

IV.—ON THE SUBDIVISIONS OF THE CARBONIFEROUS SYSTEM  
IN EASTERN CANADA, WITH SPECIAL REFERENCE TO THE  
POSITION OF THE UNION AND RIVERSDALE FORMATIONS  
OF NOVA SCOTIA, REFERRED TO THE DEVONIAN SYSTEM  
BY SOME CANADIAN GEOLOGISTS.—*By H. M. Ami, M. A.,  
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*(Read December 11th, 1899.)*

Considerable discussion has arisen of late amongst European as well as North American geologists, as to where certain series of sedimentary strata occurring near the summit of the Palæozoic should be placed, either in the Carboniferous or in the Devonian system.

Whether certain other geological formations, occurring in the Maritime Provinces of Canada, should be described as Permian, or classed as Upper Carboniferous or Permo-Carboniferous, constitutes another problem. It is not within the province of this paper, however, at this time, to discuss this latter question, which it is hoped may form the subject of another paper before long.

Where to draw the line between the Carboniferous and Devonian systems in Eastern Canada, is therefore the question at issue. It is the purpose of the writer to enter this field of enquiry without any leaning or bias to any one view, but to take up the evidence as it presents itself to him and as it was collected by him during the last four years in the Counties of Pictou, Colchester, Cumberland, Antigonish, Hants, and Kings, in Nova Scotia, referring to such other localities and additional evidence only as the occasion may require.

Numerous and varied opinions have been given by many writers on this important question of the dividing line between the Devonian and the Carboniferous. These were consulted merely with the purpose of obtaining notes of records of observations that might help to throw light upon the problem, without

any prejudice or desire to accept one view or another, unless the facts adduced proved to be wholly reliable evidence.

Abram Gesner, Sir William Dawson, Sir Charles Lyell, Dr. Jackson, Prof. Alger, Prof. J. P. Lesley, M. de Koninck, M. de Verneuil, Mr. Hugh Fletcher, Dr. R. W. Ells, Mr. Henry S. Poole, Richard Brown, Prof. T. Rupert Jones, F. R. S., J. W. Kirkby, Mr. J. W. Salter, Dr. Henry Woodward, Dr. G. F. Matthew, Prof. Bailey, Mr. A. Smith Woodward, Mr. Robert Kidston, and Prof. David White, have all contributed by their writings, published or in manuscript, to the literature of this interesting controversy.

I shall not attempt to review the difference of opinion which may exist between what may be termed the two schools of geology as regards the constitution of the Devonian system, especially as regards the uppermost members of that system,—*The Lonsdalean School*, whose characteristics of the Devonian age are based more especially upon the life-zones or palæontological evidence which the formations hold, and *the Murchisonian School*, which emphasizes more especially the stratigraphical succession, with little reference to palæontological evidence.

From a considerable study of the origin or genesis of the various geological formations in question, or of the cycles of constructive forms affecting them, the periods of erosion noticed, together with the life-zones which these formations contain, and characterize them, one has been able to arrive at a conclusion which, it is hoped, will be in accord with the views of the rest of the world, so that whatever interpretation is given to the Carboniferous system in one continent, the same should likewise hold good for another. The same with the Devonian system.

Just as Time was a constant factor during the evolution or history of the Carboniferous system of this world, and that the amount of time involved is a definite period, so also was Life a constant factor; and the several subdivisions of the Carboniferous system—the Eo-, Meso-, and Neo-Carboniferous, must be marked by corresponding series of Life-zones of the same system.

No difficulty has been experienced in separating the various geological formations in the Counties of Nova Scotia mentioned above, nor of understanding their taxonomic relations. The most excellent work of Mr. Hugh Fletcher, of the Geological Survey of Canada, who kindly furnished me with maps and plans of the region in question, shows clearly the true and natural order of sequence of the formations. The main question at issue, however, has been where to place the series of sediments hitherto known, and designated by Mr. Hugh Fletcher as the "Rocks of Union and Riversdale": in the Carboniferous or in the Devonian system. Mr. Fletcher would place them in the Devonian. I include them as formations in the Carboniferous system (and would also classify in the same system the red rocks of Mispec and the Lancaster fern-ledges of New Brunswick, which hold much the same flora and fauna). The various formations of the Carboniferous system do not form an unbroken succession of sedimentary strata in the disputed region either of Pictou, Colchester and adjacent counties. Great breaks and unconformities appear on every hand.

It may not be considered out of place here to look for a moment at some of the principles involved in such questions as arise in this problem. Portions of formations constituting cycles of sedimentation or of constructive forms, marking peculiar physical conditions of deposition, followed by periods of erosion, and subsequent depositions, occur at various horizons, and were it not for their entombed faunas it would be most difficult to state in which of the subdivisions of the Palæozoic column to place them. Where sedimentation as marked by cycles of constructive forms is not continuous, the basis or principle upon which the separation of the different members of the series depends, must obtain in the palæontological evidence collected in the various members whose succession, though not perfect, is, nevertheless, known as to its order.

Similarity in the types or organic forms found, assists one in uniting series of sediments as part and parcel of one system, just as dissimilarity enables one to separate series of sediments from

which they were derived. Comparisons must be instituted between the various life-zones occurring in the natural succession of strata, and wherever they are exposed they can easily be recognized however fragmentary or isolated they may be, provided they are fossiliferous, and that the evidence thus obtained can be compared with standard sections recognized the world over. The characteristic life-zones of the Carboniferous System, as they have been elaborated the world over, can be very easily prepared, and in order to be recognized as typical they must be in accord with the consensus of opinion with the rest of the world. They must not contain assemblages of organisms or types which are not in harmony with, but must be organically and chronologically related to, the types that are everywhere held to be of Carboniferous age. Fortunately for the geologist, although there are unconformities or breaks in the succession of strata there is abundant evidence of life of various orders and classes entombed in the various formations.

#### THE JOGGINS SECTION.

One grand and continuous section of strata of the Carboniferous system to very near the summit thereof, in which are entombed myriads of organisms, plants and animals in regular succession also, is found along the Joggins shore, in the western portion of Cumberland County, Nova Scotia. This section was described in detail by Sir William Logan, and subsequently by Sir William Dawson and Dr. R. W. Ells. It extends from Minudie to McCarren's Cove, along the shore of the Cumberland Basin. This forms one standard section. No other such exists in Nova Scotia, and a systematic collection of the fossil organic remains entombed in its strata ought to be made for reference, in order to compare the succession of life-zones here with those of other portions of Nova Scotia and North America. In the United States, Mr. David White informs me that there have been noted not less than seven standard sections of the Carboniferous System, in distinct fields: Pennsylvania, Virginia, Ohio, Missouri and other States. These all have their peculiar charac-

ters, and may be described as local series. Whereas each particular basin of Carboniferous rocks or sediments may have its own particular conditions of sedimentation which led to peculiar local differences existing between the several basins which may be under examination and comparison, there can be no doubt at all about the series belonging to the Carboniferous System, when the results obtained in Great Britain, France, Germany, and the world over, have been consulted.

Such a recognized succession as the consensus of opinion in the world has established as marking the Carboniferous System, must be a term which includes within its scope the various members of the different local series under examination.

Unequal amounts of sedimentation at different horizons in a System and in different districts, have created difficulties, but formed an interesting feature in the study of the correlation of strata. It has been conceded that in the case of the 14,000 feet of strata which constitute the Joggins section in Nova Scotia, sedimentation must have been very rapid, and though deposited in a perfectly unbroken succession, such strata may have taken much less time actually to be laid down than a few hundred feet of shales and sandstone belonging to the same system in another section.

It follows from this, that local series of Carboniferous strata may be of very great thickness in one part of the continent, or comparatively thin in another part. It is possible for the whole system of the Carboniferous to be unusually extensive in its development of sediments, as has certainly been the case in Nova Scotia when compared with sediments of the same age in Pennsylvania. There is evidence of great rapidity in sedimentation. Evidence of rapidity in sedimentation is clearly seen in the strata, what I refer to the Eo-Carboniferous of Colchester and Pictou Counties in Nova Scotia, as represented by the Union and Riversdale formations. Ripple-marked surfaces and shallow water indications occur on all sides. Hundreds of feet of unbroken succession of strata, practically each stratum beautifully marked by ripples and wind action, as well as by the foot-

prints and trails of reptilian and other animals, such as are seen to occur at East and West Bay, near Partridge Island, Parrsboro, and point clearly to rapid deposition or accumulation of sediment along a fast-sinking floor.

The main reason for introducing this argument is to combat the view advanced in certain quarters, that by placing the Union and Riversdale formations into the Carboniferous system, it would make the latter too cumbersome and unwieldy a system, and take away from an older, underlying system—the Devonian, and rob it of parts of its sediments. The following occur to me to constitute the successive series or sediments which belong to the Carboniferous system in certain portions of Nova Scotia.

#### I.—THE EO-CARBONIFEROUS.

In this lower portion of the Carboniferous system, I would place the Union and Riversdale series of sediments, which are well and extensively developed in Pictou, Colchester and Cumberland Counties; at Union and Riversdale; along Harrington River; on the Moose River; at East and West Bay, near Parrsboro; Archibald's Brook; Oliver's Mills; McKay's, etc., on the East River of Pictou, and at numerous other localities.

The expressions "Rocks of Union and of Riversdale," I would describe as formations, calling one the Union formation, the other, the Riversdale formation. These are easily recognized over wide areas, geographically, and are characterised by a well-defined fauna and flora, at least as far as the Riversdale formation is concerned, the Union formation owing to its highly ferruginous character proving almost everywhere to be very destitute of fossil organic remains.

#### FOSSILS FROM THE RIVERSDALE FORMATION.

The two principal localities from which the fossils of this formation may best be obtained, occur in the Riversdale Station district, close to the boundary line between Colchester and Pictou Counties, and in the Harrington River district near the boundary between Colchester and Cumberland Counties.

*Riversdale District.*—Fossils from this locality were obtained along the Black River branch of the Salmon River, along the Calvary Brook, just east of Riversdale; also in the numerous cuttings along the line of the Intercolonial Railway between West River Station (Pictou County) and Riversdale Station (Colchester County).

In the rather fine grained dark gray or greenish gray arenaceous and black or dark carbonaceous shales of the cuttings along the I. C. R., plants, as well as animal remains, occur. Amongst the groups of organic remains examined and reported upon up to date are a series of plants sent to Mr. Robert Kidston of Stirling, Scotland. The entomostraca were submitted to Prof. T. Rupert Jones, F. R. S., and the crustacea (Podophthal-mata) to Dr. Henry Woodward.

#### PLANTÆ.

1. *Arterophyllites acicularis*, Dawson, (= *Calamocladus equisetiformis*, Schl.)
2. *Sphenopteris marginata*, Dawson.
3. *Neuropteris*, sp.
4. *Alethopteris*, sp.; allied to *Alethopteris valida*, Boulay.
5. *Cordaites principalis*, Germar.
6. " *Robbii*, Dawson.
7. *Cyclopteris* (*Nephropteris*) *varia*, Dawson.
8. *Calamites*, sp. (?)
9. *Cardiocarpum cornutum*, Dawson.

#### CRUSTACEA, (Xiphosura).

##### *Belinuridæ.*

1. *Belinurus grandævus*, Henry Woodward and T. R. Jones.

#### CRUSTACEA, (Entomostraca).

##### *Phyllopoda.*

1. *Leaia tricarinata*, Meek and Worthen.
2. *Leaia Leidyi*, var. *Bæntschiana*, Beyrich and Geinitz.
3. *Estheria Dawsoni*, Jones.

## LAMELLIBRANCHIATA.

1. *Anthiacomya elongata*, Dawson.
2. " *obtusa*, Dawson.

*Insecta.*

1. "A neuropteroid insect allied to *Miamia Bronsoni*"—determined by Prof. Charles Brongniart, of the Muséum d'histoire Naturelle, Paris, France.

*Vermes.*

1. *Spirorbis Eriaia*, Dawson, attached to leaves of *Cordaites Robbii*, Dawson.

*Harrington River District.*—The shales and sandstones, from which the fossils of the Riversdale formation were obtained, occur along the boundary of the counties of Colchester and Cumberland—the strike of the strata being generally across the direction of the stream. As pointed out by Mr. H. Fletcher, this locality proved to be particularly rich in fossils.

## PLANTÆ.

1. *Arterophyllites acicularis*, Dawson.
2. *Calamites*, sp.
3. *Sphenopteris dilatata*, Dawson.
4. " *Hartii*, Dawson.
5. " *splendens*, Dawson.
6. " *marginata*, Dawson.
7. " sp.
8. *Aneimites valida*, Dawson.
9. *Adiantites* ? or *Archæopteris*, sp.
10. *Neuropteris*, sp.
11. *Alethopteris discrepans*, Dawson, (= *Alethopteris decurrens*, Artis, sp.)
12. *Cyperites*-like leaves.
13. *Cardiocarpum cornutum*, Dawson.
14. *Psilophytum* ? *glabrum*, Dawson.

*Animalia.*

## BATRACHIA.

1. *Hylopus Logani*, Dawson.

2. *Sauropus Dawsoni*, (M. S.)—From rocks apparently of this age which occur at East Bay near West Bay and Partridge Island, two miles below Parrsboro.

## LAMELLIBRANCHIATA.

1. *Anthracomya elongata*, Dawson.
2.       “       *obtusa*, Dawson.

## CRUSTACEA.

1. *Leaia tricarinata*, Meek and Worthen.
2. *Carbonia*, sp.
3. *Estheria Dawsoni*, Jones.
4. *Anthracopalæmon*? n. sp.

The Riversdale formation thus carries a flora and fauna, which cannot be taken as one appertaining to any other system than the Carboniferous, inasmuch as the types are all akin, and generally conceded to be closely related, even to types in the productive coal measures higher up in the system.

I have no hesitation to state that, in the Union and Riversdale formations, we have obtained in Nova Scotia a fauna and flora, which, while not as extensive nor as varied as that obtained in the productive coal measures of the same Province, are nevertheless remarkably similar in their biological characteristics, imbedded in a series of sediments, terrigenous in character, and for the most part estuarine, carrying Carbonaceous shales and sandstones, underclays and conglomerates, constituting just a series of strata as that, which, having begun in Eo-Carboniferous time, were interrupted by an encroachment of the Carboniferous Sea (Windsor formation) in which marine conditions prevailed, and limestones were deposited, holding abundance of marine shells and other fossil organic remains peculiar to salt-water conditions, and were followed by newer, or higher, or later strata, such as are met in the “Millstone grit” and “Coal measures” of the same region, of various writers, characterised also by terrigenous deposits, and enclosing a fauna and flora whose affinities are remarkably akin to the forms found in the Eo-Carboniferous

formations of Union and Riversdale, giving us the following natural, though interrupted general succession of strata, in descending order :—

SUCCESSION.	CONDITIONS.	FOSSILS.
III. Coal Measures and Millstone grit.	Estuarine.	Land plants, land animals, shallow water conditions and forms.
II. Windsor formation.	Marine.	Marine shells, corals, sea-life.
I. Union and Riversdale formations.	Estuarine.	Land plants, land animals, shallow water conditions and forms.

As evidence of the similarity of forms peculiar to the Eo-Carboniferous of Colchester and Pictou Counties and the Coal measures of the same, let us take the different orders or groups of fossil organic remains affording Palæontological evidence as noted on page 181 of the "Summary Report of the Geological Survey Department for 1898 and 1899."

#### EVIDENCE FROM ANIMAL LIFE.

*Insecta*—Neuropterous insects have been discovered in the shallow water deposits of Riversdale age, in a cutting on the Intercolonial Railway east of Riversdale and Campbell's Siding, about a mile and a half west of West River Station, and the *wing* obtained and sent to the Museum d'Histoire Naturelles, is referred to a Carboniferous genus by Prof. Brongniart, of Paris, France—a most eminent authority on the Fossil Insects of the Carboniferous.

*Phyllopoda*.—The numerous specimens of *Leaia* and *Estheria* from the Carbonaceous and other shales of the Riversdale formation of Colchester, Pictou, and Cumberland Counties, are very similar to the forms described from the Coal Measures of Pictou, County, and also from the Coal Measures of the United States. All the species of *Leaia* recorded in North America so far, are

referred to the Coal Measures. This genus, however, was abundant in early Carboniferous times, as may be gathered from those specimens obtained by me in the red, black and gray shales of the Union and Riversdale formations of Nova Scotia, which, though they underlie the Marine limestones of the Windsor formation, are nevertheless referred to the Eo-Carboniferous, a position which the enclosed fauna of Phyllopods warrants in assigning.

*Crustacea*.—Several specimens of a new genus, and new species of one of the Podophthalmata and Xiphosura, occur in the Harrington River and Riversdale collections in Colchester County. These Crustaceans are highly characteristic of the Carboniferous system in Europe and America, and their occurrence at this horizon, together with their generic characters, point to them as prototypes of higher forms found in the higher subsequent cycle of sedimentation in the series of sediments referred to in the Coal measures above. Of these, *Belinurus grandævus*, T. R. Jones and H. Woodward, has been recently described, and the authors describe it as a Carboniferous form, related to Carboniferous species in Great Britain.

*Amphibia*.—Of these animals there are both footprints and trails in the collection of the Geological Survey or National Museum at Ottawa, which are referable to the genera *Sauropus* and *Hylopus*, which were obtained from rocks of Union and Riversdale horizon, and some are of gigantic size. All other footprints referable to this genus in North America, have been described as Carboniferous and, consequently, the Parrsboro and Spencer's Island specimens are Carboniferous, rather than any other horizon.

In his "Geology, Chemical, Physical and Stratigraphical," Oxford, 1888, Professor Prestwich gives a table "Showing the character and distribution of the species of organic remains in the several main groups of the Palæozoic series in the British area." Under the head of Amphibians (including footprints) he notes the occurrence of these in the Carboniferous, but none in the Devonian.

Dr. S. A. Miller, in his "North American Geology and Palæontology," containing that useful Catalogue of North American Palæozoic Fossils, does not record a single Amphibian from rocks older than the Carboniferous, and the genera *Sauropus* and *Hylopus* occurring in the Riversdale formation of Nova Scotia, are identical with and similar to those found in the Carboniferous, or other regions of North America.

Prof. James D. Dana, in his "Manual of Geology," Sir Archibald Geikie in his "Text Book of Geology," also, all the leading nomenclators and writers on North American or European Geology and Palæontology, agree in placing the genera *Sauropus* and *Hylopus* to which I have referred the footprints from Parrsboro and Harrington River, of Cumberland and Colchester County, from the Riversdale formation, as Carboniferous.

*Lamellibranchiata*.—Of these the most conspicuous are the *Anthracomyce* of Salter, which Sir William Dawson described under the name of *Naiadites*. These shells are abundant in the Coal Measures of the Joggins, Springhill, Pletou and Sydney Basins of Nova Scotia, also in the Pennsylvania, Virginia and other coal areas of the United States, not to speak of their occurrence in the Carboniferous of England and France, and many other countries of Europe. They occur in bands in the Riversdale formation at Riversdale, and in numerous outcrops along the banks of the Harrington River, on the dividing line between Colchester and Cumberland Counties, and the term "Naiadites Bands" or "Naiadites Shales," which are usually associated with Ostracoda of the genus *Carbonia*, and other allied genera of Carboniferous affinity, is applicable to these Eo-Carboniferous bands. All writers on Geology and Palæontology, concur in placing these shells in the Carboniferous. All the species recorded from the United States are referred to the Coal Measures, whilst those from the Union and Riversdale formations of Colchester and Cumberland Counties in Nova Scotia, are, by the writer, placed in the Eo-Carboniferous. It will thus be seen that the palæontological evidence adduced in the geological collections so far obtained from the Riversdale formation of Nova Scotia,

including Insects, Phyllopo<sup>d</sup>s, Crustaceans, Amphibians and Lamellibranchiata, are all types which are markedly akin to types well known to occur in the Carboniferous of other countries, and more than that, such are usually met with in the Coal Measures of the same.\*

It has been one of my constant endeavours to obtain Devonian fossils from those areas of Nova Scotia ascribed to the Devonian in the Riversdale and Harrington River Sections; but I have found only Carboniferous types.

#### EVIDENCE FROM PLANT LIFE.

Besides the above, there is the evidence adduced from the flora collected in the strata which yielded the forms of animal life just cited above, and it can be truly said that it also has a decided Carboniferous facies. The genera *Asterophyllites*, *Sphenopteris*, *Alethopteris*, *Cardiopteris*, *Stigmaria*, *Calamites*, *Poacites*, *Cordaites* are all represented. From communications recently received from Mr. Robert Kidston, of Stirling, Scotland, the well-known author of the British Museum Catalogue of Carboniferous Plants, who has examined the forms sent him, we learn that he is satisfied that the flora is truly a Carboniferous one.

Quite independently, Prof. David White of the Smithsonian Institution and United States Geological Survey at Washington, arrived at the same conclusion when he kindly made a preliminary examination of the collections from Nova Scotia cited above, and then in our possession at Ottawa, and invariably referred the forms detected to the Carboniferous system.

From our own study of the numerous collections obtained in the so-called disputed areas in question, from the areas of the Riversdale formation, we cannot but come to the conclusion that instead of finding Devonian types of plants and animals, they proved in almost every case to be Carboniferous. Neither is it to be wondered at, that, on studying the affinities and relations of the fossil plants, etc., of Riversdale, McKay's Head, and Har-

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\* The term "Coal Measures" is an unfortunate one to designate a Geological formation, and should never be used to designate horizon. It is a purely lithological or economic term, and conveys no idea of the Geological position in the Time scale. Productive Coal Measures can occur at any horizon in the Carboniferous.

rington River, from strata now referred to the Riversdale formation, Sir William Dawson placed them in the Millstone Grit formation, so intimate are their relations to the plants of the Coal Measures; and from my own observations also to the faunas and floras which are now known to immediately underlie the Millstone Grit of certain portions of Nova Scotia.

The Riversdale formation must now, therefore, both on account of its position in the succession of sediments and especially from the life-zones it holds, be classed as an Eo-Carboniferous formation. This formation clearly underlies that series of marine limestones referable to the Windsor formation, as this has been described and mapped out fully by Sir Wm. Dawson, and more lately and with special care and accuracy by Mr. Hugh Fletcher.

## II.—THE MARINE SEDIMENTS.

In the districts of Nova Scotia under examination, besides the Eo-Carboniferous formations of Union and Rivesdale, consisting of red shales and sandstones and conglomerates, more or less strongly cemented together, together with the series of dark grey coloured, and black or greenish and rusty shales as defined by Mr. Hugh Fletcher, forming a great thickness of sediments, constitute one of the cycles of sedimentation peculiar to the Carboniferous System, there occur certain other strata overlying these unconformably, viz.: the marine limestones and associated gypsum, marls, shales and sandstones.

These marine limestones, &c., hold abundance of fossil organic remains, as shown on the East Branch of the East River of Pictou at Springville; at Brookfield; and Miller's Lime Kiln near the D. A. R. Bridge, Windsor, N. S., where the series is highly fossiliferous and the forms are well preserved. The term, "Windsor Series," is quite applicable to these strata and deserves to be recognized as constituting a typical formation or phase of the Carboniferous system in this portion of Eastern Canada.

Just where to place this *Windsor formation* in the column of Palæozoic formations has not yet been definitely ascertained. Whether it is to be classed as one of the Eo-Carboniferous sediments, or whether it constitutes a factor or part of what may be termed, according to Prof. H. S. Williams's very appropriate classification, Meso-Carboniferous, is the question occupying our mind at present. It is, nevertheless, to be remarked that the fauna it contains is one in which so far not one of the Uppermost Devonian fossils of the Gaspé and other regions of Eastern Canada have been detected.

The occurrence of this formation in certain basins of Nova Scotia marks a cessation of the conditions existing in the areas which these limestones cover, showing that the sea or Atlantic waters in Carboniferous times extended over the Eo-carboniferous deposits previously laid down, which had been subjected to subsidence and erosion previous to their being overlaid, whilst the vegetation and climate did not, probably, change very materially in the high land during this period of submergence and encroachment of the sea. A period of elevation evidently must have followed the deposition of the limestones, marls, &c., and sandstones and mudstones and shales were deposited, to be followed later again by sandstones with shales and coal seams peculiar to the "Coal Measures" and "Millstone Grit" formations.

Such deposits are essentially terrigenous as to their origin and the structure, as well as origin and mode of deposition of the Coal Measures need not be described. The flora and fauna they hold mark the estuarine conditions existing and prevailing at the time, also the luxuriant growth of plants on land with the contemporaneous animal life of the period both in the water and on the land also.

A brief summary of the succession of the sediments in the Carboniferous of Nova Scotia in Pictou, Colchester and Cumberland counties in part, such as the writer has observed it in numerous outcrops and localities, gives the following section in ascending order:—

1. *Riversdale and Union formations*: Consisting of red

sandstones and conglomerates, carbonaceous shales and mudstones, besides diorites and other basic intrusive rocks.

2. An unconformity.

3. Windsor limestones and Hopewell sandstones, constituting distinct formations which overlie the Union and Riversdale formations.

4. (An unconformity, according to Mr. Fletcher.) I have not yet been able to detect any unconformity at this juncture. There is no unconformity between the Millstone grit and the underlying shales, calcareous and other conglomerates and sandstones of Cumberland Basin.

5. Millstone grit of Skinner McDonald's Brook.

6. In certain portions of Pictou County, N. S., an unconformity occurs, *e. g.*, at Blackwood Brook, opposite New Glasgow, where the upturned edges of the "Millstone Grit" (Logan) are overlaid by the New Glasgow conglomerate of Fraser's Mountain, &c., whereas in other portions the Millstone grit is directly superimposed by the Coal Measures, *e. g.*, at Westville and the Joggins.

This peculiar geological succession in these two areas give us two series of sediments in the succession of formations which in part only are synchronous, hold similar organic remains, but exhibit great variety in sedimentation.

A. *Joggins and Westville Areas.*      B. *New Glasgow Region.*

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|---------------------|--|
| V. Millstone grit.  | V. Millstone grit.   |
| VI. Coal Measures.* | VI. Unconformity (of Blackwood Brook).                       |
|                     | VII. New Glasgow conglomerate.                               |
|                     | VIII. Spirorbis limestone.                                   |
|                     | IX. Smelt Brook shales and sandstones.                       |
|                     | X. Pictou sandstones.  |
|                     | XI. Cape John formation, red sandstones<br>and conglomerate. |

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\* The Coal Measures of Pictou County at Stellarton and Westville consisting of bituminous shales, clays and sandstones, are not anywhere seen to be overlaid by any of the formations in series B.

We would thus have the following tentative TABLE OF FORMATIONS in the Carboniferous of part of Nova Scotia:—

FORMATIONS.		Northern Areas.	Southern Areas.	Order.
NEO-CAR- BONIFEROUS	{ Cape John.....	{ Cape John Sandstones..	.....	XII.
	{ Pictou .....	{ Pictou Freestones.....	.....	XI.
	{ Smelt Brook.....	{ Smelt Brook shales.....	.....	X.
	{ Small's Brook..	{ Spirorbis limestones.....	.....	IX.
	{ New Glasgow ..	{ N.Glasgow conglomerates	.....	VIII.
		Coal Measures .	VII.	
		Unconformity.		
MESO-CAR- BONIFEROUS	{ Stellarton..... }	{ Millstone grit .....	{ Millstone grit... }	VI.
	{ Westville .....	{ .....	{ Unconformity (?) }	V.
	{ Hopewell .....	{ .....	{ Hopewell and }	IV.
	{ Windsor..... }	{ .....	{ Windsor.... }	III.
		Unconformity. ....		
EO-CAR- BONIFEROUS	{ Union .....	.....	{ Union .....	II.
	{ Riversdale .....	.....	{ Riversdale.... }	I.

NOTE.—It is not at all improbable that the Smelt Brook formation (IX.) overlying the New Glasgow (conglomerate) formation is equivalent to the Stellarton (VI.) or “Coal Measures” formation, which would indicate clearly the existence, as in other portions of the palæozoic in Eastern America, of two distinct series of formations which are nevertheless synchronous. The writer hopes shortly to describe each of the formations indicated in the above tentative Table of Formations for a portion of Nova Scotia, together with the relations of the latter to other palæozoic sediments in the same and adjoining Province of New Brunswick.