaissance of a portion of Algoma and Thunder Bay district, Ont., by W. J. Wilson. Map No. 964, scale 8 m. = 4 in.
1081. On the region lying north of Lake Superior, between the Pic and Nipigon rivers, Ont., by W. H. Collins. Map No. 964, scale 8 m. = 1 in.
} Bound together.
992. Report on Northwestern Ontario, traversed by National Transcontinental railway, between Lake Nipigon and Sturgeon lake, by W. H. Collins. Map No 993, scale 4 m. = 1 in.
998. Report on Pembroke sheet, by R. W. Ells. (French.) Map No. 660, scale 4 m. = 1 in.
999. French translation Gowganda Mining Division, by W. H. Collins. Map No. 1076, scale 4 m. = 1 in.
1038. French translation report on the Transcontinental Railway location between Lake Nipigon and Sturgeon lake, by W. H. Collins. Map No. 993, scale 4 m = 4 in.
1059. Geological reconnaissance of the region traversed by the National Transcontinental railway between Lake Nipigon and Clay lake, Ont., by W. H. Collins. Map No. 993, scale 4 m. = 1 in.
1075. Gowganda Mining Division, by W. H. Collins. Map No. 1076, scale 1 m. = 1 in.
1082. Memoir No. 6: Geology of the Haliburton and Bancroft areas, Ont., by Frank D. Adams and Alfred E. Barlow. Maps No. 708, scale 4 m. = 1 in.; No. 770, scale 2 m. = 1 in.
1091. Memoir No. 1: On the Geology of the Nipigon basin, Ont., by A. W. G. Wilson. Map No. 1090, scale 4 m. = 4 in.
1114. French translation: Geological reconnaissance of a portion of Algoma and Thunder Bay district, Ont., by W. J. Wilson. Map No. 964, scale 8 m. = 1 in.
1119. French translation: On the region lying north of Lake Superior, between the Pic and Nipigon rivers, Ont., by W. H. Collins. Map No. 964, scale 8 m. = 1 in.
} Bound together.

## QUEBEC.

216. Mistassini expedition, by A. P. Low. 1884 5. Map No. 228, scale 8 m. = 1 in.
240. Compton, Stanstead, Beauce, Richmond, and Wolfe counties, by R. W. Ells. 1886. Map No. 251 (Sherbrooke sheet), scale 4 m. = 1 in.
268. Megantic, Beauce, Dorchester, Levis, Bellechasse, and Montmagny counties, by R. W. Ells. 1887 8. Map No. 287, scale 40 ch. = 1 in.
297. Mineral resources, by R. W. Ells. 1889.
328. Portneuf, Quebec, and Montmagny counties, by A. P. Low. 1890 1.
579. Eastern Townships, Montreal sheet, by R. W. Ells and F. D. Adams. 1894. Map No. 571, scale 4 m. = 1 in.
591. Laurentian area north of the Island of Montreal, by F. D. Adams. 1895. Map No. 590, scale 4 m. = 1 in.
670. Auriferous deposits, southeastern portion, by R. Chalmers. 1895. Map No. 667, scale 8 m. = 1 in.
707. Eastern Townships, Three Rivers sheet, by R. W. Ells. 1898.
*739. Argenteuil, Ottawa, and Pontiac counties, by R. W. Ells. 1899. (See No. 739, Ontario).
788. Nottaway basin, by R. Bell. 1900. *Map No. 702, scale 10 m. = 4 in.
863. Wells on Island of Montreal, by F. D. Adams. 1904. Maps Nos. 874, 875, 876.
923. Chibougamau region, by A. P. Low. 1905.
962. Timiskaming map-sheet, by A. E. Barlow. (Reprint). Maps Nos. 599, 606, scale 4 m. = 1 in.; No. 944, scale 1 m. = 1 in.
974. Report on Copper-bearing rocks of Eastern Townships, by J. A. Dresser. Map No. 976, scale 8 m. = 1 in.
975. Report on Copper-bearing rocks of Eastern Townships, by J. A. Dresser. (French).
998. Report on the Pembroke sheet, by R. W. Ells. (French).

*Publications marked thus are out of print.

1028. Report on a Recent Discovery of Gold near Lake Megantic, Que., by J. A. Dresser. Map No. 1029, scale 2 m. = 1 in.
1032. Report on a Recent Discovery of Gold near Lake Megantic, Que., by J. A. Dresser. (French). Map No. 1029, scale 2 m. = 1 in.
1052. French translation report on Artesian wells in the Island of Montreal, by Frank D. Adams and O. E. LeRoy. Maps No. 874, scale 4 m. = 1 in.; No. 875, scale 3,000 ft. = 1 in.; No. 876.
1064. Geology of an Area adjoining the East Side of Lake Timiskaming, Que., by Morley E. Wilson. Map No. 1066, scale 1 m = 1 in.
1110. Memoir No. 4: Geological Reconnaissance along the line of the National Transcontinental railway in Western Quebec, by W. J. Wilson. Map No. 1112, scale 4 m. = 1 in.
1144. Reprint of Summary Report on the Serpentine Belt of Southern Quebec, by J. A. Dresser.

## NEW BRUNSWICK.

218. Western New Brunswick and Eastern Nova Scotia, by R. W. Ells. 1885. Map No. 230, scale 4 m. = 1 in.
219. Carleton and Victoria counties, by L. W. Bailey. 1885. Map No. 231, scale 4 m. = 1 in.
242. Victoria, Restigouche, and Northumberland counties, N.B., by L. W. Bailey and W. McInnes. 1886. Map No. 254, scale 4 m. = 1 in.
269. Northern portion and adjacent areas, by L. W. Bailey and W. McInnes. 1887–8. Map No. 290, scale 4 m. = 1 in.
330. Temiscouata and Rimouski counties, by L. W. Bailey and W. McInnes. 1890–1. Map No. 350, scale 4 m. = 1 in.
661. Mineral resources, by L. W. Bailey. 1897. Map No. 675, scale 10 m. = 1 in. New Brunswick geology, by R. W. Ells. 1887.
799. Carboniferous system, by L. W. Bailey. 1900. } Bound together.
803. Coal prospects in, by H. S. Poole. 1900. } Bound together.
983. Mineral resources, by R. W. Ells. Map No. 969, scale 16 m. = 1 in.
1034. Mineral resources, by R. W. Ells. (French). Map No. 969, scale 16 m. = 1 in.
1113. Memoir No. 16-E: The Clay and Shale deposits of Nova Scotia and portions of New Brunswick, by H. Ries and J. Keele. Map No. 1153, scale 12 m. = 1 in.

## NOVA SCOTIA.

243. Guysborough, Antigonish, Pictou, Colchester, and Halifax counties, by Hugh Fletcher and E. R. Faribault. 1886.
331. Pictou and Colchester counties, by H. Fletcher. 1890–1.
358. Southwestern Nova Scotia (preliminary), by L. W. Bailey. 1892–3. Map No. 362, scale 8 m. = 1 in.
628. Southwestern Nova Scotia, by L. W. Bailey. 1896. Map No. 641, scale 8 m. = 1 in.
685. Sydney coal-field, by H. Fletcher. Maps Nos. 652, 653, 654, scale 1 m. = 1 in.
797. Cambrian rocks of Cape Breton, by G. F. Matthew. 1900
871. Pictou coal-field, by H. S. Poole. 1902. Map No. 833, scale 25 ch. = 1 in.
1113. Memoir No. 16-E: The Clay and Shale deposits of Nova Scotia and portions of New Brunswick, by H. Ries and J. Keele. Map No. 1153, scale 12 m. = 1 in.

# MAPS.

1042. Dominion of Canada. Minerals. Scale 100 m. = 1 in.

## YUKON.

*805. Explorations on Macmillan, Upper Pelly, and Stewart rivers, scale 8 m. = 1 in.
891. Portion o Duncan Creek Mining district, scale 6 m. = 1 in.
894. Sketch Map Kluane Mining district, scale 6 m. = 1 in.

*Publications marked thus are out of print.

*916. Windy Arm Mining district, Sketch Geological Map, scale 2 m. = 1 in.
990. Conrad and Whitehorse Mining districts, scale 2 m. = 1 in.
991. Tantalus and Five Fingers coal mines, scale 1 m. = 1 in.
1011. Bonanza and Hunker creeks. Auriferous gravels. Scale 40 chains = 1 in.
1033. Lower Lake Laberge and vicinity, scale 1 m. = 1 in.
1041. Whitehorse Copper belt, scale 1 m. = 1 in.
1026. 1044–1049. Whitehorse Copper belt. Details.
1099. Pelly, Ross, and Gravel rivers, Yukon and North West Territories. Scale 8 m. = 1 in.
1103. Tantalus Coal area, Yukon. Scale 2 m. = 1 in.
1104. Braeburn-Kynocks Coal area, Yukon. Scale 2 m. = 1 in.

## BRITISH COLUMBIA.

278. Cariboo Mining district, scale 2 m. = 1 in.
604. Shuswap Geological sheet, scale 4 m. = 1 in.
*771. Preliminary Edition, East Kootenay, scale 4 m. = 1 in.
767. Geological Map of Crowsnest coal-fields, scale 2 m. = 1 in.
*791. West Kootenay Minerals and Striæ, scale 4 m. = 1 in.
*792. West Kootenay Geological sheet, scale 4 m. = 1 in.
828. Boundary Creek Mining district, scale 1 m. = 1 in.
890. Nicola coal basin, scale 1 m. = 1 in.
941. Preliminary Geological Map of Rossland and vicinity, scale 1,600 ft. = 1
987. Princeton coal basin and Copper Mountain Mining camp, scale 40 ch. = 1 in.
989. Telkwa river and vicinity, scale 2 m. = 1 in.
997. Nanaimo and New Westminster Mining division, scale 4 m. = 1 in.
1001. Special Map of Rossland. Topographical sheet. Scale 400 ft. = 1 in.
1002. Special Map of Rossland. Geological sheet. Scale 400 ft. = 1 in.
1003. Rossland Mining camp. Topographical sheet. Scale 1,200 ft. = 1 in.
1004. Rossland Mining camp. Geological sheet. Scale 1,200 ft. = 1 in.
1068. Sheep Creek Mining camp. Geological sheet. Scale 1 m. = 1 in.
1074. Sheep Creek Mining camp. Topographical sheet. Scale 1 m. = 1 in.
1095. 1A.—Hedley Mining district. Topographical sheet. Scale 1,000 ft. = 1 in.
1096. 2A.—Hedley Mining district. Geological sheet. Scale 1,000 ft. = 1 in.
1105. 4A.—Golden Zone Mining camp. Scale 600 ft. = 1 in.
1106. 3A.—Mineral Claims on Henry creek. Scale 800 ft. = 1 in.
1125. Hedley Mining district: Structure Sections. Scale 1,000 ft. = 1 in
Deadwood Mining camp. Scale 400 ft. = 1 in. (Advance sheet.)
1164. 28A.—Portland Canal Mining district, scale 2 m. = 1 in.
Beaverdell sheet, Yale district, scale 1 m. = 1 in. (Advance sheet.)
Tulameen sheet, scale 1 m. = 1 in. (Advance sheet.)

## ALBERTA.

591–596. Peace and Athabaska rivers, scale 10 m. = 1 in.
*808. Blairmore-Frank coal-fields, scale 180 ch. = 1 in.
892. Costigan coal basin, scale 40 ch. = 1 in.
929–936. Cascade coal basin. Scale 1 m. = 1 in.
963–966. Moose Mountain region. Coal Areas. Scale 2 m. = 1 in.
1010. Alberta, Saskatchewan, and Manitoba. Coal Areas. Scale 35 m. = 1 in
1117. 5A.—Edmonton. (Topography). Scale ½ m. = 1 in.
1118. 6A.—Edmonton. (Clover Bar Coal Seam). Scale ½ m. = 1 in.
1132. 7A.—Bighorn coal-field. Scale 2 m. = 1 in
Portion of Jasper Park, scale 1 m. = 1 in. (Advance sheet.)

## SASKATCHEWAN.

1010. Alberta, Saskatchewan, and Manitoba. Coal Areas. Scale 35 m. = 1 in.

## MANITOBA.

804. Part of Turtle mountain showing coal areas. Scale 1½ m. = 1 in
1010. Alberta, Saskatchewan, and Manitoba. Coal Areas. Scale 35 m. = 1 in.

*Publications marked thus are out of print

## NORTH WEST TERRITORIES.

1089. Explored routes on Albany, Severn, and Winisk rivers. Scale 8 m. =1 in.
1099. Pelly, Ross, and Gravel rivers, Yukon and North West Territories. Scale 8 m. =1 in.

## ONTARIO.

227. Lake of the Woods sheet, scale 2 m. =1 in.
*283. Rainy Lake sheet, scale 4 m. =1 in.
*342. Hunter Island sheet, scale 4 m. =1 in.
343. Sudbury sheet, scale 4 m. =1 in.
*373. Rainy River sheet, scale 2 m. =1 in.
560. Seine River sheet, scale 4 m. =1 in.
570. French River sheet, scale 4 m. =1 in.
*589. Lake Shebandowan sheet, scale 4 m. =1 in.
599. Timiskaming sheet, scale 4 m. =1 in. (New Edition 1907).
605. Manitoulin Island sheet, scale 4 m. =1 in.
606. Nipissing sheet, scale 4 m. =1 in. (New Edition 1907).
660. Pembroke sheet, scale 4 m. =1 in.
663. Ignace sheet, scale 4 m. =1 in.
708. Haliburton sheet, scale 4 m. =1 in.
720. Manitou Lake sheet, scale 4 m. =1 in.
*750. Grenville sheet, scale 4 m. =1 in.
770. Bancroft sheet, scale 2 m. =1 in.
775. Sudbury district, Victoria mines, scale 1 m. = 1 in.
*789. Perth sheet, scale 4 m. =1 in.
820. Sudbury district, Sudbury, scale 1 m. =1 in.
824-825. Sudbury district, Copper Cliff mines, scale 400 ft. =1 in.
852. Northeast Arm of Vermilion Iron ranges, Timagami, scale 40 ch. =1 in.
864. Sudbury district, Elsie and Murray mines, scale 400 ft. =1 in.
903. Ottawa and Cornwall sheet, scale 4 m. =1 in.
944. Preliminary Map of Timagami and Rabbit lakes, scale 1 m. =1 in.
964. Geological Map of parts of Algoma and Thunder bay, scale 8 m. =1 in.
1023. Corundum Bearing Rocks. Central Ontario. Scale 17½ m. = 1 in.
1076. Gowganda Mining Division, scale 1 m. =1 in.
1090. Lake Nipigon, Thunder Bay district, scale 4 m. =1 in.

## QUEBEC.

*251. Sherbrooke sheet, Eastern Townships Map, scale 4 m. =1 in.
287. Thetford and Coleraine Asbestos district, scale 40 ch. =1 in.
375. Quebec sheet, Eastern Townships Map, scale 4 m. =1 in.
*571. Montreal sheet, Eastern Townships sheet, scale 4 m. =1 in.
*665. Three Rivers sheet, Eastern Townships Map, scale 4 m. =1 in.
667. Gold Areas in southeastern part, scale 8 m. =1 in.
*668. Graphite district in Labelle county, scale 40 ch. =1 in.
918. Chibougamau region, scale 4 m. =1 in.
976. The Older Copper-bearing Rocks of the Eastern Townships, scale 8 m. =1 in.
1007. Lake Timiskaming region, scale 2 m. =1 in.
1029. Lake Megantic and vicinity, scale 2 m. =1 in.
1066. Lake Timiskaming region. Scale 1 m. =1 in.
1112. 12A—Vicinity of the National Transcontinental railway, Abitibi district, scale 4 m. =1 in.
1154. 23A—Thetford-Black Lake Mining district, scale 1 m. =1 in.
Larder lake and Opasatika lake, scale 2 m. =1 in. (Advance sheet.)
Danville Mining district, scale 1 m. =1 in. (Advance sheet.)

## NEW BRUNSWICK.

*675. Map of Principal Mineral Occurrences. Scale 10 m. =1 in.
969. Map of Principal Mineral Localities. Scale 16 m. =1 in.
1155. 24A—Millstream Iron deposits, N.B., scale 400 ft. =1 in.
1156. 25A—Nipisiguit Iron deposits, N.B., scale 400 ft. =1 in.

---

*Publications marked thus are out of print.

## NOVA SCOTIA.

*812. Preliminary Map of Springhill coal-field, scale 50 ch. = 1 in.
833. Pictou coal-field, scale 25 ch. = 1 in.
897. Preliminary Geological Plan of Nictaux and Torbrook Iron district, scale 25 ch. = 1 in.
927. General Map of Province showing gold districts, scale 12 m. = 1 in.
937. Leipsigate Gold district, scale 500 ft. = 1 in.
945. Harrigan Gold district, scale 400 ft. = 1 in.
995. Malaga Gold district, scale 250 ft. = 1 in.
1012. Brookfield Gold district, scale 250 ft. = 1 in.
1019. Halifax Geological sheet. No. 68. Scale 1 m. = 1 in.
1025. Waverley Geological sheet. No. 67. Scale 1 m. = 1 in.
1036. St. Margaret Bay Geological sheet. No. 71. Scale 1 m. = 1 in.
1037. Windsor Geological sheet. No. 73. Scale 1 m. = 1 in.
1043. Aspotogan Geological sheet. No. 70. Scale 1 m. = 1 in.
1153. 22A—Nova Scotia, scale 12 m. = 1 in.

NOTE.—Individual Maps or Reports will be furnished free to *bona fide* Canadian applicants.

Reports and Maps may be ordered by the numbers prefixed to titles.

Applications should be addressed to The Director, Geological Survey. Department of Mines, Ottawa.

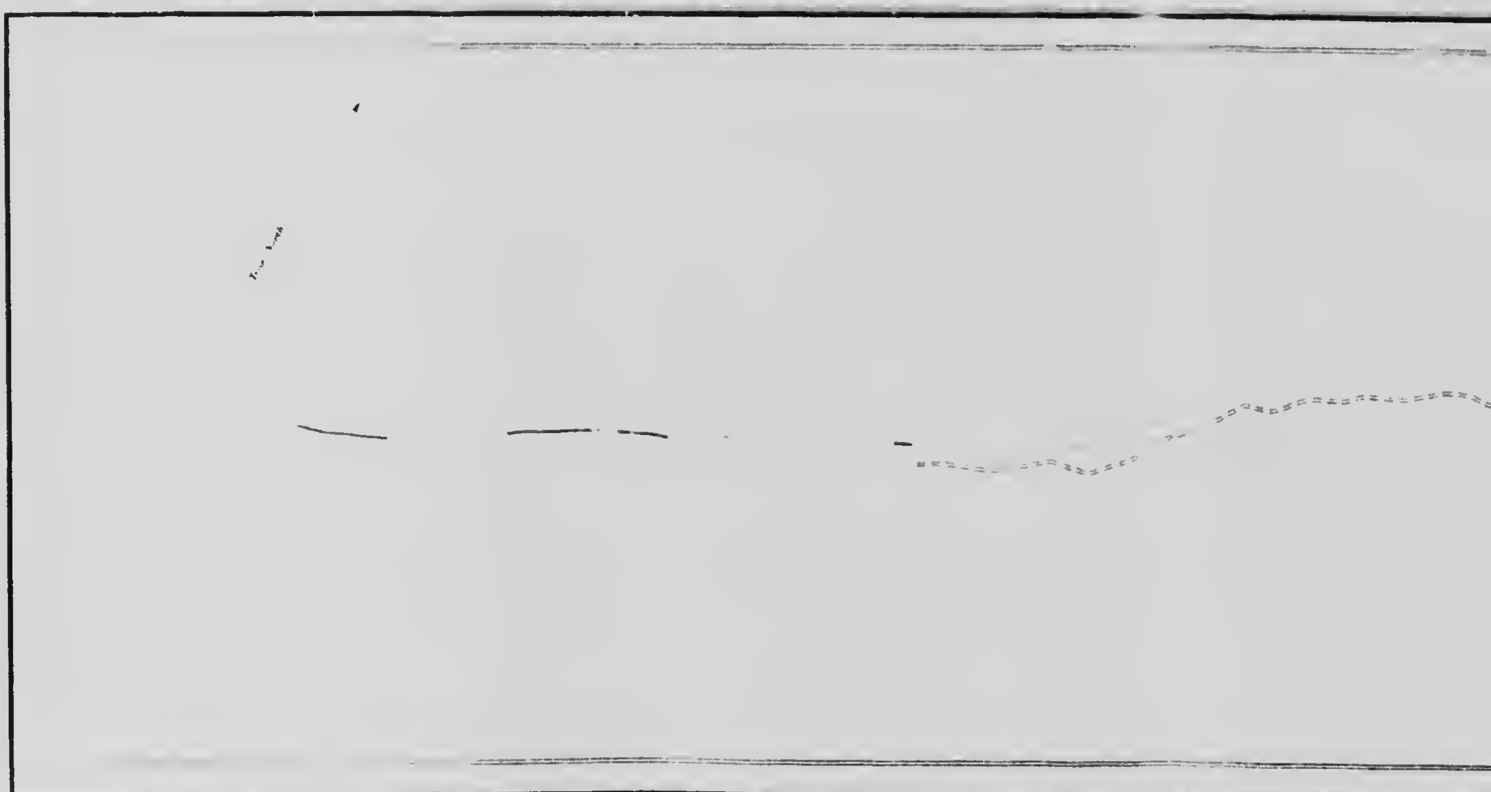
*Publications marked thus are out of print.

Can
Department
GEOLOGICA

HON W TEMPLEMAN MINISTER
R W BROCK

ECONOMIC GEOLOGY

19




LEGEND

Iron Ore Outcrops

C. O. Senecal Geographer and Chief Draughtsman
S. G. Alexander Draughtsman


MAP 2

# MILLSTREAM I

## GLOUCESTE

## NEW BRU

Scale,

Feet

Metres

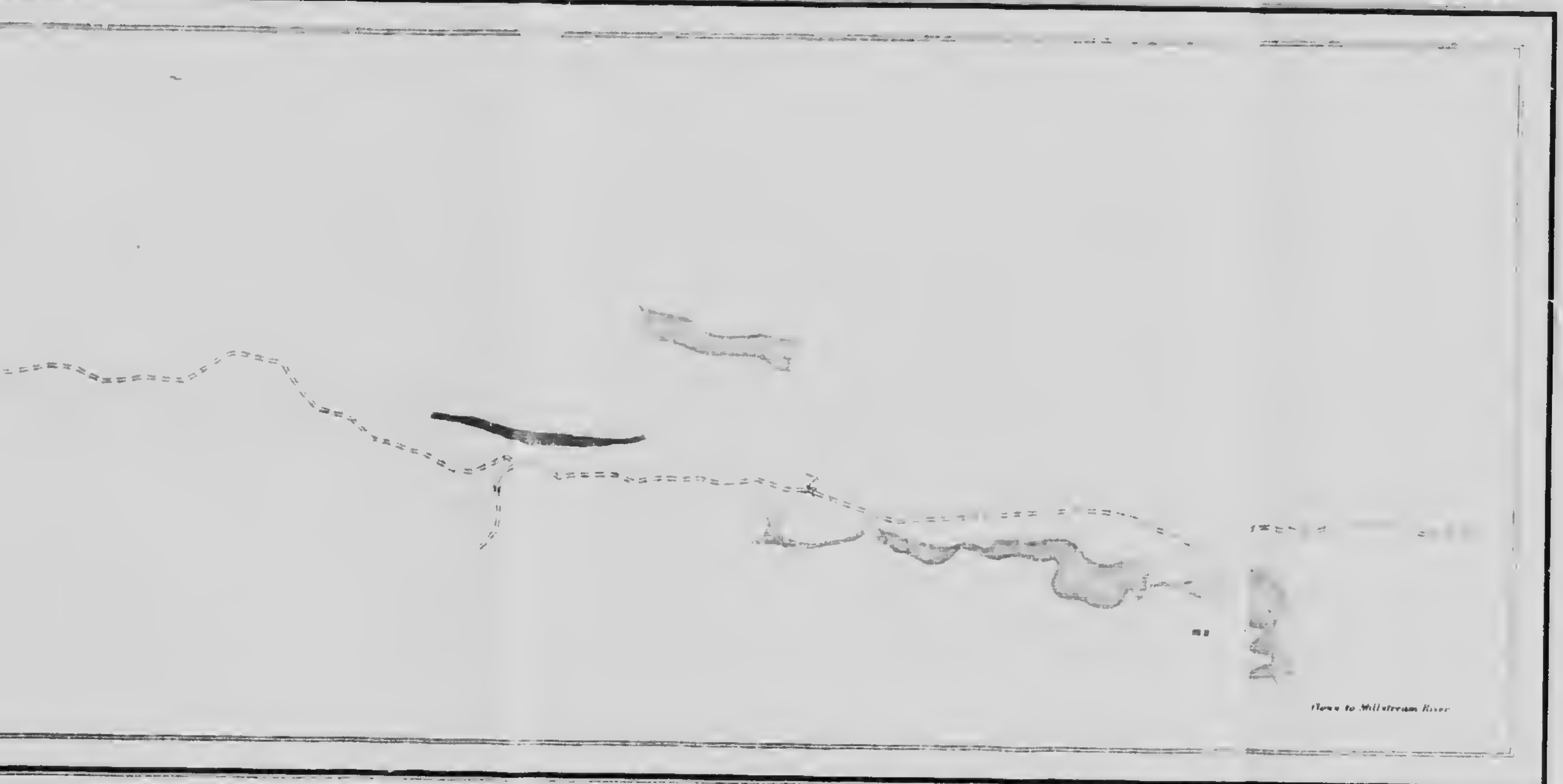
400 FEET T

Canada
artment of Mines
EOLOGICAL SURVEY

AN MINISTER A P LOW DEPUTY MINISTER
R W BROCK DIRECTOR

1911

NEW BRUNSWICK




LEGEND

Culture

Buildings

Roads not well defined

Bridges

Culverts

Water

Ponds and streams

Relief

Contours showing land forms and elevations above sea level
Interval 10 feet

Contours not well determined

MAP 24 A

# AM IRON DEPOSIT
## CESTER COUNTY
## EW BRUNSWICK

Scale, $\frac{1}{4800}$

Feet

Metres

400 FEET TO 1 INCH

GEOLOGY

G A YOUNG (ECONOMIC) 1909

TOPOGRAPHY

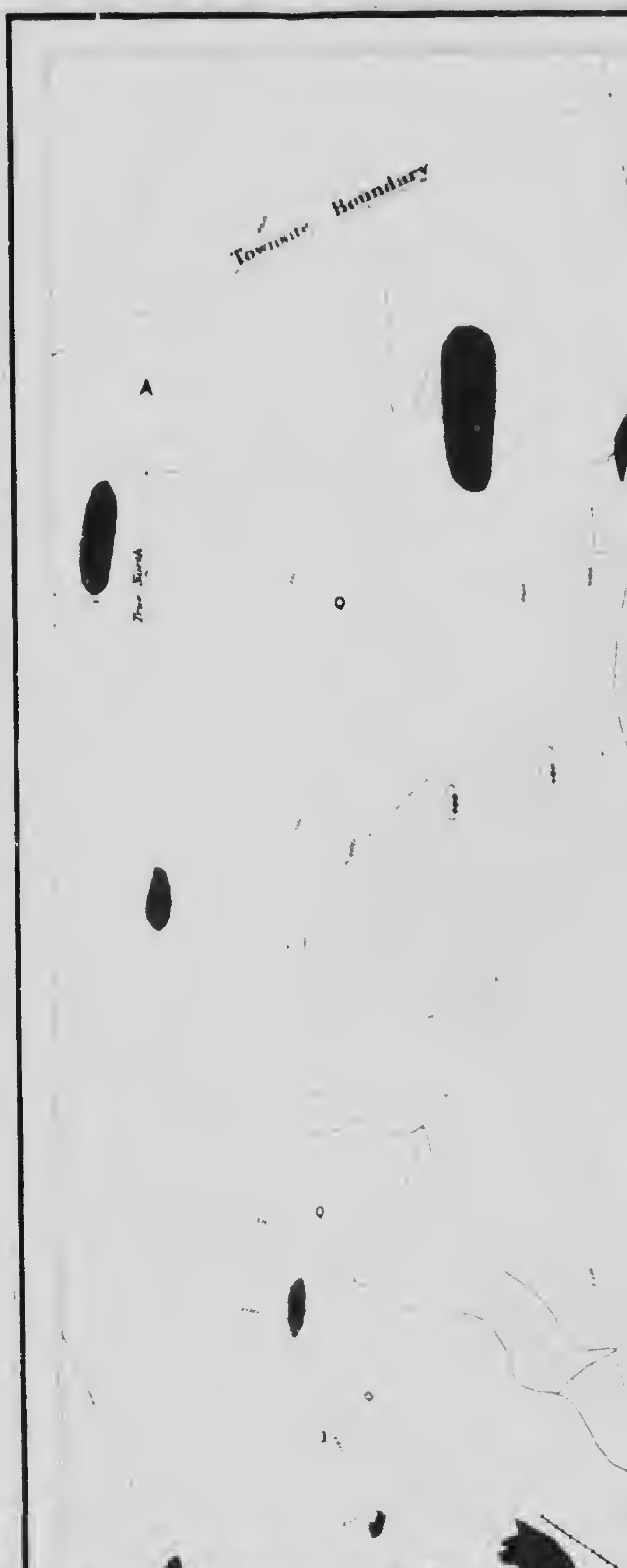
G A YOUNG (IN CHARGE) 1909
W E LAWSON 1909

To accompany Memoir N°18

Dep

HON W TEMPLEM

ECONOMIC GEOLOGY




LEGEND

**Sedimentary rocks**

PALAEOZOIC QUATERNARY

Drift

ORDOVICIAN

Tetagouche slates

**Igneous rocks**

POST ORDOVICIAN

Diabase
*massive and schistose*

2
Quartz Porphyry
*massive and schistose*

1
Quartz free Porphyry
*massive and schistose*

Iron Ore Outcrop

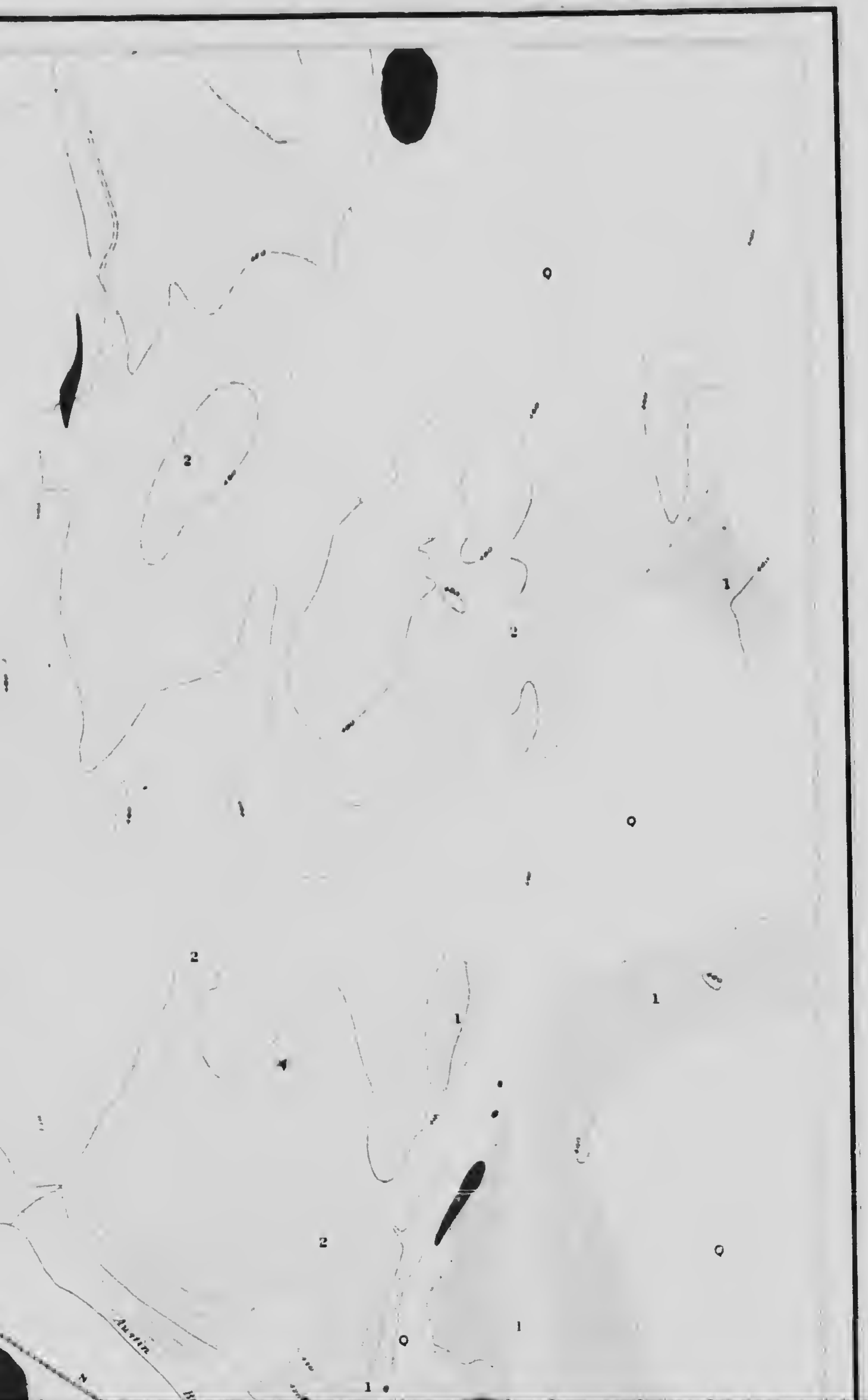
Symbols

# Canada
## Department of Mines
### GEOLOGICAL SURVEY

TEMPLEMAN MINISTER, A.P. LOW DEPUTY MINISTER
R.W. BROCK DIRECTOR

1911

NEW BRUNSWICK




**LEGEND**

**Culture**

Roads and buildings

Roads not well defined

Railways

Bridges

**Water**

Rivers and Streams

**Relief**

Contours
*(showing land forms and elevations above sea-level Interval 20 feet)*

Contours not well determined

...massive and schistose

1

Quartz-free Porphyry
*massive and schistose*

Iron Ore Outcrop

**Symbols**

Geological boundary
*accurately located*

Geological boundary
*position assumed*


C O Senecal *Geographer and Chief Draughtsman*
O E Prud'homme, *Draughtsman*


*Scale 35 Miles to 1 Inch*

MA

# NIPISIGUIT I

## GLOUCEST

NEW B

Sca

400 FEE


Rivers and Streams

Relief

Contours

Contours not well determined

Depression contours

1258

MAP 25A

# IT IRON DEPOSIT

## UCESTER COUNTY

## NEW BRUNSWICK

Scale, $\frac{1}{4800}$

Feet 500 1000 1500

Metres 100 200 300

400 FEET TO 1 INCH

**GEOLOGY**

G A YOUNG ECONOMIC, 1909

**TOPOGRAPHY**

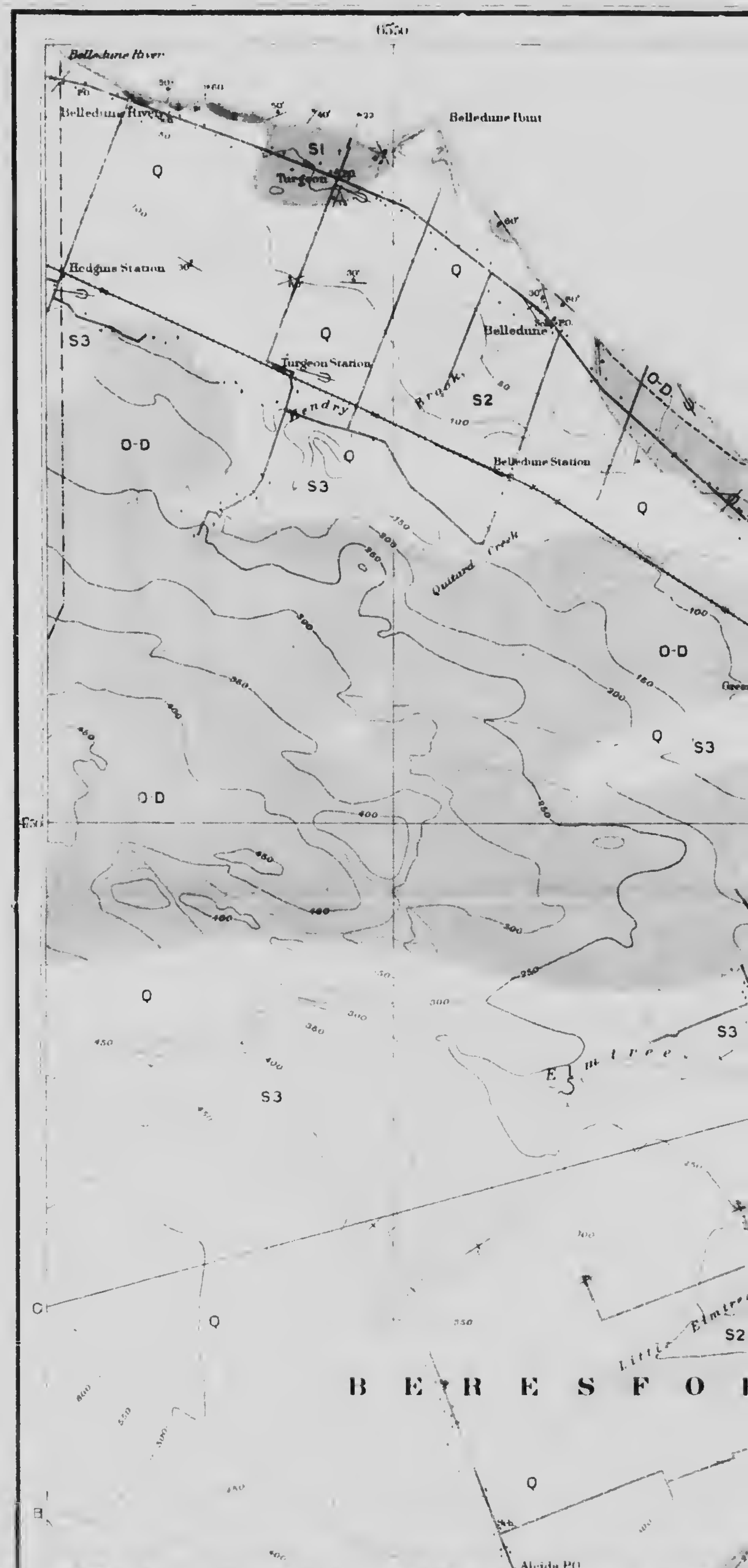
*Relief subject to revision*

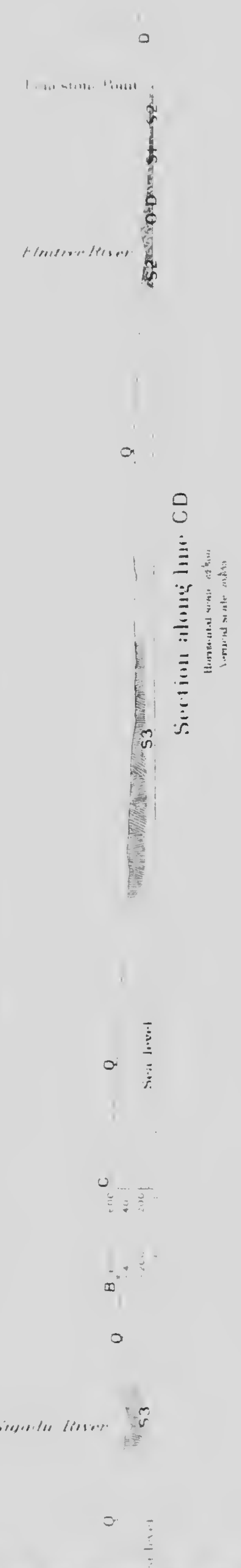
G A YOUNG (IN CHARGE) 1909

W E LAWSON 1909

*To accompany Memoir No. 18*

## AREAL GEOLOGY




LEGEND

| | | | |
|---|---|---|---|
| QUATERNARY | GLACIAL AND RECENT | Q | Drift, stratified sand and clay |
| CARBONIFEROUS | | C | Bathurst formation, red shale, sandstone and fine conglomerate |
| DEVONIAN | | O | Bonaventure formation, red conglomerate, sandstone and shale |
| | | 1 | |

Canada

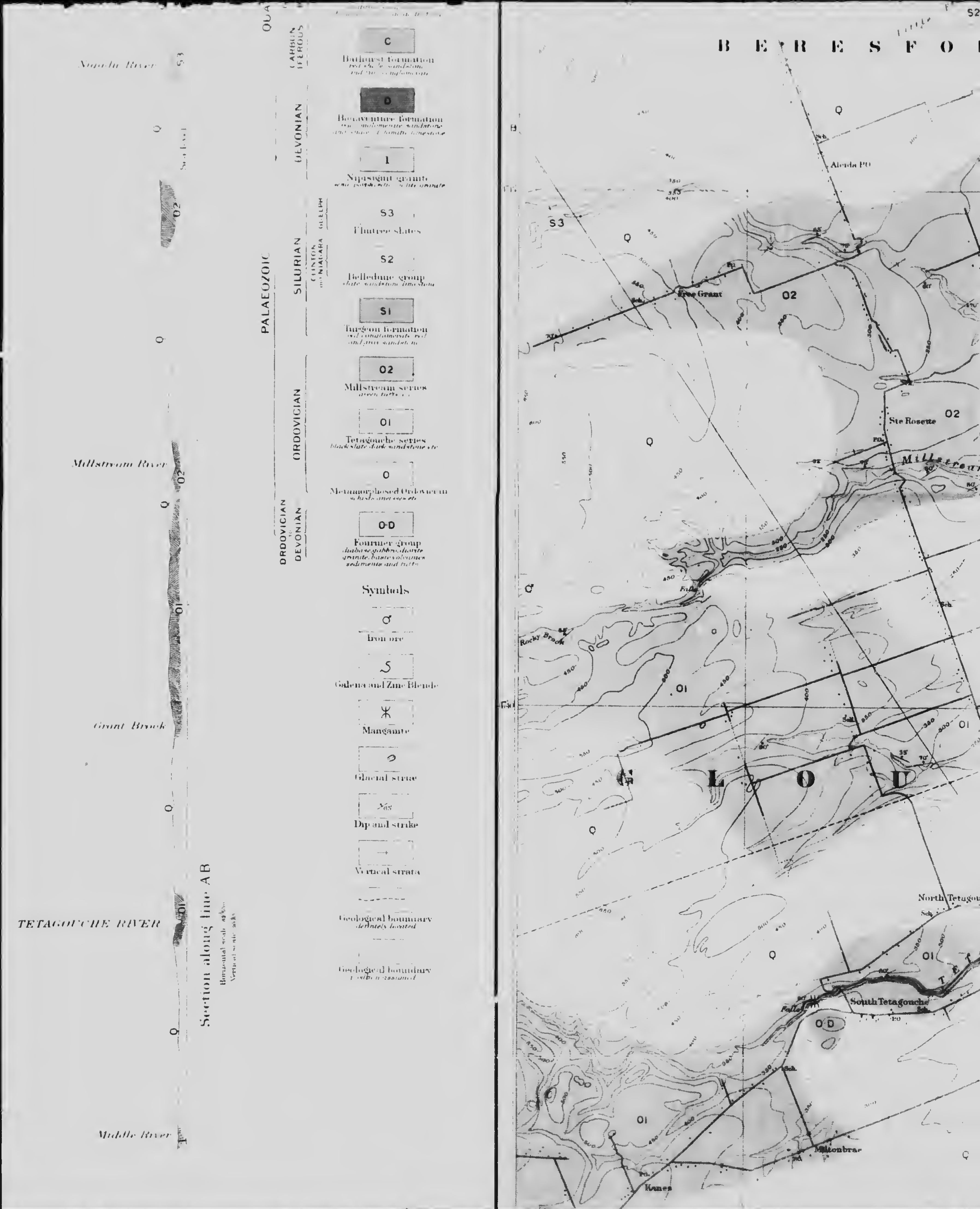
**Department of Mines**

GEOLOGICAL SURVEY

Hon W Templeman Minister A P Low Deputy Minister
R W Brock, Director

1911

NEW BRUNSWICK

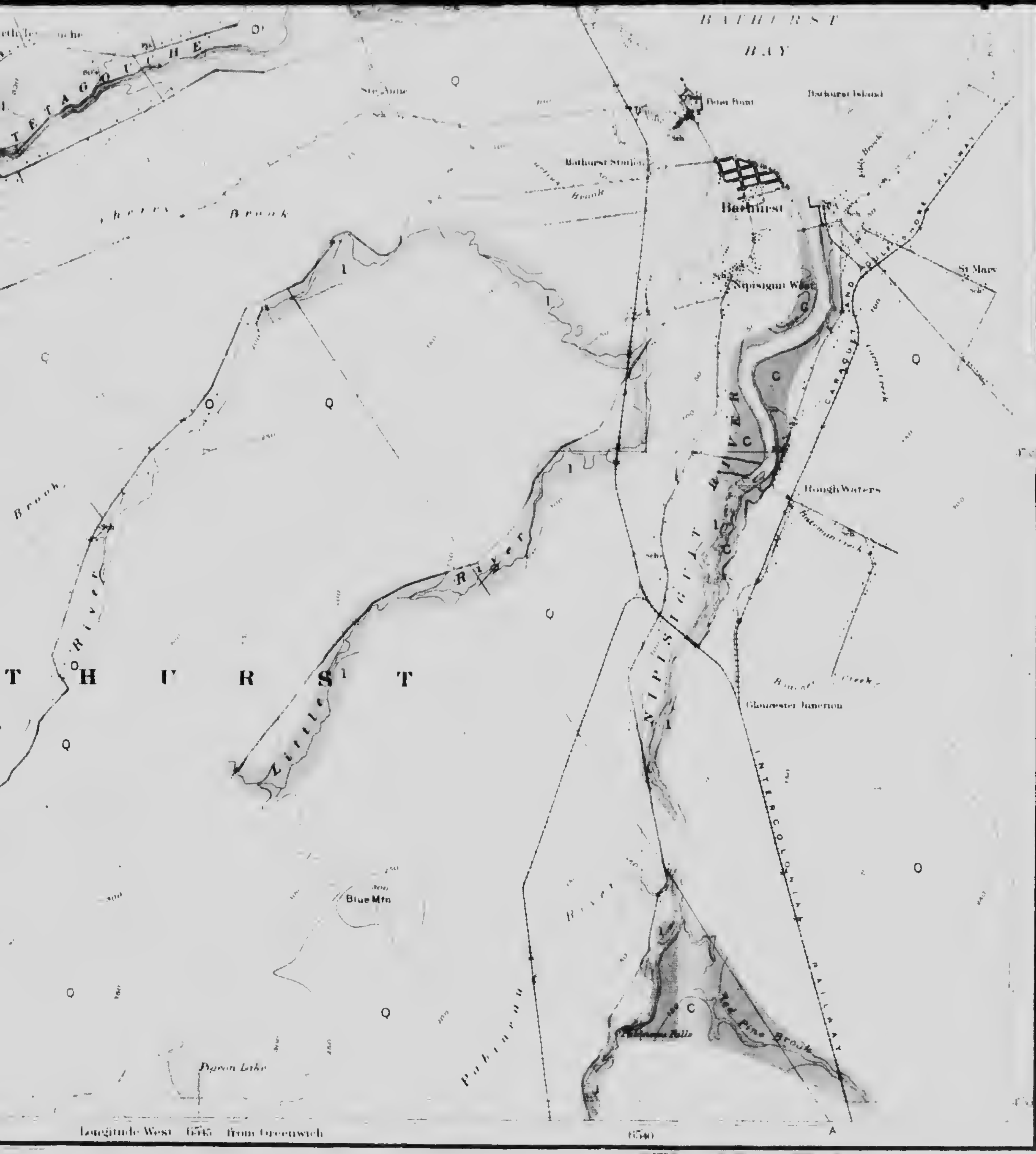

CARBONIFEROUS
C
Bathurst formation
DEVONIAN
D
Bonaventure formation
I
Nipisiguit granite
SILURIAN
S3
Flatrock slates
S2
Belledune group
slate sandstone limestone
S1
Turgeon formation
PALAEOZOIC
ORDOVICIAN
O2
Millstream series
O1
Tetagouche series
black slate dark sandstone etc
O
Metamorphosed Ordovician
ORDOVICIAN TO DEVONIAN
O-D
Fournier group
diabase gabbro diorite granite basic volcanics sediments and tuffs
Symbols
Iron ore
Galena and Zinc Blende
Manganite
Glacial striae
Dip and strike
Vertical strata
Geological boundary
defined located
Geological boundary
position assumed
Section along line AB
Millstream River
Grant Brook
TETAGOUCHE RIVER
Middle River
B E R E S F O
Aleida PO
Free Grant
Ste Rosette
Millstream
Rocky Brook
Falls
G L O U
North Tetagouche
South Tetagouche
Miltonbrae
Kanes


O R D
Laplante
Petit Rocher
Nigadu Station
Nigadu
Nigadu River
NIPISIGUIT BAY
Beresford Station
Beresford
Dunlop P.O.
Robertville
Hackey Creek
Brook
Grant Brook
Peter
E S T E R
Youghall
Alston Point
Caron Point
BATHURST BAY
Peter Point
Bathurst Island
Ste Anne
North Tetagouche
TETAGOUCHE RIVER
Bathurst Station
Bathurst
Nipisiguit West
Cherry Brook
Roads
Railways
Bridge
Culverts
Churches
Cemeteries
Wharves
Lighthouses
Water
Salt marshes
Tidal flats
Relief
Contours
Sand



...Senecal Geographer & Chief Draughtsman
...Fortin Draughtsman


BAT




MAP 27 A

# BATHURST AND VICINITY

## GLOUCESTER COUNTY

NEW BRUNSWICK

Scale $\frac{1}{62500}$

Miles

Kilometres

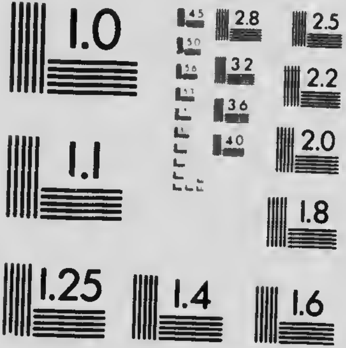
Note For practical purposes assume
1 MILE TO 1 INCH

GEOLOGY

TOPOGRAPHY

# MICROCOPY RESOLUTION TEST CHART

(ANSI and ISO TEST CHART No. 2)




APPLIED IMAGE Inc
1653 East Main Street
Rochester, New York 14609 USA
(716) 482 - 0300 - Phone
(716) 288 - 5989 - Fax

# Canada

## Department of M

GEOLOGICAL SURVE

HON. W TEMPLEMAN, MINISTER. A P LOW
R.W. BROCK, DIRECTOR.

TOPOGRAPHY

1911

nda

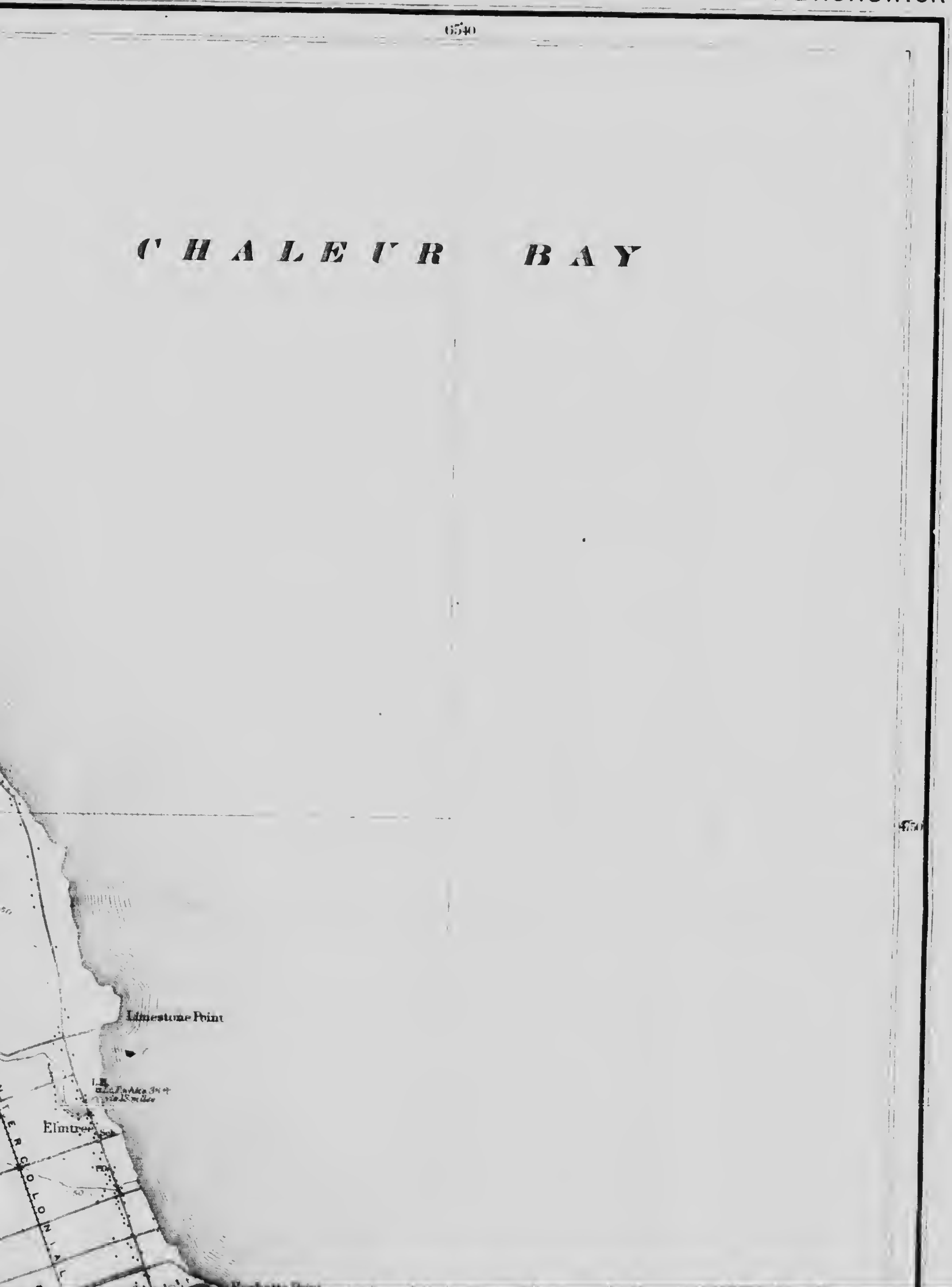
of Mines

SURVEY

A P Low. Deputy Minister:

irector.

NEW BRUNSWICK

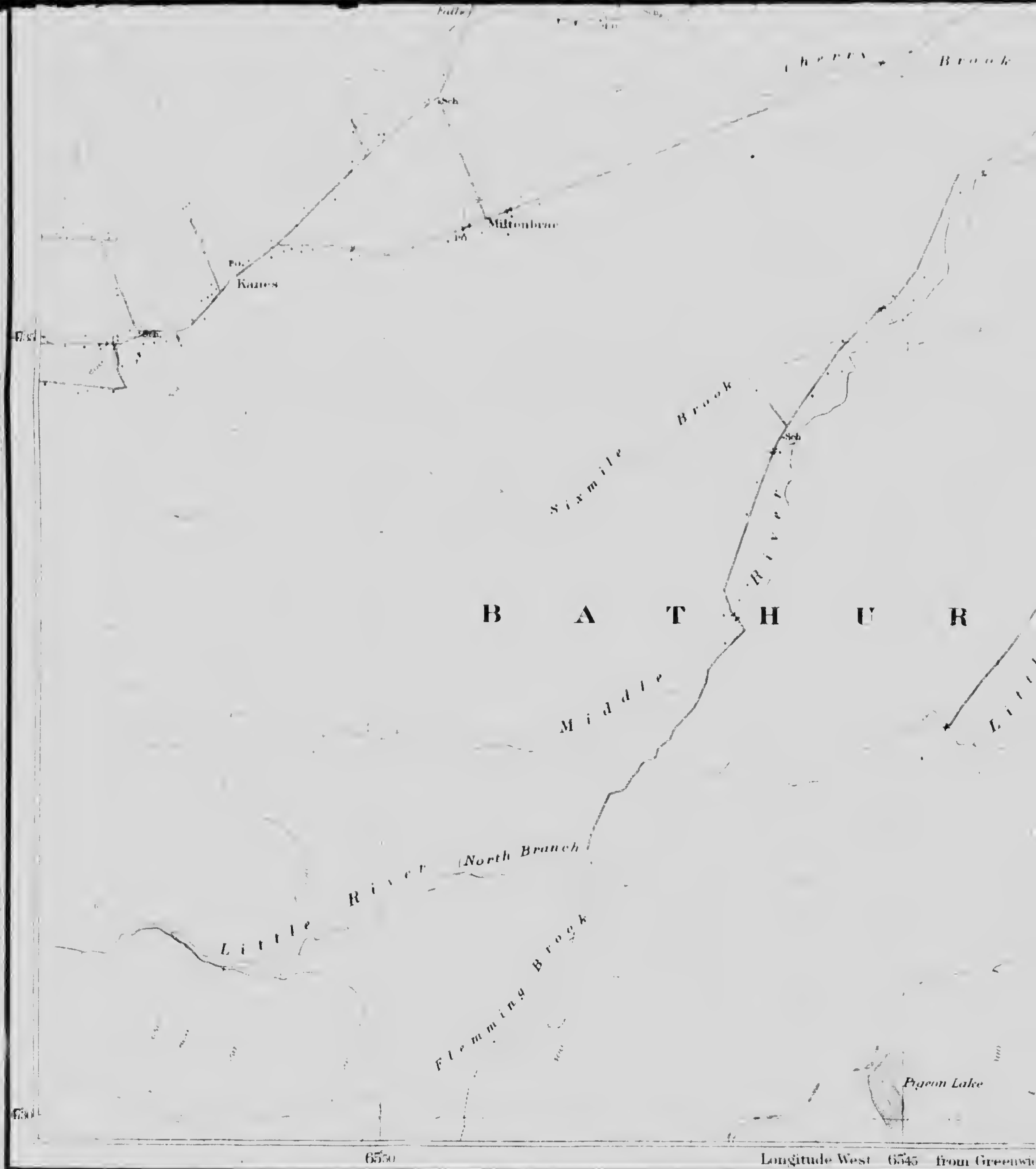



LEGEND

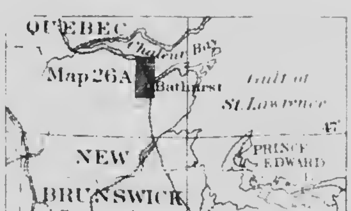
Culture

BERESFORD
Little Elmtree River
Laplante
Petit Rocher Station
Alcida P.O.
Free Grant
Nigadu River
Ste Rosette
Millstream River
Dunlop
Robertville
Falls
Rocky Brook
Grant
GLOUCES
Peter
North Tetagouche
TAGOUCHE

Rochette Point
Rocher Station
Petit Rocher
Nigadu
Nigadu Station
NIPISIGUIT BAY
Beresford
Beresford Station
Dunlop P.O.
Hackey Creek
Brook
Younghall P.O.
Alston Point
Caron Point
S T E R
RIVER
BATHURST BAY
Ste Anne
Bathurst Island
Peter Point
LEGEND
Culture
Streets, roads and buildings
Roads not well defined
Trails
Railways
Bridges
Culverts
Churches
Cemeteries
Wharves
Lighthouses
Parish boundaries
Water
Lakes rivers and streams
Salt marshes
Tidal flats
Relief
Contours not well determined




C.O.Senecal *Geographer & Chief Draughtsman.*
J.O.Fortin *Draughtsman*




*Scale 150 Miles to 1 Inch*

MAP 26 A

# BATHURST AND V

## GLOUCESTER COU

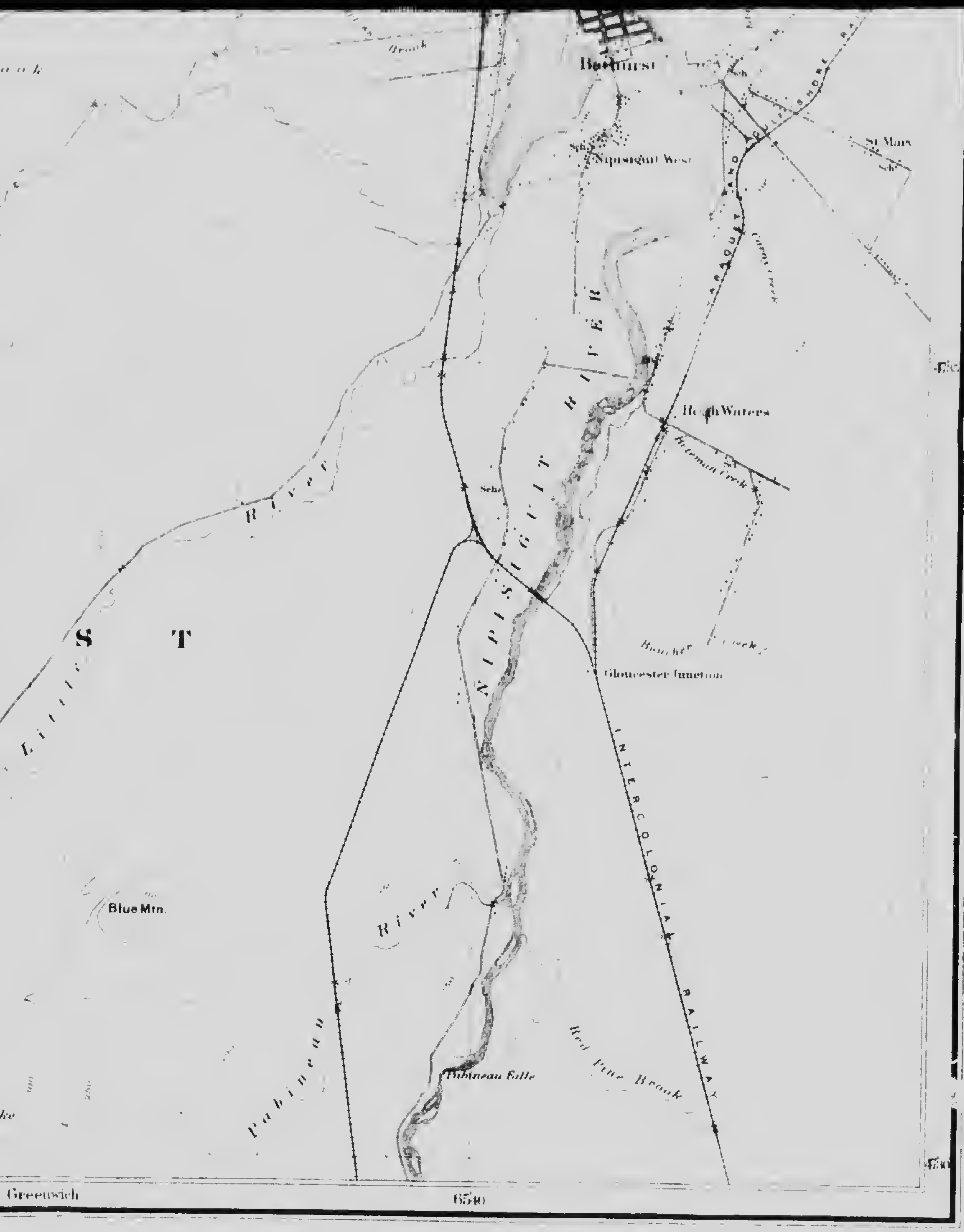
NEW BRUNSWIC

Scale $\frac{1}{62500}$

Miles

Kilometres

Note For practical purpose
1 MILE TO 1 INCH




6 A

ND VICINITY

R COUNTY

NSWICK

1
2,500

urpose assume
1 INCH

TOPOGRAPHY
*Contours provisional*

G.A. YOUNG IN CHARGE 1908, 1909
D.A. NICHOLS 1908
W.E. LAWSON 1909
W.E. LAWSON, D.A. NICHOLS, COMPILERS

*To accompany Memoir No. 18*