

GEOLOGICAL SURVEY OF CANADA

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REPORT

ON THE

COAL PROSPECTS

OF

NEW BRUNSWICK

BY

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TO ROBERT BELL, M.D., LL.D., SC.D. (CANTAB), F.R.S.,
Acting Director of the Geological Survey of Canada.

SIR,—I beg to submit my report on an examination made, in accordance with your instructions, in Eastern New Brunswick to ascertain the general prospects for finding workable coal seams in that region.

I have the honour to be, sir,
Your obedient servant,

HENRY S. POOLE.

HALIFAX, December, 1902.

REPORT
ON THE PROSPECTS FOR FINDING
WORKABLE COAL SEAMS
IN EASTERN NEW BRUNSWICK

INTRODUCTION.

The subject of this report is herein considered from an entirely economic point of view, as by one proposing to explore freely and follow up indications that may give any encouragement as to the presence of coal in seams of workable thickness, such as are found in the adjoining province of Nova Scotia.

EXPLORATIONS.

In earlier reports treating on the general geology of the Carboniferous, knowledge of which is presupposed, it has been shown that the existence of coal spread over a wide area has been long known in New Brunswick, but in all cases the beds so far discovered have been small and of a quality often inferior. The people of the province have been thoroughly alive to the value of coal; and as the country, especially along the streams, has been closely traversed by lumbermen, it may be reasonably assumed that no seam of any value crops to the surface and remains unreported. Known exposures have been examined and where of a sufficient thickness, mining operations on a limited scale have been conducted, as at Grand Lake, Coal Branch and Dunsinane. Sufficient seems to have been done to assume, that if thick workable seams do occur in New Brunswick, they must be sought for in depth. In this direction explorers have not been idle, and money has been spent in boring into unexposed strata. Of the borings, some of the cores and records have been preserved by the Crown Lands Department at Fredericton, and some of the results have appeared in the reports of the Geological Survey, while the more recent have been noted in the transactions of local scientific societies, or are recorded in the concurrent report of Dr. Bailey.

STRUCTURE OF THE CARBONIFEROUS FIELD.

Division of
the field.

From the coal operators' standpoint, the conditions of deposition in Nova Scotia and New Brunswick are not quite the same. In both, there are great thicknesses of carboniferous rocks spread over wide areas; in Nova Scotia with thick coals cropping to the surface, in New Brunswick with none such to be seen, being concealed if existing. Over the larger parts of New Brunswick the beds associated with coal seams are near the surface, nearly horizontal and little disturbed, the lower strata of uneven thickness and all comparatively poor in bituminous matter. On the other hand, the nearer lying coal-measures of Nova Scotia are generally inclined over fifteen degrees; in parts they are heavily faulted and the coal seams continue downwards to great depths.

For convenience of description, the area occupied in eastern New Brunswick by carboniferous rocks may be divided by a line parallel to the Intercolonial Railway from St. John to Moncton, passing through Indian Ridge some six miles from the latter town, thence eastward to the Straits of Northumberland. The northern division would include only strata slightly inclined and with very little faulting or marked unconformities. The southern division, while embracing rocks of similar character lying to the eastward of the Memramcook river and onward to the Straits, also includes the prolongation of strata which are largely developed in Nova Scotia, steeply inclined, greatly disturbed and showing definite unconformities.

Absence of
unconformity.

Regarded as a unit, the carboniferous of New Brunswick examined in ascending order furnishes no data for assuming that great lapses of time were represented by the passage between any of the beds. The series appears to be consecutive, no unconformity between any of the groups in the northern division being readily detected. It is, however, known that sections taken in detail exhibit divergence, and by comparison suggest some 'wants' where contact occurs with the sub-jacent older formations. But studied as a part of one widespread system embracing both provinces, certain localities show a deposition of thousands of feet of barren strata, some contain thick workable beds of coal, while in others an absence of some groups and the substitution of shale and bituminous layers for sandstone suggests that periods prolific of certain sediments to the eastward are unrepresented in parts of the New Brunswick formation.

Comparison
with rocks of
Nova Scotia.

Again, while it cannot be said that there is always unconformity in New Brunswick about the Bay of Fundy, such as is generally met

with in Nova Scotia at the passage from the red to the gray overlying series, where the demarkation of the Lower Carboniferous and Millstone Grit strata is assumed; yet the uniform position of an outflow of diabase sharply separating the gray from the red series, near Boistown, Fredericton and other places in the western and middle portions of the carboniferous is at least suggestive of some lapse of time having occurred between the deposition of these two marked series in such localities. Igneous rocks.

A reference to the issued maps of the Survey makes it plain that a wide expanse of carboniferous rocks occupies in both provinces the shores bordering the Gulf of St. Lawrence, and extends from Gaspé to Cape Breton. Within this expanse lies a hypothetical ancient coal basin retaining patches of coal-measures, now isolated, and the operated coal seams of Nova Scotia. Structural details of many portions of the greater field have been published in the Reports of Progress of the Survey. Here it is sufficient to refer only to certain features of the now disrupted and in places greatly denuded primary field, which for convenience may be styled the Gulf coal basin. Gulf coal basin.

It may be here remarked that advantage was obtained from knowledge of the dislocations, elevations and depressions that modified the country surrounding the coal field in Pictou county, N.S., in a previous study of that outlying district, * when search was made beyond the recognized narrow limits of that field for a possible extension of the thick seams. With this experience in mind it does not seem foreign to this inquiry to consider the general features of the ancient Gulf field and to contemplate conditions during the several phases of the Carboniferous period. The Pictou division.

On the eastern side of the island of Cape Breton, coal-measures form the coast of Cape Breton county from Mira bay to the Great Bras d'Or, without being seriously disturbed and with seams of coal maintaining a fairly uniform thickness and quality. These dip seaward under a shallow foreshore generally at a very light angle, and in all probability they extend seaward for many miles and beyond what now appear to be practical working limits. The Cape Breton division.

Entirely separate from them are the seams cropping on the west coast of the Island, and the changes that are noticeable in the coal deposits at their contact with Pre-carboniferous strata, suggest an original "want" of coal seams in the sedimentation of the hills of the older series which now form the backbone of the island to Cape North.

* Pictou Coal Field : Trans. of the N. S. Inst. Sc., 1893.

On the west side of the island the coal-measures occupy only patches on the coast with lower strata alternating from Margaree southward. The general dip is toward the west, at greater inclination than on the east coast, but the deposits on both sides of the island appear to have been made synchronously and under very similar conditions. South of Port Hood and within the bay formed between Cape George and the Strait of Canso, the prolongation of the Gulf field is represented about Tracadie by members of the lower measures with their coal seams. From the presence of these beds in this position it may be assumed that the southern basal contour of the Gulf field was much like what it is to-day, with a break in the Appalachian folding forming a promontory at Cape George.

Foldings and disturbances occurred after the deposition of the coal-measures off the west coast of Cape Breton and brought up members of the lower Limestone series in islands near Port Hood and in those known as the Magdalen islands. Rocks of the same age also appear in the anticline from Pugwash to Shepody in New Brunswick and on the north side of the coastal range from Lutz mountain to the river St. John and in other places under the gray series as noted in the Survey reports. The west coast of Cape Breton though distant from New Brunswick, is considered part of the Gulf basin and it was affected by the mountain-making movements to be presently referred to, and by some lines of those movements from which much of the carboniferous of New Brunswick escaped.

The Pictou division.

On rounding Cape George, carboniferous rocks again appear and extend to the escarpment made of older strata, but they are unassociated, so far as is now known, with workable coals, except inland near the escarpment where the Pictou coal field has been preserved. The features of this isolated field differ considerably from those of Cape Breton, the part that has been saved owing its preservation perhaps, as well as its origin, to the shelter given by a ridge of old rock that was a promontory or island in the carboniferous sea, and which subsequently resisted the littoral movements that exposed to denudation the immediate extension of the field seaward. The character of the deposits lends itself to this conclusion; the coal seams, which are thick and of moderate ash in the centre, become inferior and ultimately are little better than fireclays at the margins; while the intervening measures, bituminous and argillaceous in the centre, pass into arenaceous beds as they approach the older rocks.

The Cumberland basin.

The remaining districts known to yield workable seams on the confines of the great Gulf field lie still more to the westward and are in-

cluded in a triangular basin of carboniferous rocks, embracing the head of the Bay of Fundy and furnishing horizons from which measurements may be made on the one side with the Joggins coal seams in Nova Scotia and on the other with the series under review, in New Brunswick. This structure it was not possible to clearly show on a small map on a scale of four miles to one inch, published in 1885, nor is a continuity of the strata across Shepody bay evinced by delineation. The method adopted on the map to distinguish the several members of the carboniferous by a series of parallel lines was detrimental to the study of the stratigraphy, for as it is, the hatching is often incorrectly suggestive of structure.

STRUCTURAL CHANGES.

It is here assumed that the orogenetic movements among the Appala-
chian ranges, somewhat narrowed in New England, spread out more
broadly to the eastward, and that some of the lines of movement sub-
sided in intensity or altogether ceased as they approached the Gulf,
where the great Champlain and St. Lawrence fault ceases to be parallel
to the mountains. Off Gaspé, the great fault is assumed to take a more
eastwardly course and thus to have relieved some of the pressure on the
ranges prominent to the west, in a manner often seen illustrated among
the faults that coal mining in various parts of the world has extensive-
ly exposed. Some of these lines ceased to be active long before others,
in the parallel series, and left undisturbed the section of country be-
tween the Baie des Chaleurs and the line through Indian Ridge, even
prior to the time when the gray series of rocks succeeded the period of
volcanic activity to which reference has elsewhere been made. The
area thus granted repose, increased to the eastward as the ages pro-
gressed, and unbroken succeeding strata lapped Indian Ridge and the
country beyond. It subsequently included the greater part of Prince
Edward Island.

In the meantime, in palæozoic ages, the eastwardly trending branch
of the great fault off Gaspé seems to have been paralleled by move-
ments between Caledonia mountain on the coastal range and the
small exposures* of Pre-carboniferous rocks to the eastward on the
Memramcook river. In this region the Albert shales and the members
of the lower carboniferous, which include the plaster, bearing series,
are much disturbed, but the tilting and folding, so marked in them,
subsided along these lines before the deposition of the gray series and

Erosion across
the coastal
range.

* See Summary Report, 1902.

Parallel
foldings
repeated.

their underlying purplish conglomerates. The movements eastward on the deflected course paralleled, in a general way, the series of anticlinal foldings which are so marked a feature of the Cambrian rocks of Nova Scotia along the seaboard from Yarmouth to Cape Canso. Subsequently the lateral pressure landwards involved the Devonian strata of the Cobequids with their broken extension to Cape North. It is with the faulting and folding on this deflected course that our interest in the present question has to do, and in the study of which hopes may be entertained of unravelling structure now concealed. Nothing is known that would enable it to be said that the beds of the Cumberland and Pictou coal fields were even homotaxial with those of Cape Breton; in fact, present knowledge rather tends to show that both fields owe their development to local conditions, and that they are not mere outliers of one great coal field which is still wide-spread about Cape Breton, and supposed to have at one time extended to the Baie des Chaleurs.

Slight
disturbance of
higher series.

The east and west orogenetic movements in New Brunswick continued on the south side of the Coastal range into the Millstone Grit period, but on the north side they seem to have ceased before the deposition of the higher members of the gray series that include the undisturbed thin coal seams of Aboushagon, Cocagne, Moncton and other places, the range itself sinking eastward under the shallow covering supplied by these later deposits. On its south side, dislocations continued into much later times. They left a strip of Millstone Grit on the flanks of the range, and affected the coal-measures and the Permian-carboniferous of that locality. This view seems to be borne out by the structure exhibited in the Cumberland coal field, as well as in that portion around the head of the Bay of Fundy included in New Brunswick, both being parts of one basin.

Along the outcrops of the Joggins coal seams from the Bay shore to Chignecto mine, the workings show minor dislocations diagonal to the dip, but parallel to the general trend of the coastal range in New Brunswick and to the strong faults on its flanks. The dislocations, so far as they are known, are downthrows to the east, and show that the influence of the great movements continued even after the deposition of the coal-measures of this locality.

Carboniferous
overlap on the
Cobequids.

Mr. Hugh Fletcher has pointed out that the measures on the south side of Springhill, trending westward, seem to lose their identity when they reach the Cobequids, and becoming individually indistinguishable may combine to form one continuous zone of conglomerate. He has also noted that the various beds of sandstone, shale, coal, and fireclay,

distinct in the cliffs at the Joggins mines, coalesce as they extend eastward under the Styles mine, where they are represented by one very thick variable bed of conglomerate. Further along on this easterly course the continuity of the outcrop is broken; lower carboniferous strata with limestone and plaster interrupt, and when the coal-measures again appear they have resumed their varied constituents of sandstone, shale, &c., with many interposed coal seams, of which some are much thicker than those exposed on the Joggins shore. The gradual substitution of conglomerate, under the circumstances mentioned, would appear to indicate that shores of shallow water existed at the time these deposits were laid down, not only along the north flank of the Cobequids, but also on a line towards Pugwash, now represented by rocks of Carboniferous Limestone age with plaster beds along an anticline parallel to the Cobequids.

Of particular importance is that part of the Gulf field which lies to the westward of Salt Springs, and northward of a line extended through the Cobequids across the Bay of Fundy. The deposits of the carboniferous within this area overlapped the flank of the Cobequids and overspread in the Millstone Grit period, the opposite coastal range. Partly contemporaneous and subsequently continued, the movements developed an anticlinal fold on the flank of the coastal range up the Bay of Fundy to Shepody. A branch thence on a diverted line passed by the Elysian Fields, through Pugwash as already mentioned and on its way made either land or shallow water north of Springhill during the latter part of the period. A sympathetic syncline followed on the north side of the anticline, radiating also from Shepody bay. This syncline restored to the Millstone Grit beds, lying on the northern side of the anticline, a southerly dip in strata which were contemporary with those on its south side, in what may, for convenience, be called the Cumberland coal basin. In this basin, then relieved of much of the further movements, depositions continued conformable with those of the basal and medial parts of the famous Joggins 14,000 feet section. But, and here lies a fact of great moment, on the north side of the folding, the later sediments lie unconformably on the upper Millstone Grit, while the upper beds within the Cumberland basin, although apparently contemporaneous with those on the north side, lie conformably on the coal-measures, which in turn, are invariably conformable with the Millstone Grit in Nova Scotia.

The inward dip of this basin, beginning at Cape Enragé is 75°, decreasing slightly up the bay, parallel in strike, to 60° at New Horton. Here the course of the crop is quickly deflected with a dip at Mary

Important
anticline and
associated
syncline.

Portion of the
Cumberland
basin in New
Brunswick

point of 45°, continued at 50° to Cape Maringouin. On the Nova Scotian side of the water at Boss point it is 30°, which dip is maintained in the conglomerate behind the Styles mine. In the overlying coal measures, the dip to the eastward is in parts as high as 40° and 50° along the coal crops. Then follows the fault and upthrust of the limestone series and the Springhill coal field, dipping about 30°. Foldings then expose in the strata overlying the thick coals the Black River series of small seams and the extension of these upper measures to Leamington and Mapleton, as lately disclosed by Mr. Fletcher's explorations, beyond which they are lost in or against the conglomerate zone previously described. The centre of the basin is occupied by the Joggins coal dipping 19° and the overlying gray and brown sandstone series, called indiscriminately Permian and Permo-carboniferous.

Undersea
coals.

It is apparently the same group of Millstone Grit beds that is seen at Boss point, Cape Maringouin, Grindstone island, Mary point, Two islands and Cape Enragé. They lie thousands of feet below the Joggins main seam, so it would appear that the westward extension of the crop of that seam continues under water in front of the headlands mentioned, all the way to Cape Enragé, but out of reach from the New Brunswick shore and therefore unworkable. It may here be noted that the axis of this syncline within the coal basin, developed by the deflection of the strike of the beds at New Horton, originates as also does the syncline trending northeastward, at the base of Shepody mountain and it has its direction towards the gap in the Cobequids now obstructed by glacial drift, through which Halfway river flows.

Subordinate
basins at
Shepody.

It has been mentioned that on the west side of Maringouin at Hard ledge the measures are repeated, and therefore, if the reverse dip only continued far enough, a repetition of the Joggins series, although concealed, might be looked for and search made by borehole in the direction of Grande Anse under the unconformable brown sandstone series of Permo-carboniferous age. As it happens, the overlap of these rocks which is well seen at Hard ledge, is also there accompanied with evidence of a succeeding syncline restoring the southerly dip to the Millstone Grit, and thus so far as could be seen, destroying any hopes of the series as high as the Joggins mines being found repeated to the northward in that locality.

CORRELATION.

Characteristic
beds.

In a comparison of the Carboniferous of the two provinces it would probably be more easy to find the corresponding beds on the opposite

sides of Cumberland Basin, at Boss point and Ferris cove, by comparing photographs of the ledges exposed at low water, than by detailed measurements of the cliff sections. The action of the sea tending to mark in groups the series of beds, sandstones, shales and fireclays, an erosion scale becomes available to an observer of cliff sections. This grouping is made more evident by the seaweeds which clothe the harder and more enduring ledges and make them easily distinguishable at a distance from the beds that break up level with the sands of the beach and the mud flats. Individual beds in these measures are by no means regular, but, as the quarrymen say, go out and come in, thicken and thin. Of the sandstones, they distinguish between the hard and the soft, the fine and coarse, those of sharp grit and the dirty. Irregularity of deposition and false bedding are common features of the gray rock series, and would make a comparison of records of cliff sections less easy than one of a grouping of ledges arranged by the sea's erosion in lengths long enough to include the varied alternations of width and quality.

Copper ore, in the form of chalcocite and carbonate, occurs in nodules and infiltrations at several places in these rocks, as along the gray conglomerate ridge extending from Dorchester inland to the copper mine, on both sides of Maringouin peninsula; again at the same horizon at Downing cove on the opposite Nova Scotia shore and also in the other direction across the bay beyond Mary point and at New Horton. At Dorchester cape the ore in nodular form occurs more abundantly in the red series some 600 feet below the basal gray conglomerate, and apparently it is at this horizon that the similar deposit occurs which was opened on the Nepisiguit river at Bathurst. Copper ore.

It is interesting to note the greater concentration of this ore at some localities among these sedimentary rocks, but the cause is not clear, as the deposits are not confined to the tissue of plants preserved in the sandstone and conglomerate beds.

Iron ore may also supply a means for correlation. At Cherry Barton, Hematite. two miles east of Dorchester, on the rear lands of W. B. Mitten, a strong band of fine-grained sandstone dips S. 30 E. $< 10^\circ$, which in parts has coarse pebbles mingled with it. It bears on its surface a bed of silicious hematite, of variable thickness, in places as much as three inches; the sandstone itself weathers to a dead white. This ridge with its hematite cap is said to extend for three miles to the eastward. A similar rock with hematite stains in streaks is seen some four miles eastward at Read's house near the reservoir of the new water-works of Sackville, and again on a brook half a mile still fur-

ther east. In the opposite direction at Grande Anse, on the bay shore, boulders of a similar rock, bearing a layer of hematite, are numerous. At the end of New Horton cliffs nearest to Mary point is a band of what appears to be the same rock, with hematitic blotches, and possibly it is an extension of the bed that produces an iron ore near Cape Enragé.

Limestones.

Other bands with marked features can be seen in the conglomerate limestones. One, which is white, occurs in the red series of Dorchester Cape; others are gray and stained reddish, as at Alma, Maringouin, the Joggin's shore and Clifton, on the Baie des Chaleurs. These are similar to the black "bastard" limestones of Sir William Logan's section, east of New Glasgow and on River John. Then there are the beds in which Dadoxylon is a prominent fossil.

Fossil Dadoxylon.

Aid from treasure seekers was unexpectedly obtained in determining the line of separation of the gray conglomerate of Aulac ridge from the 'Permian' of Jolicure. There were no natural exposures, but a remarkable mound, a glacial drumlin, where the road to Midgie turns off, had attracted attention and French gold had been dug for, with the result that the Aulac series of rocks was exposed in situ and thus proved to extend to the depression between the hills.

Substitution of strata components.

It is generally well known that elsewhere, coal seams, when followed for a distance, do often change in quality and thickness—it may be to divide into benches or plies, perhaps to separate and diverge and become distinct seams with shale and sandstone beds intervening. While some are found uniform over wide areas, others are in places deteriorated in value and in thickness, even to become worthless for working in a comparatively short distance, as for example in the thick seams of Pictou. The converse of course holds good if the strata are examined from the other end, and beds of black shale and fireclay may be quoted as turning into good coal of exceptional thickness when followed but a few thousand feet. For example the Emery seam is triple the thickness at Schooner pond that it is at Dominion No. 4. There is the patch of "low" coal in the Sydney main seam near Keating pond; the lenticular increase to five feet over a couple of acres of the top coal of the Acadia seam; the local development in the Deep seam at Stellarton of an inferior band into good cannel coal and black band ironstone. The substitution for coal of patches of bat in the Vale six-foot seam, and the presence in parts of the Phelan seam of double the average quantity of sulphur. These and similar irregularities are found to occur in coal seams, otherwise fairly uniform, without anything to indicate their presence until they are actually discovered.

In England, in the Midlands and in Kent, seams, suspected on purely theoretical grounds to lie hidden under strata unconformable and unassociated with coal, have been sought for, and in some cases large areas of very valuable coal have been discovered and exploited.

The question then with us is: What encouragement is there to hope that similar conditions may exist on the New Brunswick shore, and that the hypothetical Gulf coal basin may yield a field of value hidden under newer formations? To this, a counter question may be asked. What reasons have we for expecting that the western field of Cape Breton has any valuable extension, or that the Cumberland and Pictou fields are other than local deposits, which owe their development to favourable situation?

It is by no means established that the circumstances of deposition in the northern division were comparable with those south-east of the coastal range, where the carboniferous is represented by sedimentary deposits of immense thickness. All the explorations go to show that there is not a tenth of the mass to the north, where the gray series rests directly on various lower formations, without trace of intermediate strata. For instance, the bore-hole of 1901 on the north side of the Cocagne river, three miles from its mouth, which reached a depth of 857 feet passed down into the red series, and left no hope of finding workable coal in that neighbourhood.

In the district of the Albert shales, east of Caledonia mountain, where erosion has shown many exposures of the red and grey transition beds, there is an excessive development of the upper part of the former, especially of the purplish beds of conglomerate near the copper mine, in Turners' brook, close to the Dorchester penitentiary, and in less complete exposures of the district, where the monocline of the lower gray series has been cut through by water courses and the underlying beds laid bare. A corresponding diminution seems to have followed in the beds overlying to the north-eastward, and that within a few miles of the Sackville section, where search might be made if at any time a trial hole looking for the horizon of the Joggins coal seams is determined on. Here is a basin-shaped area, not so complete as that of Cumberland, where the rim is of the gray conglomerate, extending from the copper mine to Dorchester island, reappearing at Dorchester cape and with its southern boundary at Westcock. There broken, the eastwardly dip is repeated at Aulac and Mt. Whatley. Within this area a section of at least 2,000 feet of gray beds is built up, and still higher strata in the series are covered by the marshes and the newer 'Permian' formation. Then, again, search might be

Concealed
coal seams.

Where search
might be
made.

made from Oromocto northward for local synclines or areas circumscribed by older formations, with a prospect of finding the surface seam better developed in them than it is generally throughout the field.

It is of course possible that there may be other spots similar to that on the north side of Grand lake, where the thin surface seam may be also thickened to the same degree. If so, such spots are more likely to be discovered by boreholes systematically following the known outcrops into ground at present unknown. Experience has shown that by shallow holes much information may be gained in a cheap way, as practised of late in Cumberland county by the Geological Survey, under the direction of Mr. H. Fletcher.

Previous reports have demonstrated that the New Brunswick field is made up of several minor undulations where the carboniferous rocks are shallow and rest unconformably on older series. It is accepted that the bright-red argillaceous measures lie below those carrying coal seams. So far as the underlying gray series have been pierced, the scattered boreholes have proved to the depths attained (the deepest 1,200 feet) an absence of a lower or second series of coal beds, or even of bituminous shales. It may be that the conditions differ in some of these minor basins and some may favour a greater accumulation of coal, but, it is only proper here to say that nothing is at present known to encourage this generalization. The structure of the field cannot fail to arouse interest, and warrant an examination in such detail as natural exposures admit of for the comparison of sections and mapping of outcrops as accomplished in strata of the same age in Nova Scotia.*

Productive
coal measures
absent.

The immediate interest of the structural movements dwelt on in this report lies in the presumption that the lines of Appalachian disturbance indicated in the red series on either side of the coastal range ceased to be active prior to the deposition of the higher members of the overlying gray series; that the extension eastward of the faulting on these lines is covered to the Strait of Northumberland by measures which carry the coal seams of Coal Branch, curve around Indian ridge and Lutz mountain to Aboushagon, and underlie the dark red-coloured sandstones distinguished as Permian or Upper Carboniferous. Should this supposition be confirmed, it follows that there is a total lack of strata, or what is practically the same thing, a valueless

* It is mentioned in *Acadian Geology* that many of the plants of the coal measures found in New Brunswick differ from those known in Nova Scotia, thus suggesting a difference in surface conditions.

attenuation of deposits representing the periods when the thick coals of Cumberland county, N.S., were laid down.

It should not to be forgotten that, apart from the extension of the coal-bearing series, there is the totally distinct question of whether the equivalents of the productive coal measures of Nova Scotia may or may not be richly carbonaceous should they be found concealed anywhere beneath higher series, and be there productive of workable coal seams.

CONCLUSION.

The examination in short resulted in a belief that the thin coal seams worked at Grand lake were of the horizon of strata classed among lower members of the Millstone Grit:—that there were no equivalents to the Productive Coal Measures of Nova Scotia deposited north of the Coastal range, and that while there were conditions south of that range more nearly approaching those of the coal basins, the features observable could not be regarded as encouraging for the presence of thick workable coal seams.

Other references to this subject have been made in the Summary Report for 1901, p. 204, and in that for 1902.

APPENDIX.

BORINGS IN THE CARBONIFEROUS OF NEW BRUNSWICK.

The accompanying logs of borings made in various places in the Carboniferous basin in New Brunswick is given as supplementary to the reports of Messrs. Bailey and Poole.

Some of these have been taken from the original records of the logs. That of the Cocagne bore-holes was made by Mr. Poole from an examination of the cores in Moncton. The log of the deep boring at Dunsinane has been taken from the original log but compiled by Mr. Harold Goodrich, M. E. The logs of the borings at Newcastle are reproduced from the reports of the Geological Survey made by Dr. Ellis, and published in 1872-74. The greater part of these holes were made by diamond drill.

NEWCASTLE BRIDGE, 1872-3.

These logs have been somewhat condensed from the originals.

1872.		Ft.	In.
Fine gray sandstone.....		4	0
Coal shales with several thin seams of coal.....		12	5
Coal, main seam.....		1	10
Shale and impure coal.....			10
Clay shale.....		4	6
Shaly sandstone.....		4	9
Coal shale.....		3	0
Shale and clay, pyritous.....		2	9
Sandstone and shale, green and gray.....		9	0
Gray micaceous sandstone.....		65	5
No cores.....		4	8
Sandstone and grit.....		28	3
Hard gray shales, coaly matter.....		9	0
Fine gray micaceous sandstone.....		5	
No cores.....		7	9
Fine gray sandstone.....		8	0
		171	7

BORING NO. 2. 1873. NEWCASTLE BRIDGE.

	Ft.	In.
Flaggy gray sandstone, with some shale.	24	4
Gray sandstone with conglomerate band.	52	4
Gray shales with thin sandstone bands.	11	0
Gray shales with thin band of conglomerate.	23	5
Gray shales and sandstone alternating	25	1
Gray sandstone, coarse and fine, occasional bands of conglomerate.	58	8
Gray shale.	4	5
Gray conglomerate and coarse grit.	18	2
Base of Carboniferous formation.		
Gray micaceous slates with quartz veins	149	4
	366	9

NEWCASTLE (NEAR LITTLE RIVER), BORING NO. 3. 1873.

	Ft.	In.
Soil.	2	0
Gray micaceous sandstone.	45	0
Gray shale and clay.	8	6
Red and brown shale.	25	9
Gray sandstone.	1	3
Red and gray shale.	10	2
Gray sandstone.	8	9
Black and gray shale.	4	5
Gray sandstone.	6	6
Brown, gray and red shale	68	6
Gray micaceous sandstone.	36	7
Purple gray sandstone.	43	3
Bottom of Carboniferous formation.		
Hard gray and blue sandy slates, quartz veins with calcite.	138	7
	399	3

BORING AT CHATHAM, N. B., FROM RECORD BY MR. H. GOODRICH,
M.E. 1899.

	Ft.	In.
Drift.	33	0
Massive gray sandstone with conglomerate.	194	0
Gray shale	3	0
Gray sandstone.	15	0
Gray shale.	5	0
Gray sandstone	40	0
Gray shale.	10	0
Possibly base of Millstone grit?		
Red marl or clay shale, probably with sandstone beds.	100	0
	400	0

BORING AT COCAGNE, ABOUT THREE MILES WEST OF THE LOWER BRIDGE.

In the absence of the journal kept at the time of boring the hole in 1901, near the Cocagne river on the north side of its estuary, the following abstract has been made from an examination of the cores and the measurements given on them. It is, however, only an approximate record in descending series.

H. S. POOLE.

	Ft.	In.
Gray marly shale with coal 4 inches thick.....		
Light gray shaly sandstone		
Light purple sandstone, marly shale.....		
Gray and red shale, total.....	63	0
Purple mottled fine gray grit.....	12	0
Fine gray purple tinted micaceous grit.....	26	0
Fine gray sandstone	6	0
Fine banded gray grit	8	0
Coarse gray grit.....	5	0
Fine gray conglomerate.....	2	0
Coarse graystone sandstone.....	9	0
Sharp gray sandstone.....	3	0
Purple shale.....	4	0
Purple and greenish-gray sandstone.....	9	0
Fine greenish-gray shaly sandstone.....	5	0
Reddish and dark gray mottled shales, coal streak.....	15	0
Shaly gray fireclay.....	6	0
Purple and gray shales and sandstone	16	0
Coarse gray grit, sharp.....	18	0
Coarse gray grit with finer bands	10	0
Gray banded sandstone	28	0
Gray banded sandstone with 2 feet gray shale.....	9	0
Coarse gray grit with shale pebbles.....	44	0
Gray and purple shales.....	12	0
Purple marls and shales.....	27	0
Gray marls and shales.....	22	0
Gray coarse and fine sandstone.....	5	0
Coarse gray grits	10	0
Fine gray sandstone.....	25	0
Dark gray marly shales	10	0
Coarse gray sandstone, green shale bands.....	12	0
Gray sandstone.....	25	0
Gray sandstone and grits.....	23	0
Gray and mottled purple shales	31	0
Gray and purple tinted shales	10	0
Gray shales with 2 feet gray sandstone.....	10	0
Fine gray micaceous sandstone, shale bands.....	11	0
Dark gray marly shales	12	0
Compact gray grit.....	47	0
Gray sandstone with conglomerate band.....	24	0
Very coarse gray grit, band of gray shale.....	14	0

	Ft.	In.
Dark gray shales.....	14	0
Gray grit and coarse sandstone.....	43	0
Fine gray sandstone.....	35	0
Gray sandstones.....	95	0
Purplish and mottled shales and sandstones.....	23	0
Purple marly shales with thin gray bands.....	12	0
Very hard greenish sandstone, compact fine white 15 inch. band of hard quartzite, with coarser grit and purplish mottled hard sandstone.....	7	0
	857	0

DUNSINANE.

Several holes have been bored at Dunsinane, which is near the line of the Intercolonial railway, about midway between Anagance and Penobscus stations. A thin seam of coal has been known to occur here and notes on it are given in a report by Mr. Matthew in connection with Professor Bailey's report to the New Brunswick Government, 1865. In all the logs of five borings with the diamond drill are to hand. One of these reached a depth of 1,292 feet. The cores which are in the Crown Lands Office, Fredericton, were examined by Mr. Harold Goodrich, who summarized the borings in tabular form, the results of which are given, rather than the lengthy logs kept by the driller at the time of boring.

From Mr. Goodrich's summary the record for the deep well is as follows:—

	Ft.	Ft.
Soil and drift.....	..	38
White sandstone.....	2	40
Purple shales and fine sandstone.....	10	50
Purple shales, mottled green.....	34	84
Fine purple sandstone.....	2	86
Purple clay shales thin bands of purple sandstone.....	44	130
Gray clay shales, sometimes purplish.....	20	150
Dark purple mottled shales.....	48	198
Purple and dark gray shales, plants.....	38	236
Coal $\frac{3}{4}$ inch, shale 2 inches ..	..	..
Coal 7 inches, fire-clay and shale ..	17	238 $\frac{1}{2}$
Gray clay shale.....	31 $\frac{1}{2}$	270
Gray sandstone and conglomerate.....	12	282
Gray sandstone and conglomerate, thin shales.....	58	340
Blackish gray fossiliferous shale ..	15	355
Fine and coarse sandstone.....	5	360
Gray shales.....	6	366
Gray micaceous sandstone ..	12	378
Gray conglomerate.....	4	382
Coarse sandstone with coaly matter.....	11	393
Gray shale ..	2	395
Gray micaceous sandstone, with beds of conglomerate and bands of shale.....	897	1,292

DUNSINANE, No. 2, CONDENSED BY MR. GOODRICH FROM EXAMINATION
OF THE CORES.

DUNSINANE, No. 2.

	Feet.	Feet.
Drift and fine sandstone.....	10	...
Gray clay shale....	10	20
Gray coal shale, thin seams of coal and plant stems...	7	27
Grey micaceous sandstone, fine and coarse, with thick beds of gray conglomerate.....	73	100
Purple and gray shales.....	15	115
Gray and micaceous sandstones, with heavy bed of grey conglomerate	73½	188½

In the boring log the thickness of two seams of coal near the top
is given at 9 inches and 12 inches.

DUNSINANE, No. 3.

(Condensed from official log.)

	Feet.	Feet.
Drift.....	..	21
Red marl.....	3	24
Sandstone and conglomerate....	8	32
Red marl.....	25	57
Sandstone.....	4	61
Red shale and sandstone.....	22	83
Blue gray shale.....	2	85
Shale and sandstone mixed....	29	114
Sandstone.....	10	124
Red marl and sandstone....	10	134
Sandstone	9	143
Grey shale and sandstone .	11	154
Sandstone.....	10	164
———— (not given).....	5	169
Coal with half inch parting.....	2	171
Sandstone.....	8	179
Coal ..	2 2 in.	184 2 in.
Fine sandstone.....	2	191 2 "

DUNSINANE, No. 4.

(350 feet S. E. of No. 3.)

	Feet.	Feet.
Drift. ....	..	41
Blue shale.....	2	43
Reddish and gray sandstone.....	13	56
Reddish marly shales	33	85
Sandstone.....	1	90
Red and blue marly shales	5	95

	Feet.	Feet.
Sandstone.....	3	98
Blue and red shales.....	9	107
Sandstone.....	3	110
Red and gray shales.....	4	114
Very hard sandstone.....	12	126
Blue shale.....	2	128
Coal..... 1 ft. 4 in.....	..	...
Blue shale..... 8 ".....	2	130
Sandstone.....	1	131
Blue shale.....	3	134
Sandstone.....	3	137
Soft blue shale.....	3	140
Coal..... 8 in.....	..	...
Soft fire-clay..... 4 ".....	1	141
Hard blue shales.....	1	142

DUNSINANE, No. 5.

(About half a mile N.W. of No. 3.)

	Feet.	Feet.
Drift.....	..	22
Fine sandstone.....	1	23
Red shales.....	9	32
Hard fine sandstone.....	4	36
Red and blue shale with fire clay...	11	47
Hard and soft red sandstone.....	13	60
Red shale and fire clay.....	9	69
Fine red sandstone.....	9	78
Red conglomerate.....	3	81
Soft and hard red sandstone.....	9 10 in.	90 10 in.
Red and blue shale.....	7 2 "	98
Red sandstone, hard and soft...	12 8 "	110 8 "
Blue and red shale.....	7 4 "	118
Sandstone.....	3	121
Red and black shale.....	2 4 "	123 4 "
Sandstone.....	8 8 "	132
Shale and fire clay.....	3 4 "	135 4 "
Coal..... 1 ft. 8 in.....	..	...
Gray shale..... 1 " 6 ".....	..	...
Coal..... 6 ".....	3 8 "	139
Black and gray shale.....	5	144
Fine sandstone.....	3	147
Blue and red shale.....	5	152
Red sandstone..... 8 in.....	..	...
White clay. 4 ".....	1	153
Red and blue shale.....	6	159
Coarse sandstone.....	13 2 "	172

LUTZ MOUNTAIN, HARRIS' LAND, No. 3.

1897.

	Feet. in. Feet.	
Light brick-coloured fine sandstone changing to gray.....	60	
Purple fine sandstone.....	8 0	68
Medium-grained gray sandstone.....	9 0	77
Fine and medium whitish-gray sandstone, coaly matter.	51 0	128
Gray micaceous shale and mottled clay shale.....	15 0	143
Mottled clay shale, purple.....	29 0	172
Fine and medium gray sandstone.....	15 2	187
Sandstone and conglomerate.....	11 0	198
Purple fine conglomerate.....	4 2	202
Very fine reddish purple sandstone.....	18 0	220
Purple and green clay shale.....	25 0	245
Fine to medium purple sandstone.....	20 2	265
Medium whitish-gray sandstone.....	11 0	276
Gray and purple shale.....	22 0	298
Gray and reddish sandstone.....	15 0	313
Purple clay shale.....	27 0	340
Gray sandstone shading into purple.....	10 0	350
Dark and reddish purple clay shale.....	88 0	438
Very fine red shaly sandstone.....	19 0	457
Mottled fine red sandstone.....	11 0	468
Purple shale.....	2 0	470
Coarse gray sandstone and conglomerate.....	8 0	478
Gray and purple sandstone.....	77 0	555
Medium gray micaceous sandstone, much coaly matter.	38 0	593
Very fine gray sandstone.....	44 0	637
Medium and fine white and gray sandstone.....	5 2	642
Sandstone and conglomerate.....	7 0	649
Medium sandstone.....	21 0	670
Massive gray sandstone.....	7 0	677
Green marly shales.....	28 0	705
Purple clay shales.....	30 0	735

LUTZ MOUNTAIN, PETER WILSON'S LOT.

1897.

	Feet.	Feet.
Clay and drift.....		18
Gray clay shale with coaly matter.....	2	20
Mottled gray and purple clay shales.....	5	25
Gray and green mottled clay shales.....	5	30
Medium gray sandstones with shale inclusions.....	10	40
Gray micaceous sandstone.....	10	50
Gray and green sandstone.....	48	98
Purple clay shales passing into purple sandstone.....	15	113
Reddish purple shale.....	2	115
Purple and gray shale.....	5	120
Fine reddish sandstone.....	25	145
Purple to brick-red shale.....	1	146

	Feet.	Feet.
Coarse gray micaceous sandstone.....	9	155
Medium " ".....	30	185
Purple and gray clay shale.....	15	200
Medium gray micaceous sandstone.....	3	203
Purple and mottled clay shale.....	7	210
Yellow and purple mottled shale.....	12	222
Brick-red clay shale.....	2	224
Brown purple shale.....	9	235
Fine purple sandstone.....	10	245
Dark purple shale.....	11	256
Fine red sandstone.....	11	267
Medium red sandstone.....	10	277
Very fine red sandstone.....	7	284
Fine and coarse gray sandstone.....	9	293
Conglomerate sandstone.....	10	303
Fine grey sandstone.....	20	323
Mottled purple and greenish shale.....	11	334
Coarse gray felspathic sandstone.....	2	336
Soft gray clay shale.....	24	360
Medium gray sandstone.....	30	390
Green-gray mottled sandstone and shale.....	2	392
Brick-red marl or shale.....	10	402
Brick-red and green mottled shale.....	7	409
Fine purple micaceous sandstone.....	11	420
Green micaceous sandstone, coaly matter.....	5	425
Dark purple shales.....	8	443
Medium reddish sandstone.....	4	447
Brick-red marls or shales.....	8	455
Fine micaceous sandstone.....	18	473
Brick-red marls or shales.....	9	482
Slightly red sandstone.....	27	510
Coarse gray micaceous sandstone, coaly streaks.....	50	560
Coarse and fine red sandstone.....	4	564
Dark red purple shale.....	4	568
Red shale.....	9	577
Compact red shale.....	23	600
Red marly shales with few quartz pebbles.....	17	617
Fine red sandstone shading to purple.....	5	622
Fine red sandstone.....	2	624