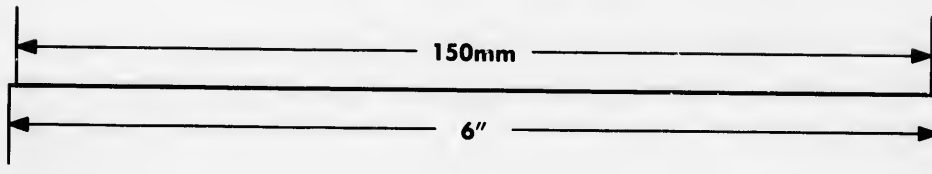
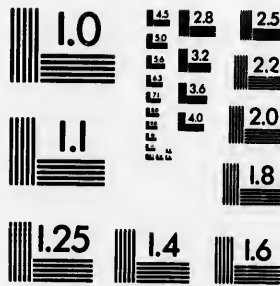
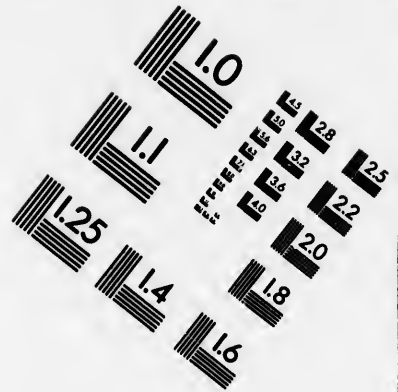
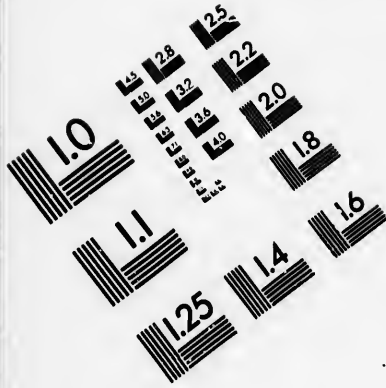


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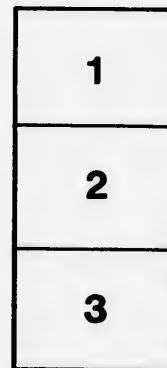
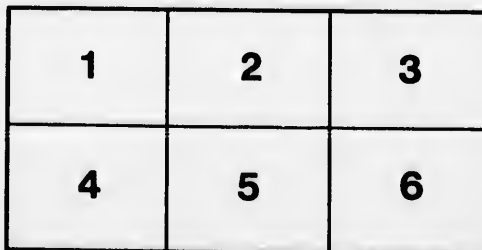
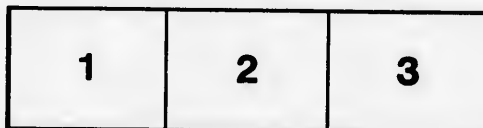
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PART E. ANNUAL REPORT, 1885.

GEOLOGICAL AND NATURAL HISTORY SURVEY OF CANADA.
ALFRED R. C. SELWYN, LL.D., F.R.S., F.G.S., DIRECTOR

REPORT
ON THE
GEOLOGICAL FORMATIONS
OF
EASTERN ALBERT AND WESTMORELAND COUNTIES
NEW BRUNSWICK
AND OF PORTIONS OF
CUMBERLAND AND COLCHESTER COUNTIES,
NOVA SCOTIA
EMBRACING THE
SPRING HILL COAL BASIN AND THE CARBONIFEROUS SYSTEM
NORTH OF THE COBEQUID MOUNTAINS.

BY
R. W. ELLS, M.A.



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Montreal :
DAWSON BROTHERS.
1885.

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ALFRED R. C. SELWYN, LL.D., F.R.S.

Director of the Geological and Natural History Survey.

SIR,—I beg to submit herewith my report on the explorations of the past season in south-eastern New Brunswick and in the counties of Cumberland and Colchester in the adjoining province of Nova Scotia. Included will be found the results of a large portion of the work done in former years by Messrs. Scott Barlow, and the late W. McOuat.

My assistants during the past year were Messrs. N. J. Giroux, C.E., P.L.S., and A. E. Barlow, B.A., and for a short time Mr. R. E. Chambers, B.A., of Truro, N.S.

The quarter-sheet map accompanying this report is No. 4, N.W. of the New Brunswick series and completes the map of the southern portion of that province.

The dips and bearings are given with reference to the true meridian, the variation being from 21° to 22° west.

Various papers on the geology of portions of the area included in this report, since the first report on the Geology and Mineralogy of N. S., 1836, by Dr. A. Gesner, have been contributed from time to time, principally by Sir William Dawson. These papers are published in the *Transactions of the Geological Society of London* and in the *Canadian Naturalist*. Their subject matter also forms part of *Acadian Geology*, 1868, and the supplement 1878. Other papers by Dr. Honeyman, and Mr. Gilpin of Halifax, have appeared in the *Transactions of the Nova Scotia Institute of Natural Science*.

The detailed measurements of the Joggins section made by Sir Wm. Logan will be found in the Report of Progress for 1845, and in the *Acadian Geology*, pages 156 to 178.

I have the honor to be,

Sir,

Your very obedient servant,

R. W. ELLS.

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SYSTEM NORTH OF THE COBEQUID MOUNTAINS.

BY
R. W. ELLS, M.A.

The quarter-sheet necessary to complete the map of Eastern New Brunswick, embraces a considerable portion of the counties of Cumberland and Colchester in the adjoining province of Nova Scotia. A large amount of topographical and geological work had been done in former years, more especially in Cumberland, by Messrs. Scott Barlow and W. McOuat, but the untimely death of the latter and the transference of the former from the field staff to the position of chief draughtsman, ^{work previously done.} prevented the completion of their surveys, and it therefore became necessary, before these could be prepared for publication, to make further explorations in that direction. The present report and map gives therefore, to a large extent, the results of the work done by these gentlemen, in addition to the conclusions arrived at from the observations made during the past season.

To render the map more accurate a number of chained lines were run, principally by Messrs. Giroux and Barlow, in order to connect the work already done with the Intercolonial Railway system extending from Moncton to Truro, and which has been used largely as a base line in its construction.

The area between the Cobequid Mountains and Minas Basin, although not included in the accompanying quarter-sheet map, has been

examined as far east as Truro. This was necessary to complete our sections and to establish our connections between the surveys on the north side of the mountain range and the coast of the Bay of Fundy.

In New Brunswick a large amount of work had also been done in former years in the area included in the accompanying map. As the results of a part of this work have already appeared in the Report of Progress for 1876-77 and 1877-78, the examinations of the past season were confined principally to the country east of the Petitcodiac River, including the copper deposits of Cape Maringouin and Dorchester and the reported coal area north-east of Sackville.

The latter part of the season was devoted to explorations in the vicinity of the Spring Hill Mines, for the purpose of determining the extension of the thick coal seams of that area to the north and west, the results of which will be given further on.

In addition to the explorations in New Brunswick and Nova Scotia, a micrometer survey was made of the Casupscull River, which flows into the Matapedia from the east at thirty-five miles above its forks with the Restigouche. This was done for the purpose of determining the western extension of the inland Devonian basin described in last report (1882-84) as existing in the interior of the Gaspé peninsula. The survey has been plotted and appears on the map of that locality (quarter sheet No. 3 N. W.) accompanying the report first referred to.

The geological systems and formations described in the present report are:—

- Triassic, H.
- Carboniferous.
 - Upper, G 4.
 - Middle, G. 3 and 2.
 - Lower, G 1.
- Devonian, F.
- Silurian, E.
- Pre-Cambrian, A. B., or Cobequid series.
- Post Tertiary, M.
- Igneous rocks.

TRIASSIC, H.

Areas of Triassic rocks are found at intervals along the shores of Minas Basin. They extend for the most part but a short distance inland and have their greatest development in the vicinity of Truro and for ten to fifteen miles west. East of that town they occupy the valley of

Survey of
Casupscull
River.

the Salmon River for about six miles and extend northward to the second bridge over the North River, about four miles in a direct line from Truro. Thence they occupy the country westward along the line of the Intercolonial railway and for a short distance north, to the vicinity of the Folly River viaduct., where the contact with the underlying Carboniferous formation is seen about 500 yards above the railroad. From this point the area becomes narrower, the northern boundary gradually approaching the shore of the Basin of Minas, which it reaches at Five Islands. The continuity along the coast is broken in the vicinity of Economy by areas of Lower Carboniferous sediments. Below this, towards Cape Chignecto, the Triassic formation occurs only in irregular patches upon the older rocks. The sediments are generally soft and consist of reddish sandstones, shales and fine conglomerates, the latter being found generally near the base. Traces of plant stems were noticed on the shore at Gerrish Mountain. These were too imperfect for determination, but from the character of the rock and the presence of fossils, it is possible that areas of Permo-Carboniferous may occur at this point. The strata are penetrated by trap dykes, often of large size, which, passing upward through the formation, have spread out in sheets and overflows, often of great extent. This is well seen on the shore at Indian Point above Five Island Village, where it constitutes the high ridge of the mountain just mentioned, as well as on the south side of the Bay of Fundy, where it forms the long range of the North Mountains. The contact of the two is also well seen at Cape Blomidon, where the trap rests directly upon the sedimentary beds. At such places the igneous rocks do not appear to have exerted any considerable influence upon the strata in contact, the metamorphism extending in no case, where observed, beyond a few feet.

Character of
Triassic rock
of Minas Basin.

UPPER CARBONIFEROUS, G. 4.

In the southeastern part of New Brunswick, the Carboniferous system is represented by the three formations, the Upper, Middle and Lower. The Middle, however, in so far as known, being confined to the Millstone-grit portion. These three are well exposed on the shore of the Maringouin Peninsula, which extends southwesterly from Sackville between the waters of Chignecto and Shepody Bays. The strata of the Upper Carboniferous, as developed in this locality, consist generally of soft reddish or purple brown sandstone, grits and shales, which rest unconformably upon the Millstone-grit, or Lower Carboniferous at various points. They occupy the central portion of the Maringouin Peninsula, from the vicinity of Green's Creek to the creek north of Wood Point on the east side, and from Hard Ledge to the lower end of the red

Areas of
Upper Carbon-
iferous in
Eastern New
Brunswick.

bluff known as Dorchester Cape, opposite Hopewell. West of Sackville, they occupy the depression through which the Intercolonial Railway passes towards Dorchester, bounded on the south by the Millstone-grit ridge of Westcock, which separates this area from that just described. The northern limit is defined by the Millstone-grit ridge that extends from Dorchester through Fairfield to the rear of Upper Sackville.

East of Sackville this area is divided by the Aulac ridge, which extends north-easterly from the head of Cumberland Basin to Hall's Hill, with a breadth of about one mile to one mile and a half. Thence, sweeping round the northern extremity of this ridge, the formation extends across the boundary into the neighbouring province of Nova Scotia, where its distribution will be presently described.

About the shores of Bay Verte and on the Tormentine peninsula these rocks have a considerable development. They occupy the greater part of the country to the north-east of Sackville and east of the Aboushagan River, whence they spread out in a thin sheet to Cape Tormentine. They here rest upon the Millstone-grit, the presence of which is indicated by a low ridge of grey sandstone and by numerous blocks of grey grit at intervals along the line of the Emigrant road. Ledges of this underlying formation are well exposed near Bayfield Corner.

On the western side of the Maringouin peninsula these rocks have an estimated thickness of 1250 feet. Their most southerly outcrop on the beach is about fifty paces east of Hard Ledge wharf, where soft, brownish-red or purple sandstones rest unconformably upon purple and grey Millstone-grit sandstone and shale, abounding with remains of plants and tree stems, the bark of the latter being frequently changed to coal. At this place they form a shallow synclinal with a breadth of 210 paces and contain a band of blackish limestone six inches thick.

A space of 225 paces then occurs occupied by grey and purple beds, of Millstone-grit age, having a southerly dip at an angle of 35° to 40° , to the axis of an anticlinal and probable fault. The dip then suddenly changes to N. 25° E. $< 10^{\circ}$, marking the southern boundary of the principal Upper Carboniferous basin. Thence exposures of these rocks extend up to the mouth of Johnston's Creek, consisting for the most part of brownish-red, and sometimes grey sandstone and shales, some of the coarser beds being a conglomerate from the presence of small pebbles of white quartz. Throughout this distance the dip ranges from 10° to 5° . The western edge of a shallow synclinal is apparent as we approach the Creek, the strata gradually curving round from N. E. $< 10^{\circ}$ to S. 80° E. $< 5^{\circ}$ and at the mouth to S. E. $< 5^{\circ}$. Thence, for a further space of a mile north, the shores are low and ledges are not seen, but from the character of the soil and drift the underlying rocks are probably of this age.

Thickness in
Maringouin
Peninsula.

At this distance low cliffs of red marly shales of the Lower Carboniferous occur on the shore and are exposed for thirty-five chains. Above this for a further distance of ninety chains no ledges are visible, but from the debris on the road and the general aspect of the country it is probable that Upper Carboniferous beds again come in and extend across the peninsula to Wood Point, on the eastern shore, where they are terminated to the north by the unconformable grey beds of the Westcock ridge. The line of contact is here also probably marked by a fault.

Distribution
about Sackville

The soil over a considerable portion of this area consists of white sand, and the surface is largely a wet barren. Numerous pieces of sandstone or quartz-grit, of a pinkish-grey colour, are seen, which are probably derived from the upper beds of the formation as here developed.

In the vicinity of Sackville, Upper Carboniferous strata are well exposed at several points. They are well seen in the quarry five-eighths of a mile in rear of that town, on the road leading to Dorchester. The rocks here are principally soft, brownish-red sandstone, containing, in some bands, much white mica. Interstratified beds of conglomerate occur, the pebbles being often of reddish shale, though some layers have pebbles of white quartz. Plant stems of large size are seen and in places much false bedding. The strata at the quarry dip generally S. 32° E. < 15°-20°. They resemble very strongly the sandstones and associated beds of Capes Bald and Tormentine and of Prince Edward Island.

Further west the Dorchester road passes over several ridges of moderate elevation, the rock being the usual soft micaceous sandstones and shales, underlaid by harder greyish-white sandstones, which have sometimes a pinkish tinge and are quartzose. These form a white sandy and gritty soil like that of the area on the Maringouin peninsula. They dip southerly S. 30° E. < 25°-30°, and at a distance of three miles and a half from Sackville, rest upon the yellowish-grey sandstones and coarse beds of the Millstone-grit which form the extension of the ridge northeast from Dorchester. On the road leading from Four Corners to Memramcook, and about two miles from the former place, the contact of the two formations is again seen, whence it extends through the western part of Cookville Settlement and gradually sweeps round to the northward, reaching the Gulf shore near Cape Bald. In the flat country or marsh lying between the town of Sackville and the Aulac ridge, no outcrops are visible, but near its upper end at Midgic, and about twenty rods east of the road at the post-office, there are ledges of impure limestone or a calcareous conglomerate of a brownish-red colour, apparently underlying greyish sandstones tinged with red. These are well exposed in a small quarry at this place. Half a mile east, at a saw-mill on a small brook, soft reddish and grey shales and sandstones dip S. 65° E. < 2°-5°, with much false bedding. The same kind of rock is

seen in the cellar of the Midgie P.O., with a dip of S. 40° E. < 20°. All these beds undoubtedly belong to the Upper Carboniferous. Thence on the road to Bristol, at the crossing of the Bill Harper Brook, soft, dark-red sandstones with white mica dip S. 40° E. < 10°. They contain plant stems and resemble the beds near Sackville. From this point to Bristol, exposures are very rare, but at Anderson's Mill Brook large pieces and possibly ledges of soft brown sandstone occur about forty rods below the road, and a pit sunk through the clay at the mill discloses the same soft rock about four feet from the surface.

Tormentine
Peninsula.

On the Coburg road, which is a new road turning off south-east about half-way between Midgie and Bristol, at about one mile and a quarter east of the main road, a small seam of coal was found on the bank of a brook, the west branch of the Gaspereau River, which flows into the head of Bay Verte at Port Elgin. This seam was reported to have a thickness of eighteen inches of coal. On testing it, however, the whole of which from three to four inches were dirty coal. The associated rocks are greyish sandy shales, and the seam is underlaid by grey clay. It probably belongs to the underlying Millstone-grit formation, and is the extension of a seam found on the Aboushagan River, and to the east of Shediac. Blocks of grey sandstone, but no ledges, were seen on the road to Bristol in the vicinity of Square Lake. The Upper Carboniferous is probably very thin at this place.

Along the shore below Bristol, at Little Shemogue, soft brownish-red sandstones like those of Capes Bald and Tormentine occur, the undoubtedly representatives of the Upper or Permo-Carboniferous, which thence extend eastward to the extremity of the peninsula.

The greater portion of this peninsula, between Northumberland Strait and Bay Verte, extending from Port Elgin to the extremity, is generally low and level, the highest elevation being Mount Pleasant, which is probably not much more than 150 feet above the sea. Over this area, exposures are almost entirely wanting, and the nature of the underlying rocks can only be determined by the character of the soil. Three miles east of Port Elgin, on the Emigrant road, an opening for a quarry discloses the presence of soft reddish-brown sandstone, dipping S. 30° W. < 3°. Eastward of this, along the road for a further distance of seven miles, the surface is strewn in places with blocks of grey sandstone, which probably mark the presence of an underlying ridge of Millstone-grit, but beyond this point the soil again resembles that of the Upper Carboniferous, and near Mr. Buskirk's house, at Bayfield Corner, the reddish beds rest upon the underlying Millstone-grit sandstone and conglomerate. Two miles south of this, soft dark red sandstones dip easterly < 7°-10°, marking the southern side of the Tormentine anticlinal.

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UPPER CARBONIFEROUS.

The road along the north side of Bay Verte shows the soft red strata of the Upper Carboniferous on the shore, at intervals, to within about five miles of Port Elgin. The soil then becomes greyer, and blocks of grey sandstones, probably of Millstone-grit age, extend thence to the head of the Bay. In the vicinity of Port Elgin also, and for two miles and a half on the road to Bristol, the soil and loose pieces are grey, beyond which reddish tints prevail and extend thence to the Strait shore.

On the roads extending north from the Emigrant road to Mount Pleasant and Murray's Corner, a narrow belt of greyish soil, covered with greyish blocks, occurs with a breadth of about half a mile. This probably marks the direction of the Tormentine anticlinal, but the lack of exposures renders accurate delineations impossible.

Between Port Elgin and Tidnish River the country is occupied by the soft reddish rocks of Upper Carboniferous age, easily recognized by the scattered blocks and the character of the soil. This is the northern portion of the great area which extends continuously from beyond Sackville.

Passing the Aulac ridge, which is a prominent feature in the otherwise flat country between Sackville and Amherst, we reach the basin of the Missequash and Laplanche Rivers, the former of which marks the boundary between the two provinces. These are probably occupied by Upper Carboniferous rocks. They appear at Amherst in the vicinity of Christie's factory on the Intercolonial Railway, the strata being soft brownish-red sandstone, with pieces of red shale, identical in character with those of Sackville, and dipping N. 10° E. < 8°. This indicates the southern side of the Amherst synclinal. Further east on the road to Leicester, soft brown micaceous sandstones and shales are seen on the Nappan River above Curran's mill. They can thence be traced along the road by the soil and debris for a further distance of one mile and five-eighths, where they rest unconformably upon limestones and shales of Lower Carboniferous age, the Middle Carboniferous being, in so far as can be ascertained, absent in this direction.

Amherst and vicinity.

North-east from Amherst, on the Tyndal road, which extends to the Strait shore at Tidnish, similar soft strata are exposed near the point where the post-road to Pugwash turns off easterly, and dip northerly at a low angle. Brownish-red sandstones are also seen at a brook about one mile further north, but the dip could not be determined. Between this and the shore of Bay Verte the country is but little above the level of the sea, the soil is reddish and sandy, with frequent barrens and without exposures. The shore of Northumberland Strait, from Tidnish River to Pugwash Harbor, and the country for some dis-

Area north-east of Amherst.

tance inland, is occupied generally by soft brownish micaceous sandstones and shales which belong to the Upper Carboniferous formation. They dip northerly where examined, at low angles, but exposures inland are exceedingly rare, the softness of the strata causing them to disintegrate very readily. The southern boundary of this area, from the contact with the Lower Carboniferous noted on the road south-east of Amherst, extends in a general easterly direction, crossing the Leicester road about six miles from the forks with the old Economy road, whence it keeps a short distance to the south of that road and crosses the Pugwash River about half a mile above the village of Pugwash, where contacts with the underlying limestones and associated strata of Lower Carboniferous age are seen.

Pugwash to
Wallace River.

On the west side of Pugwash Harbor, according to the late Mr. McQuat, ledges of rather coarse dark grey or brownish-grey sandstone, with scattered grains of reddish felspar, occur. Other associated beds of greenish-grey calcareous grit dip N. 20° W. < 38°, but change a little further west to < 25°. Thin limestones and limestone conglomerates occur about one mile from the end of the ferry opposite Pugwash, along with massive brownish-grey freestone. The most westerly exposures on this part of the shore are reddish shales with grey coarse sandstone, containing grains of reddish felspar and small pebbles of vitreous quartz, dipping N. 20° W. < E. 26°.

Between Pugwash and Wallace Harbor, dull brownish-red sandstones, with brick-red shales, the whole, with a few exceptions, micaceous and laminated, occur. About two miles east of the former place these dip N. 5° W. < 23°, changing three miles further east to N. < 26°. A small seam of coal is reported from this latter point, but is unimportant. These rocks occupy the coast to the extremity of the point, and apparently the area north of the Wallace Harbor.

Wallace River.

On the Wallace River, on which a section was made from the foot of the Cobequid Mountains to near its mouth, the rocks of this formation are well exposed. Lower Carboniferous conglomerates and sandstones are seen in the river and on either side at intervals for two miles and three quarters below the road to Wentworth station. Resting upon these are soft brownish-red sandstones and shales, dip N. 5° W. < 10°, which are identical in character and aspect with the beds of the north shore. These are exposed for nearly five miles, the beds gradually declining in dip to the centre of the synclinal, about two miles below their first exposure. The thickness of the measures here seen, assuming an average inclination of 7°, would be about 1,200 feet. Below this point the strata dip southerly at low angles. All they rest unconformably upon hard sandstones, shales and conglomerates of Lower Carboniferous age, which dip S. 40° E. < 40°. These lower beds have a breadth

of about three miles, extending for thirty-five chains below Kerr's mill, where the soft brownish beds of the formation under discussion again come in, dip N. 45° W. $< 25^{\circ}$, the dip of the Lower Carboniferous at the contact being N. 20° W. $< 70^{\circ}$. Thence the dip of the upper beds rapidly declines to 10° , and they apparently extend to the shore of Northumberland Strait. In this section also, no trace of the Middle Carboniferous is visible, the Upper resting in every case directly upon the Lower.

West of the Wallace River, exposures are very rare. The character of the soil, however, indicates that the basin just described extends in this direction between the Intercolonial Railway and the Victoria Settlement beyond the road from Thompson station to Pugwash.

The Port Philip and Pugwash Rivers do not afford good sections, intervals of marsh being frequent; but further east, on the French River, the measures just described are well exposed. The character of the country between the latter stream and the Wallace River indicates that the Upper Carboniferous basin is continuous in this direction. A paced section was made of the French River, from the New Annan road to the vicinity of Tatamagouche Harbor.

The rocks at the bridge on the New Annan road are green schists French River. and slates, which extend below the road for 200 yards. Red brownish hard sandstone and red conglomerates of Lower Carboniferous aspect then occur and form a narrow band for 100 yards, and are succeeded by grey freestone and grit, with abundance of plant stems, which dip N. $< 25^{\circ}$. These strongly resemble beds of Millstone-grit age, but may mark the lower beds of the Upper Carboniferous, as they conform closely in dip to the overlying strata of soft brown-red sandstones and shales of the latter formation, and which come in a short distance below. The dip of these latter is N. 5° W. $< 25^{\circ}$. Interstratified beds of fine conglomerate occur with the sandstones, but their bulk is small. The brownish-red sandstones, grits and shales, with occasional grey beds, thence extend down to the shore of Tatamagouche Harbor. The dips are all low, ranging from 20° in the upper part to 5° in the lower, or to perfect horizontality. Copper deposits occur at several points in the form of nodules of grey copper ore or copper glance, associated with plant beds, and have been opened at two places, the upper of which is three quarters of a mile below the New Annan road; the lower, one-fourth of a mile below the road at Porteous' mill. The deposit, however, is probably too limited and uncertain to possess much economic value, and operations have been suspended for some years. The exposed breadth of these rocks on this stream is about five miles Thickness of formation. and a half, the dip is generally north, the strike being at right angles to the course of the stream. Assuming the average dip of the measures as 7° , the thickness of the formation here would be about 3,000 feet.

Our surveys in this direction were bounded by the road from Talamagouche to Truro. On this road, north of the mountain, the soil and debris are similar to those of the areas first described, showing the further extension of this formation towards the Waugh River. On this stream, rocks, with deposits of copper ore, similar to those seen on French River, are observed. From the reports of Sir William Dawson it is evident they extend into Pictou county.

Cumberland
county.

A second area of Upper Carboniferous rocks in Cumberland county occupies the country between the Joggins shore and the Spring Hill Mining Company's property. The formation as exposed in the cliffs along the eastern shore of Chignecto Bay has been described in former reports, 1845, by Sir Wm. Logan, by whom the first measured section was made. This was subsequently revised by Sir Wm. Dawson, who re-examined the section in 1852 in company with Sir Chas. Lyell, and who has since devoted much time to the study and working out of the strata there exposed. The result of his measurements and re-examinations are given in the *Acadian Geology*, page 157.

The Upper Carboniferous as there described is divided as follows:—

	FEET.
Division 1. From Shoulie to vicinity of Ragged Reef....	1,617
“ 2. Ragged Reef and vicinity.....	650
“ 3. Vicinity of Ragged Reef to McCairn's Brook.	2,134

The latter division is stated to contain the upper part of the Middle Coal formation, and is, perhaps, equivalent to the Upper Coal formation of the American authors, as it was also so regarded by Sir Wm. Logan.

The rocks of Div. 1, or the upper portion, are thick-bedded white and grey sandstones, passing in some places into a conglomerate with quartz pebbles, and with interstratified beds of reddish and chocolate shales, the sandstones predominating. Fossils are not very numerous, and conifers and calamites are the most abundant.

In Div. 2, the rocks are also white and grey sandstones, with occasional reddish beds and red and grey shales, the sandstones and shales in nearly equal proportions. Under clays occur at two levels. As in division 1, fossils are not numerous.

Division 3 includes 1009 feet of sandstone, almost all of which is grey, and 912 feet of grey and reddish shale and clay. It contains a number of beds of coal, all of small thickness and generally of coarse quality. No seams of economic value have yet been discovered.

The rocks of this formation form a basin of considerable size, whose southern border extends eastward probably from the vicinity of Sand River on the shore to within three miles of the Spring Hill mines. Thence it sweeps suddenly to the north-east and crosses the line of the Intercolonial railway a short distance west of Spring Hill junction.

It then curves again to the eastward and extends up the valley of the Little Forks River to a point about half a mile east of the old Economy road leading to Amherst.

This basin is apparently underlain on the north by rocks of the productive coal measures, and on the south by those of Millstone-grit age. From McCairn's Brook on the Joggins shore the northern boundary extends eastward in a nearly direct line, crossing the Intercolonial Railway about one mile south of the Maccan station, whence it extends north-easterly up the north side of Little Forks River to the point already indicated. The southern boundary on the coast is not yet definitely fixed, but is probably, as stated, not far from the mouth of Sand River. Between this and Spring Hill it is difficult to trace, owing to the great covering of drift, but as nearly as can be ascertained it crosses the Maccan River not far from Harrison's inn, or about two miles and a half north of Southampton Corner. The breadth of the basin at this place is about five miles.

Extension of the Joggins area.

Owing to the soft nature of much of the rocks of this formation, ledges are rarely met with. The surface is generally a reddish-brown, sandy loam, except where the grey sandstones of the Ragged Reef band occur, the decomposition of which produces a grey, quartzose, sandy soil, differing in character somewhat from that derived from the Millstone-grit, the beds on the whole being harder and more siliceous.

What are apparently the lower members are seen in the cuttings on the railway near the crossing of the Little Forks River, and on several of the roads in that vicinity. They consist of soft brownish-grey sandstones and shales, with layers of fine-grained flaggy grey sandstone, and resemble closely the rocks of the northern area already described. Similar strata with a greater thickness of grey beds occur along the Little Forks River. The relations of the productive and upper formations to the Millstone-grit suggest the presence of a fault along the upper part of this stream, the extent of which cannot be satisfactorily determined.

On the Maccan River and westward along the River Hébert, grey sandstones of the Ragged Reef band are well exposed, indicating the upper part of the formation, and occupy the centre of the synclinal.

Centre of basin.

The inclination of the strata is generally low or from horizontality to ten degrees. The centre of the basin is probably in the vicinity of Reed's Brook, one mile and a half south of the junction of the Little Forks with the Maccan River.

Along the southern side of the basin, the Upper Carboniferous rests upon the Millstone-grit at all observed points, no trace of the productive measures being visible. This may be due to simple overlapping or to the presence of faults, probably to some extent the latter; since

Contact with Millstone-grit.

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extensive indications of faulting are seen in the Spring Hill area and along the several streams flowing westward from that locality. These will, however, be described further on.

MIDDLE CARBONIFEROUS—*Productive Measures, Millstone-Grit.*

Following the plan pursued in describing the preceding or Upper Carboniferous formation, we will first state the extent and distribution of the Middle Carboniferous in the portion of New Brunswick embraced in the map, and then take up in detail the structure, in so far as it can be ascertained at present, of the Spring Hill basin and adjoining areas.

In New Brunswick, the result of the examination of the last few years has been to confirm the statement made in former reports, that the Middle Carboniferous was probably confined to the lower member, and that if the productive measures were at all present, their distribution was exceedingly limited. That such is the case in the portion of the map accompanying this report is very evident.

Character of
beds in New
Brunswick.

The rocks of the Millstone-grit differ greatly in their general aspect from those of the productive measures. Lithologically they present greater resemblance to those of the Upper Carboniferous. Throughout the measures, the grey grits, which are often hard and fine-grained, contain beds of chocolate or purple colored slate and sandstone, and in their lower portions, beds of greyish conglomerate, largely made up of white quartz pebbles, and of considerable thickness. The purple beds differ from those of the Upper Carboniferous just described in their greater hardness and coherence and in the general absence of the large scales of yellow and white mica so abundant in the upper formation, as also in their darker shades.

The general distribution of these rocks in central and eastern New Brunswick has already been given in the published reports and map. In general their inclination is slight, but along the coast of Shepody Bay the dip of the beds rises to the vertical, indicating a period of considerable disturbance and probable faults. In eastern Albert and Westmoreland, their distribution is exceedingly irregular, exhibiting well the extensive denudation to which they have been exposed.

Coast from
Shepody River
to Cape Enragé.

Along the southern coast of Albert county the formation extends in a narrow belt from Cape Enragé to the mouth of the Shepody River, with an average breadth inland of half a mile. At New Horton the dip is S. 70° E. < 60°, which course is generally maintained to the extremity of Cape Enragé, the angle of dip increasing midway to 80°-90° with a local anticlinal, the strata for a short distance dipping north-westerly < 85°. The rocks of the greater part of this distance are grey sandstone, grit and fine conglomerate, with occasional beds of

greyish shale. The sandy beds are often beautifully ripple-marked and plant stems and large trunks of trees are common. In places irregular streaks of coal are seen from half an inch to two inches or more in thickness, and have been considered, by some persons, of economic value. In all cases examined the coal is simply the carbonized bark of probably drifted tree trunks. Below Two Islands Cove, thin beds of purple shale and sandstone occur with the grey.

Near the mouth of the Shepody River, the rocks of this formation have a greater superficial development, sweeping inland as far as Harvey Corner. In this area, traces of coal, the carbonized remains of tree stems, are found, and have led to the expenditure of small sums in the vain hope of finding a workable seam. Leaving the mainland, the formation includes Mary's Point and Grindstone Island, at both of which places there are extensive quarries. Crossing the waters of Shepody Bay to Cape Maringouin, its continuation rests upon Lower Carboniferous red marls, a short distance above Flagging Reef Cove, or about half a mile north from the southwest extremity of the cape, the beds at the contact dip S. 10° W. < 40°, the underlying red marls dipping S. 15° E. < 50°. The lower beds of the Millstone-grit here consist of purple sandstone and shales with layers of grey grit, admirably adapted for grindstones, which have been and still are quite extensively quarried.

Maringouin Peninsula.

The formation strikes across the end of the Maringouin Peninsula and appears on the eastern coast on the north side of the North Joggins Cove, which is the indentation to the south of Peck's Point. Thence, crossing the Cumberland Bay, it reaches the coast of Nova Scotia at Boss Cove, where the contact with the Lower Carboniferous is again seen. A second area, north of Cape Enragé, separated from that just described by a belt of Lower Carboniferous rocks, occupies the eastern shore of Salisbury Bay, where it has a surface breadth of three miles and a half, partially concealed, however, along the coast by overlapping Triassic sandstone. It extends north-easterly for six miles to the eastern extremity of the New Horton Lakes, and is probably a thin irregular capping on the underlying Lower Carboniferous. But a third and more extended area occurs further north, flanking the south side of the Caledonia Mountain range, and stretching from the vicinity of Herring Cove below the Upper Salmon River, with few interruptions, due probably to unequal denudation and possibly local faults, across the central and southern portions of Albert county and eastern Westmoreland to the Strait of Northumberland. The outline of this belt is very irregular from the generally horizontal position of the strata and the extensive denudation.

Second area in Southern Albert Co.

Third area.

West of Hopewell Corner, one-eighth of a mile below the road lead-

ing to New Ireland, hard grey sandstones, much broken, contain a small deposit of manganese, long since worked out. On the New Ireland road, the sandstones are associated with conglomerate, and dip S. 65° E. < 20°. These rest upon the crystalline rocks of the mountain about one-eighth of a mile south of Crank Hill Brook. Near the Germantown road they are much broken and indications of a fault are plainly seen.

Fault at contact
of Millstone-
grit and Lower
Carboniferous.

Further west, where the second road turns north from the Germantown road at the lower end of the lake, the Millstone-grit and Lower Carboniferous are in contact, both formations dipping southerly, with the Millstone-grit underlying, plainly indicating a fault and an upthrow of the Lower Carboniferous. The rocks of the lower formation thence occupy the road westward to the rear of the Owl's Head Mountain, where they again shew in ledges and extend thence to Salmon River, five miles distant.

East of Hopewell Corner, on the road from Riverside to Caledonia Mountain, ledges of Millstone-grit sandstone are seen at intervals as far as the road leading across to Chester, the dips, where noted, being S. 65° E. < 5°-30°, and the exposed breadth three-fourths of a mile. On the Chester Settlement road, one mile and three-eighths east, they appear in a narrow outcrop near the upper end of the settlement, which marks the eastern termination of the Millstone-grit in this direction. It is probable that the formation, as here developed, occupies the centre of a shallow synclinal in the Lower Carboniferous, as this structure is apparent in the lower formation on Sawmill Creek in rear of Hopewell Hill.

East of Hopewell Hill, on a road which runs north-easterly through Woodworth Settlement, the continuation of this belt is again seen. Blocks and ledges of Millstone-grit sandstone occur one mile distant from the forks of the road leading to Curryville, and thence occupy the road, which runs for the greater part through woods, nearly to the cross road leading out to Demoiselle Creek. On the road from Hopewell Hill to Curryville, they are first exposed on the summit of the ridge in rear of Shepody Mountain, and extend thence to the Creek road, sweeping round the northern and eastern flanks of the mountain, and down the valley to the mouth of the stream. The beds are nearly flat, dipping S. 30° E. < 5°-10°. The celebrated Curryville quarries occur in this belt. East of this, between the Demoiselle Creek and Petitcodiac River, this formation occupies the greater part of the country, forming a ridge of considerable elevation, and extending northward uninterruptedly to the road leading from Lower Hillsborough to the Albert Mines. North of this, in the vicinity of the gypsum quarries, it occupies irregular areas capping the Lower Carboniferous hills. Their contact on the Petitcodiac River is well seen

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just below Edgett's Landing, in the cliff opposite the end of the road to the mines. The grey sandstones and conglomerates here rest upon the red marls with very little appearance of unconformability, both series dipping S. 20° E. < 5°-10°, though several faults of small extent are visible in the face of the cliff.

Contact of
formations on
Petitcodiac
River.

North of the great ridge of the Caledonia Mountains, the belt of Lower Carboniferous rocks which include the Albert shales extends continuously for many miles to the Petitcodiac River. These have been fully described in Report of Progress, 1876-77, and in the map accompanying that report, the general outline of the Millstone-grit northward is given. The formation has its southern boundary on the west side of the Petitcodiac about one-fourth of a mile north of Stony Creek, whence it extends with a gradually increasing westerly direction to the Irving Settlement P. O., in Baltimore, beyond which its distribution has already been given in the published maps of Southern New Brunswick. Northward it extends continuously to the Strait of Northumberland.

Extension of
boundaries.

In the peninsula between the Petitcodiac and Memramcook Rivers, the Millstone-grit is developed in a long irregular area, extending northward from Folly Point, which is the southern extremity. In the vicinity of Rockport and Boudreau villages, large quarries have existed for many years, and the formation occupies the surface from shore to shore, but north of this it recedes from the coast on either side and with a curving outline extends through the centre of the peninsula to the rear of St. Joseph College, about two miles from Memramcook Corner. Another small outcrop, capping the Albert shales and red marls, is seen on the road a short distance south of Beliveau Creek.

Memramcook
and Petitcodiac
Rivers.

The southern boundary of the main area, which has been stated to occur near Stony Creek on the Petitcodiac River, reaches the east bank about one mile north of Dover P. O., whence it curves eastward in an irregular line to the vicinity of Calhoun's mill on the Memramcook River, which stream it crosses about three miles and three-quarters north of Memramcook Corner. Thence it bends southerly and crosses the Beechhill road one mile and a half east of the latter place.

Between this and Dorchester the outline is very irregular, the formation being nearly horizontal and occupying the high lands, while in the valleys the Lower Carboniferous has been exposed by denudation. Two and a half miles below Memramcook station, the Millstone-grit ridge comes nearly to the railroad and the easily disintegrating conglomerates of the lower portion have been extensively quarried for ballast. It, however, recedes up the Valley of Breaux's Creek or Anderson's Mill Brook, and curves round to the rear of the Squirrel Town settlement, at which place the Dorchester copper mine is located.

Dorchester
and vicinity.

Thence it trends southwesterly and forms a bold escarpment which comes to the vicinity of the Memramcook River, near Dorchester Corner. The extension of the area northward passes about one mile and a half in rear of Upper Sackville and occupies, so far as can be determined, the entire surface to the Northumberland Strait, west of the Aboushagan River.

Maringouin
Peninsula
area.

On the Maringouin Peninsula three bands of Millstone-grit are seen. The most southerly, occupying the extremity, has been already described. The second is well exposed in the vicinity of the roads which cross from Upper Rockland to Hard Ledge, and rests upon Lower Carboniferous red marls and sandstones forming the north side of the great anticlinal which occupies the portion of the Peninsula to the south. The breadth of this area is about three-fourths of a mile, extending along the east shore from Harvey Creek to Green's Creek. At the contact, the two formations are apparently nearly conformable, the Lower Carboniferous dipping N. 30° W. < 70°-80°, while the lowest beds of the Millstone-grit dip N. 25° W. < 75°. At the eastern extremity of this belt, the beds appear to extend northeast in the direction of Aulac, the ridge at which place being directly in the continuation of the strike of that just described. The anticlinal structure of this ridge is seen by contrasting the dips at the two extremities. At Aulac, the dip is S. 65° E. < 35°, while at Hall's Hill, where the ridge terminates, it is N. 45° W. < 10°-20°. The third area on the Maringouin Peninsula is continuous on the western side with that which reaches the river at Dorchester. Its southern margin is at Dorchester Cape, three miles and a half south of the village, the contact with the Lower Carboniferous being well exposed on the shore. Eastward of this point it forms a prominent ridge which includes the Settlements of Westcock and Second Westcock, and terminates at the mouth of the Tantamar River. At the eastern extremity, the rocks dip N. 10° E. < 80°, and they apparently overlies the Upper Carboniferous of Wood Point, the beds of which lie in a nearly horizontal position. There is evidently a fault of considerable extent in this vicinity, by which the lower beds are brought into their present position.

Extensions
north-east.

Coast of North-
umberland
Straits.

The country to the north of Memramcook and Dorchester, and extending to the Northumberland Strait, is occupied by the rocks of this formation, which are the extension of the great area in the vicinity of Moncton, and which continue thence to Shediac. Coarse grey grits, sandstone and pebbly conglomerates shew at intervals in a nearly horizontal position. Near Cape Bald chapel, the soft reddish beds of the Upper Carboniferous come in and overlap the lower formation. The country is generally sandy and uninteresting. Several out-

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crops of coal are reported along the northern margin, one of which, near Tidnish or Dupuis Corner, has been referred to in Report of Progress, 1880-81, page 6v. What is probably the extension of the same seam is seen on the Aboushagan River, where it is exposed in the bed of the stream for some distance. Its further extension on the Cobourg road has already been noted. The general thickness of this seam is from two to four inches only.

Eastward, in the Tormentine Peninsula, the occurrence of a low ridge of grey sandstone of this age, terminating at Bayfield, has already been referred to in the section on the Upper Carboniferous. This anticlinal is probably the extension of that seen on the Aulac ridge.

In the formation just described, minerals are rare. Extensive deposits of excellent building stone are however found at various points, some of which have been worked on a large scale for many years, and will be referred to under the head of economics. Traces of copper are found at several places, among which may be mentioned Cape Enragé, New Horton and several points on the Maringouin Peninsula. At all these the quantity of ore is inconsiderable and the deposit of little or no economic value. The largest, and by far most important location, is that known as the Colonial Copper Mine, about three miles and a half north-east of Dorchester. At this place the escarpment of Millstone-grit, which extends north-east from Dorchester, rests upon red marly shales of Lower Carboniferous age, for some distance. The existence of the copper, which occurs near the contact of the two formations, was first discovered by the presence of bare spots on the hillside, where the vegetation had been apparently destroyed by the action of some mineral solution. Upon examination of the locality, deposits of grey copper ore (copper glance) with much green carbonate were found in the lower beds of the grey sandstone and conglomerate. The ore was especially abundant and rich where the plant stems were numerous. The face of the escarpment was carefully prospected, and the ore found at intervals for a mile and a half. During the past year a company has commenced its systematic extraction. Commodious buildings have been erected, and improved mining and hoisting machinery introduced. At the time of my visit in October, forty-five men were employed, the men working in shifts of eight hours each, and a large quantity of hard grey silicious sandstone had been taken out. A portion of this contained plant stems upon which the copper was deposited, and the remainder was stated by the manager to carry from 4 to 5 per cent. of copper glance in a fine state of division, scarcely visible to the naked eye. The quantity of nodular ore in connection with the plant remains did not seem sufficient to war-

Minerals.

Dorchester
 copper mine.

rant the expenditure of much capital, but if some process of concentrating the disseminated ore from the sandstones can be made available on the spot, a considerable quantity of copper should be realized. Experiments to this end are now being made by the manager, the results of which have not been made public. In the bottom of the shaft, which had a depth of 100 feet, the red marls of the Lower Carboniferous had been reached. The two formations were entirely unconformable, the upper dipping S. 30° E. < 25°-28°, while the lower was inclined at a very high angle.

Indications of this deposit are found further east at Beech Hill, in rear of the Four Corners, which would give it an extension of from four to six miles.

Albertite.

Albertite is found in limited quantity in the rocks of this formation at several places. The most important yet noted is at the East Albert Mining Company's property, one mile and a half west of Edgett's Landing, in Lower Hillsboro.' This locality was worked for a time some years ago, but finally abandoned, probably from the lack of material. In the other cases the mineral is present only in small strings and disseminated grains.

It will be seen from the foregoing remarks that the productive portion of the Middle Carboniferous is entirely wanting in this area. The productive measures of the South Joggins in Nova Scotia strike too far south to reach the coast of New Brunswick, and only a portion of the Millstone-grit series, representing the beds probably as high as the grindstone quarries of Seaman's or Lower Cove, is found at Maringouin and the coast from New Horton to Cape Enragé.

Thickness in vicinity of Dorchester.

The thickness of this formation as developed on the shore south of Dorchester from the contact with the Lower Carboniferous beds of Dorchester Cape to the centre of the synclinal, in the vicinity of the Intercolonial Railway, is about 1,000 feet. The exposures, after leaving the cliffs along the shore, are limited, but in a quarry about half a mile south of the railway the beds are nearly flat. This point probably marks the centre of the basin in this direction, the northern slope of which terminates at Dorchester Corner, where the dip of the grey conglomerates is S. 35° E. < 30°.

In the adjoining Province of Nova Scotia, both divisions of the Middle Carboniferous are well represented. The typical section given in the Acadian Geology makes the thickness of the productive measures to be 2,539 feet, and they are stated to extend from McCairn's Cove to the high cliff beyond Coal Mine Point. The rocks are principally grey sandstones and grey and dark-colored shales. The formation contains a number of coal seams, the greater part of which are, however, too thin to be of economic value; but in the vicinity of the South Joggins

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several seams occur which have been worked somewhat exten-
sively for many years. The character of the measures and their con-
tained coals have been so minutely given in the report of Sir Wm.
Logan, 1845, and subsequently by Sir Wm. Dawson, in the *Acadian
Geology*, 1868, that it is not considered necessary to devote further
time to their description.

The lower or Millstone-grit portion of the Middle Carboniferous is, ^{Divisions and thickness of the formation.} in the work already referred to, divided into three sections. The first portion consists of reddish shales and red and grey sandstones, with-
out seams of coal and with a thickness, according to Sir Wm. Logan,
of 2,082 feet. It represents the upper part of the Millstone-grit.

The second division has many beds of coarse sandstone and much
red shales and contains nine thin seams of coal. The thickness of this
division is 3,240 feet. The third division consists of red and chocolate
shales with red and grey sandstones, conglomerates and thin beds of
concretionary limestones, forming the base of the formation and having
a thickness of 650 feet. It may be mentioned that a remeasurement
of the measures was made by Mr. Scott Barlow in 1875, but without
appreciably changing the thicknesses of the various formations as
above stated.

In the sections given, the northern side of the synclinal has in all
cases been examined. The same regularity of measures does not
appear on the south side, and, in fact, with the exception of several
small seams, most of which are near the base of the Millstone-grit, ^{Faults on south side of Joggins basin.} no traces of the numerous coals seen in the Joggins section are to be
found in this direction. It is probable that this area is profoundly
affected by faults, indications of which are visible at several points.

In the vicinity of the South Joggins, the productive measures have
a superficial breadth of about two miles, their dip being regular
throughout. They extend eastward in a band of uniform width for
eighteen miles, and, in so far as can be ascertained, terminate a short
distance east of the Economy Road, on the Little Forks stream, ^{Extension of the productive measures of the Joggins area.} being cut off in this direction, probably by faulting, as they come
abruptly against what is considered to be a ridge of Millstone-grit.
They are overlaid to the south by the Upper Carboniferous of the
Little Forks and Maccan Rivers already described. Along the northern
margin a number of mines are located on what is the extension of
one of the thicker Joggins seams, but as these have never been traced
continuously, it is exceedingly hazardous in the present state of our
knowledge to affirm decidedly on which particular seam these col-
lieries are placed, since they are known to change their character at
various points.

It seems, however, probable from the explorations of Messrs. Barlow

and McQuat that the mines east of the Maccan, viz., the Scotia, the Chignecto, the St. George, and further east the Styles mine, are all on the same seam.

Spring Hill area probably distinct from the Joggins area.

The southern side of the synclinal of the productive measures, if not entirely cut off by faults, is overlapped by the Upper Carboniferous already described as resting on the Millstone-grit formation of the Maccan River and west of Spring Hill, as no traces of it can be seen in this direction throughout all the area east of the Joggins shore, and it does not appear to be in any way connected with the productive measures of the Spring Hill mines.

The presence of several seams of coal in this latter area, embracing at least five of workable size, ranging from four to thirteen feet in thickness, renders this section one of the most important mining centres in the province. It was deemed advisable, therefore, to make some further examination of the country to the north and west, with the view of determining, if possible, the extension of these great seams in this direction, and also to make available for publication the great amount of work done in previous years by Messrs. Barlow and McQuat, to the former of whom belongs a large portion of the credit of tracing out the seams now known to exist in the Spring Hill basin proper. A considerable portion of the season was, therefore, devoted to the attempt to elucidate the structure both to the north and west, as also of the Spring Hill area itself.

General structure of the Joggins area.

The general structure of this portion of the country will now be given. Leaving the belt of Millstone-grit which underlies the productive measures at the Styles mine, and going down the brook which flows thence to Little Forks River, we find a series of sandstones and shales dipping southerly at angles of 30° to 40° . No coals have been recognized in this section other than that known as the Styles seam. Just before reaching the Little Forks River, grey sandstones dipping south-westerly $< 13^{\circ}$ occur, which are supposed to mark the Upper Carboniferous, whose distribution has already been given.

Valley of Black River.

Between the Little Forks River and the ridges of Claremont and Spring Hill is the valley of the Black River. The Economy road, which connects the two places, passes over a ridge of greyish sandstone, very much of the character of the Millstone-grit; no ledges are seen on the road except at one point where it makes a sudden bend to avoid the spur of a hill. Here, in a quarry, the dip is generally S. 70° E. $< 12^{\circ}$ - 16° . This place is two miles and a half from the crossing of the Little Forks at Stewart's. Thence to the vicinity of Black River the soil is grey, coarse and gritty.

From the corner of the road north of Black River a road runs north-easterly to the old Economy road, which crossed that stream about three-

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an, viz., the Scotia, the Styles mine, are all on

productive measures, if the Upper Carboniferous-grit formation of which traces of it can be seen of the Joggins shore, and with the productive

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MIDDLE CARBONIFEROUS.

eighths of a mile above the Forks of the Chase Lako Brook. Along this ^{Chase Lake Brook.} road the soil is generally reddish, indicating a change of formation, and a prominent ridge or escarpment which keeps along the north side, marks the limit of the grey sandstone in this direction. Between the road and the Black River, as well as in the bed of that stream, red Lower Carboniferous sandstones and conglomerates, with large pebbles, occur, dipping S. 20° E. < 16°-20°. These extend up the Chase Lake Brook for fifteen chains, to ledges of grey sandstones, shales and conglomerates of Millstone-grit aspect, which are a portion of the ridge crossed by the road from Little Forks stream. They dip S. 50° E. < 15°-20°, and further up stream are associated with purple sandstones and shales, which dip also in the same direction at an angle of 20°. It was formerly supposed by Mr. McQuat that the grey and purple beds, just described, belonged to the Upper Carboniferous, and were the equivalents of the Ragged Reef sandstones, and that the Lower Carboniferous of Black River was brought into its present apparent position above the newer beds by a fault of great extent. The examination of the past season tends to confirm the opinion held by Mr. Scott Barlow, that the ridge ^{Millstone-grit ridge.} under discussion is much older and is a true portion of the Millstone-grit formation.

The presence of the Lower Carboniferous along the Black River and its vicinity, in a generally undisturbed condition, proves the thinness of the overlying formation. The lack of exposures on the road crossing the ridge prevents the conclusive evidence of its anticlinal structure in this direction being observed, but it seems probable from the overlying members of the Upper Carboniferous on Little ^{Anticlinal in Millstone-grit.} Forks River, that a reverse dip occurs, and that the true structure of the ridge is that of a low anticlinal, capping the underlying Lower Carboniferous conglomerates. Evidences of this structure are apparent on the Intercolonial railway, about one mile east of Spring Hill junction, where a reverse dip to that noted in the quarry on the road is met with.

The various cuttings on the railway, between Salt Springs station and Spring Hill junction, also throw much light on the structure of this section of the country. West of the crossing of the South Branch of Black River, grey sandstones, shales and conglomerates, bearing a strong resemblance to Millstone-grit sediments, appear at intervals for ^{Contact of Millstone-grit and Lower Carboniferous.} three miles. They dip generally N. to N. 10° W. < 15°-20°. These represent the western prolongation of the ridge already described. A quarry is now worked in these sandstones about two miles west of the Black River crossing. About one mile and a half beyond the quarry hard grey quartzose sandstones, altered and sliken-sided, show in a cutting, dip west < 5°, though apparently much broken. The

nearest exposure of the Millstone Grit sandstones is half a mile east, where they dip N. 10° E. $< 20^{\circ}$ - 25° . These altered sandstones probably indicate the outcrop of the underlying Lower Carboniferous and the existence of a line of fault at this point, which is directly on the course of the main north and south fault of the Spring Hill mines, presently to be described. Thence west, at 1,440 paces, a small brook and culvert mark the lower end of Stewart's meadow. At this place ledges of soft red and greyish marly shales occur, associated with beds of gypsum. These extend for 1,100 paces to the top of the grade east of Spring Hill junction, plaster pits being numerous along the north side of the railroad at several points, and mark the presence of a Lower Carboniferous outlier, which may have been brought to the surface by the fault just indicated.

It is probable that the outcrop of gypsum and shale at this place represents the beds of Black River and vicinity, the gypsiferous belt being recognized as far as the River Philip in the direct line of strike. Proceeding west from the summit of the grade the grey sandstones of the Millstone-grit are again seen, dipping N. 50° W. $< 16^{\circ}$, indicating an anticlinal structure in this direction, and confirming the hypothesis that the measures comprising the ridge already described have no great thickness, and that the productive formation is probably, or at least in so far as can at present be ascertained, entirely wanting in this direction.

On the branch railroad to the Spring Hill mines and 'Parrsboro', no ledges are seen till we pass the East Brook, two miles and a half from the junction. The surface on both sides is frequently strewed with large blocks of coarse grey grit and conglomerate. Between the East Brook and the mines, at a distance of one mile from the east slope, a ridge of limestone holding Lower Carboniferous fossils comes to the track from the east. The intervening space to East Brook shews several cuttings in grey grits, with two thin seams of coal, one of which has a thickness of one foot four inches. The ridge of limestone referred to is the western terminus of the Lower Carboniferous area which extends thence continuously to River Philip, and flanks the high land of Claremont Hill, being connected also with the conglomerate and gypsum of Black River.

The northern boundary of this Lower Carboniferous area runs in a nearly straight easterly direction from the terminus on the Spring Hill railroad, to the south branch of Black River, which it crosses near the head of Dixon's mill pond. Here evidences of a fault are clearly seen at the junction of a small stream from the west known as Deep Brook, the Lower Carboniferous conglomerates, sandstones and shales dipping N. 5° W. $< 90^{\circ}$, while the succeeding beds dip N. 10° W. to N.

Lower Carboniferous outlier.

Lower Carboniferous limestone near Spring Hill mines.

Fault.

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45°. Thence eastward, the boundary of the Lower Carboniferous gradually curves to the north along the west flank of Claremont Hill, till it reaches the River Philip road about one mile and a half east of Salt Springs station.

Resting upon the Lower Carboniferous beds, at the mouth of Deep Brook, are ledges of grey sandstone and sandy shales. These, on the east side of Dixon's pond, are underlaid by coarse reddish grits and conglomerates, broken and slickensided, indicating the presence of a fault in this direction. The grey sandstone and shales resemble the lower members of the Middle Carboniferous, and contain an abundance of plants from which a collection was made by Mr. Scott Barlow, and examined by Sir Wm. Dawson, the results of which also tend to establish their horizon as that of the Millstone-grit. One hundred yards below the mill there is a seam of coal of excellent quality, one foot four inches thick, and three chains and a half further a second seam with a thickness of two feet six inches is seen. This was opened during the past season (1884), and a considerable quantity of coal extracted. The measures at this place dip N. 10° W. 40°. Thence to the railroad, grey sandstone and shale occupy the stream.

Coal seam of
 South Branch
 of Black River.

The structure of the area just described is plainly a shallow synclinal, the reverse dips being seen to the north of the Intercolonial, and bounded on both margins by Lower Carboniferous sediments, of which that noted at Stewart's meadow is the northern outcrop. From the character of the sediments, and the contained fossils, it is doubtful if the true productive measures appear at all in this direction. That the thick seams of the Spring Hill basin are absent is quite manifest. The eastern extension of this synclinal is somewhat difficult to trace, owing to lack of good exposures, but from the outcrops of gypsum and other Lower Carboniferous sediments along the north side of Claremont Hill it appears to terminate about one mile and a half east of Salt Springs station, beyond which the Lower Carboniferous formation apparently occupies the surface between the River Philip road and Black River.

Synclinal
 structure.

The structure of the Spring Hill basin is exceedingly complicated, owing to the presence of several faults which have seriously affected the regularity of the measures. The eastern and southern limits have been carefully traced by the examination of all the available outcrops.

Beginning with the southern boundary, it may be generally stated that the contact of the Middle with the Lower Carboniferous is not far from the line of the Maccan River in its upper part. On the south side of this stream exposures of rocks of the lower formation are seen at intervals from the line of the railway from Spring Hill to Parrsborough, below Halfway Lake, forming a belt from a mile and a half to three miles in width, and resting upon the northern flank of the Cobequid range.

South side of
 Spring Hill
 area.

On the road from Maccan River to Five Islands these rocks are well exposed at an old mill about 250 yards south of the stream. They consist of red conglomerates and sandstone, dip N. 45° W. $< 20^{\circ}$.

Boundary of
Spring Hill
Basin.

South-east of Spring Hill mines their outcrop crosses the road to Windham Hill, near the house of the widow Tillot Smith, whence it extends east for 100 chains and sweeps gradually round to the north-west, terminating the Middle Carboniferous basin in this direction. The eastern boundary is somewhat sinuous. It crosses the south branch of Black River fifty chains north of the road from Spring Hill to Henry Smith's, whence it curves along the east side of the Spring Hill ridge and crosses the road leading from the mines to Salt Springs at forty chains west of the Black River crossing, beyond which it extends north-westerly to the outcrop of the limestone already described as occurring on the railway between the junction and Spring Hill mines.

Streams
surveyed.

The principal streams which intersect this area and on which exposures are found are the East Branch of the Maccan River, along the southern border, Ratling, Harrison's, Coal Mine and East Brooks. But few ledges are seen on the roads. Both streams and roads were carefully chained by Messrs. Barlow and McOuat.

Section on
Etter road and
Ratling Brook
by Mr. McOuat.

The Etter road, to which reference has been made by Mr. McOuat—(Report of Progress, 1873-74, p. 169)—extends from the Upper Maccan River road to the road leading from Spring Hill to Athol. Several outcrops are visible between the river road and the line of the Parrsborough railway. These consist of greenish-grey grit and sandstone, with thin beds of conglomerate, and are well exposed at a small quarry half a mile north of the fork of the road. They dip N. 35° W. $< 16^{\circ}$ and are overlaid a little further on by large ledges of coarse conglomerate, conforming in dip with the underlying beds and containing pebbles of grey quartzite, white quartz, felsite and slates. Thence to Furlong's house, sandstones, grey and sometimes thin-bedded, occur, between which and the railroad no ledges are seen. The Ratling Brook, which runs north-westerly across the formation and crosses the Etter road a short distance north of the railway, affords us a very good section of the remaining members of the formation under discussion, and as the strata exposed in this stream are very similar to those noted on the other brooks to the east, the characters and descriptions of the rocks here observed may be applied to the other localities. The dips are uniformly regular and the section is given in ascending order from their most southerly outcrop and taken from the notes of the late Mr. W. McOuat:—

Grey and reddish-brown fine grained sandstones with arenaceous shales. N. 60° W. $< 25^{\circ}$

These rocks are well
 of the stream. They
 dip N. 45° W. < 20°.
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 Tillot Smith, whence it
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MIDDLE CARBONIFEROUS.

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Grey sandstone.

Coarse greenish-grey sandstone, soft argillaceous sandstone, mottled red and grey.

Bluish-grey, overlaid by thin-bedded red sandstone.

Fine reddish-brown sandstone, with greyish bands. N. 60° W. < 25°.

Grey sandstone, mostly flaggy and coarse. N. 55° W. < 43°.

Reddish sandstone, mostly in thin beds, underlaid by red shales.

Grey sandstone, with fossil plants, underlaid by reddish, argillaceous sandstone.

Grey, moderately fine sandstone in thin beds, passing upward into red sandstone and shales. Dip N. 45° W. < 25°.

Measures concealed for forty chains.

Soft red argillaceous sandstone. N. 40° W. < 15°.

Coarse grey conglomerate, 40 feet thick, with thin bands of coarse grey grit in upper part.

Measures concealed for ten chains.

Coarse grey conglomerates and grey sandstone.

Measures concealed to railroad thirty-five chains.

The brownish-red sandstone and shales are similar to the purple beds described elsewhere as a portion of the Millstone-grit series.

The upper part of this section is seen on the East Brook below the Etter road and consists of

Coarse grey sandstone approaching a conglomerate in thin beds, inclining to brownish-grey shales at top. N. 28° W. < 10°.

Grey sandstone.

Coarse conglomerate and grit in large blocks.

The last exposures half a mile north of the railroad are red sandstone in even layers of half an inch to two inches thick. Dip N. 30° W. < 5°-7°.

Thence for one mile and a half along the road no exposures are seen to the crossing of Coal Mine Brook, where soft, brownish-red sandstones of Upper Carboniferous aspect are noted, dipping N. 65° W. < 8°.

The stratigraphical relations of the rocks of the section just described, together with the character of the sediments, very conclusively establish their horizon as that of the Millstone-grit, and the unconformable superposition of the Upper Carboniferous at Coal Mine Brook tends to confirm this view, and, as on the Maccan River further west, shews that the true productive measures do not appear at the surface in this direction.

The Mountain road runs parallel to the Etter road three miles further east and about two miles west of the Spring Hill mines. No ledges are seen, except at the crossing of Harrison Brook, where purple shales and sandstones dip N. 65° W. < 20°. On this stream, however, exposures are quite numerous. The strata dip uniformly north-

Unconformity
 of Upper
 Carboniferous
 on Millstone-
 grit.

Harrison's
 Brook.

westerly $< 30^{\circ}$ - 50° , and are, undoubtedly, the continuation of those described on Rattling Brook, consisting of heavy beds of conglomerates and grits with red and purple sandstones and shales. Indications of faults are seen at several places. None of the productive measures are visible on this stream, though indications of coal in thin seams have been noted in its upper part.

Fault in the northern portion of basin

The Spring Hill and Parrsborough railway, which traverses a large extent of the Carboniferous area under consideration, while shewing very few rock cuttings, gives us at two points very material assistance in the attempt to work out the structure of the Spring Hill basin, and enables us to determine with great exactness its northern and southern limits. The former is indicated by the ridge or outcrop of Lower Carboniferous limestone, already described, which approaches the railway one mile north of the east slope. The coal seams and associated strata as they approach this outcrop rapidly increase the angle of dip to 70° or more, and in the underground workings in this direction the coals are stated by the manager to be terminated abruptly against the limestone, the rocks near the contact being much confused, indicating a line of fault, the course of which at the northern extremity is found to be S. 28° - 31° W. magnetic, or S. 6° - 9° W. with reference to the true meridian. It is very evident that the Lower Carboniferous outlier ends the Spring Hill basin in this direction.

Fault on Mill's Brook.

The fault just mentioned is well seen at the surface on Mill's Brook, which flows across the measures midway between the east and west slopes. Descending this stream, limited outcrops of the strata of the productive measures, which overlie the thick seams of this area, are seen for 1,970 paces from the railroad crossing or to a point thirteen chains beyond where the stream turns west, where the strata which are hard grey sandstones and purple grey shales dip N. 82° W. $< 60^{\circ}$ to 85° , the underlying beds of the productive dipping W. $< 30^{\circ}$. By this fault the beds of the Millstone-grit formation are apparently thrown upward and cut off the coal seams of this area. Thence down Mill's Brook the rocks are similar to those in the two brooks already described, consisting of coarse and fine grey conglomerates, the pebbles of which are white quartz, coarse and fine grey grits and sandstones, with purple sandstones and shale. They dip generally north-westerly, ranging from N. 60° - 75° W. $< 15^{\circ}$ - 30° , but in one place are nearly horizontal, or S. W. $< 2^{\circ}$. Indications of faults are seen at several points.

East Brook.

These rocks extend at least to the forks of this stream with East Brook, exposures being very rare in the last half mile, and below this to the Athol road few ledges are seen. Ascending the East Brook no ledges are observed, but a ridge of Millstone-grit sandstone and con-

glomerate extends between the two branches north-easterly to the line of the Spring Hill railroad.

On the railway to Parrsborough the limit of the Spring Hill coal basin to the south-west is clearly seen at a distance of 512 paces west of the crossing of Coal Mine Brook. At this point, ledges of hard grey sandstone, grit and conglomerate are brought up by a well defined fault against the productive measures. The older or overlying portion, at the line of contact, dip N. 70° W. < 85°-90°, the inclination decreasing in fifteen paces to N. 55° W. < 60°. The ridge caused by these hard grey rocks is seen to extend across the Athol road, beyond which it is concealed by the intervening forest.

Fault on the railway to Parrsborough.

The line of this fault is also well seen in the Coal Mine Brook about seventeen chains below the railroad crossing, the hard sandstones dipping N. 55° W. < 45°. If we connect the several points thus indicated it will present a nearly straight line between the northern and southern extremities. It is presumed, therefore, that a line so drawn will determine approximately at least the western boundary of the Spring Hill coal field.

Fault on Coal Mine Brook.

Descending the Coal Mine Brook, the rocks of the Millstone-grit, brought into view by the fault just described, are seen almost to the crossing of the Athol road. They consist of hard grey sandstone, grit and conglomerate, interstratified with beds of purple shale and sandstone. Abrupt changes of dip are seen at several points. At one of these, half a mile in a direct line from the railway crossing, heavy beds of red shales much polished and slickensided are brought into contact with grey gritty sandstones, the former dipping N. 20° W. < 75°-80°. The course of this break is apparently nearly east and west magnetic, or nearly along the course of the stream. Below this, brown shales dip N. 65° W < 25°, changing a little further down to N. 85° W. < 14°.

Succeeding these beds, heavy masses of coarse grey sandstone and conglomerate, the latter with white quartz pebbles and of Millstone-grit aspect, dip N. 40° W. < 15-25° and continue to the last exposures on this stream. The great similarity of the rocks on all these brooks will be readily recognized, the heavy beds of grey conglomerate being a prominent feature, while the absence of any measures to the north and west of the faults just indicated, which may properly be said to belong to the productive formation, will be easily seen. It is supposed that the overlap of the Upper Carboniferous upon what is here regarded as the Millstone-grit is about half a mile west of the forks of East and Mill's Brooks.

Millstone-grit, character of beds and overlap of Upper Carboniferous.

Along the south side of the Spring Hill area two faults at least are visible. One of these was definitely located by Mr. Scott Barlow and

Faults on south side of Spring Hill area.

is laid down on his map of this area already published. This had the effect of throwing the coal seams to the eastward. A much more important one, however, must exist in close proximity, by which the measures are entirely cut off in this direction. Its exact position is not easy to determine, owing to the general covering of soil and drift, but in a small brook flowing into the South Branch of Black River, about two miles east of Miller's Corner, it is clearly seen. Here the Lower Carboniferous strata at the contact dip S. 10° E. < 80°, while the nearest beds of the Middle Carboniferous dip S. 30° W. < 10°. The western prolongation, if continuous, would carry it thirty-five chains south of Miller's Corner.

It is probable, however, that other faults of greater or less extent may exist in this area. The abrupt change in the strike of the measures seen at the south slope as compared with that seen on the road to Rodney proves conclusively a great disturbance in the rocks of this locality. The Middle Carboniferous to the south and east is evidently quite distinct from that at the mines, and forms a shallow basin which terminates about one mile and a fourth east of the road at Thomas Boss's place. The beds in this area are nearly flat, dipping at angles of 2°-10°, and it is very evident from the synclinal structure of this portion and the general horizontality of the measures that no space exists for the extension of the Spring Hill seams in this direction. The small seam of dirty coal found to the east of the South Branch may possibly be the broken portion of one of the thin seams of the Millstone-grit, to which formation it is likely the shallow synclinal in this section belongs. To the east of the Spring Hill mines the underlying Millstone-grit formation comes in under the productive measures in its regular order, and overlies the Lower Carboniferous of the South Branch. It can also be recognized on the road leading to Salt Springs and on the south flank of the limestone ridge which terminates at the railway.

The structure of the Spring Hill basin, as here explained, will, if correct, have a very important bearing on the prospects of finding the extension of the great Spring Hill seams to the north and west. By the faults just described as bounding the area on the west and south, the lower or Millstone-grit portion of the Middle Carboniferous appears to be thrown upward several thousand feet, and the coal seams have doubtless been subsequently removed by denudation. To the north and west the productive measures do not, as already stated, again appear at the surface, the Upper Carboniferous in all observed contacts apparently resting on the Millstone-grit.

It would be rash to say that the thick seams of the Spring Hill coal field may not be found in the area between the mines and Athol, but no indications, pointing in that direction, are to be observed.

Character of
measures
between Spring
Hill and the
Maccan River.

No indication
of the Spring
Hill seams
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d.

The country lying to the west and north of the Millstone-grit up-throw is occupied by what is apparently the eastern prolongation of the great Joggins basin, the seams of which, with the exception of those of the Joggins mine and its extension eastward, are all, in so far as can be learned, too thin to be economically valuable. From the remarks already made on the character of the area in the valley of the Black and Little Forks Rivers to the north, it is evident also that a repetition of the Spring Hill basin can not reasonably be looked for in this direction.

Eastward of Spring Hill on the River Philip, a detached basin of ^{Millstone-grit.} Middle Carboniferous sediments is seen, the western boundary of which ^{area of River Philip. —} is the ridge of Claremont Hill. The strata, which contain one or two thin seams of dirty coal, belong, without doubt, to the Millstone-grit portion of the formation, and rest upon Lower Carboniferous rocks on all sides. Outcrops of coal are seen at two points, one on Polly Brook, a short distance from its junction with the River Philip; the second about half a mile east of Oxford station on the Intercolonial railway. ^{Coal near Oxford station.} At the latter place two thin seams are seen, separated by about four and a half feet of grey shale. The thickness of the upper seam was about fifteen inches, and of the lower two feet and a half, but the coal seemed dirty. The dip of the strata in the opening was S. 30° E. < 15° 20'.

On the south side of the Cobequid Mountains the areas of the Middle ^{Areas south of Cobequid Mountains. —} Carboniferous are apparently very limited. They are, in so far as observed, confined to the lower or Millstone-grit portion, and occur as small patches at intervals along the shore of Minas Basin and Channel, between Five Islands and Advocate.

LOWER CARBONIFEROUS. G. 1.

By reference to the Report of Progress, 1876-77, it will be seen that this formation, as developed in Albert and Westmoreland counties, is divided into five groups. These in ascending order are:—

	FEET.	
1. Basal conglomerate, sometimes wanting; when present, usually of a dull greenish colour, made up mostly of slate fragments; thickness, presumably about	200	Divisions recognized in New Brunswick
2. Calcareo-bituminous shales, from grey to dark brown in color, including the so-called Albert shales.....	850	
3. Grey bituminous and micaceous oil-bearing sandstone, and lower conglomerates, in massive beds, usually of reddish tint, less rubbly and more calcareous than those of No. 1, and uncompressible to the preceding.....	700	
4. Red and grey calcareous, sandy and argillaceous beds, in frequent alternations, with thin beds of conglomerate, and towards the top, heavy beds of fine rubbly brownish-red shales.....	450	
5. Red and grey conglomerates, grey and flaggy limestones and gypsum.....	1,950	

In the last division a small thickness of not more than 50-75 feet of red marly shales lies above the gypsum.

These measurements were made in the vicinity of the Albert mines, and at various points between Baltimore and the Petitcodiac River. The sections seen on the west side of the Maringouin Peninsula will change the character of No. 5 by adding over 2000 feet to the red marly shales which come above the gypsum and underlie the Millstone-grit series of Cape Maringouin, the details of which will be given later.

The distribution of the Lower Carboniferous in central Albert county and the portion of Westmoreland, west of the Memramcook River, is stated in detail in the Report of Progress, 1876-7. It will not be necessary, therefore, to give any further description of that area, but to limit our remarks to its distribution along the southern coast, from Cape Enragé eastward.

On the road leading from Harvey Corner to Cape Enragé, reddish sandstone and red and grey marly shales are seen in a brook at an old mill 500 yards in rear of James Reid's house in New Horton. They dip S. 65° E. < 35°. These underlie the Millstone-grit which occupy the point south of Harvey Corner. Thence they extend along the road west to a point in rear of Two Rivers Cove, where they are overlaid by the Millstone-grit of the coast already described.

Areas of Lower Carboniferous in southern Albert county.

On the west side of the Cove beyond Cape Enragé lighthouse, hard sandstones, mostly grey, considerably broken up, and with indications of faulting, dip S. 70° E. < 70°. They contain small veins of limonite from half an inch to an inch thick. Around the point, the rocks are a good deal disturbed, hematite occurring along the joints, but north of this, red and grey sandstones and shales, with conglomerates, occupy the shore for seventy chains across the strike. The angle and direction of the dip continuing constant, the estimated thickness of the measures here exposed would be about 4,500 feet. At the contact with the Millstone-grit on the north side there is probably a line of fault, the first exposures of the latter dipping N. 65° W. < 80°.

North of the second parallel ridge of Millstone-grit already described a second area of Lower Carboniferous rocks occurs, which comes to the coast of Salisbury Bay at Owl's Head, and thence extends easterly along the valley of the Germantown Lake and Shepody River, and terminates on the Petitcodiac River at Demoiselle Cape. It includes the elevation of Shepody Mountain in its eastern portion. The first outcrops are noted on the road from Hopewell Corner to Salmon River, about midway between Crooked Creek and the shore of Salisbury Bay, the Lower Carboniferous beds dipping S. 65° E. < 20°, and resting upon the Millstone-grit formation, indicating a probable line of fault at this place. In the Germantown and Shepody area, exposures are few, but

Increased thickness of No. 5.

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the character and color of the soil indicate the extension of the formation in this direction. East of Hopewell, a good section is afforded on Saw Mill Creek, which crosses the road half a mile west of Hopewell Hill. On this stream, two miles and a half north of the P. O., Lower Carboniferous conglomerates rest upon the upturned slates of the Caledonia Mountain, and dip S. 20° E. < 5°-10°. They are well exposed to the junction of the Middle Branch, sixty chains below, where a reverse dip to N. 50° W. < 5° in flaggy brown sandstone is observed, below which the dip gradually changes to N. 20° W. < 20°, indicating the presence of a shallow synclinal. Gypsum occurs at several places in this vicinity, the most westerly being on the banks of the Shepody River, near Riverside. ^{Gypsum.}

Shepody Mountain, 1,050 feet high, is a rugged peak which forms a prominent landmark for many miles in all directions, and was one of the signal stations for the Admiralty survey of the Bay of Fundy. It is composed largely of red conglomerates, which are well exposed on the east flank in Robertson's Brook and its branches. A deposit of reddish impure limestone has been opened up at this place for a marble quarry, but the rock was found to be too much shattered to be of great value. The limestone contains a small quantity of manganese. The rocks of the mountain rest upon a small outlier of the talco-chloritic schists, which shew on the road to the north, leading to Curryville, and are flanked on the east by the grey sandstones of the Millstone-grit. On the north-west side, a large deposit of manganese was worked for some years, a tunnel being driven into the mountain along the contact with the underlying schists for nearly 1,000 feet. The ore, which consisted of pyrolusite and psilomelane, occurred at the base of the conglomerate in irregular pockets. Operations have been suspended for some years and the workings have all fallen in. At the mouth of the slope the conglomerates dip N. 15° E. < 15°-20°. ^{Manganese.}

Along the valley of the Demoiselle Creek, between Curryville and the Albert mines, Lower Carboniferous sediments are also found. On the east, between the creek and Petitecodiac River, they are covered by the overlying ridge of Millstone-grit, but on the streams flowing in from the west, they occupy a considerable extent, forming the prolongation of the area of the Albert mines. The rocks are principally red and grey marly shales and sandstones, but on Wilson's Brook large ledges and cliffs of gypsum from 80 to 100 feet high are seen. A fine quarry of reddish grey limestone was opened in the vicinity some years ago by Mr. McHenry, and a large quantity of lime of excellent quality has been burned. ^{Limestone.}

On the west side of Cape Maringouin Peninsula red marly shales and sandstones of the Lower Carboniferous are in unconformable con-

tact with the Millstone-grit, which forms the extremity of the peninsula for half a mile. The Lower formation extends along the shore, obliquely to the line of strike, for sixty-five, or directly across the measures for twenty-seven, chains. The following section was made:—

	FEET.
Red marly shales and sandstones, the latter often greyish but distinct in character from the Millstone-grit.....	1518
Measures concealed, red clay, probably the same.....	729
Reddish and grey fossiliferous limestone.....	130
Gypsum, with red and grey marls, much twisted, and actual thickness very uncertain—Exposed breadth.....	500
Thence, measures concealed to small brook, on which gypsum again appears, along the beach, for.....	1188
Measures concealed, thickness unknown.....	2112
Red marly shales, S. 5° E. < 85°-90°, to axis of anticlinal.....	264
Red marly shales, vertical, to contact with overlying Millstone-grit	1650

Section on
Maringouin
Peninsula.

Further north, one mile above Johnston's Creek, similar red marly shales crop out on the shore, dipping N. 5° E. < 35°. They are exposed for nearly half a mile and represent, in this place, a thickness of 1,150 feet. Still further north, at the creek below Dorchester Cape, red marls and dark red conglomerates with beds of sandstone are again seen, dip N. 15° E. < 30°. They are exposed for seventy-five chains, and, measured directly across the strike, have a thickness of 1,250 feet. No gypsum is seen in this direction.

East of the Memramcook River, between Dorchester and Calhoun's mill, the denudation of the horizontal beds of Millstone-grit has disclosed the underlying Lower Carboniferous measures, and produced a very irregular and sinuous outline. The distribution of the Albert shales which form a conspicuous feature in this area, and other members of the formation, has already been given in the Report of Progress, 1876-77, pages 371 and 378.

On the east side of the Maringouin Peninsula, the Lower Carboniferous rocks are exposed on the north side of North Joggins Cove, underlying the Millstone-grit. The measures are the same as those described on the west side, with the exception of the limestone and gypsum. They dip S. 5° E. < 40°, changing at Peck's Point to S. 20° E. < 40°. Plant beds are numerous at several places, and where found often disclose traces of copper which are, economically, unimportant. From Peck's Point the measures strike directly across Cumberland Bay to Boss' Cove, on the south side of which the contact between the two formations is seen.

Copper.

North of the creek above Peck's Point, and thence up to Harvey's Creek, the Lower Carboniferous beds dip N. 30° W. < 75°-80°, indicat-

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ing the presence of an anticlinal, which is the extension of that noted in the section on the west side. A short distance north of Upper Rockland P. O., they are overlaid by Millstone-grit sediments already described.

On the north side of Peck's Point, near the upper limit of the exposures, a bed of very fine grained red sandstone of peculiar texture is found. It has been quarried to some extent and shipped in all directions for grinding and polishing marble, for which purpose it is peculiarly adapted, and commands a high price in the market. The merits of this stone were first pointed out by Mr. H. J. McGrath, marble cutter of Dorchester. Since 1876, in which year the report on the Lower Carboniferous belt was written, extensive explorations, more especially in the group of the Albert shales, have been carried on, involving the expenditure of large sums of money in the search for albertite and petroleum. The celebrated Albert mine became entirely exhausted at a depth of a little over 1,500 feet, the vein gradually thinning out as traced downward. Explorations were made in various directions by the Albert Mining Company in the vicinity, but no other veins of workable size were found, and the mine has accordingly been dismantled and allowed to fill with water.

Sandstone
for finishing
marble.

Albert mine.

The explorations on the adjoining or Princess Alexandra area, where borings were made to a depth of over 1,100 feet, were alike unsuccessful in finding any vein of economic importance. In the western part of the county, at Elgin, where the shales are also well developed, several bore holes were put down, but without meeting with albertite in any quantity. East of the Petitcodiac River, on the Beliveau Mining Company's property, both at Beliveau and Taylor village, extensive explorations were carried on for some years. At the former place a shaft was sunk to a depth of 500 feet, and tunnels driven in different directions, involving an outlay of over \$40,000. In the latter, the operations were carried on with a diamond drill, several holes being put down. In both places only small veins were found.

Princess
Alexandra
mine.

Beliveau mine.

Boring operations have been carried on for years, both in the vicinity of the Petitcodiac River, near Dover, and in rear of St. Joseph's college at Memramcook, in the hope of finding petroleum. A small quantity of oil is reported in several of the holes, but the amount so far found has been insignificant.

Petroleum.

In Cumberland county the extension of the Lower Carboniferous anticlinal, seen on the southern part of Cape Maringouin, after crossing Cumberland Bay, reaches the Joggins shore, as stated, at Boss' Cove, and is thence exposed northward along the beach, to a point half a mile beyond Downing's Cove, with a breadth of two miles and a half. There it is overlapped by the Upper Carboniferous of the Amherst basin,

Extension in
Cumberland
county.

whence it extends eastward, crossing the Macean River and forming an unbroken belt to the extremity of Cape Malagash, on the north side of Tatamagouche Bay. This ridge forms the north side of the Joggins or Cumberland Coal basin.

Southern side
of Lower Car-
boniferous.

A second belt of Lower Carboniferous rocks which forms the southern side of the basin is found on the shore at Chignecto Bay, at Spicer's Cove, seven miles north of the end of Cape Chignecto. Where it comes to the coast it has an exposure of about 500 yards, but inland it rapidly spreads out, including the village of Eatonville, and with a breadth of from two to four miles, keeps along the north flank of the Cobequid range nearly to its eastern extremity.

East of the Spring Hill mines these two areas are joined by the elevations known as the Windham and Claremont Hills, the overlying Middle and Upper Carboniferous sediments being thus separated into two distinct basins.

Character of
the formation
in the Joggins
section.

The rocks of the coast sections north of the Joggins are reddish shale with greenish and red sandstone, grey shales, grey compact limestone and gypsum, with heavy beds of marine limestone in their lower part, containing characteristic Lower Carboniferous fossils.

Throughout the northern belt, gypsum and limestone are very abundant, and are exposed at intervals from Minudie to Malagash. This area probably represents the upper members of the series given at the beginning of this section. The strata of the Joggins' shore are similar in many respects to those of Maringouin, and the same character of rock is maintained with considerable uniformity throughout to its eastern extremity.

Along the southern belt the gypsum seems to be wanting or very rare. The rocks are largely grey and red conglomerates, often coarse and hard, with bands of sandstone and shale. They possibly represent division 3 of the New Brunswick series.

From the preceding description of the upper and middle formations, the outlines of the Lower Carboniferous have been generally given, at least for the region west of Spring Hill. They occupy the greater part of the valley of the south branch of Black River and the ridges known as Claremont and Windham, whence crossing the River Philip road the area is apparently unbroken almost to the mouth of the River Philip.

River Philip.

The section on this stream is not continuous. Limestone and gypsum are first seen about three-fourths of a mile below the Intercolonial railway crossing, and the country in the vicinity to the east and west is occupied largely with these rocks. Though exposures are rare, the strata on this stream seem to lie in the form of two anticlinals, the axis of one being seen at Goose Point, about midway between Oxford and the mouth, while the axis of the other is probably not far from

the vicinity of Oxford itself, the exact position being concealed by the thick mantle of drift.

The Pugwash River further east also shews but few exposures. At the crossing of Grey's road, three miles north of Thompson station, large outcrops of gypsum occur, which extend down the stream for several hundred yards. These mark the southern limit of the southe-ly anticlinal in this direction. Exposures below this on the stream and roads are very few, but from the character of the soil and the loose pieces, it is probable that this formation extends continuously to the lower part of Pugwash Basin, as limestone and gypsum are well developed in that locality both to the east and west.

The Wallace River, the next stream to the east, affords a fine section of the rocks of this formation, underlying the Upper Carboniferous basin already described. On the north flank of the Cobequid Mountains at Wentworth, brownish and grey sandstones and shales rest upon the Silurian strata of Whetstone Brook. They dip N. 5° W. < 30°-45°, the underlying Silurian at the contact dipping S. 20° E. < 40°. The sandstones are also well exposed at an old quarry on Caldwell's Mill Brook, just beyond the end of the road leading down the mountain from Wentworth station.

Thence down the Wallace River for several miles exposures are few. Where seen they consist of red conglomerates, often coarse, dip N. 10° E. < 10°. These also show on the roads down the east side of the river, and they extend northward to the vicinity of the road leading to Swallow Settlement, where they are overlapped by the Upper Carboniferous.

The finest exposures of the lower formation are about eight miles north of the road to Wentworth station and five miles from the mouth of the river. Here a continuous section for over three miles is exposed, the beds being inclined at a high angle, generally from 60° to 80°, and the dip very uniform in direction for two miles and a half. The section is a descending one, the beds being unconformably overlaid by the soft red sandstones of the Upper Carboniferous, and is as follows:—

	FEET.	
Red sandstone and shales, S. < 40°.....	330	
Hard, dark reddish grits and fine conglomerates to head of pond, S. 20° E. < 40°.....	200	Section in Wallace River.
Coarse grits with fine red shales and red conglomerate bands, the pebbles often coated with red hematite and polished or slickensided, S. 40° E. < 45°.....	150	
Coarse grits and conglomerates in alternate beds, the latter with pebbles of grey quartzite, felsite, granito, etc., coated with hematite and with a bed of greyish-white marly clay, 3 to 4 feet thick.....	200	

Conglomerate and sandstone often hard and greyish.....	385
Hard grey conglomerate with thin bands of sandstone, S. 40° E. < 70°.....	76
Coarse brown-grey irony conglomerates, with large polished pebbles, slickensided, greenish-grey conglomerates and grits, the latter with plant stems, greenish-grey and brown shales, with grits and conglomerates.	660
It is possible that in this portion of the section some of the con- glomerate beds have been repeated by faulting—	
Brown and purple-tinged sandy shales, with conglomerates and grits in the upper part, S. 30° E. < 75°-80°	FEEET. 860
Greyish and brownish-grey sandy shales and sandstones with plant stems, S. 20° E. < 75°-80°.....	1600
Brown and grey sandstones and shales, in thin beds, S. 40° E. < 70°.....	210
Soft brown shales and grey hard sandstones, S. 40° E. < 50°-70° to foot of pond and Howard's mill.....	350
Brown and grey shales, with beds of hard sandstone, S. 20° E. < 80°.....	360
Brown and grey shales, with nodular limestones and sandy and calcareous conglomerates, calcareous and sandy shales, red brown and blackish-grey.....	810
Fault. Probable fault—reported silver mine.	
Red grits and conglomerates, with a bed of limestone four feet thick, S. 20° E. < 60°.....	640
Brownish shales and sandstones, measures concealed the greater part of the distance, S. 20° E. < 70°.....	2430
Brown shales and sandstones, with occasional band of hard grey sandstone, S. 20° E. < 80°-90°.....	3730
To axis of anticlinal at Kerr's mill.	

Then for a further distance of 1000 paces down the stream, the beds above described are repeated with northerly dips at angles of 70° to 80°, when they are again overlapped by Upper Carboniferous sediments which form the shore area.

The exposed breadth of these rocks from their first outcrop in the River to the anticlinal is 210 chains. This, at an average dip of 70°, would give a total thickness of 13,000 feet. As this thickness would be entirely unprecedented for the Lower Carboniferous formation, we can only suppose that the various members are in places repeated. Unfortunately there is no continuous section of these rocks, either to the east or west, to compare with that just given. But on the shore of Malagash Point, a partial section throws some light upon the structure of this belt.

The anticlinal seen at Kerr's mill, on the Wallace River, comes to the shore in a small cove near the extremity of Malagash Point, the

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 S. 40° E. 76
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axis itself being concealed in a salt marsh, the strata on either side of of which dip, respectively, N. 10° W. < 74°, and S. 10° E. < 65°. It also appears on the shore in a depression on the north side of the point, about midway between the end and the entrance of Wallace Harbor, the opposing dips being well seen. On the north side of the anticlinal, the portion corresponding with that to the north of Kerr's mill, shews the presence of several faults. Gypsum occurs at several places on this portion of the coast as well as about Plaster Cove, just inside the entrance of Wallace Harbor.

Brownish-red and grey micaceous sandstones and shales, apparently in small outlying patches, rest upon the gypsum and other Lower Carboniferous rocks of this area. These are unconformable and probably are limited exposures of the Upper Carboniferous. Their inclination is generally low, from 16° to 18°.

As on the Wallace River the Lower Carboniferous sediments of Malagash Point consist of dark greyish-brown sandstone and shale, with interstratified beds of moderately coarse grey grits and grey limestone. These contain traces of copper at several places near the extremity, in every observed case in association with plant stems, as on the French River and elsewhere.

In the Wallace River section, the upper portion, to the bridge below E. Howard's mill, at several points shews slight local changes in dip, but just in the vicinity of the bridge a more extensive line of fault probably exists, by which the measures, seen on the lower part of the stream, are repeated, a general similarity between the members of the two sections being apparent. On this hypothesis, the beds on the lower end of the section from Howard's mill to Kerr's mill would have an aggregate thickness of about 6,800 feet, while the thickness of the portion lying to the south of the bridge would be 6,200 feet.

In the upper part of the lower portion, a band of limestone four feet thick occurs with red conglomerate. No limestone is found in the upper portion, but further east, in Dewar's River, near the head of Tatamagouche Bay, a similar band of limestone is seen, having the same thickness. This marks the southern limit of the Lower Carboniferous in this direction, and if extended west, should cross the Wallace River a short distance south of the beginning of the outcrop of the Lower Carboniferous on that stream, thus rendering the parallelism of the two sections more complete. It may be added that the section on this river was made by pacing only, and the thickness of the various members is, therefore, merely approximate.

East of Wallace River, along the flank of the Cobequid Mountains, the Lower Carboniferous belt quickly narrows, being overlapped by the beds of the Upper formation already described. On the road to

Gypsum.

Malagash Point

Copper.

Probable thickness in Wallace River.

New Annan but one small exposure was observed, in a quarry on a small branch of Higgins' Brook, nearly four miles east of Wallace road. The dip was Northerly $< 35^\circ$. On the East Branch of French River a small band of red-brown conglomerate, 200 paces north of the New Annan road, dips N. 10° W. $< 20^\circ$, having a breadth of only 75 paces, which is probably the extension of this formation in this direction. East of this we have not traced it.

East of Spring Hill no strata of the true productive measures were recognized. The Lower Carboniferous has an extensive development occupying the entire surface, with the exception of the small areas of Millstone-grit already described, and the western prolongation of the Turner Carboniferous basin of the Wallace River, from the foot of the mountain range almost to the mouth of the River Philip. The productive measures, if deposited in this area, must be concealed by the overlapping Upper Carboniferous formation.

The more northerly anticlinal at Goose Point, on the River Philip, after crossing the Pugwash River near the basin, is apparently also concealed by the upper beds, a short distance to the east of that place, as it does not, in so far as can be ascertained, appear on the shore beyond, the whole coast, from the head of Bay Verte to Wallace Bay, being apparently occupied by the beds of the Upper Carboniferous.

On the line of the Intercolonial railway, between Thompson station and Wentworth, several cuttings are observed. These are apparently all in rocks of Lower Carboniferous age, red conglomerate and red and grey sandstones. On the east branch of the Wallace River these are, to the north of Greenville, also overlaid, unconformably, by the soft red beds of the upper formation.

On the south side of the Cobequid range, the Lower Carboniferous formation has a considerable development and apparently extends in a continuous belt from the coast west of Advocate Harbor eastward to the North River, in the vicinity of Truro, where our examinations in this direction terminated. Sections were made across the measures on a number of the streams between the North River and Five Islands, including the Chiganois, the Debert, Pine Brook, Folly, Great Village, and Economy Rivers. The rocks on all shew considerable disturbance, frequent and abrupt changes of dip indicating the presence of faults of greater or less extent. A thin seam of coal is seen at several places in their lower portion, generally not far from the contact with the older series along the flank of the mountains and has been opened at several points from Kemptown on the Pictou road to the Folly River. The character of the coal seam at all the places where tested appears to be much the same, and it is apparently of but little economic value.

The structure of the formation on the Debert River, of which a care-

Exposure on
Intercolonial
railway.

Development.

Distribution
south of the
Cobequid
Mountains.

Coal.

ful micrometer survey was made from the mouth to within four miles of its source, is evidently a double synclinal, and as the character of the strata varies but slightly on the several streams, the description of the rocks here seen may be given as fairly illustrative of the whole.

The first exposure of Lower Carboniferous strata is seen in a limited outcrop near the mouth, at the crossing of the river by the road leading from Truro to Economy. Here at 100 paces below the upper of the two bridges, ledges of hard, bright red sandstone, strongly resembling in color the sandstone of the Triassic, come up abruptly from beneath the soft sandstones of that formation, the strata of which thence occupy the stream upward to the Intercolonial railway. Their dip at this point is N. 5° W. < 60°, and they are associated with red, grey and purple marly shales of Lower Carboniferous aspect. A band of impure gypsum is also noted on the lower of the two roads at this locality.

Section on
Debert River.

On the east side of the river these shales and sandstones dip S. 5° E. < 60°, thus indicating the presence of an anticlinal at this place. Twenty-five chains below the lower bridge, on the west bank of the stream, beds of greyish and buff-colored limestone, overlaid by a bed of fibrous gypsum about four feet thick form the upper part of a cliff. They dip N. 20° W. < 40°. The red sandstones extend from this place westerly to the Folly Village, where, on the south side of the Folly River, they are well exposed for some distance and have a high northerly dip, the reverse dip of the anticlinal being seen a little lower on the stream and the formation is overlapped by the soft beds of the Trias. West of the Folly River the Lower Carboniferous beds of this area do not appear. The outlier has an exposed length of a mile and a quarter and a general breadth of forty to forty-five chains.

The Triassic sediments which occupy the Debert River from this outcrop to a point one mile north of McCulloch's Corner have a general dip S. 10° W. < 4°-7°. At the point indicated, bright red, hard and coherent sandstones and marly shales, identical in character with those just described, appear from beneath, with a southerly dip and shewing the presence of a synclinal basin in the intervening space. These are exposed for 240 yards and are underlaid unconformably by hard grey jointed sandstone or quartzite, which has a breadth of forty-five yards and rests upon black carbonaceous shales. These latter are apparently identical in character with a band which is associated with or accompanies the iron ore deposits presently to be described, and which has been traced continuously along the south flank of the Cobequid range for over sixty miles.

The black shales at this point have been opened, apparently in a vain search for coal, and, to all appearances, form one series with the

Black shale.

quartzite. Though much broken up they appear to dip generally S. 40° E. $< 60^{\circ}$. A little above, the shales become grey and are ochreous in places from the presence of a small quantity of iron ore. Indistinct traces of plant stems also occur.

Quartzite.

The hard and quartzose sandstones are exposed for about fifty feet. Then, for 200 yards, the measures are concealed, to ledges of grey shales which, though somewhat broken, have a general dip S. 10° E. $< 35^{\circ}$. These also contain plant stems and have nodules of clay ironstone. In character they are very like the grey sandy shales seen on the Pictou railway east of Riversdale station.

Twenty-seven paces up stream, the grey shales are unconformably overlaid by dark-brown, irony-looking conglomerates, and roddish-brown shales, which dip N. 30° W. $< 65^{\circ}$. These are much slickensided and contain large quantities of red hematite, the conglomerates resembling very closely those of the Wallace River section already described. An anticlinal structure is very apparent in the underlying strata at this place.

The conglomerates are succeeded or overlaid further up stream by brownish or indian-red sandstones, with occasional bands of red conglomerate, which dip N. 10° W. $< 70^{\circ}$. Occasional patches are grey and shew remains of plants, among which pieces of a calamite were noted. These extend for 220 yards. Thence for 450 yards the strata are brownish-grey sandstones, hard and quartzose, with grey grits and thin bands of brownish-grey shales, the dip remaining the same. At 180 yards further, dark-brown sandstones and shales, with remains of plants, dip N. 25° E. < 50 , and are exposed for 270 yards. Thence for 800 feet further the measures are concealed to brownish and grey shales and sandstones, the shales sandy and slickensided in places, in others very fine grained, brown and marly, dip N. $< 75^{\circ}$ - 90° , to line of fault. This is fifty chains in a direct line from the anticlinal mentioned above.

Thence measures are concealed for 500 yards, after which brown sandy and marly shales, changing to sandstones in 100 paces, occur and dip S. 10° E. $< 20^{\circ}$. The angle of dip increases to 30° in 100 paces more, but in a couple of hundred yards is reduced to an angle of 5° . A little above, the dip is reversed to N. 10° W. $< 5^{\circ}$, denoting a low anticlinal. 700 yards above, the dip is again reversed to S. 35° E. $< 30^{\circ}$, the rocks being brownish sandstone and brownish-grey shales.

The strata, all along this portion, it will be observed, are very similar in character and have a decided Lower Carboniferous aspect. At the last noted exposure, the sandy portions are greyish and the shales marly.

A few yards above, grey sandstones and shales come in on the west bank of the stream, dipping N. 35° W. $< 30^{\circ}$, indicating another anti-

clinal at this point. They here contain a seam of coal which is underlaid by grey clay, and where exposed in a slope on the west bank showed a thickness of 12 to 14 inches, associated with black and grey shales. The coal was apparently dirty and of little value.

In the vicinity, or a little below, several openings had been made and shafts sunk for a short distance. These, though filled with water, showed small quantities of coal and black shales at the surface, and were, in so far as could be ascertained, sunk on the same seam but on the southern side of the anticlinal. No other seam could be observed, either at the surface or in the bed of the river. This place is ten chains below the back road leading to Cotnam settlement, and no ledges appear on the stream between the coal opening and the bridge.

Above the bridge, the measures are concealed for nearly 200 yards. Then ledges of grey sandstone and marly shale are exposed in a small outcrop dipping S. 30° W. < 30°. Measures are again concealed for half a mile to ledges of red and greyish-brown conglomerate with thin bands of sandstone. The conglomerate contains pebbles of slate, quartzite, felsite, syenite, &c., and dips S. 20° E. < 35°, overlaid by others, which are coarse and irony, and like that noted at the anticlinal near the beginning of the section. These are in turn underlaid by greyish-brown coarse grit, and fine brown shales, dark red-brown conglomerates and thin bands of red sandstone, dipping S. 45° E. < 45° to black carbonaceous shales, dip S. 30° E. < 90°, like those first noted on the lower part of the stream, which complete the section. They are much broken and become grey in their lower part, and are exposed at intervals for thirty chains, having midway an outcrop of hard, greenish-grey rock, mottled with dark shades and containing a small quantity of calcite. This is probably a fine-grained diorite. The slates in this lower portion are graphitic, and dip S. 5° E. < 40°. Greenish-grey and purple altered slates and quartzite containing limonite and spathic iron ores directly underlie the black slates, and are apparently conformable, dipping S. 5° E. < 40°. These are the eastern extension of the iron-ore belt of the Londonderry mines.

Throughout this section no rocks which could be recognized as belonging to the Middle Carboniferous were seen, the strata throughout have a marked Lower Carboniferous aspect, and the coal seam, instead of belonging to the productive measures, is much more likely to be one of the thin coals, found in the lower formation at intervals along the north side of the Basin of Minas.

On the Pine Brook, a branch of the Debert River, a similar synclinal structure is found on the portion of the stream to the south of the road from the Cotnam settlement to the East mines, and about one mile and a half west of the section just given. The strata are brown

and brownish-grey sandstone and shale of Lower Carboniferous aspect, resembling those on the Debert, but the measures are much less disturbed; the dips on the south side of the synclinal on the Pine Brook are generally N. 5° - 10° W. $< 30^{\circ}$ - 50° , and the exposed breadth of the formation from the contact of the Trias to the centre of the synclinal is eighty chains. The dips on the northern side, which apparently extend to the band of black carbonaceous shales near the foot of the mountain, are S. to S. 30° W. $< 35^{\circ}$ - 50° . No traces of coal are visible on this stream.

Chiganois
River.

To the east, on the Chiganois and North Rivers, paced sections were made. On the former stream, Triassic sandstones extend for one mile north of Belmont Corner, and have a low southerly dip. They rest unconformably upon brown and brownish-grey shales and sandstones of Lower Carboniferous age, which dip N. 10° W. $< 35^{\circ}$. These are overlaid by red sandstones and conglomerates, which are like those seen on the Debert, and which are probably their equivalents. They dip N. 60° W. $< 30^{\circ}$, gradually changing to west, the angle decreasing to 15° , and are exposed for sixty chains, when they are unconformably underlaid by grey and brown sandy shales containing remains of plants. These are much shattered, but in one place dip N. $< 85^{\circ}$ - 90° .

Coal seam.

Similar beds, with occasional bands of grey sandstone and shale, extend up stream with a uniform dip of N. to N. 20° E. $< 50^{\circ}$ - 60° for ninety-five chains. At this point a small shaft was sunk some years ago in a bed of grey sandstone and blackish coaly shale, which dip N. 15° W. $< 50^{\circ}$. Small pieces of coal were strewed about the mouth of the shaft, and a thin seam of dirty coal occurs at this place. Above this, for sixty-five chains in a straight course along the stream, this dip is pretty uniform. A reverse dip is then seen to S. 35° E. $< 60^{\circ}$, indicating the presence of a synclinal which is, doubtless, the extension of that already described on the Debert River and Pine Brook. The character of the sediments is also very similar, being mostly brownish-grey sandstone, shales and conglomerates. Above this to the mill, at the end of the road from Delany Settlement, the strata are more disturbed, frequent and abrupt changes of dip being noted. The rocks, however, continue similar in character, with perhaps a greater thickness of grey beds. A short distance below the mill, and for 150 yards above, hard, green and grey conglomerates occur, dip S. 40° E. $< 30^{\circ}$, associated with hard and fine grained sandstones and shales, and with interstratified beds of black shale, which contain abundance of remains of plants in some of the layers. These, while presenting some of the features of Millstone-grit plants, are from their stratigraphical position without doubt older and probably indicate a portion of the Lower Carboniferous formation. A shaft has been sunk in a bed of

Fossil plants.

black shale just above the mill at this place in the search for coal, but ^{Black shale.} without discovering any.

This shale lies between thick beds of hard green conglomerates of Lower Carboniferous aspect, which rest upon greenish-grey and purple quartzite, containing spathic iron, the representatives of the iron ore belt in this direction.

The green conglomerates can be traced eastward through the Delany Settlement and across the road leading from Onslow to Judge Monro's house. Between this point and McCallum's mill, on the south branch of the North River, a small seam of coal occurs, which was ^{Coal.} opened many years ago, but found to be of no economic value. This is, probably, the extension of the seam seen at the Debert River.

The section on the west branch of the North River reveals strata ^{North River.} similar to those already described. A well defined anticlinal is seen sixty chains north of the upper bridge, eight miles from Truro, between which and the iron ore belt, near McCallum's mill, the structure is a synclinal. The Lower Carboniferous, as exposed lower down on the stream is a good deal disturbed. Westward, on the Folly River and on the Intercolonial railway, north from Londonderry station, good sections of this formation are afforded. The synclinal structure already noted is evident at both places. On the Folly River, the con- ^{Folly River.} tact with the overlying Triassic beds is near a small brook from the east, 500 yards above the railway viaduct. The first exposures are red sandstone and conglomerate, like those of the Debert outlier, which dip S. 10° - 30° W. $< 50^{\circ}$, the upper measures being nearly horizontal or dipping southerly at a low angle. Underlying these red beds, brown-grey sandstones and shales of the same character as those already described on the other streams dip S. to S. 30° W. $< 30^{\circ}$ - 80° , and extend up stream, and at forty-five chains from the overlap of the Trias show an anticlinal structure, the opposing dips being S. 20° W. $< 80^{\circ}$ and N. 20° E. $< 50^{\circ}$ - 60° . Thence to the centre of the synclinal a breadth of seventy-five chains is occupied by similar strata, dipping generally N. 15° - 20° E. $< 45^{\circ}$.

Above the road from Folly Mountain to the East mines, the strata are much disturbed and the dips irregular. A series of grey sandstones, shales and conglomerates are exposed for twenty-five chains which very closely resemble the lower portion of the Millstone-grit. They are unconformably underlaid by hard, green Lower Carboniferous conglomerates, which form high cliffs and extend up stream for twenty chains, where they rest upon the band of black shale and associated ^{Black shale.} iron ore rocks. A fault is evident here which throws this band back to the north for twenty chains. Should the rocks above the bridge be of ^{Fault.} Millstone-grit age they are exceedingly local, since no trace of them is

visible either to the east, at the East mines, or west in the direction of the Great Village River.

Between Pine Brook and this point the Lower Carboniferous sandstones and conglomerates are well exposed at several places. They dip uniformly S. 30° E. $< 40^{\circ}$ - 50° .

The line of separation between the Triassic and Lower Carboniferous crosses the Intercolonial railway, one mile and a fourth west of the Folly River. Thence to Londonderry station an anticlinal structure is apparent, the opposing dips being S. 30° W. $< 70^{\circ}$ and N. 30° E. $< 45^{\circ}$.

The road from Great Village to Londonderry mines keeps along the east bank of the Great Village River and affords a good section. The contact with the Trias is near a small brook, about a fourth of a mile north of the road leading to the Londonderry station. The first outcrops, underlying the Triassic, are dark red conglomerates and sandstones, the former containing pebbles often of large size. These extend for 1960 paces to a fault, the dip being generally southerly at an angle of 20° . North of the fault the dips change to a northerly direction at angles of 40° to 50° , which continue to the crossing of the East Branch just south of the mines village, the last ledge consisting of brown shale and sandstone, dipping N. 55° E. $< 15^{\circ}$.

On the other side of the brook, ledges of grey, coarse grit and conglomerate with grey shale, containing plant remains, often of large size, dip S. 25° - 30° E. $< 45^{\circ}$. They are entirely distinct in character from the Lower Carboniferous strata already described and have a strong Devonian aspect. These beds cross the East Branch between the road and the foot of the dump, where they form a cliff on the west side of the stream. Patches of red Lower Carboniferous conglomerate rest unconformably upon them in places, both along this stream and on the road round the spur of the hill on the west side of the river, not far from the manager's house. Two distinctly unconformable formations are here exposed, the upper of which dip S. 80° E. $< 40^{\circ}$. The underlying beds which are like those of the ridge between Truro and the Stewiacke valley are possibly the equivalents of the hard quartzose beds noted in the lower part of the Debert River section. They also occur further west, in the vicinity of Economy and Five Islands. Their relations to the unconformably overlying Lower Carboniferous measures will be presently described.

Between the mines and the Economy River, the exposures are few. The Lower Carboniferous extends continuously in this direction as indicated by their presence on the road from Port-au-Pic to Castlereagh Settlement, and westward at Pleasant Hill in the rear of Upper Economy.

Contact of
Triassic and
Lower Carbon-
iferous.

Great Village
to Londonderry
mines.

Londonderry
mines.

Londonderry
mines to
Economy.

The sections on the Economy River and in the roads in the vicinity, ^{Road up Economy River} display a considerable diversity of lithological character in the various groups exposed between the Economy falls and the shore. On the road leading back from the shore road, one mile west of Upper Economy, after passing over the Trias, which has a breadth of three-eighths of a mile north from the main highway, we ascend a ridge having an elevation of 450 feet. On the south slope of the hill, reddish-brown sandstones, shales and conglomerates are exposed in the gullies alongside, with a southerly dip at angles of 45° . These extend for about fifty-six chains to brownish-grey altered shales, which dip N. 55° E. $< 40^\circ$. The exposure here is limited, but along the top of the ridge, pieces of grey quartzite and slates, of a much older aspect than the rocks first seen, are met. These extend down the north slope of the ridge till we approach the valley, when bright red sandstones and conglomerates, the extension of the upper members of the Lower Carboniferous from the east, come in. These have a breadth of a mile and a half, and occupy the valley of the east branch of the Economy River.

The road up this stream keeps close to the west bank for a couple of miles, or to the bridge, where it crosses to Pleasant Hill. ^{Pleasant Hill road.} Here the bright red sandstones, just noted, are again seen, and have a breadth on the river of 120 chains, and thence extend west to Five Islands. The dip at the bridge is N. 30° W. $< 40^\circ$. One fourth of a mile below this bridge the rocks, which constitute the ridge, described on the other road are met, and consist of grey shales and hard, brownish-grey and grey quartzite or quartzose sandstone, distinct in character from the beds of the Lower Carboniferous of the sections to the east. They are distinctly unconformable, not only to the bright red sandstones and conglomerates of the Pleasant Hill settlement, but also to the ordinary brown sandstones and shales of the formation in rear of Upper and Middle Economy villages. Where traversed by the river, they present cliffs of considerable height, and have an exposed breadth of twenty-eight chains. They dip generally at high angles, 75° to 90° , and their strike is the same as on the top of the ridge two miles east.

At the point where the sharp bend occurs in the stream, one mile ^{Faults.} above the Economy road, a fault occurs, the rocks on the opposite side of which dip S. 15° W. $< 50^\circ$ to 80° and S. 80° W. $< 40^\circ$. Below this, brown sandstone and brown and grey marls and sandy shale of Lower Carboniferous aspect, are exposed for twenty-seven chains, below which the country is flat to the shore.

The portion of the Economy River directly below the falls, which ^{Economy River} are four miles and a quarter north of Central Economy P. O., is occupied for 1,900 paces by brown sandstones, shales and conglomerates of the usual character, having a southerly dip at high angles, and rest

Iron ore rocks. upon the iron ore belt seen at the falls, and on the hillside to the west. Altered shales and quartzite like those described in the lower part of the stream then appear with an exposed breadth of only 100 yards. A fault is apparent between these and the strata to the north. The hard beds dip south $< 70^{\circ}$ - 90° , and are overlaid unconformably by the bright red sandstones and coarse conglomerates already described. They are probably the equivalents of the altered series of the ridge lower down, and may form the outcrop of the northern side of a steep synclinal basin.

It is evident from the difference in the character of the rocks on this stream as well as from the diversity of dips, that at least three unconformable series occur below the Trias. Of these, the upper, embracing the red sandstones and conglomerates, is undoubtedly a portion of the Lower Carboniferous, as it underlies the Triassic unconformably at several places. The second includes the brown and brownish-grey sandstones and shales with beds of grey and brown-red conglomerates, and while unconformable to the red sandstone portion just mentioned, is also a portion of the same formation. The third and lowest series, while distinctly unconformable to the other two, has, in addition, a much older and more metamorphic aspect, the shales being at times slaty and the sandstones quartzose and often a true quartzite. They are identical in character with the rocks of the ridge which extends between the Salmon River and the Stewiacke valley and which have been hitherto classed as Upper Silurian. They contain, however, plant remains at various points and on the whole resemble much more closely some of the plant beds of the Devonian of southern New Brunswick than either Silurian or Lower Carboniferous sediments. Between Economy and Harrington Rivers, Lower Carboniferous sediments are exposed at rare intervals. They appear from beneath the Trias on the shore sixty-four chains below the mouth of Carr's Brook and extend for half a mile. A small outcrop is also seen in the brook mentioned at three-fourths of a mile above the road. Between this and Lower Five Islands, ledges are apparently wanting, but the debris on the several roads and the character of the soil shew the continuance of the formation in this direction. On the Bass River it has a breadth of one mile, beyond which it is probably terminated by the underlying quartzite series.

The North River, a small stream one mile east of Harrington's River, affords a good section of the rocks of this series which have generally been considered as a part of the Lower Carboniferous formation. Upon examination, however, they are found to be mostly altered shales and quartzites of the underlying unconformable series, described on the Economy River to the east. The strata are well

Three unconformable series below the Trias,

Probable Devonian areas

North River.

exposed on the stream between the road and the falls, 130 chains up, or to the contact with the old schists of the Cobequid series, and are as follows:—

At the road, and for ten chains north, fine red conglomerates, sandstones and shales of presumably Triassic or Carboniferous age. Then hard brownish quartzites, with sandstones and shales containing traces of plants, cordaites, &c., identical with the quartzite series south of Truro, dip N. 30° E. < 40°, with grey, micaceous, sandy slates and slaty shales and sandstones, in places a hard quartzite also containing plants, same dip, to centre of synclinal basin.

The exposed breadth of these rocks is sixty chains and the estimated thickness is 2,500 feet.

On the north side of the synclinal these beds are repeated, the dip ranging from S. 10°-20° W. < 30°-70°, and are distinctly and conformably overlaid by the greenish-grey quartzite and slates of the Londonderry mines series which here carries veins of iron ore of considerable size. The black carbonaceous shale band is here a part of the series which holds the iron ores.

West, on the Harrington River, near the crossing of the road to Parrsborough, similar greyish and brown quartzite occur, the extension of this area. Both lithologically and stratigraphically they are distinct from the ordinary sediments of the Lower Carboniferous in this direction, and are, as stated, more like beds which have been designated Devonian in New Brunswick.

Beyond this, in the direction of Parrsborough, the two series have not yet been separated.

DEVONIAN.—F.

No rocks which can be assigned to this horizon were observed by us on the north side of the Cobequid range, but on the southern flank at several places, strata, intermediate in position between the iron ore belt and the Lower Carboniferous, and distinctly unconformable to the latter, occur. They have a strong Devonian aspect, but as their character and relations have been pretty fully considered in the last chapter, and as further examination will be necessary to fix their precise horizon, their further discussion may be for the present deferred.

SILURIAN.—E.

On the north side of the Cobequid range, the only area of this age recognized by us was at Wentworth station, on the Intercolonial railway, and for rather more than a mile west. As here exposed, the following characters are presented:—One hundred paces south of the

Wentworth
station.

Dykes.

station, greyish conglomerates, apparently felspathic, are indistinctly seen on the west side of the track. Their relations to the fossiliferous slates are somewhat difficult to determine, but they probably underlie them unconformably and belong to a distinct group. They are succeeded directly to the south by the syenites of the mountain. West of the station, a cutting occurs in soft greyish and dark bluish-grey rubbly shales, which are traversed by several dykes of hard, green dioritic rock, often epidotic (diabase). These cut the beds transversely and have shattered and otherwise altered the shales with which they are in contact. The fossiliferous rocks are thence exposed to a point on Caldwell's Brook, 112 chains from the station, where their contact with the Lower Carboniferous is seen in the tunnel under the railroad. The most westerly exposures consist of hard slates of a greyish color and with a yellowish tinge in places, and are apparently more altered than those near the eastern end of the section. They dip S. 40° E. < 30°, and on Caldwell's Brook have a breadth exposed for 150 yards, being terminated at an old mill just south of the railroad by ledges of reddish syenite. On Whetstone Brook, twenty-three chains west of the station, these rocks are observed for one-fourth of a mile below the railway, having a dip at the northern edge of S. 20° E. < 35°. This is at the forks of a small branch from the west, below which Lower Carboniferous sediments occupy the stream.

The Silurian rocks of this locality lie in the form of a narrow basin, the reverse dip to the north being seen in the first cutting near the station. The fossiliferous beds, therefore, of that locality, occupy the centre of the synclinal, while the rocks of Caldwell's Brook, to the west, probably represent the lower members.

East of Wentworth, as far as the French River at least, these rocks have not been seen by us on the north side of the mountains, nor do they appear, in so far as known, to the west of Caldwell's Brook, being either entirely absent or covered over by the overlapping Lower Carboniferous beds.

From the collection of fossils made in 1873 by the late Mr. W. McOuat, the age of this outlier was determined by the late Mr. Billings as probably that of the Clinton. The species recognized by him in Mr. McOuat's collection were as follows. (See Report of Progress, 1874-5, page 10.)

Fossils.

- Graptolithus*, allied to *Gr. Clintonensis*. Hall.
Lingula oblonga. Conrad.
Leptaena transversalis. Dalman.
Strophomena corrugata. Conrad.
Rhynchonella Eva. Billings.
Atrypa reticularis. Linnæus.

From a small collection made during the past summer the following species were determined by Mr. H. M. Ami, B.A.:—

- Lingula oölonga.* Conrad.
Strophomena rhomboidalis. Wilckens.
Orthis. Sp. undet.
Leptocælia. " "
Atrypa reticularis. Linnæus.

Fossils.

These confirm the conclusions of Mr. Billings in 1873.

The same view has also been taken by Sir Wm. Dawson in the supplement to the *Acadian Geology*, 1878, page 75, where a list of fossils similar to those above enumerated is given.*

On the south side of the Cobequid range the belt of rocks containing the iron ores of the Londonderry mines and vicinity have a very extensive development. They were found during the past season to form a continuous band, from the road leading from Truro to Tatamagouche, west to the Harrington River, good exposures being seen on every stream section, and from the observations of Mr. Scott Barlow, further west, it is evident they extend almost to the extremity of Cape Chignecto. Throughout their whole extent, the rocks can be easily recognized, not only by the presence of ores of iron, in greater or less quantity, but by their lithological character. They are greyish and brownish-grey quartzites, with grey and brown shales, and others of greenish shades, while a belt of black graphitic shale is found along the southern border almost continuously throughout its whole extent.

Iron ore series
of Londonderry
mines.

No fossils have yet been observed in the area examined by us, and it is, therefore, very difficult to pronounce definitely as to their age. In lithological characters they very closely resemble Devonian rocks of other parts of the province as well as of New Brunswick. The researches of Sir Wm. Dawson and Dr. Honeyman in the county of Pictou, on what they consider the equivalents of this belt, tend, however, to shew that they belong to the horizon of the Silurian, but as this area is for the most part beyond the limits of the accompanying sheet, discussion as to the exact age of the rocks in question is deemed unnecessary, pending further examinations during the coming season. The characters of the rocks and associated ores are given in detail in *Acadian Geology*, 1868, and Supplement 1878, also in Report of Progress, 1872-3, page 19-31.

The fossiliferous Silurian strata of Earleton, referred to by Sir Wm. Dawson, supplement to *Acadian Geology*, page 75, have not been seen

* From a paper on this locality read by Dr. Honeyman of Halifax, in 1873, (see Transactions of the N. S. Institute of Natural Science, Vol. III, page 353,) it will be seen that that gentleman dissents from the views above expressed and claims that these rocks should be assigned to a lower horizon, probably Hudson River.

in the area included in the present report, the rocks underlying the Carboniferous basin on the French River and its branches being talchloritic schists and felsites, which will be described in the chapter on pre-Cambrian.

PRE-CAMBRIAN.—A. B.

Characters
of the rocks in
Albert county.

The pre-Cambrian of eastern New Brunswick, embraced in the accompanying map, is confined to the county of Albert, and represents the eastern extension of the great pre-Cambrian area of the southern part of the province, which terminates a short distance west of Demoiselle Creek. Good exposures are seen on the roads, leading north, from Hopewell Corner and Hopewell Hill, which cross the range of the Caledonia Mountains. In character they are similar to those in Kings and St. John counties, and are fully described in previous reports, 1877, and later. They consist of hard green and purple slates, talco-chloritic and micaceous schists, red flinty felsites and fine-grained gneiss, often hornblending, syenites and granites, sometimes protogine, with green, often epidotic, diorites. The dip is generally northerly, on the south flank of the range, at about an angle of 50° , rising, however, near the summit of the mountain, to 90° . The surface breadth of these rocks, as here displayed, is nearly eleven miles, which, with an average dip of 50° , would present the enormous thickness of 43,500 feet. The structure is, however, probably an overturned synclinal, as has been shown to be the case in Kings and western Albert.

A small outcrop of these rocks is also seen on the road leading from Hopewell Hill to Curryville, in rear of Shepody Mountain. They consist of purple and green chloritic and talcose schists, sometimes containing epidote, and are exposed for about three-eighths of a mile along the road. They are flanked by Millstone-grit sediments on the north and east, and by the Lower Carboniferous conglomerates of Shepody Mountain on the south. They dip N. 5° E. $< 50^\circ$.

In the Geological Survey Report, 1877-8, page 6 D, a reference is made to a supposed outcrop of pre-Cambrian rocks on the Beech Hill road, east of Memramcook Corner. Re-examination shews this area to consist of drift pieces only, and the underlying formation to be Carboniferous.

In the province of Nova Scotia, the area included in this formation embraces the greater part of the range of the Cobequid Mountains, which extend, from the south-west extremity of Cumberland county, east into Pictou. North of Minas Basin, the average breadth of this belt is about eight miles, which, in its western extension, becomes somewhat reduced. During the past season, a number of sections were made across the range, along the streams which take their rise in the numerous lakes found along the top of the mountain ridge, and flow south to

Minas Basin or north to the strait of Northumberland. Among those on the south may be mentioned the Chiganois, Debert and Folly, of the Intercolonial, while to the west, the Great Village, Economy and the streams in the vicinity of Five Islands, were examined. On the north, sections were made on the Mill Brook, which heads near Debert Lake, and on the several branches of the French River, as well as on the Intercolonial railway. On all these streams excellent opportunities are presented for studying the structure of the mountain chain, as well as along several of the roads which cross its summit.

In general, it may be stated that in lithological character, the Cobequid series is almost identical with the pre-Cambrian of southern New Brunswick, consisting of a great thickness of crystalline rocks. Among these are large areas of syenite and diorite, the former both red and green or the protogine of the New Brunswick series, often epidotic, red crystalline felsites sometimes porphyritic, schists of various kinds, chloritic, talcose, micaceous and hornblende, quartzite, gneiss and hard green slates with crystalline limestone. The schistose portion apparently rests upon the syenites and diorites, which seem to constitute the bulk of the central and northern areas. On the north the series is overlaid, at Wentworth, by the fossiliferous Silurian just described, and, elsewhere, by Lower Carboniferous sediments, while on the south the belt of rocks containing the iron ores extends along its whole length in unconformable contact.

The upper part of the Debert River and the road connecting with New Annan shew well the character of the rocks now under consideration. Beginning at the contact with the iron ore belt, we find—

Hard green felspathic slaty schist, in places slightly pyritous. Dip S. to S. 10° W. < 80° to 90°.

Hard greenish and greyish felspathic rocks, in places a pure felsite, chloritic, with masses of diorite and syenite, the former often coarse.

Brownish-grey and reddish-grey felsites, sometimes schistose, green schistose slates. Some of the beds a white felspathic quartzite, with coarse grey diorites and fine reddish syenites.

Felspathic quartzite, whitish-grey felsitic schists and diorites, in upper portion the felsites are gneissic. S. 35° E. < 75°.

Hard greenish felsites, greyish gneissic and hard, whitish-grey, felsites, with quartz. The felsite much jointed in sharp square blocks. Hard green felspathic schist. S. 20° E. < 75°.

Grey felspathic gneiss, with diorites and schistose slates, to falls over fine-grained, massive green diorite.

Gneissic felsite cut by diorite dykes.

Fine-grained syenite (hornblende).

Reddish gneiss and protogine syenite.

Protogine granites, green slates, and fine green diorites.

Various streams examined.

Similarity of the Cobequid series to the Pre-Cambrian of New Brunswick.

Section on Debert River.

NEW BRUNSWICK AND NOVA SCOTIA.

Green chloritic schist, S. 35° E. < 60°. Talco-felspathic schist, S. 15° W. < 55°. Hard bluish-black rubbly felspathic slaty schist, S. 15° W. < 40.

Hard green schist with epidote. S. 30° E. < 50°.

Hard green epidotic diorite, with green schist, to McMullins' mill.

Dark greyish-green altered slates. S. 20° E. < 65°.

Dark green crystalline diorites.

Greyish-green hydromica schists. S. 5° E. < 30°.

Chloritic schist. S. 50° W. < 65°.

Red syenites and fine-green diorites, with occasional bands of schist to Debert Lake.

On the upper part of Mill Brook, which completes the section to the New Annan road, the only rocks seen were:—

Fine-grained, dark-green diorite, sometimes porphyritic.
Brownish-red, porphyritic felsites.

Road from
Debert River
to New Annan.

The road from McMullin's mill to New Annan shews, at the crossing of Shatter Lake Brook or east branch of Debert River, large ledges of green talcose and chloritic schist, dip S. 30°-50° E. < 40°, resting upon reddish granite. Thence, to within a short distance of the rear road in West New Annan settlement, ledges of red felsite, syenites and green diorite, with occasional bands of green chlorite schist, are seen. The syenites are occasionally greenish, resembling the protogine of southern New Brunswick. A gneissoid structure is seen at several points.

On the brook flowing from Byer's Lake, the prevailing rock is finely crystalline, dark-green diorite, which is intimately associated with reddish porphyritic felsite and with gneissic hornblendic rock. The diorite often contains much epidote.

Pine Brook.

A second section measured on Pine Brook, a branch of Debert River, disclosed the presence of strata similar in character to those just described. They consist of chloritic, talcose, hornblendic and felspathic schists, schistose gneiss, hard, green felsite, greyish-white felspathic quartzite and true gneisses, with fine green diorite, resting, as on the Debert, upon the nucleus of dioritic and syenitic rocks. These are all very strongly pre-Cambrian in their aspect.

On the Polly River, after passing the Lower Carboniferous sediments and the belt containing the iron ore, the first rocks of the mountain series are dark-green crystalline diorite, with a band of hard greyish-white felspathic quartzite. Thence ascending the stream we have:—

Diorites, reddish gneiss and schist, S. 20° E. < 55°. Green chloritic schist and fine, hard green slates. Fine, green crystalline diorites, with hard, fine, green schistose slates.

Hard green chloritic, felspathic and hornblendic schists, with small veins of white quartz.

Green and grey, hard felspathic schist. S. 40° E. < 45°. Schists, chloritic, micaceous and hornblendic, with slaty diorites. Thence to foot of Folly Lake, hard, green diorites, mostly fine-grained, hard, green slate, and occasional bands of chloritic and hornblende schist, occupy the stream.

A similar series of rocks is found on the Intercolonial railway in the several cuttings, south of the Lako, except that fewer schists and slates are visible, the cuts being principally through the crystalline volcanic portion, fine-grained diorite, epidotes, &c. Section on Intercolonial railway.

A paced section was made along the railway between Wentworth and Londonderry stations. The portion between Wentworth and the Folly station, which embraces the northern and central portions of the range, discloses principally syenitic, dioritic and felspathic rocks. These are often intersected by transverse dykes of granite. The prevalence of epidote will be at once seen by reference to the section below. The first rocks, after leaving Wentworth station, are apparently:—

	PACES.
Syenitic, hard greenish-grey and dark gray, composed of quartz, felspar and hornblende, then hard fine-grained diorites, with reddish-brown felsite, sometimes porphyritic, the whole series containing epidote in considerable quantity, and extending	655
No exposures	794
Fine epidotic and red porphyritic felsite.....	224
No exposures to large brook.....	83
Hard, green diorites	532
Red, moderately coarse, syenite.....	260
Red, fine syenite, almost a pure felsite.....	122
Hard grey diorites, red syenites, felsite and epidotic diorites to end of cutting.....	330
No exposures.....	341
Fine-grained diorite, with veins or dykes of red felspar and fine-grained granite.....	60
No exposures	580
Hard coarse diorite, with large crystals of black hornblende and felspar—bright red felspathic granite with scattered grains of quartz, epidote and hornblende	220
No exposures	70
Red felspathic syenite and fine green diorite.....	535
No exposures	414
Hard, fine-grained red felspathic syenite.....	1330
Fine green diorite and red, fine-grained syenite, almost a felsite..	1100
To head of Folly Lake.	

The red syenites of this section are largely composed of red felspar, with very sparsely disseminated grains of quartz. In places the rock is a red felspar porphyry. These are apparently cut by dykes of fine green

diorite, often of small size. The coarse hornblende diorites are much more extensive. The schistose rocks seen on the southern flank appear to be absent from this part of the mountain, which stratigraphically underlies them.

The entire width of the crystalline portion of the range from Wentworth station south to the the overlap of the iron ore belt is 640 chains. Of this space, nearly seven miles is occupied by the dioritic and syenitic rocks just described, the overlying schists, which compose the south flank of the range, being rather more than one mile in breadth.

Similar rocks in the same order of succession are seen on the roads and streams north of the Londonderry mines.

Further west, on the road from Port-au-Pic to Sugar Loaf Mountain, the first rocks of the Cobequid series are blackish hornblende gneiss, composed of quartz, felspar, hornblende and mica, dipping S. 35° E. < 75°, then going north we have—

Hard, fine grained diorite, green and purple shades.
Talco-chloritic and gneissoid felspathic schists.
Diorites and syenites, containing hornblende.
Green chloritic schists and slates.

These latter extend to within a mile of the county line. Here on the farm of R. Fulton, red slates resembling in character the reddish slates of the Quebec group are seen, but their area is exceedingly limited, having a breadth of about one-fourth of a mile and extending only for a few hundred yards. They are, probably, a portion of the mountain series. Diorites again come in and extend to the county line.

North of this, the road runs through the woods till it joins the road from River Philip to Londonderry. Exposures are not numerous, but where seen consist of green epidotic diorites and syenites with occasional bands of green schist, the most northerly exposure at the overlap of the Lower Carboniferous being red syenite. This is sixteen chains from the cross-road on the east branch of River Philip. The section further west on the road from Maccan River to Five Islands discloses a like succession, the granites and diorites occupying the northern and central portions, while the schists constitute the south flank.

On the line of the Spring Hill and Parrsborough railway, the first rocks underlying the Lower Carboniferous on the north side are hard greenish-grey and green felspathic slates, much altered and with patches of white quartz. Further south they apparently become more felspathic, weathering a dirty pinkish grey, and with disseminated crystals of pinkish and grey felspar, constituting a true feldspar por-

Breadth of
the Cobequid
series.

Road from
Port-au-Pic to
Sugar Loaf
Mountain.

Five Islands to
Maccan River.

Spring Hill and
Parrsborough
railway.

phyry. Large veins of white quartz occur at intervals. In the vicinity of the lake, near the lower end of the pass, red felspathic syenites and fine green diorites are seen, and at a mill on a brook coming from the east, green chloritic schists of pre-Cambrian aspect appear. South of this, the only rocks on the railway are apparently reddish felsites, often hard and porphyritic, a true felspar-porphry, in some places having a purple tinge. They extend to the flat which lies between the mountain range and Parrsborough village, where, owing to the dense covering of gravel, no ledges are visible. The schistose belt, so conspicuous in all the eastern sections, is here largely wanting, owing probably to the denudation of the southern slope of the mountain.

The western end of the range on the Bay of Fundy discloses a series of rocks very similar to that between Wentworth and Folly Lake, except that the crystalline felsites are more extensively developed. Like the last, the schistose portion is largely wanting. The first exposures are on the south side of Spicer's Cove and consist of hard crystalline and porphyritic red felsites. Between this and Cape Chignecto, felsites and syenites, with occasional large masses of epidotic diorite, occur. Dykes of fine-grained syenite and felsite also cut the rocks along the shore and extend inland for some distance. Bands of dark-green chloritic slates and schist occur at intervals. At Spicer's Cove the dip of the felsites seem to be S. 25° W. < 80°, and this is the general inclination along the whole of this section. This portion of the coast is so rough that accurate measuring along the shore is impossible, and the strong tidal currents render boat navigation dangerous.

Spicer's Cove
to Cape
Chignecto.

In the Cobequid series just described, no reference has yet been made to the crystalline limestones. These occur at several points, more particularly in rear of Five Islands on the North River and between Londonderry mines and Port-au-Pic. At the former locality the marble is found in the stream about two miles from the mouth and 330 paces north of the main fall which marks the boundary between the pre-Cambrian and the iron ore belt. The rock, much of which is beautifully white and crystalline, is associated with red syenite, green felspathic schist and hard slates. Small dykes and veins of diorite have so shattered it as to render the ledge practically valueless for obtaining large blocks. A short distance further up stream the marble is greenish-grey and serpentinous, and in places traces of asbestos are found. The width of this ledge is from ten to twelve feet, but it has not been traced beyond the bed of the river. The marble of this place occurs associated with green talco-felspathic schist, probably as an integral portion of that belt.

Crystalline
limestones of
Five Islands.

About four miles west of Londonderry mines, on the property

Crystalline limestone near Londonderry mines.

erty of D. and A. Morrison, Cumberland road, and about two miles from the new mines, large outcrops of white marble resembling much of that in the vicinity of St. John, New Brunswick, are seen. It occurs on the south flank of the mountain apparently overlying the schists. A large quantity was taken out some years ago for use at the iron works and is yet lying along the tramway to the new mines. It would, undoubtedly, make a fine quality of lime, but little use has as yet been made of it for that purpose.*

It will be observed from the foregoing that the rocks of the Cobequid range in their lithological character and crystalline structure present, as stated, a marked similarity to the so-called pre-Cambrian of southern New Brunswick. The stratigraphical arrangement of the various groups may be thus briefly given.

1st. The mountain range proper, presenting a series of red syenites, generally fine grained and felsitic, red felsites, crystalline and often porphyritic green diorites, often fine grained and epidotic, but occasionally coarse grained with large crystals of hornblende. These form the great bulk of the chain.

2nd. A considerable thickness of schists, schistose felsites, gneisses and protogine granite, with hard green slaty schists, resting generally upon the southern slope of the mountain, but appearing also at some points on the north side.

3rd. Crystalline limestone, both white and serpentinous, resting generally upon the south flank of the schistose series.

A second, but limited area of schists, is seen at New Annan, on the north side of the Cobequids, which resemble in many respects those already described. They are talcose and chloritic and cut by numerous irregular quartz veins, some of which are reported to be auriferous. They are well exposed on the Four Mile Brook, a branch of Waugh's River, and on the several branches of the French River. In rear of Byer's mill they form the elevation known as Baxter's Mountain, the west face of which presents a bold front overlooking the Byer's Mill Brook. The dip is N. 25° E. < 75°. Thence they cross the stream and extend north-westerly in the direction of Wentworth for several miles. On the east branch they have a breadth of one mile, and rest upon trappean rocks, the dip at the contact being N. 20° W. < 40°, changing in a short distance to north-east, which direction is generally maintained, though there is a low anticlinal about midway on the exposure.

Schists of French River and vicinity.

* From the association of the latter deposit with black shales and quartzites of the iron ore series, it is probable that this band of limestone may belong to the Silurian beds of the vicinity instead of the pre-Cambrian, the immediate cause of alteration cannot, however, be determined.

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This belt is separated from the syenitic and felsitic masses of the Cobequid series proper by an area of trappean rocks which appear to be of more recent date than the schists, and to have been thrust up between them and the red felsites. Their contact with the latter is well seen in Irving's Mountain and at the forks of Byer's Lake Brook and Whirlewha Lake. They extend from the road leading to Truro from Tatamagouche, north-westerly for over six miles. The trap varies considerably in character, in places being roddish and felspathic, while the great mass is either rubbly and irony or dark greenish-grey and amygdaloidal. At the contact with the schists on the east branch of French River, at Mr. Swan's mill, there is a bed of decomposed trap or red ochre with lumps of ironstone, the whole being two to three feet thick, separating the two formations. On the old Chiganois road, now abandoned, these rocks have a breadth of over two miles, but their outline is very irregular.

IGNEOUS ROCKS.

Trappean rocks of various kinds penetrate sediments of Triassic and Carboniferous age at various points. In New Brunswick the only observed exposure of this kind in the area under discussion was noted some years ago by Prof. Bailey on Calkin's Creek (Demoiselle Creek?) a short distance back from the road leading from Hopewell Cape to the hill. The rock is coarse, dark green, nodular and columnar, and contains small veins of magnetic iron of an inch in thickness. The dyke penetrates reddish-grey shales which at the contact have been altered to the aspect and hardness of chert.

On the north side of Minas Basin and channel, areas of trap are found at many points, among which may be mentioned Cape d'Or, Spencer Island, Cape Sharp, Partridge Island, Clark's Head, Moose River, Gerrish Mountain and the chain of the Five Islands and Port-au-Pic Mountain. These are separated by areas of Carboniferous and Triassic rocks, and though now detached are without doubt the eastern extension of the great trap overflow, which has formed the North mountain range of Kings, Annapolis and Digby, on the south side of the Bay of Fundy. Beautiful specimens of the various zeolites, calcite, amethyst, agate, &c., are found, as well as veins of magnetic iron, sometimes of considerable size. The latter has been opened in Gerrish Mountain, near the road from Economy to Five Islands, and a quantity of the ore extracted and sent to the Londonderry mines. The cost of transport would, however, seriously affect its economic value. The trap area of this locality has an extension of five miles and a quarter from Indian Point to its terminus, midway between the villages of Central and Lower Economy, and forms a prominent ridge with an

Areas of trap
around Minas
Basin.

Iron ore.

Gerrish
Mountain.

elevation of 300 to 450 feet. Seaward it extends through the group of the Five Islands in the direction of Blomidon. The section presented on the shore at Indian Point shews the trap to have burst through red shale and sandstones, presumably of Triassic or Permo-Carboniferous age, in a dyke 210 paces wide, which has ascended and then overflowed the soft red shales in either direction. The contact of the two formations is well seen in the cliffs at this place, the trap occupying the upper part for 1,080 paces, gradually descending till it reaches the beach at the neck of the dyke, while the red stratified beds occupy the lower portion. The greatest breadth of the overflow on the mountain is 100 chains.

Moose Island, and one other of the chain to the west, show also both formations, the trap occupying the north side and the shales and sandstones the south.

Port-au-Pic
Mountain.

Port-au-Pic Mountain, eleven miles east from this area, is a roughly egg-shaped mass of trap, with a length of 114 chains and a breadth of sixty-five at its eastern end. In character it is like the other traps of the Minas Basin, sometimes amygdaloidal, at others massive. It is flanked on the south by fine reddish conglomerates, which may mark the lowest members of the Triassic formation, but is not far from the contact of that formation with the Lower Carboniferous.

The characters and distribution of the trap rocks of the upper part of the Bay of Fundy, including the Minas Basin, are so fully given by Dr. A. Gesner in his "Remarks on the Geology and Mineralogy of Nova Scotia," 1836, and later by Sir Wm. Dawson in "Acadian Geology," 1868, that further descriptions are not here considered necessary. Though always regarded as Triassic in age, they must belong to the close of that period, since they are found to have broken through and overflowed that formation at many observed points. Their action upon the sediments through which the dykes pass is very slight, the metamorphism extending, in no observed case, more than a few feet from the line of contact.

Dioritic dykes
in the Silurian.

Dioritic rocks occur at many points, in connection with the iron ore belt. These are, however, apparently a distinct and older set of intrusions than those just described, differing greatly in character. They are generally green and fine-grained, and are more of the nature of the dykes that penetrate the Silurian and older rocks. It may be doubted if the metamorphism seen in these strata is due so much to these intrusions as to other and more general causes.

Throughout the range of the Cobequids, dioritic and syenitic dykes are common. In the vicinity of Wentworth station the former, which are of the nature of a diabase and frequently contain epidote, cut transversely across Silurian fossiliferous rocks, altering them to some extent near the contact.

In many cases the dioritic and syenitic masses appear as an integral part of the mountain series, having a marked resemblance to similar rocks recognized in the pro-Cambrian of New Brunswick and of parts of Nova Scotia. They often constitute large areas and are well exposed on the railroad between Wentworth and Londonderry stations. In places along the railway, dykes of red felspar, porphyry, and reddish granite, cut the dioritic and syenitic rocks. The same is also seen on the coast in the vicinity of Cape Chignecto. Large masses of diorite, generally fine-grained, greenish and grey, are also found associated with the schistose series of the south side of the mountain range.

Dykes of diorite and felsite in the Cobequid series.

In the vicinity of the Spring Hill mines, the ridge to the east, known as Claremont Hill, though for the most part covered with Carboniferous sediments, is undoubtedly a mass of red syenite, as can be ascertained by the quantity of debris along the road up the west slope of the hill. The conglomerates of the northern side and summit are also largely made up of large angular blocks of syenite in a reddish syenitic paste. It does not appear to be connected with the range of the Cobequids, but is apparently an isolated mass.

Syenite of Claremont Hill.

The area of trapeean rocks in New Annan has already been referred to at the close of the chapter on pre-Cambrian. Their age is uncertain, but from their amygdaloid character they more closely resemble the Triassic traps than the fine-grained diorites of the older formations. Where observed, the trap was in contact with talcose schists, on the one hand, and hard crystalline red felsites on the other.

Traps of New Annan.

In New Brunswick, the area of syenite on the Memramcook River has been referred to in the Geological Survey Report, 1876-7, page 378. The rock is reddish, partly fine-grained, but generally coarsely crystalline and porphyritic. It is pre-Carboniferous, as the lower beds of the Lower Carboniferous in this district are largely made up of its debris.

SUPERFICIAL GEOLOGY.

This branch of the subject has, to a certain extent, been discussed by Mr. R. Chalmers in his report on the Superficial Geology of New Brunswick, and all the data obtained by us, relating to striae and ice action, have, in so far as relates to that province, been given to him. In Nova Scotia, north of the Cobequid range, striae, with a direction S. 63° W., were observed on the road from River Hébert to the South Joggins. This may indicate the course of the ice sheet which assisted in the denudation of the upthrow of the Spring Hill coal seams, and which, like those whose traces are seen following the valleys of the Petitcodiac and Memramcook Rivers, and in the vicinity of Aulac, joined the main stream which flowed down the Chignecto Bay and out by the Bay of Fundy.

Striae in the vicinity of the Joggins.

Probable course
of ice-sheet
through the
Cobequid
Mountains.

In the pass through the Cobequids now traversed by the railway from Spring Hill to Parrsborough, striae were observed in the course of the gap, but whether the ice-flow was in the direction of the latter place or towards Maccan could not be determined. Probably the former, since on the south slope of the mountain at New Mines, west of Londonderry, an escarpment of rock, dipping S. $< 50^\circ$, has its face beautifully striated in an east and west direction, following the course of the range towards the outlet of Minas Basin, and into which the Parrsborough valley stream might have discharged.

Striae in New
Annan.

In New Annan, on the north side of the mountain, grooves and striae, in dioritic rock, were noted, course N. 10° E., or down the valley of the French River to Tatamagouche Bay.

Owing to the generally wooded and unsettled character of the Cobequid range, ice markings are very rarely seen, while the generally soft sandstones of the areas on either side disintegrate so readily that, except on freshly uncovered surfaces, they are apparently entirely absent. The remarks of Mr. Chalmers on the distribution of ice sheets in New Brunswick will doubtless apply equally to Nova Scotia. The frequent divergence of the striae points, to some extent at least, to the action of local glaciers following general lines of depression, such as river valleys and the slopes of local water sheds.

Character
of soils.

The soil of much of the country underlain by the soft red rocks of the Upper Carboniferous and by the sandstones, shales and limestones of the Lower formation, is generally of excellent quality. The same may be said of that formed by the decay of the Triassic along the north side of the Basin of Minas. But on the ridge of the Cobequids the hard granite and dioritic rocks produce a soil of no great depth and difficult to work; and being clothed with a dense growth of maple, birch and other hard woods, has been neglected for the more fertile areas around its base.

On the Millstone-grit areas also, the decay of the grey grits and sandstone produces a soil of little value, being generally sandy, and in places there are extensive barrens, especially in the area between Shoulie and Southampton, the favorite resorts of the moose.

Barren soils are also produced from the underlying grey quartzose sandstones of the Upper Carboniferous, such as the Ragged Reef band, the soil being a whitish quartz sand. This is also seen at places on Cape Maringouin, and in rear of Sackville, where this formation occurs.

There is, however, apparently, much good land available for settlement in the northern part of Cumberland and Colchester counties, lying in the first county between the Leicester road and the strait shore, and in the latter, to the south of Wallace and Tatamagouche, and now principally covered by a dense forest of spruce, generally of small size.

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Gravel ridges are not very numerous, and in the flat country on either side of the mountains, not many stray boulders are seen. When found they are generally derived from the Cobequid range and consist of the hard rocks of that series.

A prominent ridge, however, extends northward along the west bank of the River Hébert, producing a marked feature in the otherwise generally level country. This has been referred to in *Acadian Geology*, page 82. It was examined during the past season by Mr. R. Chalmers, whose observations are herewith appended.

"A singular gravel ridge or kame called the 'Boar's Back' occurs ^{Boar's Back.} on the west side of Hébert River, Cumberland county. About a mile to the north of Half-Way Lake, near the foot of the Cobequids, its southern end is reached, whence it extends northward seven or eight miles and is distinctly traceable to Atkinson Brook, near the head of the tide on the above mentioned river. Although its general course is nearly in a straight line, it has numerous local curves and sinuosities which give it a striking resemblance to a winding river course. Its height above Hébert Valley at the southern end is fifteen to twenty feet, at the northern, probably forty or fifty feet, the bottom of the valley having a gradual descent down stream, while the summit of the kame, which, by aneroid measurement, is 100 to 110 feet above high tide level in the Bay of Fundy, appears to be nearly horizontal. The kame follows the river closely and is continuous except where intersected by small streams. Branches run off from the main ridge at intervals, either extending along side of it for short distances, or diverging nearly at right angles therefrom and, after a few hundred paces, sweeping round to the general course of the principal ridge, enclosing hollows which usually contain peat bogs. The crest for fully half its length is little more than wide enough for a wagon road, but in other places it spreads out into terrace-like flats. As a rule, both slopes are steep—as steep as declivities, composed of sand and gravel, will remain stable under atmospheric action, without the materials sliding down from their own weight. Great quantities of boulders, from three feet in diameter downwards, wholly of local rock, that is, of grey Carboniferous sandstone and conglomerate, are interspersed through the sand and gravel. Generally speaking, they are well rounded, but a few were seen to be angular.

"The width of Hébert Valley is from a quarter to half a mile, and its depth, which increases northward, is, perhaps, 50 to 100 feet. The summit of the kame is, therefore, below the general level of the country on both sides of the valley.

"In the absence of any knowledge of its relation to the other Quaternary deposits of the district (our examination being merely a

cursory one), it is inadvisable to speculate regarding the origin of the kame, but its external characteristics and position with respect to Hébert River and the nature of the materials composing it, give it every appearance of a deposit laid down by rapidly flowing waters, and indicate, moreover, that Hébert River must, in some way, have been instrumental in its formation."

ECONOMIC MINERALS.

Coal.—The workable coals in the area embraced in this report are, in so far as at present known, confined to the county of Cumberland and the Joggins and Spring Hill basins. In the former the principal collieries are the South Joggins, Minudie or River Hébert and the Chignecto. The output from the former, during the year ending December 31, 1884, was 25,034 tons, but changes in the working and management of the mine have lately been made, by which the output can be increased to 300 tons per day. The new works, which are one mile and a quarter east of the wharf, are down to a depth of 1,400 feet and are connected with the landing by an endless wire cable, by which the empty cars are hauled back to the slope, the loaded cars descending by gravitation. The parting of shale between the two seams here worked is decreasing in thickness to the east.

Joggins Coal mine.

River Hébert mine.

The Minudie, or River Hébert mine, has rapidly increased its output during the past year to 10,023 tons. It is located on what is probably the extension of the lower or Hard Scrabble seam, having a thickness of three feet nine inches.

Chignecto mine

The output at the Chignecto mine for the past year amounted only to 11,644 tons, the mine being idle for a good part of the time.

Milner and Maccan mines.

At the Milner and Maccan collieries, small quantities only were raised; at the former 155 tons, and at the latter, lately opened by Mr. Wm. Patrick, a short distance west of the old Maccan mine, only 94 tons. The seam at this place is a little under two feet thick. The relations of the seams on which these collieries are placed to the main Joggins seam has never been thoroughly settled, the thickness ranging from two to four feet, but they are capable of yielding a considerable amount of coal if economically worked.

Spring Hill mines.

The Spring Hill colliery is by far the most important in this section of the province, and though not worked to its full capacity, the total output during the past year exceeded by over 30,000 tons that of any other colliery either at Pictou or Cape Breton. There are four slopes known as the North, East, West and South. Of these the two latter are situated on the lower seam, the two former on the upper seam. The thickness of each of these is eleven feet, and they are separated by a vertical thickness of ninety feet. In addition, there are two seams of

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thirteen and six feet overlying, and others of four feet and two feet and a half underlying. The description of these will be found in Mr. Barlow's report, 1873-74. The second eleven feet or upper seam was not at that time definitely located. The capacity of the four slopes is about 2,000 tons per day and the quality of the coal generally is excellent for house and steam purposes.

A new area on the South Branch of the Black River known as the ^{Salt Springs} mine was opened by a Truro company during the past season. A few tons only have been removed. The seam has been described in the remarks on the geology of the area, and at the outcrop has a thickness of two and a half feet. It was traced westward some years ago for one mile and a fourth by Mr. Barlow and Mr. Anderson and its thickness proved by three openings. It was found not to increase in value, but rather the opposite. (For details, see Report of Progress, 1875-76, pages 344-5.)

The Oxford seam has already been described in the chapter on the Oxford mine. Middle Carboniferous.

The remarks on the Debert River area will be found in the chapter on Lower Carboniferous.

Iron Ores.—The only deposit of economic value in the area examined ^{Londonderry} mines during the past summer was that of the Londonderry mines and their extension east and west. Careful surveys were made of all the openings both at the East and the New mines, as well as those in the vicinity of the iron works. The character of the ore varies, embracing limonite, hematite, specular ore, ankerite, yellow ochrey ore, resulting from the decomposition of the latter, and spathic ore, which is now being largely used. Analysis of these several ores will be found in the Report of Progress for 1873-74, pp. 231-233.

Full descriptions of the area have been given in *Acadian Geology*, pages 582-591, and in the Report of Progress, 1872-3, pages 19-31. The ore is extensively raised both at the East and New mines as well as at the village. A railway four miles in length connects the former place with the Intercolonial at East Mines station, while a narrow-gauge railway connects the new mines with the works.

Limestone for flux is brought from a Lower Carboniferous deposit, ^{Limestone for flux.} three miles south of Brookfield, or eleven miles from Truro. The amount of iron ore used during the year ending Dec. 31st, 1884, according to the report of the Department of Mines, was 54,855, and 5,799 tons of ankerite. The production of pig iron per day for the two furnaces was about 70 tons, but one of the furnaces was closed during the latter part of the season. The number of men employed was about 800.

Copper.—The deposits of this mineral, though numerous, are for the most part of little economic value. The most important is that near

Colonial copper mines, Dorchester. Dorchester, already described in the body of this report. There is here a shaft 100 feet in depth, with galleries in all directions, employing about 45 men, and the mine has a good outfit of running machinery. The output consists principally of a hard, grey sandstone, impregnated, to some extent, with copper glance in a very fine state of division. A large amount has been extracted, but no returns are to hand regarding its economic value, which will depend entirely on the ability to concentrate the copper on the spot.

The openings at Malagash, Greenville, French River and other points seem to be abandoned, the irregular distribution of the ore being much against its successful working.

Gold.

Gold was reported from a quartz vein found in sinking a well in New Annan on the property of Robert Wilson, French River. The veins cut green chloritic and talcose schists, but are generally small and irregular. The gold, of which but a small sight was visible, was associated with iron pyrites.

Gypsum of Hillsborough.

Gypsum is abundant at many points throughout the Lower Carboniferous area. In New Brunswick, the great deposits of Hillsborough have long been worked by the Albert Manufacturing Co., whose works have a capacity of 600 barrels per day of calcined plaster, and give employment in the quarries and mill to about 100 persons. Large quantities of the crude gypsum are also exported. A deposit on the west side of Maringouin Peninsula has already been referred to. The gypsum is soft and fibrous, and occurring on the beach could be easily quarried and cheaply shipped. This area is understood to be in the possession also of the Albert Manufacturing Co.

At Nappan, Stewart's Meadow, Claremont Hill, River Philip, near Oxford and vicinity, Victoria Settlement, at the crossing of the road from Thomson station, Pugwash, Wallace Hartor, and Malagash, immense quantities of this material are exposed. They are practically undeveloped, the local demand being small, and the foreign market can be more cheaply supplied from the immense deposits of the Minas Basin and Cape Breton.

Limestone.

Limestone is quarried to some extent in the vicinity of Pugwash and shipped to Prince Edward Island, where it is burned. Local kilns are found at several points, but the supply of rock being practically unlimited the demand is not great. The largest deposits observed were on the road south-east from Amherst to Economy, on the Spring Hill Branch railway and in the vicinity of Pugwash and Wallace River. On the south side of the mountain, the large deposits west of Londonderry mines, which is a true crystalline limestone, are available for lime burning.

On the Demoiselle Creek, in Albert county, N.B., large operations in

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lime burning have been carried on for some years. The stone belongs to the Lower Carboniferous formation and the resulting lime is of excellent quality and has a high reputation all over the country. The great competition with kilns in the vicinity of St. John has to a certain extent retarded the progress of operations in this direction. Much of the limestone about Hillsborough is highly bituminous, and the quantity is practically unlimited.

The marble of Five Islands has already been described in the chapter on pre-Cambrian. It is, in so far as can be seen, so penetrated by diorites, and as a consequence so shattered, as to render the extraction of large sound blocks very doubtful.

Building Stone and Grindstone.—Of the former, quarries of excellent quality and of established reputation are found at many points throughout the Carboniferous area. In New Brunswick these are principally confined to the Millstone-grit portion, and occur at Curryville and other places along the Demoiselle Creek, at Boudreau and Rockport on the Point and Grindstone Island in the upper part of Shepody Bay. In the Upper Carboniferous formation a quarry was opened some years ago at Wood Point, below Sackville, which, from the lay of the rock and the color, promised excellently, and a large amount of money was spent in developing. The presence of small pebbles of soft red shale, however, was found to be so prejudicial as to affect the value very seriously, and the quarry is now closed.* The color of the stone in the Millstone-grit area varies from grey to brown, and at some of the quarries blocks of any required size can be obtained.

In Cumberland county, N.S., quarries of building stone are found, principally in what is regarded as the upper formation on the Wallace River and at several places along the north shore, from Tidnish Head eastward. The stone is both brown and grey, and generally of excellent quality. Fine quarries also have been worked in the Millstone-grit near the Intercolonial, in the vicinity of River Philip, and also at Claremont Hill. A beautiful series of reptilian footprints was obtained from the slabs at these quarries some years ago.

The building of the Intercolonial caused many quarries to be opened in this section of the country, some of which yielded a very excellent building stone. Many of these have, since the completion of the line, been closed, the cost of transport being against the profitable shipment of the stone, though some of them are still worked to a limited extent on local orders.

Grindstones.—These are manufactured in large quantity, principally

* Recently re-opened, 1885.

on the Joggins shore, at the Lower or Seaman's Cove quarries. The cutting and turning machinery here is driven by a steam engine, and the output for the last year was—of grindstones 2,000 tons, and of scythe-stones 2,000 boxes, valued at \$28,400. Other areas, where grindstones are made, are the southern extremity of Cape Maringouin, Port Philip, and several places along the Joggins shore, south of the Joggins mines. No returns have been obtained from any of these places, though the totals must be considerable.

Petroleum.

Petroleum.—Large sums of money have been spent in the area between the Petitcodiac and Memramcook Rivers during the last few years in a vain attempt to obtain oil in quantity. The operations have been confined to the belt of Albert shales and associated bituminous sandstones, and the bore holes have in some places reached a depth of not far from 2,000 feet. Reliable records could not be obtained of the several bores, but oil was obtained only in very small quantity.

Albertite.

Albertite.—Since 1876, operations have been carried on from time to time by shafting and boring for the purpose of finding deposits of this mineral at points other than at the Albert mine. Large sums of money have been spent, at times very foolishly, but no deposits have yet been found, except as mere traces. Though the shales in which the albertite occurs have a very extensive development (see Report of Progress, 1876-7), the peculiar conditions found at the Albert mine, by which the great vein at that point was formed, have not been recognized elsewhere. Numerous faults occur at other places, but there are only small strings of Albertite and nothing more.

The exhaustion of the great vein at the Albert mine, several years ago, closed one of the most profitable mining enterprises of the Dominion. The wedge-like character of the deposit, which was a true fissure, was well illustrated in the lower levels, the vein gradually decreasing downward, as well as at both extremities, to four inches, beyond which, becoming unprofitable, it was abandoned.

Infusorial earth.

Infusorial earth was discovered in several lakes in New Brunswick some years ago and the localities indicated in former reports. In Nova Scotia, although occurring at different points, perhaps the largest, certainly the largest yet known, is found to occupy the bed and shores of Folly Lake on the Intercolonial railway, just at the summit over the Cobequid Mountains. This lake has an area of over 200 acres, the two-thirds of which are probably covered with this deposit. The quality is excellent, and considering the variety of uses to which this material can be applied, it seems strange that no attempt has yet been made towards the development of these localities. The earth is specially adapted for the manufacture of boiler and steam-pipe coverings, fire brick, tiles, &c., being a perfect non-conductor of heat.

Folly Lake.

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It is also largely used for the manufacture of water glass (soluble silicate of soda) and in the manufacture of dynamite, as well as an absorbent in the preparation of fish manures. Being a perfect non-conductor, it would seem to be specially adapted for the packing of safes, and should its non-conductivity as regards electricity be equal to that in regard to heat, its value would be greatly increased as an insulating medium in the underground laying of telegraph wires. The action of the material in this respect has, in so far as I can learn, not yet been ascertained.

Lately, a very valuable deposit of this earth has been found by Mr. David Grant, occupying the bed of Fountain Lake, on the road to Fountain Lake River Philip (West Chester Mountain). It is of remarkable purity and in large quantity, and the lake is said to be easy to drain. It is about eight miles distant from the Minas Basin at Port-au-Pic, and the same distance from the Intercolonial railway. Other deposits of greater or less extent occur in the numerous lakes of this mountain region.

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Explanation of Colours

Permian Carboniferous Period & Upper Carboniferous

Coal Measures

Millstone Grit

Lower Carboniferous

Silurian

Cambro-Silurian

A.B. Pre-Cambrian

Dolerite Quartz &c

Granite

Geological boundaries

Parish

County

Province

Compiled and drawn by Scott Barlow, assisted by N.J. Giroux from Surveys made by the Admiralty, Intercolonial Railway and Geological Surveys. Geologically Surveyed by Messrs Scott Barlow, W.A.F. Dal and R.W.F.H.

PROVINCE OF NOVA SCOTIA AND PART OF NEW BRUNSWICK

Nat. Scale : 250,000.

Scale : 4 miles to one inch.



Diap. & Pel. Iron. V. Cl. Copper. M. Mn. Manganese. Gypsum.



NOTE 1.
The iron ore deposits of the Londonderry Mines and vicinity occur in a well-defined belt of rocks which extend for many miles along the south flank of the Cobeguid Mountain range. They also have a considerable development in the Co. of Down, where their stratigraphical position is more easily determined. Though iron ores occur in this county in formations of various ages, the series of rocks, largely slate and quartzite, which contain the Londonderry ores and their equivalents elsewhere, are now generally regarded as of Middle or Cambro-Silurian age. (See Supplement Acad. Geol. Inst. pages 80 and 92. Trans. N. S. Inst., vol. 1, page 207.) The same view is presented by Mr. Gilpin in his paper before the American Inst. Mining Eng., 1865. Their exact horizon cannot yet be given, but they may be stated to be intermediate between the fossiliferous Upper Silurian and the gold-bearing strata of the south coast of Nova Scotia. A short distance west of the Londonderry Mines, local beds of highly crystalline limestones occur, associated with black slates, which apparently accompany this belt of rocks throughout a great part of its extent.

NOTE 2.
The age of the rocks composing the Cobeguid Mountain range has been for many years a vexed question. They were for a long time regarded as a lower portion of the Upper Silurian, until the discovery of fossiliferous rocks of this age on their northern flank, at Wentworth, proved them to belong to a much lower horizon. In Trans. N. S. Inst. of Nat. Sci., vol. III, page 348, the older metamorphic and largely volcanic portions of the range were compared by Dr. Hensman to the altered Quebec group, and subsequently in vol. V, page 271, he claimed for them an Archæan (Laurentian) age. In Supplement Acad. Geol., 1878, and even as far back as 1865, (see Obs. on Geology, Southern New Brunswick, Bailey,) Sir Wm. Dawson pointed out their great resemblance to the Kingston group of New Brunswick, the Huronian or Pre-Cambrian age of which was subsequently clearly indicated by the presence of unconformably overlying areas of Tri-mordial rocks. The Cobeguid series underlie unconformably the rocks of the iron ore belts which flank the range on the south, and which are presumably of Cambro-Silurian age; but their close lithological resemblance in many respects to Pre-Cambrian rocks, both in New Brunswick and Cape Breton, has led to their being assigned to the same low position in the geological scale.

Map of NOVA SCOTIA AND PART OF NEW BRUNSWICK.

To illustrate Reports by Messrs Scott, Hartlow, W. C. Ouat and R. W. Ellis 1872-1886.

Nat. Scale: 253,440.
Scale: 4 miles to one inch.
0 10 20 Miles
8 Ft. Iron 9 1/2 Copper, 10 Mn. Manganese, 11 Gypsum, 12 Forests

