Proceedings and Transactions

OF THE

NOVA SCOTIAN

INSTITUTE OF NATURAL SCIENCE,

FOR

1875, 1876, 1877, 1878.

VOLUME IV.

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1878.

642

PROCEEDINGS

OF THE

Nova Scotian Institute of Natural Science.

VOL. IV. PART I.

Institute Room, Province Building, Oct. 18th, 1874.

ANNIVERSARY MEETING.

DR. J. B. GILPIN, B. A., M. D., M. R. C. S., in the Chair.

Inter Alia.

THE following gentlemen were elected office-bearers for the ensuing year :—

President—J. B. GILPIN, B. A., M. D., M. R. C. S.
Vice-Presidents—WM. GOSSIP, FRED. ALLISON, M. A.
Secretaries—REV. D. HONEYMAN, D. C. L., F. G. S., A. ROSS.
Council—Rev. Dr. WARREN, A. P. REID, M. D., Rev. A. S. HUNT, M.A., ROBERT MORROW, G. LAWSON, Ph. D., L. L. D., J. R. DEWOLF, M. D., M. R. C. S., Sheriff BELL, AUGUSTUS ALLISON.

ORDINARY MEETING, 9th Nov., 1874.

WILLIAM GOSSIP, *Vice-President, in the Chair.*

The SECRETARY announced that the Council had duly elected Professor KENNEDY, Prof. HOW, D. C. L., and Rev. JOHN MCKINNON, as Associate Members, and J. M. JONES, Esq., as a Corresponding Member.

Dr. HONEYMAN read a paper entitled "*A Month among the Geological Formations of New Brunswick.*" This paper was illustrated by a Geological sketch map of New Brunswick, and numerous specimens of rocks and fossils.

ORDINARY MEETING, Dec. 14, 1874.

J. BERNARD GILPIN, M. D., etc., *President, in the Chair.*

The SECRETARY announced that Messrs. JOHN M. WALKER, and THOMAS ROBERTSON, had been elected members of the Institute.

Dr. A. P. REID gave some account of his experiments in the manufacture of Gaseous products at the Halifax Gas Works.

Ordinary Meeting, Jan. 11, 1875.

J. Bernard Gilpin, B. A., M. D., *President, in the Chair.*

The Secretary announced that the following gentlemen, proposed at a previous meeting, had been duly elected members: John Forbes, John T. Mellish, M. A., J. Somers, M. D., and Andrew Dewar.

The President read a paper "*On the Porpoises and Dolphins of Nova Scotia.*" The paper was beautifully illustrated by Diagrams, and by parts of the Porpoise and Dolphin.

A paper "*On Magnetism,*" by Dr. T. R. Fraser, was read by the Vice-President.

Ordinary Meeting, March 8, 1875.

A. Ross *in the Chair.*

The Secretary announced that the Council had elected A. H. McKay, B. A., an Associate Member.

Dr. A. P. Reid read a paper "*On Cheap Gas.*"

Dr. Lawson, submitted analysis of specimens of ice from Halifax Harbor.

Ordinary Meeting, April 12, 1875.

The President *in the Chair.*

Mr. Andrew Dewar, read a paper "*On Spontaneous Generation.*" This paper elicited considerable discussion, and a majority of those present expressed themselves as opposed to the theory advanced; but the Publishing Committee, not wishing to constitute themselves rigid judges, have decided upon giving it a place in the Transactions, leaving it open to the public for scientific criticism.

Ordinary Meeting, May 10, 1875.

Fred. Allison, M. A., read an interesting paper "*On the Meteorology of Halifax, for 1873–'74.*"

Dr. Honeyman also read an elaborate paper "*On Nova Scotian Geology, Antigonish County, etc.*"

John T. Mellish,
Secretary.

Date of Admissio		
1873.	Jan.	11
1869.	Feb.	15
1869.	Feb.	15
1864.	April	3
1863.	Jan.	8.
1873.	Jan.	11.
1874.	April	13
1864.	Nov.	7.
1874.	Feb.	10.
1867.	Sept.	20.
1874.	April	13.
1871.	April	4.
1872.	April	12.
1863.	May	13.
1874.	April	13.
1870.	Mar.	30.
1875.	Jan.	11.
1863.	Oct.	26.
1863.	Dec.	7.
1871.	Nov.	29.
1874.	April	13.
1872.	Feb.	12.
1874.	April	13.
1863.	Jan.	5.
1863.	Feb.	2.
1863.	Jan.	26.
1863.	June	27.
1866.	Dec.	3.
1875.	Nov.	9.
1868.	Nov.	2.
1872.	Feb.	5.
1874.	Dec.	10.
1873.	Jan.	11.
1863.	Jan.	5.
1866.	Feb.	1.
1864.	Mar:	7.
1872.	July	5.
1872.	May	1.
1875.	Jan.	11.
1872.	Feb.	12.
1866.	Feb.	3.

LIST OF MEMBERS.

Date of Admission.

1873.	Jan.	11.	Akin, T. B., D. C. L., Halifax.
1869.	Feb.	15.	Allison, Augustus, Halifax.
1869.	Feb.	15.	Allison, Frederick, Halifax.
1864.	April	3.	Bell, Joseph, High Sheriff, Halifax.
1863.	Jan.	8.	Belt, Thomas, F. G. S., Newcastle-on-Tyne, England.
1873.	Jan.	11.	Binney, Edward, Halifax.
1874.	April	13.	Black, G. P., Halifax.
1864.	Nov.	7.	Brown, C. E., Halifax.
1874.	Feb.	10.	Brunton, Robert, Halifax.
1867.	Sept.	20.	Cogswell, A. C., D. D. S., Halifax.
1874.	April	13.	Colford, Henry, Halifax.
1871.	April	4.	Compton, William, Halifax.
1872.	April	12.	Costley, John, Halifax.
1863.	May	13.	Cramp, Rev. Dr., Wolfville.
1874.	April	13.	Creighton, Aylwin, Halifax.
1870.	Mar.	30.	Day, Forshaw, Artist, Halifax.
1875.	Jan.	11.	Dewar, Andrew, Halifax.
1863.	Oct.	26.	DeWolf, James R., M.D., Edin. L.R.C.S.E., Vice-Pres., Dartmouth.
1863.	Dec.	7.	Downs, Andrew, *Cor. Memb. Z. S.*, Halifax.
1871.	Nov.	29.	Egan, T. J., Taxidermist, Halifax.
1874.	April	13.	Forbes, John, Dartmouth.
1872.	Feb.	12.	Foster, James, Barrister-at-Law, Halifax.
1874.	April	13.	Frith, G. R., Halifax.
1863.	Jan.	5.	Gilpin, J. Bernard, M. D., M. R. C. S., President, Halifax.
1863.	Feb.	2.	Gossip, William, Granville Street, Halifax.
1863.	Jan.	26.	Haliburton, R. G., F. S. A., Halifax.
1863.	June	27.	Hill, P. C., D. C. L., Halifax.
1366.	Dec.	3.	Honeyman, Rev. David, D.C.L., F.G.S., &c., Secretary, Halifax.
1875.	Nov.	9.	How, Prof., King's College.
1868.	Nov.	2.	Hudson, James, M. E, *Superintendent Albion Mines*, Pictou.
1872.	Feb.	5.	Hunt, Rev. A. S., A, M., *Superintendent of Education*, Halifax.
1874.	Dec.	10.	Jack, Peter, Halifax.
1873.	Jan.	11.	James, Alex., Barrister-at-Law, Halifax.
1863.	Jan.	5.	Jones, J. Matthew, F. L. S., Halifax.
1866.	Feb.	1.	Kelly, John, *Deputy Chief Commissioner of Mines*, Halifax.
1864.	Mar.	7.	Lawson, George, Ph. D., L. L. D., *Prof. of Chem. and Natural History*, Dalhousie Gollege.
1872.	July	5.	Lawson, Walter, C. E., Montagu Gold Mines.
1872.	May	1.	Longley, J. W., Halifax.
1875.	Jan.	11.	Mellish, John T., M. A., Halifax.
1872.	Feb.	12.	McKay, Adam, Engineer, Dartmouth.
1866.	Feb.	3.	Morrow, James B., Halifax.

1872.	Feb.	13.	Morrow, Robert, Halifax.
1873.	Mar.	10.	Moseley, E., Dartmouth.
1870.	Jan.	10.	Murphy, Martin, C. E., Halifax.
1875.	Nov.	9.	McKinnon, Rev. John, Hopewell.
1865.	Aug.	29.	Nova Scotia, the Rt. Rev. Hibbert Binney, D. D., Lord Bishop of
1874.	Mar.	9.	Pitts, D. H., Halifax.
1873.	Jan.	26.	Poole, Henry, Derbyshire, England.
1872.	Nov.	11.	Poole, H. S., F. G. S., *Inspector of Mines*, Halifax.
1870.	Jan.	20.	Power, L. G., Barrister-at-Law, Halifax.
1866.	July	28.	Reeks, Henry, Manor Hall, Truxton, Hamp., England.
1871.	Nov.	29.	Reid, A. P., M. D., Halifax.
1874.	Nov.	9.	Robertson, Thomas, Halifax.
1869.	June	27.	Ross, Angus, Sec., Halifax.
1866.	Jan.	8.	Rutherford, John, M. E., Halifax.
1864.	Mar.	7.	Silver, W. C., Treasurer, Halifax.
1868.	Nov.	25.	Sinclair, John A., Halifax.
1872.	May	1.	Stewart, John J., Halifax.
1874.	April	11.	Stirling, W. Sawers, Halifax.
1875.	Jan.	11.	Sommers, J., M. D., Halifax.
1873.	Jan.	13.	Waddell, W. Henry, Halifax.
1874.	Nov.	9.	Walker, John M., Halifax.
1866.	Mar.	18.	Young, Sir William, *Chief Justice of Nova Scotia*, Halifax.

ASSOCIATE MEMBERS.

1863.	Oct.	6.	Ambrose, Rev. John, A. M., Digby.
1873.	April	11.	Gilpin, Edwin, M. E., F. G. S., Halifax.
1864.	July	1.	Marett, Elias, St. John's, Newfoundland.
1872.	Feb.	5.	McKay, Alexander, *Principal of Schools*, Dartmouth.
1875.	Jan.	11.	McKay, A. H., Pictou Academy.
1875.	Nov.	9.	Kennedy, Prof., Acadia College.
1865.	Dec.	28.	Morton, Rev. John, Trinadad.
1872.	Mar.	27.	Moseley, E. T., Barrister-at-Law, Cape Breton.

CORRESPONDING MEMBERS.

1871.	Nov.	29.	Ball, Rev. E., Mahone Bay.
1868.	Nov.	25.	Bethune, Rev. J. S., Ontario.
1866.	Sept.	29.	Chevalier, Edgecumb, H. M. Naval Yard, Pembroke, England.
1871.	Nov.	1.	Cope, Rev. J. C., President of New Orleans Academy of Science.
1870.	Oct.	27.	Harvey, Rev. Moses, St. John's, Newfoundland.
1866.	Feb.	6.	Hurdis, J. L., Southampton, England.
1871.	Nov.	1.	King, Dr. V. O., Vice-Pres. of the New Orleans Acad. of Science.
1873.	April	14.	Poole, H., Derbyshire, England.
1872.	Feb.	5.	Tennant, Prof. J., F. G. S., F. Z. S., *&c.*, Mineralogist to H. M. the Queen, London, England.
1872.	Nov.	11.	Turner, Jabez, Madden Grange, Peterboro, England.

LIFE MEMBER.

Hon. Dr. Parker, M. L. C., Nova Scotia.

TRANSACTIONS

OF THE

Nova Scotian Institute of Natural Science.

Art. I.—A Month among the Geological Formations of New Brunswick. By Rev. D. Honeyman, D. C. L., F. G. S., &c., *Director of the Provincial Museum, Halifax.*

(*Read November* 9, 1874.)

SAINT JOHN.

This City and its surroundings abound in the picturesque. Metamorphism, upheaval, pressure, and glaciation, have hardened, tilted, faulted, twisted, hewn, polished, and striated its ancient rocks, giving boldness to the rock sculpture, and intricacy and variety of lineament. The rock formations of the City are regarded as Huronian (Cambrian), Lower Silurian and Devonian. Carleton has Laurentian; on this the Suspension Bridge rests. Laurentian heights, separated from St. John by a valley in the rear, extend eastward, (?) westward, (?) and northward to the Kennebeckasis. I have thus indicated the four geological formations which occur in this district. In making my observations, I shall start from the Kennebeckasis. We shall thus *generally* ascend geologically. Near Torryburn we have an outcrop of grey granite. This is part of an apparent granite band, which skirts the south side of the Kennebeckasis, to some distance towards Rothsay, and then retreats south. It also runs westward, and is well exposed on the road from St. John to Sandpoint. There the rocks are Syenite, being largely granitoid. The feldspar of the Syenite is red and the hornblende light green. The granite of Torryburn closely resembles that found in the Cobequid mountains near Sutherland's lake, and the syenite (gneissoid) is not much different from that associated with the marble of Five Islands, in the same mountains, so that this granite band of the Kennebeckasis may be regarded as corresponding with the central band of the Cobequid, and the syenite and other granitoid rocks of the Lower Arisaig series of Nova Scotia. Following the granite gneissoid syenite we have the great limestones for which the district is celebrated. These are largely crystalline; some are dolomitic. Lime is manufactured in large quantities, in several localities. One quarry on the road from Rothesay to St. John, with kilns, was examined. The limestone is bluish and not obviously crystalline. The limestone was parted by a bed of diorite (?) It was seen outcropping in all directions. Quarries are abundant, and sections are seen on the St. John and Shediac Railway; diorites are also seen in connection with the limestone. Massive crystalline cryptodiorites of the I. C. R. type are often met with. I would particularize. Near the Suspension Bridge the limestones are graphitic. The bridge on the Carleton side rests upon graphitic rock and schists. On the south side of the harbour there are eminences formed by a siliceous rock. This *seemed* to be the upper rock of the band of crystalline rocks.

I have no hesitation whatever in regarding this band of rocks as a counterpart of the Lower Arisaig series of Nova Scotia. This is the first opportunity I have had of examining a series of this kind out of Nova Scotia, with the exception of the George's Mountain series, Cape Breton. The resemblance of the Cape Breton series to that of Arisaig of Nova Scotia, is sufficiently obvious, but not more so than of that before us. The great lithological characteristics of the three series are identical, *e. g.* syenites, diorites, calcites. Each has also its lithological peculiarities. (Vide Papers by the author in Transactions of the Institute, and Report of Bayley and Matthews.) This is reasonably to be expected, as *precisely* similar conditions of formation could not be expected to exist in separate localities.

The New Brunswick Geologists seem to have established the Laurentian age of the series of rocks that we have been examining. They are older than the primordial (Lower Silurian). They are even older than another series which underlies the primordial, and which is found intervening between the Lower Silurian and the rocks in question. There are no fossils in either of the series underlying the primordial. Their lithological character, however, is strikingly dissimilar, and therefore the descending series is regarded as established, viz: Primordial (Lower Silurian), Huronian (Cambrian), and Laurentian. I consider that from this point of view, we are led to regard the Laurentian age of the Lower Arisaig series as probable.

At Coldbrook I observed rocks strikingly different from the preceding Laurentian, conglomerates and quartzites. This is the upper part of the Coldbrook or Huronian series of the New Brunswick geologists, from what I have observed of this series, and from the described characteristics of the lower part of the same series. (Vide report of Bayley and Matthew.) I am disposed to establish a relationship between them and the conglomerates, quartzites, jaspers and crypto-crystalline diorites of the northern part of the section of the I. C. R. in the Cobequid. (*Vide paper by the author in Transactions*, 1873–'74.) This series intervenes between the Laurentian and the Primordial. It is said to extend to the cove below the Suspension Bridge, on the St. John side.

Succeeding this is the St. John Primordial (Lower Silurian) strata. These were seen outcropping on Coldstream Brook, at Iron Works. This is regarded as the lower part of the series. The corresponding part is in the cove below the Suspension Bridge on the Carleton side. Here the Lower Silurian is in contact with the graphitic schists of the Laurentian series, the Huronian being missing.

The Lower Silurian slates of the cove are peculiarly interesting, as they produced the Primordial Fauna which determined the age of the slates, and consequently the age of the series already described. This series of slates is generally dark in colour. They have been metamorphosed, and remarkably twisted, folded and faulted. The beautiful sections on the sides of the streets in St. John, show these characters in a very striking manner. The slates are also well exposed on the shore of Courtenay Bay. My attention was particularly directed to a fine exposure of crystalline rock, near the cross roads, near the old Episcopal cemetery. This rock is very dark, hard and glistening, being crypto-crystalline diorite, precisely similar to those of fossiliferous series of the I. C. R. The St. John slates are well exposed in close proximity to the rock, or associated with it. I have already referred to this in a note on my paper on the I. C. R. sections; I have been led to regard these slates and the fossiliferous strata of the I. C. R. as belonging to the same great period (Lower Silurian.) I must at the same time acknowledge that I am rather disappointed in not discovering some lithological resemblance between the St. John slates and those of our City and environs.

On the shore of Courtenay Bay, I found *apparently* overlying the St. John slates, a dissimilar series consisting of conglomerate. Finely laminated red slate having crystalline limestone disseminated in amygdal form, silicious schists, slates and diorites. It will be observed that the lithology of this series is much more varied than the preceding.

The sequence *seems* to be regular, and therefore was once regarded by the N. B. geologists as a more recent formation than the Lower Silurian slates. It was called the Bloomsbury group, and was regarded as of Devonian age. I was guided in the examination of the locality by the paper communicated to the Geological Society of London, by Prof. Bayley and Mr. Matthew.

I may mention that although I now generally quote their *Report* of the Canadian Survey, it was only after my return to Halifax that I examined it, and compared it with my observations.

I had had so much to do with supposed Devonian in Nova Scotia, which had invariably turned out to be something else, that I could not altogether accept the rock in question as Devonian. I found however from the Report that these rocks are now regarded as of Huronian age, the regularity of sequence being only apparent; the older series having been brought up, and the seeming regularity having been induced by a peculiar folding of the lower silurian series—*the folding on itself*. (*Vide the Report.*) This arrangement was ascertained by a more extended observation.

In this way the Devonian of the locality became curtailed in its proportions. Succeeding the Huronian there is another distinct series also exposed on the shore of Courtenay Bay, consisting of metamorphosed grits, conglomerates, sandstones, and shales. At first sight one might regard this as a hardened carboniferous series, the *black shales especially* at the top have a carboniferous aspect. This impression might be confirmed by the frequent appearance of Flora having a carboniferous aspect. The unusual hardness of the rock, especially evident when struck by the hammer, tends to unsettle this opinion. I was fortunate enough to find, and at the base of the series opposite Sheffield street, a fine specimen of the characteristic *Dadoxylon Ouangondia num. Dawson*, associated with *calamites*, &c. It was apparently in a favorable position for easy detachment. My hammer and chisel were of no service. Mr. Brittain, of the Gas Works, kindly gave me the assistance of a workman, who with crow-bar and sledge-hammer, succeeded in extracting the specimen. The rock is not distinguishable from the quartzites of our gold fields, and equally hard.

The constitution of the Fossils is also another peculiarity. The bark of the calamites at this point has the appearance of graphite, instead of coal or lignite, and the Dadoxylon, seems to be generally calcified, sometimes converted into a beautiful marble, and the bark converted into graphite; this is the case with the specimen which we extracted. In the Museum there is a beautiful polished section of a trunk, found in the same locality by Mr. Brittain. Its diameter is from eight to nine inches. It shows the internal structure of the tree very strikingly. On the south shore of Carleton there are ledges of slate which are regarded as the highest part of the series. These produce a beautiful flora of asterphyllites, cordaites and filices. The general character of the *flora* is considered to be different from the carboniferous, and is regarded by Dr. Dawson as Devonian. I received a beautiful collection for the Museum from Mr. Brittain.

Proceeding on toward Mispeck Point, we come to a very rough and rocky region. There is a great band of conglomerates, red and grey slates. These are seen traversed in all directions by quartz veins—some of them are of great thickness. They were formerly regarded by the N. B. Geologists as Devonian—(*vide Geological Journal*—paper already referred to; now they are regarded as Huronian. *Vide Report.*

Mr. John M. Walker positively assures me that he found a sight of gold in a piece of quartz in this region, some years ago. On the shores of Courtenay Bay and Carleton are seen boulders, sometimes of immense size, of a very coarse conglomerate. This is largely composed of angular pieces of limestones and diorites, in an arenaceous and calcareous cement. On the road to Sandy Point these were seen, *in situ*, succeeding (on the north) the Laurentian Syenitic gneiss, limestone and diorites, from which they have been largely derived. These conglomerates are of Lower Carboniferous age. To the east of these at Drury Cove and Long Island, the St. John slates, with primordial fossils, are said to succeed the Laurentian series. I was not aware of this when I was examining the region. I hope next summer to have an opportunity of looking at these rocks.

I have thus given the results of a personal examination, and a busy week's work among the Formations of St. John and vicinity. I do not claim to have made any new discovery. All that I profess to have done is to have scanned the work of others, and to have indicated, more precisely than was previously done, the very natural relationship of the formations in two Provinces, which require the construction of a canal to separate them; the two being more immediately connected than two parts of the same Province, Nova Scotia (Proper) and Cape Breton, which are separated by the Strait of Canso.

I cannot help contrasting this week with another spent in the same region about fifteen years ago. Then the formations were regarded as few in number, comparatively recent and uninteresting, Carboniferous, Devonian, Upper Silurian (?) and igneous rocks.

There are now sufficient number and variety, some of them dating to the remotest antiquity—Carboniferous, Devonian, Lower Silurian, Huronian and Laurentian. For the present state of things we are chiefly indebted to the zealous and successful labours of Matthew, Hart and Bayley. For guidance to localities, facilities of travel, and hospitality provided throughout my whole month's exploration, I am very much indebted to my excellent friend, John M. Walker, Esq., of St. John and Halifax. I may be allowed to add fifteen years extra experience in the examination of cognate formations in Nova Scotia and Cape Breton as also of considerable service.

ST. JOHN TO BATHURST.

Leaving St. John by the St. John and Shediac Railway, we start from the primordial slates, traverse the Huronian and the Laurentian. The last is exposed by a fine series of sections on either side of the road. At a distance of about eighteen miles we pass into the carboniferous formation—the older formations retreating on either side. On our way we pass through Sussex Vale, with its lower carboniferous limestones having saltsprings and manganese deposits, and at length we reach the Gulf of St. Lawrence at *Point du Chene*, with its exposure of soft sandstones. We are thus on the base of the great carboniferous triangle of New Brunswick, having cut off its southern angle. From Point du Chene to Miramichi, we pass along the base by sea to a distance of about seventy miles. Reaching Miramichi we sail up the river to Newcastle, where carboniferous sandstones are seen quarried on the river bank. Driving across the country from Chatham to Bathurst, we reach the northern side of the carboniferous triangle, at the same time cutting off the northern angle.

SOMERSET VALE

was our head quarters in this part of New Brunswick. This lovely spot is the property of Francis Ferguson, Esq. of St. John. It is situate about three miles north of Bathurst. The property is of great extent—through it flows the River Tattagouche, which winds beautifully through the vale with its green meadows, fertile fields, venerable homestead and spacious buildings. The retirement and quietness of the vale with its meadows shaded by numerous and graceful elms, its fairy river, abounding in salmon and sea trout, the kindness and hospitality of Mr. and Mrs. Ferguson, with an enthusiastic disciple of Isaac Walton (Mr. Walker) supplying the establishment with salmon and sea trout, together with delightful weather, combined to make the retreat, after a hard day's work among rocks, rivers, wilderness, horse flies and mosquitoes, perfectly enchanting.

The rocks exposed on the sides of the Tattagouche, and in a cutting of the I. C. R. beyond it, showed that we had passed the boundary of the carboniferous formation. It is to the geology of the region that the Tattagouche is indebted for its salmon-holes. These have been formed by direction given to the waters and the eddies made by jutting rocks. These rocks are slates of uncertain age; I have little doubt from their lithological character that they are of upper silurian age. I failed to discover any fossils in them. The first of the slate exposures occur a little above the Railway Bridge. Up the river about nine miles from this point are seen the Falls of Tattagouche. The rocks of the falls and on either side of the river for some distance below the falls are lofty and precipitous; they consist chiefly of red and grey slates, cave adits, and other arrangements, show that this has been the scene of mining operations. Copper and other metals were sought for in these rocks in economic quantity, but without success. These rocks also are of uncertain age; they are probably upper silurian.

I have referred to a Railway Bridge on the Tattagouche. The quietness of Somerset Vale is soon to be disturbed by the noise of the railway. The I. C. R. passes through the vale, and crosses the Tattagouche by a magnificent iron bridge. The top of it is sixty feet above the river, and seventy feet above the sea level. I give this measurement as I intend to make a practical use of it in a subsequent part of this paper.

In the second cutting across the bridge are the only remaining rocks met with in this locality. These rocks are crystalline diorites, homogeneous, porphyritic and amygdaloidal. I did not ascertain their relation to the Silurian slates of the Tattagouche. They are also seen outcropping on the post road, making themselves uncomfortably felt by the jolting of the carriage.

Exposed rocks are therefore a rarity in this region. The carboniferous rocks to the south of Tattagouche lie at a gentle inclination, and the older and harder rocks are much covered by drift. The magnificent pillars of the new bridge across the Tattagouche are formed of fine blocks of a peculiar granite. The peculiarity arises from the prevalence of large crystals of red feldspar in a base of quartz, black mica, and red feldspar.

NEPISIGUIT RIVER.

We were urged to examine the copper mines on this river.

On our way we came to the I. C. R., about six miles above Bathurst. Here the navvies were hard at work cutting into a deep deposit of drift, consisting of the very coarsest material with overlying clays and sands. I now notice these by the way.

The principal work here is the construction of even a grander bridge than that of Tattagouche, over the Nepisiguit. The great columns are of the porphyritic granite, already described. Here they have the solid granite for their foundation. This granite is spendidly exposed on the river, and it is quarried on its sides. The granite band is exposed down the river as far as the Rough Waters, about three miles above Bathurst. Proceeding about three miles farther we cross the Pabineau river, and come to the Pabineau Falls, on the Nepisiguit.

The exposure of granite is extensive. The great riven rocks rounded, with the great rush of waters dashing and splashing, are indescribably striking. The mosquitoes came in clouds, marring enjoyment. The granite is homogeneous. We had passed over the porphyritic. I was interested in the *pot-holes*. These were hollowed out in the solid granite by the revolving of boulders by the agency of the rushing waters. Some of them are large, round, deep and entire, with the rounded boulders at rest in the bottom; others surviving only in part, the revolving and excavating boulders having worn their way out of the sides of the pots, to be hurried away with the rushing waters. I examined them and collected specimens in spite of the mosquitoes. About two miles farther we had passed over the band of granite. The bands of rocks succeeding were examined on the side of the river opposite the Copper Mines.

Owing to a disaster—the maddening of our horses by swarms of horse flies—their rushing into the water, smashing our carriage, and a similar treatment of the horse and carriage of our guide, we were prevented from crossing the river and examining the copper mine.

In spite of our misfortune we examined the rocks accessible; characteristic specimens of rock were also brought from the mines. These enabled me to form an opinion of the rocks containing the deposit of copper. We were disappointed however in not being able to examine the mines and deposits. The prevalence of schists and magnesian rocks indicate an age and condition of formation similar to Tilt Cove, Newfoundland. I consequently concluded that the band of rocks was of lower silurian age, (metamorphic).

Afterwards, we visited the Grand Falls, about twelve miles farther up the river. On our way we glanced at the rocks on the river, as they appeared at intervals. They seemed to be similar to those of the Copper Mines; at length we reached the Falls, coming upon them from above. The scene far surpassed that of the Pabineau Falls, but our old enemy the mosquitoes, of monstrous size, and in numbers formidable, assailed in every direction, so that I could hardly manage to secure a characteristic specimen of the rocks over which the waters rushed. The rock is a schist, highly siliceous, having the appearance of an amygdaloid. Its hard constitution has enabled it to resist the degrading action of the waters; its elevation has given them great scope for descent. I had no hesitation in regarding the rocks as a continuation of the band of the mine, and as being of lower silurian age.

Subsequently we ascended the river from the bridge at Bathurst. On the sides of the river, below and above the bridge, exposed layers of a red sandstone shewed that we were within the area of the carboniferous *triangle*. Ascending the river on the south side the same kind of sandstone continued until we reached the Rough Waters. I was shewn *nodules* of copper ore (grey sulphuret) which were found in this sandstone. The ore is rich, but the supply is limited, as Nova Scotian experience, under similar circumstances, would lead us to expect.

At the Rough Waters I found matters altogether different from what I anticipated. I expected to find the granite of the Rough Waters overlaid by Lower Silurian (metamorphic) slate, as we have already observed on the northern side, and as indicated in our geological map. Instead of this I found the carboniferous sandstone lying almost flat upon the granite with only a few feet of rotten granite intervening. I must, however, in justice state, that while the Atlas map of the Canadian Survey inserted a broad lower silurian band between the granite and the carboniferous, I afterwards found that the arrangement was well understood, as it is well described in the volume accompanying the Atlas. *Geology of Canada, page* 451.

The granite of the Rough Waters is fine grained. The constituents are the same as of the porphyritic granite of the higher waters. The large crystals of red feldspar only are absent. The arrangement of the formations ascending the Nepisiguit as far as the Grand Falls, is—

Carboniferous,	Sandstones, &c.
——?——	Granites,
Lower Silurian,	Slates, Schists, &c.

I would observe in regard to the age of the granites:—There can be no question that they are pre-carboniferous; the arrangement at Rough Waters proves this. If we regard them as intrusive then they may be of Middle or Upper Silurian, or Devonian age. I regard them as of the same age as the granite near Purcell's Cove and other localities on the North West Arm, Halifax. Halifax granite is sometimes porphyritic, having large crystals of white feldspar,—both seem to be bedded. If Halifax granite is a Laurentian gneiss, so is that of Nepisiguit. Both are associated with Lower Silurian (metamorphic.) In the western extension of this granite, Mr. Robb, of the Canadian Survey, considers that he has convincing proof that the granite is igneous. I can produce many cases at Halifax where such a conclusion seems to be inevitable.

The Rough Waters, the Pabineau Falls and the Grand Falls have given the Nepisiguit fame as a resort of the angler.

The extension of the rocks, which we have been examining on St. John River and its tributaries, and the Miramichi River, has been the sphere of the operations of Mr. Robb, of the Canadian Geological Survey.

It will be evident by a glance at the Geological map of New Brunswick, that the pre-carboniferous formations traverse the country in approximate parallels, running N. E. and S. W. The so-called central band of granite appears as one of those parallels, traversing the whole of New Brunswick. Of this the granite of the Nepisiguit is the N. Eastern extremity. Although there is nothing intervening between the carboniferous and the granite on the Nepisiguit, there is an intervention of another formation, between the granite and the carboniferous to the west. In this fossils were found, but not sufficiently distinct for determination. On the north side of the granite *graptolites* were found, but not in *situ*. It was regarded as probable that they came from the strata that occupy the position of the metamorphic slates of the copper mines, which we have regarded as Lower Silurian.

SOMERSET VALE TO DALHOUSIE.

On our way we had to pass over the crystalline rocks of the railroad cutting, north of the Tattagouche. At *Petit Rocher*, about twenty miles distant, we saw a limekiln on the road side in active operation. This led to inquiry after the position of limestone. It was seen at a short distance crossing the road. Search was made for fossils but we found none; the limestone was dark in colour. We passed over a considerable width of diorite and grits before we reached *Belledune*.

At Chambers' inn I found that the Rev. Mr. Fowler had kindly told our host to send me to the shore. I here found a very interesting series of rocks, replete with fossil-corals. I collected a large and fine specimen of *Halysites*, *Catenulatus* (chain-coral), fine specimens of *Favosites*, *Gothlandica,?* *Stromatopera,?* a large branching coral, gen. and spec.(?), and a beautiful *Cyathophyllum*. The rocks were singular in colour and having trap interbedded. There was no difficulty in determining their age. The *Halysites Catenulatus* indicates Niagara limestone (Upper Silurian). Prof. Hall, in a paper read before the American Association, August, 1873, "On the relations of the Niagara and Lower Helderburg

Formations," thus observes: "The upper limit of *Halysites Catenulatus*, so far as known in New York, is in the *Niagara limestone*."

Before reaching Jacquet River we observed a point with singular looking rocks; on closer examination they were found to consist of conglomerates, very much resembling the new red sandstone conglomerates of Nova Scotia. These repetitions of *post Silurian* rocks seemed somewhat perplexing, occurring in a supposed Silurian region. It was only afterwards that I found them to be carboniferous. We crossed the mountain and reached Dalhousie without understanding the character of the rocks which formed the elevation. We then crossed the Restigouche and landed in the province of Quebec, just in time to examine the rocks on the shore by twilight. We had landed among sandstones. In these I found the part of a fossil fern. I walked along the shore and examined the junction of the sandstones with the conglomerates of new red sandstone? apart by moonlight. I took note of an enormous mass of the conglomerate which had recently fallen. I retraced my steps to our boat and we recrossed to Dalhousie. Mr. Walker promised to take me to a locality where he understood that curious rocks were to be found.

Early in the morning (5 o'clock) we were found in our boat of the previous evening. We rounded the Island and landed somewhere at Cape Bon-ami. We had passed slate which seemed to be sandstone. The rocks which we first met were Traps. I had come expecting to find fossils and was rather disappointed; I could never expect to find fossils in Trap rocks. However, the rocks themselves were a study. Their rugged form and arched gateway; their columnar and amygdaloidal structure, were sufficiently interesting. Their minerals too, veins and amygdals of agate and calcites, and geodes of quartz crystal, merited attention. Beyond the first Trap, in the cove, we unexpectedly found what we most wanted—Silurian strata perfect coral reefs. *Favosites gothlandica?* in abundance, and *Cyathophylla*, *Strophomena depressa*, *Atrypa reticularis*, *Athyrus nitida*, *Orthoceras*, *Crinoidea*.

My perplexity was great, and also regrets at having before me such a rich field, so little time, hunger an impatient companion, and a long day's journey. However, by diligence, perseverance, abstinence and good fortune, I succeeded in making a valuable and interesting collection.

I at once recognized the Niagara limestone — the C. of Arisaig—and with so good an exposure I expected to find the other members of the Arisaig series. Considering this as of even greater importance than the collection of fossils, I proceeded with the examination of the rocks. Where I expected to find Clinton strata I found Trap. In this I saw a beautiful shaped *Amygdal*, which turned out to be a fossil. *Favosites* sp? This led to a further search for fossils, and another was found; a beautiful section in a small portion of the original stratum, the slate and Trap being so closely connected that a line of connection could not be distinguished. All along the shore beyond was Trap, with intercalary beds of Niagara limestone.

These exposures seem to be cross sections of the rocks of the mountain which we crossed the preceding evening, and which I crossed on my return overland to Dalhousie, and recrossed shortly after on our way to Somerset Vale. These Trap rocks and coral reefs give boldness and variety to the scenery of Dalhousie, and fertility to the fields and meadows. The phenomenon of Fossils in the Trap shews :—

1.—That the Trap of Cape Bon-ami and Niagara Limestone are not contemporaneous.

2.—That the formation of the Trap was posterior to that of the Niagara Limestone.

3.—That the Trap was in molten state when the fossils detached from the sedimentary strata dropped into it.

4.—That organic structure may be preserved in molten Trap, especially when in a condition adapted for the formation of Amygdaloid.

POST PLIOCENE.

I have already in passing referred to a deep cutting on the north side of the new bridge of the Nepisiguit. This is in the deep drift overlying the granite. That this is the glacial drift is evident from the great coarseness of the material—the massiveness of the enclosed boulders—the want of the stratification—and the absence of marine relics (fossils).

I also noticed the first cutting across the Tattagouche.

This is of a different character from the preceding. The material here is stratified. It is of marine origin. The abundance of shells to be found in the beds unmistakably indicate the origin of the deposits. The Rev. C. H. Paisley, of Bathurst, has described the various beds as they appeared when the cutting was fresh, giving the measurements and characteristics of each. When I examined the cutting, the sides were washed and run down, consequently the thinner beds were obscured. For Mr. Paisley's description, vide Canadian Naturalist, vol. 7. 1. From 1 to 7 of Mr. Paisley's section were indistinct. 8 and 9, the two to which Mr. Paisley gives an average thickness of about ten feet, are the most interesting; these consist of clay and sand. Springs of water issuing from them, wash out the shells from the beds and expose them in the furrows. Besides shells I noticed peculiar sandy concretions washed down by the water. These were of varying shape, circular and irregular; many of them have the shape of ginger root; one of them of the *pelvis* of a mammal. The fossils which I collected out of clays 8 and 9, are the following:—

Saxicava rugosa,	*Leda truncata,*
Tellina grœnlandica,	*Buccinum undatum,*
Tellina proxima,	*Natica grœnlandica,*
Fusus tornatus,	*Natica clausa,*
Mya arenaria,	*Balanus Hamerui,*
Mya truncata,	*Balanus crenatus.*

On our way to Dalhousie, when approaching the Jacquet River, we found the road crossing the I. C. R. On the road to the right at a distance of about a quarter of a mile, I entered a deep cutting, similar to the fossiliferous section at Somerset Vale. Here the beds were obscured, still the clays were sufficiently distinct for recognition. From these I collected the same fossils as in the preceding section.

This section is south of Jacquet River, I. C. R. bridge. To the north of the bridge I examined another deep cutting. A road bridge was in the course of construction, spanning the cutting. In this I found as before, clay with gravel and sands overlying. These beds are now somewhat famous as the sepulchre of the *Beluga vermontana* (?). [Dr. Gilpin's paper in the Transactions.] I was enabled to identify its bed by clay and fossils found in the neural arches of the vertebrae. In the clay bed of the section I found the same fossils as before.

A quarter of a mile from Dickie's, four miles farther north, I examined a deep cutting and found beds similar to those already described. In the clay bed I found fossils of the same genera and species as in the others. The fossils in the last cutting were better preserved than those found at Tattagouche. This may arise from the difference in the moisture of the clays. We have thus in a distance of eighteen miles examined four localities, all containing Post Pliocene beds of the Champlain epoch, with characteristic fossils.

I examined cuttings in the vicinity of River Charlos, but the clay beds, if they exist, did not appear. I also examined others, south of the Tattagouche, with the same result. When I was leaving Bathurst, the Hon. John Ferguson, senator, gave me a small oyster, said to be taken from beds in a cutting on his farm near Bathurst.

I have this evening directed your attention to the principal Geological Formations of New Brunswick.

These are the Laurentian; Huronian or Cambrian; Lower Silurian; Upper Silurian; Devonian; Carboniferous; Igneous; Post Pliocene.

In time we have ranged from the far remote past, to time comparatively of yesterday.

We have begun with a period when life was eozonal. Passing through a period when life was rare and doubtful, we entered on a period which is termed Primordial, Lower Silurian, an age of crustaceans and mollusks, principally the former, having forms peculiar to extreme antiquity, living and enjoying life, where now we have the busy harbours of Saint John and Kennebeckasis, the choice waters for modern aquatic contests. We have also roamed among the coral reefs of Upper Silurian seas, with their abounding *trilobites*, *cephalopods*, *brachiopods* and *favosites*. These and their tombs give geological interest to the Bay des Chaleurs. We have wandered among Devonian fields examining their peculiar vegetation, among which sported the earliest winged insects—the remains of these are found at Courtenay Bay. From these we passed easily and naturally into the carboniferous region—the period of luxuriant ancient vegetation. In this period we saw submarine volcanoes in vigorous operation, shaking and rending the Upper Silurian foundations of the carboniferous period in the north—the ancient coral reefs being elevated, parted and broken—the coral polypedoms and their tombs are seen dropping into the molten lava, and narrowly escaping destruction.

A great leap brought us into the Post Pliocene period, with ice sheets—glaciers and icebergs—the debris of rocks accumulated in the railway path attesting their existence.

A later stage of the same period brought us into seas with their walruses, seals and cetaceans and molluscs, with specific names that chill, *Grœnlandica*, of Greenland, the land of ice. These at the same time introduce us to the *molluscs* of the time in which we live.

Art. II.—On the Smaller Cetaceans inhabiting the Bay of Fundy and Shores of Nova Scotia. By J. Bernard Gilpin, A. B., M. D., M. R. C. S.

(*Read Jan.* 11, 1875.)

In making out five distinct species of this order, I have had much difficulty from the want of material. Some species abound in our waters, but being useless, are rarely taken, and are thus only seen. Of others I have only the skull or parts of the skeletons of dead ones, thrown upon our shores. Of others, the Beluga for instance, I have the report alone of the Indians, and there remain but two species of which I have material sufficient for a paper. These are the common Porpoise, or puffing pig, and the ocean Porpoise, which is confounded by fishermen with the true Dolphin, and which has no doubt been described by Jackson (Boston Nat. History Report), as D. Delphis. This paper must be considered then, as very imperfect, and hereafter to be added to. Though there must be much valuable information locked up in the various American Journals, I can put my hand on no American systematic work, but have found much benefit from "Catalogue Seals and Whales." B. Museum. J. E. Gray, F. R. S., 1866, and have used his nomenclature, giving the American synonyms when able.

ORDER:

CETACEÆ.

FAMILY:

DELPHINNIDÆ.

Delphinus delphis. Linn. Cuvier. Gray.

DOLPHIN OF ALL SEAS:

Lagenorhyncus leucoplurus. Gray.
Delphinus delphis? Jackson (Boston Nat. History S.)

WHITE SIDED DOLPHIN. SEA PORPOISE.

Phocœna communis. F. Cuvier. Gray.
Phocœna tuberculifera. Gray.
Delphinus phocœna. Linn.

THE PORPOISE.

Beluga catadon. Cuvier. Gray.
Physeter catadon. Linn.
Delphinopterus lincus. Pallas. Bell.

WHITE WHALE.

FAMILY :

GLOBIOCEP HALIDE.

Globiocephalus intermedius. Harlem. Gray.
Globiocephalus melas. Dekay.
Delphinus globioceps. Jackson (Boston Journal).

AMERICAN BLACK-FISH.

Delphinus delphis. Dolphin of all Seas.

Of this species, there is a part of a skeleton in the Provincial Museum, Halifax, a skull from the ocean, and jaw of one caught near Liverpool, N. S. They all agree in the teeth being more numerous, (from one hundred and fifty to one hundred and sixty,) the rostrum being longer and narrower, the palate having a central ridge with a deep sulcus running inside the teeth, and differ from other skulls in all these particulars. As they coincide with the description of writers on this species, I have no doubt in placing it among the cetæ of Nova Scotia.

Lagenorhyncus Leucoplurus.

At Digby Gut, August, 1875, I examined two Sea Porpoises shot by the Indians. The measure of one of them taken upon the spot was—

Length	5 ft.	10	inches.
From nose to base of flipper	1 "	3	"
From nose to base of back fin	2 "	8½	"
Height of back fin		7	"
Length of back fin		9¼	"
Spread of caudal fin	1 "	4½	"
Length of flipper		9	"
Length of mouth		7¾	"
Eye from mouth		2	"

The other fish was rather larger, but agreed in form and colour. In form they were very round. The forehead sloped upwards from a beak or snout, in a convex line to the back fin which was falcate in form. From its posterior edge the line of back sloped rapidly to the tail. The lower line of belly sloped gently to posterior edge of flipper ran straight to beneath dorsal, then rapidly upwards to tail. The dorsal and pectoral fin (flipper) were both falcate. The back behind the dorsal became carinated, ending in a ridge between the caudal fins. The mouth was formed into a beak or snout, with gentle curves. The eye black, about two inches from mouth, the lines of which ran upward. The blowhole on the forehead, between the eye crescentic concave forwards; ear, a small puncture. In colour the beak was white with tips of both jaws black (in one specimen the lower jaw was all black). The back, fins and tail blue-black. There were three irregular ill-defined white spots shaded by black dots on the sides, the black of the upper parts shading gradually into bluish ash around them. The eye was in a whitish spot, and there were two faint parallel white lines running along the sides and losing themselves in the white patches. The belly was pure white, with a tolerably well defined edge. The eye was dark reddish black. On inside the mouth the palate was white, with a black triangular spot on the point. The palate membrane was very thick, apparently holding the teeth firmly, as there were no alveola processes, and the teeth dropped freely out after removing the membrane. The teeth were pointed and slightly incurved; twenty-two in upper jaw, lower jaw twenty-five on each side. There were no teeth at the points of either jaw. It seems probable that the teeth vary in different individuals. The genital organs are concealed in a deep fold in both sexes. In the female may be seen two smaller folds on each side of the larger one concealing milk paps. On opening the body and removing the blubber the muscle was very full of blood, deep red, and coarse fibre. The heart and blood vessels, and lungs very well developed and full of blood. The liver moderate, the kidneys with well-developed ureters and bladder of urine. The stomach very capacious, constricted in several parts, resembling the colon of a horse. Inside the mucus membrane deeply corrugated, in some parts a deep rose colour, suddenly succeeded by pale pearl, answering to the constrictions.

This very imperfect account must be taken as the result of a very rough dissection done upon the sea beach. The jaws of this fish corresponded exactly with those of several skulls in my possession, from Bay of Fundy, Sable Island, and Halifax Harbour. To the latter one, lent me by my friend, Dr. Somers, Dalhousie College, was attached a portion of the skeleton. In all of them we found the palate flat, composed of maxillars, intermaxillars, and portion of vomer showing between them, but no central ridge, or deep sulci running parallel with teeth, as in D. delphis. The spinous process of atlas is large and rakes backward, covering the four next vertebræ. The spinous process of second and third are anchylosed to it. To the body of the fifth is a small process pointing forward on either side. The spinous process of the sixth is larger. To the seventh, both to its body and to its transverse process is articulated a short broad rib. This mark of articulation on the bodies is lost after the tenth vertebra. From the atlas to the tail there is an elastic cartilagenous disk between each vertebra. The vertebræ are articulated to the sides of each other, until the seventeenth vertebra, where the point of articulation has risen above the neural arch, and forms the sub-spinal process, common to the whole order. The vertebræ increase on their spinous and transverse process, rather than bodies, to the middle of the body, the spinous becoming more erect and longer, the transverse longer and flatter. After the middle they decrease in the same order, retaining the sub-spinal process almost into the tail. Sixty-two vertebræ remained upon the skeleton which had lost a portion of the tail. Twenty V. bones, each attached to the cartilagenous disk remained. These V. bones form an attachment for the muscles moving the flukes of the tail downward and backward. Though not attached to this skeleton, I found in others a well developed scapula, with coracoid and acromion process, the humerus, radius and ulna massed into one, and metacarpals and phalanges, typed out by spots of bony deposits upon cartilage. The true ribs or those attached to sternum were all jointed, one third rib from sternum, and all the ribs were articulated to the transverse process. These divergences, no doubt common to the smaller genera of the order become important when we consider this class as the first type of air breathing warm blooded mammals created. That this species is now confounded with D. delphis by the fishermen of our coasts, and has been described as such by Godman and Jackson, cannot be doubted. Of its habits little is known, though common upon our coasts. The Indians readily distinguish it from Phocœna communis, and care little for its capture, as it yields less oil and is more difficult to kill. Of their relative number with Phocœna in the Bay of Fundy, perhaps half-a-dozen are captured during the season, at Digby Gut, while of the other, perhaps one thousand. The specimens I have described were small, and no doubt young fish, some individuals going above eight feet in length. The adults may have the marking more decided and teeth more numerous. In its skull and skeleton it so resembles the Genus Lagenorhyncus that I have placed it there and adopted Gray's conjecture of its being the D. delphis of Jackson.

Phocœna communis,
Phocœna tuberculifera,

COMMON PORPOISE.—PUFFIN PIG.

This is by far the most common species inhabiting our shores. They are met with on all our coasts, but mostly along the sides of the Bay of Fundy, especially where it pours its rapid tides through the Digby Gut into the Basin of Annapolis. Here in spring and summer they may be seen in eager pursuit of the gaspereaux and herring, which are running for their spawning and feeding grounds. In this turbid tide they may perpetually be seen rising and disporting themselves, unmolested indeed by the fisherman, but keenly hunted by the few remaining Micmacs, who come from the interior and form temporary camps on its rocky shores.

On the 23rd July, 1874, at the fishing beach, Digby Gut, I examined a large female porpoise, which, with her young one, was freshly brought ashore, both covered and killed by one shot.

Extreme length	5 feet	1	inch.
From nose to D. fin	2 "	7	"
D. fin in height		9	"

D. fin in breadth		7	inches.
Girth in widest part	3 feet	3	"
Width of tail	1	"	
From nose to fore fin	1	"	
Eye from nose		10	"
Length of mouth		4	"
Blowhole from nose		7	"

In external form the body was very round but tapered very fast behind the dorsal to the tail. The two last feet being scarcely one quarter the circumference of the body; the mouth was not prolonged into lips or snout like the ocean porpoise. The outline arising from a somewhat prominent forehead rose gently to the back fin, then fell suddenly to the tail which was set up like a duck's. The lower line of belly, commencing from lower lip, slightly concave, swelled rapidly into a convex line till beneath dorsal, then sloped rapidly to tail. The whole appearance, though evidently elastic towards its tail, was that of a firm inflexible body, which did not give way to its own weight, or become flattened when out of water, as the sharks often do. The line of mouth ran upwards crossing the line of the axis of body at about an angle of 40°. If produced it would run through the back fin. The under lip closed into the upper; the eye was small and near the angle of the mouth, the external orifice of the ear a little behind the eye, was of the size of a bristle; the fore fin was very small, inflexible, of a long oval, and though nearly immovable yet having a slight flexion at the humeral joint, and this joint was outside the integuments; the back fin was a little higher than long, anterior edge slightly concave at base, but well convexed at tip—the posterior edge well concaved. In this instance I did not notice the small spines on the anterior edge of fin, but as my attention was not called to it, and as afterwards I examined eight or ten of both sexes and found them upon all I must have overlooked them, and must conclude they are typical. The spread of the tail which was horizontal and turned up, was one foot; the mammæ were hid in two small folds on either side of a deeper and larger fold, holding the vulva; the male organs were hid in a like fold; the mammary glands, when opened, appeared to be a plexus of vessels, turgid with red blood, and a thick white milk flowed from them. In colour, the entire upper parts, including edge of lower lip, fore fin, dorsal and caudal fins were beautiful shining black. This black emarginating the lower lip, and passing through the fore fin ran irregularly to the tail. Below this, pure white shaded at the junction of the colour by ashy grey, which grey also appeared in irregular patches upon the belly. In others that I observed afterwards the black line was less distinct, and large greyish patches above the shoulder. These last answer to the colouring in Jardine's Nat. Library. The young beside the mother was about three feet long, or two-fifths the size of herself. The whole figure just out of water—the skin soft, yet glittering—its symmetrical rotundity—its beautiful black and pearly white—its arched forehead and emarginated lower lip, with its appearance of strength, mingled with flexibility, strike you at once. A recent skull measured:

From occiput to tip of nose	$9\frac{1}{2}$	inches.
Greatest width of maxilla bones	5	"

As usual in this order, the os frontis was nearly covered by the maxilla bones, its superior surface thrown up into high ridges, the nasal bones, two knobs posterior to the spouting holes, and the intermaxilla bones forming two irregular cubes directly in front of these holes, instead of the plane concave surface found in other genera of this order. The palate was broad and flat, and formed by the maxilla bones, the intermaxillas, and a small portion of the vomer. The teeth were on upper jaw, about twenty-two or three on either side, and in lower jaw about the same. They were contracted at the root, but broad and trenchant at the edge. The number is given as an approximation. There was no alveola process—no teeth at either commissure, and teeth were held in a thick mucous membrane, rather than in an alveola process.

In a recent skeleton of one three feet and one-half long, examined in July, 1875, the sternum was of one piece, but hollowed on one side of the interior surface. The ribs were fourteen, one pair so small as almost to escape notice. Eight were articulated to the sternum by a cartilage longer or shorter, and all these eight had a joint one-third of rib distant from sternum; the spinous processes were short and broad; the transverse long and pointed, especially at the middle of the body; the ribs were attached to the transverse processes. The scapula was shaped like a pole axe, with acromion and coricoid processes; the humerus ulna and radius massed into one bone, and the carpal, metacarpal and phylange bones pretypified by osseous deposits, rather than separate bones. In the Phocœna then we find the short, broad, spinous process, differing from the other genera, but in common with them the rib articulating with the transverse process and jointed in the middle.

The porpoise probably frequents our coast the entire year. It is seen in early spring and again in December, but is only hunted during the summer months, when they approach the shores in pursuit of the migratory fish, and when only they are fat enough as our Indians say, to repay their capture. At other seasons they doubtless prey upon bottom feeders, on cod, flounder, haddock and hake. They pup in April or early May, and produce one at a birth, which about the end of June is three feet long, or two-thirds the size of the mother, which still suckles it. During pairing time they are exceedingly bold and careless of your approach, seemingly not noticing you as they pursue each other in frolicksome play. In ordinary times they rise to the surface about every ten minutes, sometimes throw themselves entirely out of the water, but usually make about three rotatory dives on the surface, and then retire below. If you are near you will hear a slight puff or snore. They usually swim in small herds, both male and female—the young beside the mother. Though, doubtless, the fishery of them might be made systematically profitable, and much more oil extracted from them than by the rude Indian way, yet our fishermen have never abandoned their more valuable herring or hake and cod, in their pursuit. It is left for the few lingering descendants of the ancient Souriquois to follow a sport they must have caught from their conquerors rather than received from their ancestors. The ancient Indian had no market for their oils, or iron pots to boil them in, or guns to shoot them. They could obtain food easier than by chasing them with stone-headed lance, hurled from a birch canoe. But however got, it sits them well. It shows well, in that waiting, patient, but fiery glance—taking in everything in a moment—in that double instinct, or two men acting as one like a machine, and in that absorbing love of sport, devouring hunger and cold, and making age for a time spring to labour, forgetting what it has lost, and youth to anticipate that strength it has never yet attained, A sweet rural lane from the town of Digby, insensibly losing its cart ruts, then changing into a bridle path, then obstructed by brush fence, ending in a sheep walk, winds under the brow of the north mountain, and brings you out upon Fishing beach, looking broadly out upon the Bay of Fundy. Here the ruins of countless ages and continual landslides from the steep mountain side, have formed at its foot a terrace level, now well clothed by alder and spruce pine, the rough shingly beach lying seaward far beyond with its ceaseless roar. Here the red man has pitched his tent. It is only a summer one, and you miss the neat birch bark wig-wam with its conical form of poles tied at a centre. A curious patch of old rags, dead bushes and broken boards, picked up in the landwash serve as a substitute. You have come down to see a porpoise hunt; the whole place reeks with oil; the stones themselves are slipping with it, and the smoke fires poison the very air. All is quiet. The lords of the soil lie sleeping in the hot July sun—the dogs are too lazy to bark, and the children are playing on the shingles to seaward. You ask a squaw, invariably using their terse tongue, "Sister no porpoise to-day?" and she answers you shorter, "Too much wind." As you turn to depart, you notice the sleeping men almost simultaneously starting up, glancing around, and with light hand and lighter foot, noiselessly but rapidly preparing their guns, lances, paddles and canoes. The wind is rapidly falling, and looking seaward large patches of simmering calm are forming in the rapid tideway, and yet those sleeping fellows found it out before you. Carefully as if it were a baby, their frail canoes are launched, and the little flotilla is at sea. A school of porpoises have been breaking water far to seaward, and each Indian seeks the place where he thinks they will break next.

Each canoe has a standing figure forward. He is a poor fellow, drunk last night, ill fed, and ill clothed, and his greasy red skin shows through many a tattered rag; yet as he stands there, with his gun across his breast, no Grecian demigod, no Roman conqueror ever stood so firm upon pedestal of bronze or marble as he does upon his bit of frail bark, tossed upon the savage rolling tide. His pose is both strong and easy to indifference. His high cheek bones, and flattened features are downright ugly, yet the light of sport has so lit that broad nostril and tossing hair, that his bronze figure would pale not, if put beside an ancient hero lit by battle light, or martyr illuminated by holier fire.

Behind him, at the stern, sits his "alter ego"—two men with one mind. This rearward fellow's duty is to keep his canoe even balanced, and to watch every motion of his superior. Not a word is spoken, and your dull Saxon eye sees nothing, yet there is a dirty flattened palm thrust out from the foremost fellow's rags, now elevated, now depressed, directing every motion. The stern fellow too sits his rolling perch, his paddle across his lap with the easiest indifference, and yet an untrained foot would never stand an instant, or untrained man sit for a moment upon the thwart of that canoe without being shot into the sea, and rolling her over and over for many a yard. A flotilla of some half dozen of these pretty crafts roll, and wait and watch their prey. A porpoise now breaks water within thirty yards of the nearest canoe, quietly—a slight snore—and a broad glittering back, followed by a fin goes gliding in a circle through the water. The nearest Indian fires, and his canoe is whirled to the bloody water, and now armed with a long lance, he drives it into the dying fish, lying with its white side and belly, broad upon the red and oily water. With it he controls its feeble struggles, keeps it from sinking, and guides it to the side of his canoe. Here an inclined plane is formed by resting the handles of the paddles upon the sides of the canoe, the blades floating upon the water. Up this watery plane the round fish is urged, and pulled and guided by their dexterous hands, and finally the handles inside being tilted, it is rolled safely on board. Its weight between two and three hundred, that of the canoe scarce fifty pounds. This feat so daintily, so silently performed, could not have been done without the most dexterous balancing, the nicest handling, and the most perfect accord betwixt man and man. Nature teaches her forest child some lessons she withholds from his civilized conqueror. As flies the fish hawk with his prey straight to his nest, so usually the red man brings to camp his victim, but they are not unknown sometimes to pile a half dozen in their canoes in one hunt. "Malti Pictou," said his paddle man to me, "once took thirteen in one canoe, he say, he then had enough—suppose where me sit just so much above water," measuring off upon his greasy finger about half an inch, to show me the canoe was loaded to gunwale; "Basin all over glass," he added to explain the perfect calm. The fish when brought to shore is flenched like a seal, and the blubber about two-thirds of an inch thick attached to the skin, is cut into small pieces by the women and children and thrown into an iron pot filled with boiling water. Sitting around this, they collect the oil as it rises to the surface. In this rude way some two or three gallons may be obtained from one fish. Some Indians have had fifty or sixty fall to their own gun, and perhaps from three or four thousand gallons may be the yearly produce of the South shore of the Bay of Fundy. The oil is valuable, gradually increasing in price, and if the Indians could place it properly in the American market, it would net them a good return.

In naming this species I have, following Bell, Camper and Jackson, considered "communis" and "tuberculifera" as identical. Gray on the other hand makes two species, differing by the one having short spines on the anterior of dorsal fin, and in its osteology. In the American species these spines are so small that they may be overlooked, but having taken about ten specimens of both sexes at the water's edge, and finding each to have spines, I may say it is the exception for them to have none. In counting the ribs of a young one taken in the Bay of Fundy, I found fourteen pairs and eight attached to the sternum. As Gray makes thirteen pairs only and seven attached to the sternum, I recounted them and caused others to count them for me, but with the same result. The fourteenth pair were so small that they might easily have been overlooked.

Beluga catadon.

WHITE WHALE.

Of this beautiful species I have only the report of our Indians, of its casual appearance in the Bay of Fundy and on our coasts. They call it a white porpoise, and all agree in its size and appearance. They have a superstitious dread of it and never attack it. There is a tradition of one having been stranded in the Digby Basin many years ago.

Our visitors are doubtless strays from the Gulf of St. Lawrence, where they abound and are fished for their oils.

Globiocephalus intermedius.

AMERICAN BLACK FISH.—BOTTLE NOSE.

This species is common enough upon our coasts, but seldom taken. They are too large for the Indians to attack, and their habit of rushing to each other's support when wounded or stranded makes them too formidable to be attacked from frail canoes. When a large number of them appear off a harbour's mouth, in which are many strong and well-manned boats, the boats go to seaward of them and returning in close order upon them, by firing guns, loud shouts, and splashing the water with their oars, the whole herd is easily frightened and stranded. The whole settlement rejoices in this rich harvest of oil—sometimes twenty are thus taken.

One was stranded by the tide-way at Lunenburg, Nova Scotia, during the summer of 1873. The long falcate pectoral—the caudal fin, and the skull and jaws are in the Provincial Museum, Halifax. This fish has been confounded with the black fish of Europe, (G. melas), (G. Svineval Gray), by DeKay, but is considered a separate species by Gray from osteological differences. The skull preserved at the Provincial Museum, Halifax, measures :—

Length	2	feet.		
Width widest part	1	"	7	inches.
Length of Lower jaw	1	"	9	"
Width of lower jaw at condyle			6½	"
Teeth in lower jaw extended			7	" from tip.
The largest tooth			1	"

In form, this skull was lower and broader or flatter than Phocœna or Delphis. The intermaxilla bones very broad, covering the maxilla's almost to the end. Posterior to spouting holes the nasal bones appeared higher than crest of maxilla's, which here covered the os frontis. Anterior to spouting holes, the intermaxilla's were very flat and concave. The teeth were all gone from the upper jaw but in the lower jaws there were only fourteen left. They were strong, conical, incurved and pointed, and of various sizes, the largest being one inch long. From the state of upper jaw it was impossible to say if the teeth had dropped out after death, but in the lower jaws there were seven alveola cups, showing where a tooth had been lost during life. Unlike the other genera, Phocœna, Delphis, and Lagenorhyncus, whose teeth have no alveola socket, their teeth seemed set in a strong but spongy alveola bone, extending seven inches on either side of jaw, and wherever a tooth had gone, there a shallow cup remained, as if during life, the tooth had been gradually pushed out by a bony deposit filling up the alveola process into a shallow cup. Thus counting the remaining teeth with the cups we could say the lower jaw had ten teeth on one side and eleven upon the other, which would give over forty for all. The palate was very flat and no vomer showing. The commisure of the lower jaw round, strong with no teeth inserted at its arch. The pectoral fin was four feet long and eleven inches in its widest part. In shape it was a very long oval with its long axis produced to a narrow point and depressed downwards.

Art. III. — Spontaneous Generation, or Predestinated Generation. By Andrew Dewar.

(*Read April* 12, 1875.)

In giving a paper on the above subject, we are well aware that we are treading on dangerous ground. The bare mention of the title is enough to arouse bitterness and contention in many whose minds have been trained in the strict theological schools of a past day; but, knowing well that we are addressing a Scientific Society who look at and discuss the subjects brought before them from no other than a scientific point of view, we desire to claim your attention for a short time to the much debated question of spontaneous generation.

We do not come before you with any new experiments to illustrate the subject, for we are of opinion that so far as experiments are valuable, no new ones can be performed that would materially alter the position of affairs, or give a further insight into the beginnings of life. Such have been made scores of times and by as many different men. Besides, no one would put faith in experiments performed in such a benighted country as Nova Scotia.

Sceptics on the subject are of opinion that a microscope will yet be made which will enable us to see the very evolution of life; but it must be apparent to any one, that until we can see an atom separate and distinct as an individual—a result which of course can never ensue as the very atmosphere we look through is composed of atoms —we can never see two atoms coming together and exhibiting life; thus the birth of life will remain for ever a phenomenon buried in infinity. But this should be no hindrance to our reasoning out the *modus operandi* by analogy, a proceeding which, under the circumstances, is perfectly allowable and scientific.

The general meaning of the term Spontaneous Generation is, that matter of itself and by itself, without seed, egg, or antecedent vegetable and animal life, creates out of its own substance a living plant or animal.

Taking this as our groundwork, we proceed to state that we believe in Spontaneous Generation, in so far as that life may be originated in matter without seed, egg, or antecedent life, but with this essential difference that we believe in a power higher than matter or the force implanted in matter, and that it is *this power* which is the original source of life in matter.

Instead of Spontaneous Generation therefore, we would rather say *Predestinated Generation*, because when a new creation is formed, it has only come into being by the exertion of a law implanted in matter in the beginning, by which it was ordained that when certain atoms of matter came into a certain position and condition, a plant or animal of a certain character would be the result.

Even in this statement, however, we go further than the Evolutionists, or the most advanced so-called materialists of the modern school of thought, for Dr. Tyndall (who may be taken as one of the leaders of the school) in his late Belfast address said: "They will frankly admit their inability to point to any satisfactory experimental proof that life can be developed save from demonstrable antecedent life." Of course Dr. Tyndall here means that they have no proof that life has been developed save from antecedent *vegetable or animal life, from the seed or the egg;* but if, as we maintain, and will shortly show, that magnetism, or the force which governs matter, is only a lower form of animal and vegetable life, any new creation, or instance of spontaneous generation, is only a development from this lower inorganic life (as we may call it), to the higher organic life; so that all life, in one sense of the term, *must be and is*, developed from antecedent life.

Darwin, and Huxley who supports him, have another theory to the same effect as Tyndall's. In his "Origin of Species," Darwin says: "I should infer from analogy, that probably all the organic beings which have ever lived on this earth have descended from some one primordial form." Again: "I view all beings not as special creations, but as the lineal descendants of some few beings which lived long before the first bed of the Silurian system was deposited." No explanation is offered of the origin of this primordial form. We not only say it is unnecessary that there should be any antecedent animal and vegetable life, but it is not even necessary to have a primordial form to father everything. We assert that out of the "dead hydrogen-atoms, the dead oxygen-atoms, the dead carbon-atoms, the dead nitrogen-atoms, the dead phosphorous-atoms, and all the other atoms, dead as grains of shot," which Dr. Tyndall speaks of,* (but which we say are all alive,) new forms of life are created and brought into being every day.

Furthermore, so much is this the case, that were it possible to translate all the living animals, great and small, visible and

*Belfast Address.

invisible, to another world, so that not even a primordial form was left, we believe that with the properties with which matter is endowed, and with the limitations which the Deity has imposed on the creation and propagation of monstrosities, that the earth in the course of a few centuries would be re-inhabited with animals and men that did not materially differ from the earth's present occupants. The only faculty probably which could not be evolved out of matter would be the divine mind of man, which the Deity alone, by another special interposition could restore.

To our minds the doctrine of special creation is an invidious, if not a very reprehensible one. To say that no new plant or microscopic being can come into existence without the special interposition of the Deity, is idolatry of a worse kind than that of the heathen; for while the heathen make their God capable of all things, from causing the rain to fall on their fields to saving their souls, we make a God for ourselves, and limit his powers to correspond with our finite knowledge. A man can make a machine which goes of itself if it is only wound up, and it does not again require his supervision, but our God who has made his machine, requires continually to superintend and interpose in its progress. A man may invent a kaleidoscope which gives a never ending succession of new and beautiful forms and figures long after he is dead and buried, while the Deity must be present at the birth of every new form of life in the earth which he has himself made and peopled. A God which endowed matter from the beginning with properties which enabled it when in a certain condition to form new life, is certainly greater than one who had to interpose in every new creation. The more grand, the more omniscient, and the more omnipotent our God is, the more worthy he is of our worship and adoration; it ill becomes any-one, therefore, to detract from His glory, or to put any limit to His Majesty.

It is denied by many that instances of spontaneous generation have ever taken place, but it is an undoubted fact, that wherever experiments have been performed, whether by Pasteur, Childe, Bastian or others, and whenever fair play has been given to the experiments and life has had a chance of budding, life has resulted.

There are of course scores of men who conduct experiments in such a way that life has not a chance of exhibiting itself. They enter into the subject with a mind predisposed against the theory, and perform the most useless experiments under the most absurd conditions. They did not want to produce animals which lived under like conditions with ourselves, or the animals around us, but creations which would be subject to conditions which are imposed on no living thing. Because animals would not form in solutions known to be destructive to all animal life; because animals could not be evolved with a body which would endure being boiled or roasted; because animals would not come to life in an atmosphere below zero, or could live without water, spontaneous generation was a farce! Many also would mix up mineral substances alone, expecting an animal to result, when the only possible one would be of cast iron, rivetted and jointed with nuts, screws, and washers; they forgot that even such an animal—a locomotive for instance—requires fire, air, and water, to set it in motion. These experiments by incapable or prejudiced chemists, do not, however, affect the main proposition—which, indeed, forces itself on everyone who has seen stale beef, cheese, fruit or vegetables—viz: that under favorable conditions, life will continually spring up spontaneously in matter.

As our time is limited, and it is impossible for us to analyze the subject as we would like, we will confine ourselves to showing what life is, and if we can prove that the life which forms crystals and rocks and moves the compass needle, is the same as that which grows trees and moves our bodies, then we may consider our premises proved, for as all organic beings are composed of so-called inorganic matter, and if the same life pervades both, what should prevent the life force from gathering several inorganic atoms, and growing them into an organic animal? We do not say to grow into an elephant or a hippopotamus in a few days, but into a microscopic animal, having as much semblance of life as an oyster or a sponge. That these animals might, however, develope into creatures as large as elephants, if deposited in favourable situations, and left undisturbed, is not only possible, but probable.

Strange to say, although the origin of life has always been a fascinating one with philosophers, and the laws which regulate the physical and inorganic creation have allured the minds of an equal number of men, yet so far as we are aware, no one has ever attempted the very obvious problem of tracing the connection between the two. They have always been considered as two forces separated by a very wide gulf indeed, but if we only look at it in a common sense light, it is surely more in accordance with the grand workings of nature that there should be only one law of life or motion than that there should be several.

In the first place what is life in the broadest acceptation of the term? We should think any movement or motion of bodies would be called life, for the only death that we can imagine is stillness.

Secondly, is there such a thing as stillness, unchangeability or immovability in matter? None that we know of; even those physicists who deny that inorganic matter has life say that matter is possessed of motion, but what that motion is they do not understand, and they do not even hint at its affinity to organic life.

Seeing then that all nature has motion or life, what in the third place is the lowest form of it? Looking at any object around us, we see that there seems to be an attraction of like to like—for instance in a table or chair the woody fibre has such a strong tenacity, each atom for the other, that they cannot be separated except by force, as by fire or chemical action. Take iron, coal, stone, our bodies, or indeed anything, and this one fact stares us continually in the face, *that matter has an attraction for its like.*

Again, the lowest form of force we know of is magnetism. A piece of iron magnetised will attract other pieces of iron to it. But besides this attraction there is also a repulsion, and thus we have become acquainted with the polarity of iron. If we break a magnet each piece has polarity, and if we break till we can break no longer, each piece will still exhibit polarity, and then we, as Tyndall says, "prolong the intellectual vision to the polar molecules" and see them endowed also with polarity. This reasoning has been objected to by Tyndall's critics as unscientific, because, as one said, "by crossing the boundary of experimental evidence it is no longer in any sense a scientific conclusion," but we fail to see its unsoundness, and if such deductions are not to be allowed, there is a limit put to all scientific investigation and first causes would never be discovered. If we thought the question worth arguing we could easily show that in all sciences when direct evidence is impossible, analogical evidence is accepted. The world will not, we think, in this instance, submit to be led by an anonymous critic, even although he is a contributor to *Blackwood*.

The next form of force that we know of is in a plant or tree. We before drew the attention of the Institute to the great similarity between the force of a tree and the manner in which the tree grew, to a magnet with filings at either end. We showed how there was no growth comparatively speaking from the trunk, as the centre of the magnet, and how the roots and branches repelled each other and never came into contact; all exactly as we find it in the iron magnet.* Seeing then that there was no theory before the world of the cause of the life of a plant, and seeing that all the exhibition of its force could be explained by magnetism, we thought we were justified in concluding that the life force of a tree was magnetism.

We also spoke of an animal exhibiting somewhat similar peculiarities in its shape and growth, to the iron magnet. A man's legs and arms spread out at either end of his trunk or body, and the life force or action is from the centre (or stomach where the food is dissolved) to the extremities. If we take the lowest form of life—the zoophyte—we find that if we cut it into innumerable pieces each piece will form another complete zoophyte, thus further resembling a magnet. The problem of the vital force of men and animals not being known either, we thought ourselves justified in also saying that the highest as well as the lowest development of life or force was magnetism.

Furthermore, what is true of one magnet ought to be so with another. If then we are correct in saying that the molecules of an iron magnet have polarity, *the molecules of all plants and animals being magnets, should also have polarity*. Again, as

* As in breaking a magnet also, each piece shows itself a complete magnet; so in plants or trees, each cutting shows itself also a complete magnet by growing.

all minerals, rocks, etc., have a certain structural power which may be traced to magnetism, we make the broad assertion that all the atoms *of matter in the earth have polarity*. But it will be said this is only an assumption and nothing more, and as it cannot be proved, we may only take it for what it is worth. Yet strange as it may seem, nothing is easier of proof, and we do it in the following manner:

We have said that in breaking a magnet each piece is found to be a separate magnet having polarity, but if we reverse the experiment, and incorporate a number of magnets into one, each magnet merges its individual polarity into the magnetism of the whole, and no matter what may be the size of the magnet, or the number of magnets incorporated with it, there can never be more than the two poles in it. This leads us, in passing, to say that if an argument holds good in one extreme, it ought to hold good in the other. Thus with regard to Tyndall's prolonging the intellectual vision to the polarity of the magnetic molecules, if such a deduction is not scientific because "it crosses the boundary of experimental evidence," then neither is it scientific to say, that if a million magnets were welded into one great magnet a mile long by half a mile broad, it would have only two poles, because such an experiment is beyond the experimental boundary; yet no one would ever dream of doubting it. Strange also as it may seem, we have a real magnet much larger than the imaginary one we have pictured, composed too of innumerable smaller magnets; but this anticipates the concluding proof to our magnetic or rather *ato-magnetic* theory of life, (for we include the atomic attraction of like to like in it, because the two forces are inseparable). We have said that the atoms of all iron are magnets; we have also said that the atoms of all plants and animals are magnets; we have even hazarded the assertion that the atoms of all matter in earth, air and sea, are magnets, and herein lies our proof of it. If all the atoms in the earth are magnets, then the earth itself ought to be one vast ponderous magnet, with only two magnetic poles. And is it so? The only answer is, Yes!

In conclusion, is not this as it should be, for where is the necessity for a multiplicity of forces when one is sufficient for the purpose. We enter a machine shop, and amid the buzz of wheels and bands we see an engine in a corner running not only the small wheels, but turning the large fly-wheel as well; or we look on our harbour and see the same power moving not only the pleasure steam-yacht but the ponderous iron-clad as well. If then such is the manner in which man accomplishes his objects, if it is his endeavor in every force he controls to make it work not only small things but great, how much more should it be nature's mode to work in a similar way, for all man's highest efforts are but to imitate or to copy her, and it is not possible that the original should be less perfect than the copy.

Spontaneous Generation, therefore, or the cause of it, is only one quoin stone in the arch which girdles the universe, without which nature herself would be incomplete, and in a state of chaos.

ART. IV.—HALIFAX METEOROLOGY 1874. BY FREDERICK ALLISON, M. A., *Chief Meteorological Agent.*

(*Read May* 10, 1875.)

I HAVE confined myself this evening to brief remarks upon my meteorological observations at this station the past year; as, although statistics are now rapidly accumulating, it is well to defer extended deductions from comparisons of observed facts until a still larger mass of figures and notes be obtained, so as to ensure more accuracy in normals and limits, to work from in the future time.

Summarizing 1874 then, we find a cool moist year, varying in these principal characteristics very slightly from its two immediate predecessors. The actual tabulated results were as follows:—Mean temperature 42°25—or .61 below the mean temperature of 12 consecutive years from 1863 inclusive. The maximum was 86°, 93°1, being the highest I have ever recorded here—that was in August 1872. The minimum was 15°8—the lowest degree I

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General Meteo

HAL

Latitude 44° 39′ 20″ North.

OBS

1874.	Jan'y.	Feb'y.
Mean Temperature	27.15	19.85
Difference from Normal (twelve years)	+3.82	-3.24
Maximum Temperature	51.0	46.2
Minimum Temperature	-15.8	-11.5
Monthly and Annual Ranges	66.8	57.5
Mean Maximum Temperature	36.48	29.76
Mean Minimum Temperature	18.93	9.52
Highest Daily Mean Temperature	45.80	40.05
Lowest Daily Mean Temperature	-7.39	-4.70
Mean Daily Range of Temperature	17.55	20.24
Greatest Daily Range of Temperature	40.7	40.0
Mean Pressure, corrected	29 977	29.841
Difference from Normal, (twelve years)	+.210	+.080
Maximum Pressure	30.604	30 602
Minimum Pressure	29.173	28.830
Monthly and Annual Ranges	1.431	1.772
Highest Daily Mean Pressure	30.536	30.566
Lowest Daily Mean Pressure	29.308	29 042
Mean Pressure of Vapour	.146	100
Mean Relative Humidity	83.0	77.4
Mean Amount of Cloud	6.97	5.52
Difference from Normal, (eight years)	+60	-.50
Prevalent Direction of Wind	S.W.	N.W.
Mean Velocity of Wind	6.09	6.66
Difference from Normal, (four years)	-2.64	-2.28
Amount of Rain	3.80	2.28
Difference from Normal, (twelve years)	+.11	-.78
Number of days Rain	13	4
Difference from Normal, (twelve years)	+6	-2
Amount of Snow	15.7	29.9
Difference from Normal, (twelve years)	-.8	+14 8
Number of days Snow	12	11
Difference from Normal, (twelve years)	+2	+3
Total Precipitation	5.42	5.31
Difference from Normal, (twelve years)	-.24	+.01
Number of Dry Days	12	15
Difference from Normal, (twelve years)	-5	-1
Number of Auroras	1	4
" Gales	4	3
" Fogs	6	2
" Dews	2	0
" Hoar Frosts	9	10
" Thunders	0	0
" Lightnings	0	0
" Hails	0	0
" Rainbows	0	0
" Lunar Halos	0	1
" Lunar Coronæ	3	3
" Solar Halos	1	0
" Days Sleighing	16	28

General Meteorological Register for 1874.

HALIFAX, NOVA SCOTIA.

Latitude 44° 39′ 20″ North. Longitude 63° 36′ 40″ West. Height above Sea, 98.5 feet.

OBSERVED BY F. ALLISON.

.874.	Jan'y.	Feb'y.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	YEAR 1874
	27.15	19.85	30.78	33.39	49.19	53 66	62.45	61 33	57.42	48.74	36.77	26.21	42.25
mal (twelve years)	+3.82	-3.24	+2.10	-4.34	+1.60	+5.14	-.94	-1.73	4.04	+.36	-.58	+ 42	-.61
ure	51.0	46.2	53.7	53.8	81.6	79.2	86.0	85.7	79 8	69.6	57 6	48.1	86.0
ure	-15.8	-11.5	-9.0	7.2	30 0	36.5	43.3	43 6	40 0	27.3	12.3	-4.0	-15.8
l Ranges	66.8	57.5	62.7	46.6	51.6	42.7	42.7	42.1	39.8	42.3	45.3	52.1	101.8
mperature	36.48	29.76	41.16	42.50	62.01	64.26	75.56	73.67	69.35	60 00	45.01	34.23	52 83
nperature	18.93	9.52	22.27	25.53	38.69	45.57	53.51	52.51	49.36	40.11	28.90	17.86	33.56
Temperature	45.80	40.05	43.07	41.94	61.30	63.83	69.23	67.42	62.56	56.81	50.51	44 37	69.23
Temperature	-7.39	-4.70	14.01	19.55	40.44	45.79	49.91	54.89	50.55	37.32	23.74	3.86	-7.39
f Temperature	17.55	20.24	18.88	16.97	23.33	18.69	22.05	21.16	19.99	19.89	16.11	16.31	19.26
e of Temperature	40.7	40.0	38.9	27 8	38.1	34.9	33.8	30.8	35.0	29.7	28.1	26 5	40.7
rected.	29 977	29.841	29.658	29.792	29.785	29.767	29.895	29.854	29.936	29.862	29.900	29.791	29.838
mal, (twelve years)	+.210	+.080	-.051	+.061	+ 069	+.006	+ 117	+.069	+.080	+.038	+.158	+.037	+.065
	30.604	30 602	30.309	30.254	30.204	30.206	30 161	30.200	30 373	30.430	30.480	30.455	30.604
	29.173	28.830	28.896	28.951	29.216	29.242	29.501	29.414	29.234	29.072	28.985	28.898	28.830
l Ranges	1.431	1.772	1.413	1 303	0.988	0.964	0.660	0.786	1.139	1.358	1.495	1.557	1.774
Pressure	30.536	30.566	30.271	30.155	30.132	30.150	30.146	30.142	30.347	30 349	30.426	30 397	30.566
Pressure	29.308	29 042	28.943	29.251	29.283	29.363	29.586	29 496	29.378	29.274	29.146	29.180	28.943
apour	.146	100	.143	.152	.248	.338	.459	.442	.396	.287	.182	.129	.252
dity	83.0	77.4	79.9	79.2	71.2	81.6	81.4	81.4	83.4	81.9	78.9	81.0	80.2
ud	6.97	5.52	5.35	6.08	6.00	7.30	5.66	6.47	5.51	4.88	5.85	6.60	6.02
nal, (eight years)	+60	-.50	-.41	-.24	-1.55	+1.19	+.04	+.88	-.17	-.49	-.67	-.05	+.03
of Wind	S.W.	N.W.	N.W.	S.W.	S.W.	S.E.	S.W.	S.	N.W	S.W.	W.	W.	W.S.W.
nd	6.09	6.66	5.99	6.37	5.38	5.37	3.85	4 25	4.97	4.48	8.40	10.92	6.06
nal, (four years)	-2.64	-2.28	-4.70	-1.80	-3.07	-.81	-.30	-.29	-.42	-1.57	-1.63	+2.90	1.57
	3.80	2.28	3.63	1.90	4.76	7.92	2.29	3.37	5 04	2.46	3.37	4.42	45.24
nal, (twelve years)	+.11	-.78	+.70	-1.00	+.69	+4.48	-.20	-.29	+1.17	-2.74	-1.43	+1.00	+1.80
	13	4	8	10	13	20	12	12	12	13	10	13	1.40
nal, (twelve years)	+6	-2	+3	0	-2	+6	+1	+1	+2	+1	-2	+4	+16
	15.7	29.9	3.7	26.5	0.1	0	0	0	0	0	2.1	11 0	89.0
al, (twelve years)	-.8	+14 8	-13.6	+17 3	-0 6	0	0	0	0	-.5	-2 1	-5 7	+8.2
	12	11	7	13	1	0	0	0	0	0	4	12	60
nal, (twelve years)	+2	+3	-4	+7	0	0	0	0	0	-2	0	+1	+12
	5.42	5.31	.98	4.55	4.77	7.92	2.29	3.37	5.04	2.46	3.58	5.49	54.18
al, (twelve years)	-.24	+.01	-.44	+.61	+.70	+4.48	-.20	-.29	+1.17	-2.74	-1.69	+.58	+1.95
	12	15	17	12	18	10	19	19	18	18	18	12	188
al, (twelve years)	-5	-1	-1	-5	+2	-6	-1	-1	-2	-2	+3	-2	-16
	1	4	3	5	0	4	2	0	4	4	1	0	28
	4	3	1	4	1	0	0	0	1	1	2	1	18
	6	2	2	0	3	7	10	7	3	5	2	1	48
	2	0	1	0	0	2	4	10	14	13	1	0	47
ts	9	10	7	9	4	1	0	0	0	6	11	6	63
	0	0	0	0	0	2	2	1	0	1	1	0	7
s	0	0	0	0	1	2	2	1	0	1	1	0	8
	0	0	0	0	0	1	0	0	0	0	0	0	1
	0	0	0	0	0	0	2	1	0	0	0	0	3
los	0	1	3	0	0	1	0	0	2	0	1	1	8
ronæ	3	3	2	2	0	0	0	0	1	0	0	0	11
os	1	0	0	0	0	0	2	0	1	0	2	0	8
hing.	16	28	3	10	0	0	0	0	0	0	0	7	64

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know of in Halifax; though approached within .8 on the evening of the 7th of January, 1866. These extremes gave a range of 101°8 — somewhat more extensive than usual. The mean daily range of temperature was 19°26, but on one day in January it ranged 40°7.

The mean pressure of the year, abnormally increased in some months by their want of heat, and lightened in others by excess of wet, came out only .065 over the 12 years normal. The barometer varied between 30.604 in January (a most extraordinary height in Nova Scotia), and 28.830 during a snow storm in February; giving a total range of 1.774.

The mean pressure of vapour was .252, and relative humidity 80.2. Mean amount of cloud 6.02, which shews a comparative deficiency in clear sky, readily accounted for if we examine below the small proportion of absolutely dry days.

45.24 inches of rain fell. This depth is above the normal of this climate by 1.8 inches; and it fell on 140 days, instead of only 124, the mean number classed as rainy. Though mentioned in former papers, I may repeat, chiefly for the information of members joined within the last few years, that I call a "rainy day" one on which appreciable rain falls during any part of the 24 hours, and as we measure to .01 of an inch, many days may appear "fine" to the public, which the meteorological record marks as "rainy." Time will not permit to give all the reasons for my introduction of this method into Nova Scotia, but I may say I follow the classification of the British Office, G. J. Symonds, and the most experienced rain observers. 89 inches of snow fell, 8.2 inches more than the 12 years normal; though less than in 1871, 1872 and 1873, all of which were exceptionally snowy years. And this snow fell on 60 days, a number 25 per cent. greater than the normal. Melting this snow, (and I may mention in passing, what is known to most of my hearers, that new fallen snow in this country gives an average equivalent in water of one-tenth), and adding its product to the rain, we have a total precipitation of 54.18 inches, being 1.95 inches greater than the normal depth. Our "dry days", (days be it remembered without even .01 of precipitation), numbered 188.

204 days is the average of a year since 1863. I have purposely avoided, for the present, comparisons with any other stations at home or abroad. This is not the object of this paper. But I may be allowed to remark that our 204 Halifax dry days exceed considerably the yearly Kew number.

Closing the year with the record of occasional and miscellaneous phenomena, I noted in 1874—

28 Auroras,	8 Lightnings,
18 Gales,	1 Hail,
48 Fogs,	3 Rainbows,
47 Dews,	8 Lunar Halos,
63 Hoar Frosts,	11 Lunar Coronæ,
7 Thunders,	8 Solar Halos.

On 64 days we had fair sleighing.

That we may have clearer insight into the details of the weather of the year under discussion, I now take up the months in order :—

January was mild, although shewing on the 27th, the extraordinary minimum above mentioned 15.° 8 below zero. Its mean pressure reached 29.977 (.210 above the month's normal). It was a cloudy month: mean obscuration of sky reaching 6.97. Light S. W. winds prevailed with a mean velocity of 6.09 miles per hour. Rain was in excess—3.80 inches falling, and the depth of snow 15.7 inches, slightly deficient. We look for 17 dry days in January. We had but 12. There were 4 gales, none heavy. Frequent breaks occurred in the sleighing; leaving only 16 days for runners.

February was cold—nearly as much below the mean as January was above it. The barometer still stood high: mean 29.841. This month was much brighter than last, wind prevailing from N. W., but mean velocity yet only 6.66 miles. 2.28 inches of rain fell, or about 75 per cent. of the month's normal. Snow doubled itself, however, 29.9 inches coming down. This reduced the dry days to 15 instead of 16. 3 gales were recorded, and there was sleighing on every day.

March became again milder, rising to a mean of 30.78, or 2.10 above the 12 years normal of the month. As the winter declined the pressure decreased, coming down now to a mean of 29.658. The mean amount of cloud was 5.35. N. W. winds still prevailing, but very moderate, only averaging 5.99 miles. We had rather more rain than the normal fall—3.63 inches; but the very slight depth of 3.7 inches of snow. (17.3 is the March average and in March, 1875, we had 14 inches.) There was but one gale, and that not strong; and sleighing on the first three days only.

April made small progress towards spring. Its mean temperature was 33°39 — only surpassing that of March by 2°61, and falling short of its 12 years normal by 4°34. On the 1st the thermometer was down to 7°2. The mean barometer rose to 29.792. Mean amount of cloud was 6.08. The prevailing wind fell back to S. W., with a mean velocity still light—6.37 miles per hour. Only 1.90 inches of rain fell, or about 66 per cent. of the normal; but the extraordinary quantity of 26.5 inches of snow was measured, being 17.3 inches above the fall we expect in April. There were 4 gales, and 10 days sleighing, the latest on the 14th of the month.

May, with a mean temperature of 49°19, (1°60 above the normal) offered a great contrast to the preceding month. The mean pressure was 29.785. The clouding but 6.0. Wind remaining S. W. fell to a mean of 5.38 per hour. The rain fall was abundant, measuring 4.76 inches, though not on many days. 0.1 of an inch of snow fell on the 2nd. We average about three quarters of an inch of snow early in May. The wind blew a gale on the 26th.

In June we retrograded sadly in mean temperature. It was scarcely warmer than May; 53°66 in place of a normal of 58°80. With considerable vacillation the barometer resulted in 29.767. It was the most cloudy month of the year; and the prevalent wind was S. E., though remaining with the small mean of 5.37 miles. The normal June rain fall is 3.44 inches. Last June 7.92 inches fell, making 20 wet days. Twice we had thunder and lightning.

July was more moderate in every respect. 62°45 was the mean temperature—close to its normal. The barometer was high, mean 29.895. The maximum heat of the year, 86°0, was reached on the 10th; while the 15th, mean 69°23, proved the hottest day. Mean cloud decreased to 5.66, and the wind to 3.85 miles per hour, returning to a S. W. prevalent direction. 2.29 inches was the rain depth, almost the same as the average for July; falling on an ordinary number of days, 12.

August again became colder, both absolutely and as compared with former Augusts. Mean temperature 61°33. Mean pressure of atmosphere, 29.854. This month was not so pleasant as July. We had more cloud, mean 6.47; winds were light, giving a mean of but 4.25 miles; and S. was the prevalent direction. The rain fall was still not large, being .29 below the normal, or 3.37 inches. 19 dry days were recorded.

September scarcely varied at all from its mean temperature since 1863. This month gave 57°42, while 57°38 is my calculation for the 12 Septembers. The temperature never fell below 40°, and that not till the 24th. Pressure was rather great; mean 29.936. The brightness sensibly increased: mean cloud being only 5.51. The returning N. W. wind gave evidence of the decay of summer. The mean velocity of 4.97 miles per hour was very small. A large quantity of rain fell on 12 days: 5.04 inches, or 1.17 inches above the normal. The first autumnal gale was felt on the 30th; very heavy.

October, as last month, resulted in temperature nearly the normal. 48°74 was the mean; and the pressure also continued steady—29.862. The month was very clear; only 4.88 being the mean clouding. We had a quiet month, the wind only giving a mean of 4.48. miles, and the prevalent direction fell back to S. W. The rain fall was very small, not half the normal which is 5.20 inches, while this October measured but 2.46 inches. This rain was scattered over 13 days. No snow fell, generally we have about half an inch in this month. A moderate gale blew from the S. W. on the 30th—morning. The first hoar frost formed on the 7th, and the atmosphere first fell below 32° on the 23rd.

November, though slightly colder than the average (which is 37°35, while this November's mean temperature was 36°77) was a pleasant month. The mean pressure was very great: 29.900.

The mean amount of cloud showed a deficiency of .67, being 5.85. Wind force was increasing, giving a mean velocity 8.40 miles, though still 1.63 behind its normal; and prevalent direction was from due W. Rain fell only to the depth of 3.37 inches; whereas the 12 years shew an average of 4.80 inches. 2.1 inches of snow, dispersed over 4 days, fell; being exactly one-half of the normal fall. 18 days were completely dry. 2 gales visited us, but neither were violent.

In temperature, December presented nothing extraordinary: its mean 26°21 was a very small fraction over the normal. For the first time that winter the thermometer marked down to 0 on the 30th, and registered —4° on the morning of the 31st. The mean pressure, though much diminished from last month, kept up to 29.791. The mean amount of cloud was nearly as is common, 6.60. Winds still prevailed from W. and increased much; at last passing the normal speed, and resulting in a mean of 10.92 miles per hour. The rain depth, 4.42 inches, was just 1 inch above the 12 years average; but the 11 inches of snow fell short by over one-third, or 5.7 inches. The total precipitation, 5.49 inches, slightly exceeded the normal fall. But one gale was felt in Halifax, but it was long and fierce. It began from N. E. on the evening of the 14th. At 1 a. m. of 15th it blew from N. 45.6 miles per hour. Veered N. W. that day, and above 24 miles all day. On 16th, still from N. W., it blew over 30 miles till noon, when it gradually fell. The first sleighing was on the 18th, and we had 7 days of it in all December.

Art. V.—Nova Scotian Geology — Antigonishe County.

By the Rev. Dr. Honeyman, D. C. L., F. G. S., &c.
Director of the Provincial Museum, Halifax, N. S.

(*Read May* 10, 1875.)

Introduction.

In the session of 1865–6 I read a paper on the subject of my present memoir, which was illustrated by a map. (*Transactions.*)

This paper and map showed the results of amateur work in connection with the views of others. Since then—in the summer of 1868, I made a *thorough* survey of a great part of the County in the service of the Canadian Survey. I also reviewed a part of this work in 1871. These examinations, with others connected, made large accessions to our knowledge of Nova Scotian Geology, and led us to see the great imperfections of our amateur work of 1866.

After all this work, difficulties still existed in the way of understanding certain parts of the Geology of Arisaig township—the part of this county which is the most interesting to the geologist and palæontologist. These difficulties have been dissipated by the revelations made during my examination of the I. C. R. section of the Cobequid Mountains. This is my apology for the production of this memoir "On Antigonishe Geology."

Antigonishe County

is named after the county town Antigonishe. It was formerly called the County of Sydney. It is the north-east County of Nova Scotia proper. It is bounded on the west by Pictou County; on the south by the County of Guysboro; on the north by Northumberland Strait; and on the east by St. George's Bay and the Strait of Canso.

Arisaig

is familiar to the Canadian geologist as a "household word." The use of the word in Nova Scotian geology has been somewhat vague and unsatisfactory. I have elsewhere proposed to give it an exact application, and to use it in its widest sense—as indicating

Arisaig Township.

This is the north-west township of the county. It is bounded on the east by Morristown township; on the west it is bounded by the County line and Pictou county.

A great part of Arisaig is still covered by forest, and thus far in a geological sense it is largely obscure. The soil is generally fertile, as might be expected from the prevalence of feldspathic and calcareous rocks. The numerous brooks which intersect it in various directions, are pathways to the geologist. They afford water power to the saw-mill, grist-mill and factory, and supplies of water for other uses. The country is well watered.

The brooks are: Malignant Brook, McNeil's Brook, Doctor's Brook, Arisaig Brook, Smith's Brook, McAdam's Brook, McAra's Brook, Knoydart Brook.

The northern boundary of the township—Northumberland Strait—affords abundance of fish to the settler. Its shore is of surpassing interest to the geologist. Its beaches make it an admirable watering place.

The Arisaig mountains rise to the elevation of 1010 and 1000 feet.

McNeil's mountain is considered the second highest mountain in Nova Scotia proper.

Cape Breton has an elevation 1360 feet.—*Admiralty Chart.*

GEOLOGY.

I purpose to illustrate the Geology of Arisaig by a series of Sections, traversing it in different directions:

1 Malignant Brook Section,
2 Shore to McNeil's Mountain,
3 McNeil's Brook,
4 Doctor's Brook,
5 Shore to McDougall's Mountain,
6 Frenchman's Barn to McDonald's Mountain,
7 Mountain Pass (Doctor's Brook),
8 Arisaig Pier to Mountains,
9 Smith's Brook,
10 McAdam's Brook,
11 McAra's Brook,
12 Knoydart Brook,
13 Shore Section from Morristown township to Knoydart Brook.

I propose also to illustrate the Geology of the whole County by continuations of two of these Sections—of Sections 8 and 13:

SECTION 1.—*Malignant Cove to Sugar Loaf (Mountain.)*

At the Malignant Cove we have a patch of Lower Carboniferous conglomerate, penetrated by trap (diorite) in a singular manner. This conglomerate has been hardened by contact with the trap. The conglomerate and trap in contact are exposed to a short distance up the brook, below and above McDonald's grist mill. The conglomerate is then discontinued. The trap continues to a farther distance and is succeeded by slates. Returning to the diorite (trap) and crossing it westerly a short distance we take our course again southward.

The diorite extends to the summit of the Sugar Loaf, a distance of *one mile*. A band of red slates coming from the west seems to terminate abruptly on the back of the mountain.

SECTION 2.—*West of Malignant Cove to McNeil's Mountain.*

From the shore to the bridge over which the road passes, we have diorite exposed in the brook. Under the bridge there is red syenite. This extends up the brook to some distance. Turning to the right, we come to an eminence of diorites, having a thin vein-like band of red slates, six inches wide, which terminates here. Following this slate westward to the mountain road, we find it in broken patches alternating with the diorite. It occurs in similar manner to some distance up the road, then it becomes a continuous band extending toward the west.

Proceeding along the road toward the mountain we cross *diorite (extending?)*. Succeeding this is the band of red slate of which that of the Sugar Loaf is the eastern extension. This also extends westward.

Another part of this band extending to the rear of the Sugar Loaf, becomes associated with *syenite* and intercepted. Crossing the bridge of McNeil's Brook, beyond it we have associated with these slates a *boss* of a peculiar *Porphyry*. The outcrop is about 28 x 28 feet. This porphyry was long familiar to me from the occurrence of boulders on the shore.

Proceeding onward and topographically upwards we have occasional exposures of slates and quartzites to a distance of —— feet. We come to a porphyry similar to the preceding—we have reached McNeil's Mountain. This is a large *boss* of red syenite, having an elevation as has already been observed, of 1010 feet. On the south side of the mountain the ground is swampy, beyond is wilderness. The distance of this mountain from our point of departure is *two miles*.

SECTION 3RD.—*McNeil's Brook.*

At the mouth of the brook on the shore there is exposed a patch of strata, having a low dip. These are fossiliferous, the fossils indicating C. of the upper series.

Along the brook to the south all is obscure until we reach the diorite of the preceding sections. Passing through this, a straight distance of ——— then comes the band of red slates of preceding sections. In these I found patches of calcite, but no fossils.

From this the brook passes eastward to the last section.

SECTION 4TH.—*Doctor's Brook to McIntosh's Mountain.*

On the shore and a little way up the brook, trap is crossed. From the miller's house to the height above the mill, and on either side of the mill dam, great and even picturesque exposures of singularly mixed and indescribable rocks are seen, which are regarded as metamorphosed sedimentary rocks, of A of the Upper Arisaig series. Succeeding there is a band of slaty rocks of A or Mayhill Sandstone age, having characteristic fossils. These have a width (thickness) of —— feet. After this there are black shales, (laminated), having *graptolites*, and a large concretion. These have a width of 146 feet. To a farther distance of 192 feet there are black shales and slates. These have *lingulæ* and other fossils. This is B of the Upper Arisaig series.

We have still in the section at the side of the road and the brook, 47 feet of slates—lithologically dissimilar. These are also fossiliferous. I regard these as the lower part of B'.

Continuing the section we have an obscure interval of lofty banks, having a hard rock jutting into the brook. This is probably the passage of the C strata of the last section. Following the course of the brook westward, for a short distance we have shelving strata, having a northerly dip. These are soft and hard, light green and unctuous. They have fossils characteristic of B' of the upper series. We have thus a *syncline*.

Passing over a field on an elevation of these strata, we reach diorite, a continuation of that of the preceding section. This contains about ———

We have now reached the eastern branch of Doctor's Brook, which here takes a southerly course, being direct south from the main brook and along our line of section. Succeeding the diorite are quartzites and slates having a very thin bed of *öolitic iron ore* (hematite). We have come to the red slates of preceding sections. Here they are parted in several places by diorite—before the *trifurcation* already noticed. After these are slates and quartzites—sections of the mountains on the eastern side of the brook.

The section terminates with the diorite of McIntosh's mountain. Beyond this the rocks are obscured.

SECTION 5TH.—*McDonald's Cove to McDougal's Mountain.*

Commencing at the Point on the east side of the cove, there is first the trap dyke of last section, succeeded by a peculiar green and red jaspideous rock. Then follow the fossiliferous slates of A.

After these come the laminated black shales of B. The contour indicates the probable continuance of these and the shales of B up to the rising ground. We pass on to Doctor's Brook. On its north side strata are observed having a northerly dip. The fossils of these indicate C of the upper series. We are then upon the south side of the Syncline. After these come the B shales of the same side of last section. These are exposed in a section of the elevated ground already referred to. This part is on the bend of the brook formed by the east branch. A strip of interval or meadow extends to the south of the ridge and onward to the preceding section. Along this intervale flows the brook, first on the south side; it then crosses and flows on the north side. As it flows on the north side it skirts sections of B strata—on the south it washes *strata of limestone.*

This limestone is of lower carboniferous age—it is part of an isolated patch. A continuance of the section shows an outcrop of conglomerate of the same age underlying it and *trap* following. This insertion among pre-carboniferous rocks seems peculiar.

Proceeding we have a considerable width of brown porphyry. This terminates a great exposure of diorite which rises boldly on the east. This diorite as well as that of McNeil's Brook and Doctor's Brook sections is ferruginous. Some have represented these as *mountains of iron.* Passing over to an elevation on the right, covered with small wood, we reach the red slate band; crossing this we have a band of diorite. We descend a steep well and crossing "Bruin's Highway," we have an equally steep and much greater ascent of precipitous slate and quartzite. We are on the side of McDougall's Mountain—climbing still farther the summit is reached—1000 feet above the sea level.

The summit rock upon which Bayfield's *cairn* stands is *petro-silex.* The last rock exposed is a *hard jaspideous conglomerate Ash.* Beyond all is obscure.

SECTION 6TH.—*Frenchman's Barn to McDonald's Mountain.*

In the sea north of the Frenchman's Barn (rock), trap is seen rising. This is a continuation of the trap of two last sections. The Frenchman's Barn is a huge oblong mass of Jaspideous rock—being strata A *porcellanized* by the trap. It is pervaded by veins of *quartz* and *baryte.* After the jaspideous strata there come slates. These have a width of —— feet.

Next come shales B. Shales are seen outcropping on the south side of the road and in a depression to the west through which the road passes. On the elevated ground all is obscure until Doctor's Brook is reached. In the brook there is an outcrop of strata B' of the southern side of the *syncline.*

Ascending we have an obscure interval, outcrops of diorite on either side indicate a continuation in our section. Then come red and gray slates—these have a width of —— feet. Succeeding is the band of diorite as in the last section having a width of —— feet. An abrupt descent brings us into "Bruin's Highway." Here evidences of Bruin's depredations are met with. All rocks are obscure until we ascend to the sides of McDonald's mountain. Occasional outcrops of slates are seen with *diorite*. The elevation at this point is 1000 feet. Passing over the *petrosilex* band, all becomes obscure. On the mountain road leading from Arisaig to Antigonishe there is an outcrop of *granitoid* rock which may be regarded as a continuation of our section.

SECTION 7TH.—*Mountain Pass along Doctor's Brook.*

Passing along the band of red and grey slates from the last line of section westward; these seemed to terminate, great diorite rocks taking their place. These in turn terminated before reaching Doctor's Brook.

Beginning at the bend of the brook we have elevations with slates and diorites. Then comes the obscure interval which takes the place of the diorites as already described. Crossing the brook as it passes into the mountain, we follow the road along its eastern side. The rocks are obscure. Approaching the site of a saw mill diorites appear on the road side. In the section these have a width of —— feet. Climbing the diorite as it rises towards McDonald's mountain, a beautiful piece of rock scenery stands out before us. Titanic masses are piled one upon another in magnificent order. Masses hoary with lichens and moss, and crowned with gnarled trees, their naked roots clasping the rocks and entering the crevices. This diorite extends a considerable distance up the mountain side.

Extending the line of section we have outcrops of the mountain slates extending to a distance of —— feet. Then follows a section of the *petrosilex* band, showing a thickness of —— feet. This band rises boldly on the east toward McDonald's mountain. Doctor's Brook now crosses the road and passes to a short distance in rear of the ridge, turning again southward at no great distance the brook is lost.

SECTION 8TH.—*Arisaig Pier to the Mountains.*

The Arisaig Pier rocks begin the section. The first rock is the Trap of preceding sections. It is here largely exposed in bold reefs. The second rock is hard porcellaneous jasper, beautifully banded with numerous veins of *quartz* and *baryte*. These have a width of —— feet. Following these are sand and sand banks having arenaceous shales, apparently unaltered representatives of the original of the porcellaneous jasper. They are of A and are non-fossiliferous. After these come B shales, the fossiliferous slates of A in sections 5th and 6th being missing. The B shales are fossiliferous and have the apparently characteristic *cone in cone* concretions. We have then a hill having B' strata. Descending the hill we cross the road and following an old road ascend what is locally called *double hill*. As we take the new road we come upon Arisaig brook, and find on either side sections of *double hill*, having abundance of fossils of B'. On the top of the highest (second) part of the hill the outcropping strata produced a *lingula* of unusual size. The succeeding strata exposed on the side of the brook, show a ferruginous bed, about nine inches thick; some parts of this bed have the qualities of iron ore. It is very fossiliferous.

The fossils seem to indicate the horizon of C Aymestry limestone. Regarding this section as dividing the area of the upper series into two parts. This bed may be considered as a *passage between C of the two divisions*. These strata dip at a high angle.

Proceeding along the old road we have other strata exhibiting both a northerly and a southerly dip. This is the approximate position of the synclinal axis. The southern strata are non-fossiliferous—they are red and gray. From their relative position to the strata succeeding in the line of section, and from considerations to which I shall afterwards turn attention, I am disposed to regard these as part of a higher member of the upper series, *i. e.*, higher than D Upper Ludlow, and consequently equivalent to the Ludlow tilestone of *England*. I would designate this E of Upper Arisaig series. Succeeding this at a distance of —— feet strata are seen outcropping in considerable extent. These have abundance of fossils of D Upper Arisaig. Descending the hill no farther outcrops are seen until we cross the road. About —— feet south of the road the mountain series is reached. Here are outcrops of slates. Ascending the mountain we find indications of the red slates of preceding sections. From this the red slates pass on westward and seem to terminate in the mountain beyond. No traces of them could be found west of the mountain. Extending the line of section to the southward of this mountain we have slates, very hard grits, (ash)? and *petrosilex*. Spanning a precipice and deep *gulch*, we have again *petrosilex*, and at a distance of about a quarter of a mile we reach great outcrops of granitoid rocks — *Syenites or diorites?* I am not precisely certain.

SECTION 9TH.—*Smith's Brook.*

At the mouth of the Brook the waters fall over strata B' having characteristic fossils. Up to the bridge and beyond it the same strata continue. Farther up there is another fall. The rocks here are of C Upper Arisaig; this is evident from the fossils found in them. In the field above the brook C fossils are abundant; these strata extending westward are well exposed on the road, above it, and in the fields. The rocks are coarse and hard, giving boldness to the outcrops.

SECTION 10TH.—*McAdam's Brook.*

This section begins with strata of the lower part of C of the upper series—Aymestry limestone. These strata are very fossiliferous. It continues through outcrops of the same strata having abundance of fossils a degree higher in the series. It passes through strata having numerous fossils of D Upper Ludlow. At a distance of —— feet there is a small waterfall with strata having a low dip.

Continuing the section we have a broad band of red slates having a high dip. These extend to the top of the brook, terminating in a swamp, where the brook takes its rise. These slates are apparently non-fossiliferous. I have designated them E as already intimated.

SECTION 11TH.—*McAra's Brook.*

This section begins with amygdaloid (trap); the brook flows through it. Passing through this we come to red slates; then continue up the brook, mixed grey and red slates with *trap*; these slates are apparently non-fossiliferous. As they succeed the strata of the shore section which are the equivalent of the lower Ludlow, I regard them as higher, and although they occur on the north side of the series I consider that they correspond with the red slates of the syncline in section 8, and with the red slates of last section (10). Still ascending the brook we have the lower carboniferous grits of the overlying formation.

Passing through the woods to the north to a distance of about ———, we reach an outcrop of red slates with trap. (*in situ?*) These seem to be a continuation of the red slate (band) of McAdam's Brook.

This ends the section.

RETURN TO ARISAIG.

To the south of the section there is a valley through which a branch of Knoydart Brook flows in a westerly direction. On the south side of the valley rise the Arisaig mountains.

We descend into the valley and find a pathway along the side of the brook. This valley is a continuation of Bruin's Highway. It occurs to us that the pathway may be a short way homeward, and that at the same time work may be done. Windfalls, brushwood, and a doubtful path make our way both difficult and tedious. We reach a swamp where our guiding brook takes its rise. Consequently our guide is gone. Alone, apprehensive of approaching night, and the unwelcome society of bruin, we proceed.

At length another brook appears flowing in an easterly direction; we suspect that it is Arisaig brook; we are assured, and following its friendly guidance, we ere long emerge from the thicket, reach the familiar road of section (8), and consider that all is right.

KNOYDART BROOK.

In the Arisaig mountains—on the table land south of the mouth of McAra's Brook, we find an outcrop of slates in a little brook. This brook proceeds through a hollow which seems to be a short way to Moydart.

We now descend into the bed of the brook and make it our pathway as there is none other to be found. Coming into the line of the mountains of our sections we see lofty exposures of rocks. They are sections of the *petrosilex* band. Descending the brook the lofty mountains rise on either side without showing outcrops of rocks. We find that the path instead of being a comparatively straight and short one is tortuous and long, as the brook makes considerably west of south. We are diverted from our path as *Bruin* is seen to lie in our way; we climb and pass him by on the steep mountain side. After some time we descend and reach a saw mill on the side of the road. To the left the mountain rises, an outcrop of slates is seen and examined. We proceed.

Coming to the side of the advanced mountain we see an outcrop of rock towards its summit. We climb and find the outcropping rocks to be slates, but not red slates. The Lower Carboniferous Formation succeeds, having a *brine spring* on the roadside, a common occurrence in this geological horizon in Nova Scotia.

We are now on the west of the upper Arisaig series. The eastern branch of Knoydart Brook here unites with the branch which we have just traversed. We are again in *Bruin's Highway*, and near the Pictou County line. A range of lower carboniferous mountains and level ground now take the place of the upper Arisaig rocks. These mountains on the north and the continuation of Arisaig mountains on the south bound a beautiful and fertile valley, which is hid from the traveller who passes along the shore road.

SECTION 12.—*The Coast from Morristown Township to the mouth of Knoydart Brook.*

Beginning at the line of Morristown and Arisaig Townships, *i.e.* about —— miles from the north side of Cape St. George, we find exposed on the shore metamorphic slates of dark colour. These slates escaped observation until 1871. I was equally astonished when I found them, as I had been in 1868, when I discovered those that succeed them in our section. With our predecessors we had taken for granted that Lower Carboniferous strata skirted the shore, having for their termini the conglomerates of Malignant Cove and Cape St. George. The rocks before us are, as far as observed, non-fossiliferous. They are, however, unquestionably pre-carboniferous—a thin bed (?) of calcite is regarded as of organic origin. Their age is considered to be Upper Arisaig. They may be on the Middle Arisaig horizon. Farther examination is required to decide this point.

We have next the Lower Arisaig series. The first rocks of this series are syenites, dark red, cream-coloured and white; they are finely granular, sparingly hornblendic and susceptible of a fine polish. Green feldspar occurs in these syenites; they are also traversed by veins of calcite, several inches thick, and penetrated by veins of diorite. Succeeding these are strata of petrosilex. These are traversed by quartz veins, having mica. After these come steep cliffs of granitoid diorites which project into the sea. We have then a bed of ophicalcite and ophite. This extends to the road where it outcrops. To a distance of nearly two and a half miles there is a series of diorites, ophites, crystalline limestones and ophicalcites. The diorites are often granitoid; sometimes the hornblende is in large crystals, set in albite. These are the rocks which produced the boulders in the drift and on the shore at Ogden's. Often the diorite is homogeneous and crypto-crystalline. One rock is almost entirely hornblende and coarsely crystalline.

Veins of *snow-white calcite* and quartz traverse the diorites in the same manner as the syenites. In one thick vein of quartz in the diorite there is *talc* in *prismatic crystals* as well as *amorphous*. The ophite often passes gradually into the hornblendic rocks (diorites), as if *pseudomorphous*. A hand specimen in the museum has the ophite blending with the diorite. I regard this series as divisible into two members as I have already indicated. 1st — syenites, diorites, and hornblendic rock; 2nd — ophites, ophicalcites, granular limestone (marble), and petrosilex. I consider that the syenites and diorites and hornblendic rock, were of earlier formation than the ophites, calcite, crystalline limestone and petrosilex, and that conjointly they had been subjected to metamorphic action, by which the calcite veins had been formed in the syenite and diorite marbles formed; and the whole series blended and metamorphosed.

Passing Boulder Point we enter Malignant Cove, with its sections of drift, and come to the carboniferous conglomerate with intruded diorite.

This is the beginning of section 1st.

Proceeding along the shore we pass sand banks and then come to a little brook having diorite at its mouth. This is the beginning of section 2nd. We have then sections of banks, of clay, sand and gravel, until we reach the mouth of McNeil's Brook. Here the upper Arisaig series commences with a small outcrop of C strata, having fossils. These have a northerly dip. This is the beginning of section 3rd. Then follows an obscure interval, and an outcrop of rock appears of doubtful character. After these there are outcrops of jaspideous rocks of A, or the lowest member of the strata on the northern side of the *syncline* of sections 4th, 5th, 6th, and 8th, so that in the obscure interval passed there is concealed a *synclinal axis*. These jaspideous rocks include 12 feet of soft rocks, (Dysyntribite) *hydrous, silicates of alumina*. Parts of these rocks are easily polished and are very beautiful. The rocks were at first regarded as a variety of *saponite*. These rocks have been metamorphosed by the succeeding trap dyke.

Of this dyke we have now a magnificent continuing exposure extending about ——— along the shore. This *trap* is compact, porphyritic, amygdaloidal and tuffaceous. At Doctor's Brook it is the first rock of Doctor's Brook section, No. 4. The termination of this exposure is the first rock of McDonald's Cove, section No. 5.

The rocks of our section here are 1st, a jaspideous rock; 2nd, slates and sandstones of A. Mayhill sandstone, having abundance of *fossils*; 3rd black laminated shales of B Lower Clinton, having abundance of *cone-in-cone* and other concretions. The latter are fossiliferous. A few years ago these shales were trenched with the expectation of finding a vein of ore, of which specimens were found on the shore. On the west side of the cove we have again slates of A, having lenticular beds of fossils. These have a thickness of —— feet. Succeeding these on the shore is trap, compact and tuffaceous. Then trap and altered strata of A are seen. The trap then disappears.

We have then a recurrence of the *Hydrous silicates of Alumina*, having brilliant yellow colours. Polished specimens of these are very beautiful. There are also jasper, like serpentine, associated with the Frenchman's Barn and trap of section No. 6. Beyond this is the greatest amount of *hydrous silicate of alumina rocks.* After their discovery, these were regarded by some as of probable economic importance, and were consequently quarried to some extent without realizing expectation. In these are veins having the characters of true agalmatolite (Figure stone). After an obscure interval we have again, trap, with an elevation to the south, consisting of red porcellaneous rocks. After this comes clay, which seems to overlie *hydrous silicate of alumina* rocks, and to have been formed from them, and then the trap and jaspidious rocks of Arisaig Pier—section No. 8. The rocks of A, whether metamorphosed and non-fossiliferous, or partially metamorphosed and fossiliferous, do not extend beyond this. The latter is not known to the west of the Frenchman's Barn, and it is only fossiliferous, from Doctor's Brook outcrops on the road 200 feet east of Doctor's Brook, and at the shore at McDonald's Cove, so that this, the lowest member of the Upper Arisaig series, is *very limited*. It does not occur elsewhere in the township of Arisaig. Its next occurrence being at *Marshy Hope* and *Lochaber Lake*.

Continuing the section, we have in the Cove the black laminated shales of B, Lower Clinton, having *cone-in-cone* concretions and abundance of fossils. These terminate at the mill sluice of Arisaig Brook, where strata of B' Upper Clinton commence. These are lithologically unlike the strata of B. They are greenish, while the others are black. They also shew *distinct* stratification, by the alternation of slates and shales. These are exposed in low sections along the shore, being overlaid by great accumulations of drift. They are also seen on the beach at low water. They dip with varying angles, and in different directions. One of the highest sections is at the mouth of Smith's Brook, being the first rocks of the section No. 9. Here by a *fault* they are thrown forward upon the shore; another set of strata coming in between them and the lofty bank of drift on the south.

Large boulders of amygdaloid are seen on the shore at this point. These seem to indicate the existence of a continuation of the trap dyke, covered by the sea.

The character of the strata now reached differs very much from the preceding.

On palæontological considerations, I have separated them from the others. This conclusion has been confirmed by the analogy of the Upper Arisaig series of Springville, East River of Pictou. Peculiar organisms, found nowhere else, are common in the same position to both. [*Collections in the Provincial Museum, and in the Museum of the Geological Survey of Canada, Gabriel Street, Montreal.*]

Being palæontologically and lithologically different, I regard the strata in the section as the beginning of C, Aymestry limestone. These strata are black, coarse, hard slates and shales. The one is so hard that it is scarcely possible to extract fossils from them—the others are so yielding that it is almost equally impossible to preserve the fossils taken out of them.

These rocks extend along the shore in ledges as far as McAdam's Brook. They have a southerly dip. Succeeding them in the section are shaly strata, also of dark colour, having numerous and large concretions, regularly rounded. Beautiful fossils abound in them, but they cannot be extracted, as the concretions are very hard, besides they have a cross fracture.

After these come the ledges of Moydart Point. These consist of compact argillaceous strata with shales. They are very fossiliferous; the fossils being highly characteristic of C.

Extending along the shore to some distance south west of this point, and strongly resisting the elements by their hardness, they form bold ledges, precipices and deep recesses. They pass into D, Upper Ludlow. These strata present the same general aspect as the preceding. Only the highest strata become beautifully variegated with alternating red strata, presenting a bold precipice with a beautiful series of layers, having a dip 45°.

Following these and seeming to butt against them is a wall of dark red strata. The colour of these is uniform. They have a southerly dip. The great change of direction shown by these is doubtless the effect of the action of a mass of amygdaloid. This is the first appearance of igneous rock since we left Arisaig Pier.

The observer now can see the effect, although the cause is not so strikingly apparent as it was when I became acquainted with the spot about 20 years ago. This piece of rock scenery then was truly magnificent. The huge rounded mass of amygdaloid extending across the shore toward the sea so as to project into it at full tide, while at the same time it overlapped and reposed on the wall of silurian strata on the shore, covering what was then regarded as the point of junction between the devonian and lower carboniferous formations. When in 1868 I re-visited this scene of a multitude of interesting associations, of much hammering, and many interesting disclosures of new forms of ancient silurian life. I must confess to a feeling of sadness at the changes wrought on the scene by the almost total disappearance of the great black rock with its friendly shelter from the hot rays of the midsummer sun. The junction of the then *supposed Devonian* and *Lower Carboniferous*, and subsequently of the *Upper Silurian*, and *supposed Lower Carboniferous*, is now completely exposed by the removal of the mass of trap (amygdaloid), by the action of the tides and storms.

Mr. Weston, of the Canadian survey, informed me last summer that he had found fossils which were not carboniferous, in the soft unstratified (apparently) rocks which succeed the silurian well of our section, so that the said point of junction is no longer to be regarded as that of the silurian and carboniferous, but as the probable junction of two *pre-carboniferous formations*, or D and E of the Upper Arisaig series, *vide* sections :—

McAra's Brook,	No.	11.
McAdam's Brook,	"	10.
Arisaig Pier,	"	8.

Passing these soft strata we reach a ledge of trap, then a sinus of the soft strata, and then another ledge of trap. A third exposure of trap includes the mouth of McAra's Brook, section 11. Continuing the section we have unmistakable lower carboniferous conglomerate. This brings the junction of the pre-carboniferous and lower carboniferous to McAra's Brook—the *junction* being concealed by the trap of the McAra's Brook section.

The continuation of the lower carboniferous conglomerate becomes interbedded with trap at intervals, which may be regarded by some as contemporaneous, by others as intrusive. I regard them as the latter, and consequently of a time subsequent to the formation of the conglomerate.

This alternation of hard igneous, and comparatively soft rocks on a shore exposed to violent storms and wasting ice sheets, has resutled in the formation of jutting ledges, precipices and caverns, with trappean roofs.

Running the section a short distance beyond the county line, we have alternations of grits, sandstones and slates. A considerable bed of Lower Carboniferous limestone, resting on slates, marls, and a thin bed of öolitic limestone, with characteristic Lower Carboniferous fossils.

Still farther we have sandstones with two thin beds of *lignite* having grey sulphuret of copper. After these sandstones continue—some of these have *arenaceous* concretions.

We have now reached the end of our coast section.

KNOYDART BROOK, PICTOU CO.

The sections described shew that we have in the Township of Arisaig, three series of Pre-carboniferous Rocks :

1. A crystalline series.
2. A mixed crystalline and uncrystalline series.
3. An uncrystalline series.

I have characterized the 1st as the Lower; the 3rd as the Upper, and I would now characterize the 2nd as the Middle series.

The granitoid members of the *lower series*, e. g. syenite and diorites, pass on so as to beard the middle series on the south.

The middle series is distinct in sections 5, 6, 7. In 5 and 6 it is bounded by members of the upper series. In section 8 it is bounded by the upper and lower series.

Collating the various sections, we find the *middle series* as consisting of—

1. Jaspideous conglomerate (ash).
2. Petrosilex.
3. Quartzite.
4. Argillites—red and grey, mixed and separate.
5. Diorites.
6. Porphyry.
7. Syenite. (?)

In section 2 the series has a width of nearly two miles. From the shore to the red syenite of McNeil's Mountain. In sections 5, 6 and 8, the series has a width of about one mile.

SECTION 5th.—*McDougall's Mountain to the shore* may be regarded as the representative section of this series, as it is characteristic, and as it also exhibits clearly the relation which the middle series bears to the lower and upper.

Assuming that syenites or diorites of the lower series lie in the obscure district to the south of McDougall's Mountain, as we are warranted to do by the existence of these in similar positions in sections 1, 2, 4 and 8. The sections are as follows:

1. Syenite or diorite. Lower.

2. Jaspideous conglomerate (ash), 3. Petrosilex, 4. Slates—grey, 5. Diorite (homogeneous), 6. Slate—hard, red, 7. Diorite and porphyry,	Middle series.
Diorite (Trap, Conglomerate, Limestone,	Carboniferous.

$$\left.\begin{array}{l} \left.\begin{array}{l} \text{A} \\ \text{B} \end{array}\right\} \text{wanting,} \\ \text{B}' \\ \text{C} \\ \text{B} \\ \text{A} \\ \text{Diorite (Trap),} \end{array}\right\} \text{Upper series.}$$

The resemblance between this section, until the Upper Arisaig series is reached, and a great part of the Wentworth section of the I. C. R. (*Transactions* 1873-4) is sufficiently obvious.

The sequence of the section shews that this series is *between* the other two series, and that it is below the upper—Middle Silurian—and that it is therefore Lower Silurian.

The upper series is wholly *uncrystalline*, being unmixed.

Lithologically this seems to indicate that the whole Wentworth section of the I. C. R. between the syenite and the carboniferous, with an exception to be afterward noticed is *Middle Arisaig*—as it is mixed crystalline and uncrystalline.

Palæontology *may* lead to a different conclusion in reference to the *last part* of the Wentworth section of the pre-carboniferous rocks. (*Vide* Paper on the I. C. R.)

It is only in this section that the carboniferous comes between the middle and upper series—in sections 4, 6, and 8, it is absent. Section 5 vies with the Wentworth section in having a representation of the *Oldest Sea Beach*. In Nova Scotia it surpasses it by having it at the loftiest elevation. The conglomerate of the section is about 980 feet above the present sea level, being only 30 feet lower than the syenitic top of McNeil's Mountain, of Section 2nd, 1010 feet, which as far as known, is the second highest in Nova Scotia Proper. If the conglomerate is *volcanic ash*, this may be a *sea bottom*.

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* This band of Petrosilex seems to have supplied the aborigines of Prince Edward Island with choice material for stone implements. (*Vide* specimens of hatchets in the Provincial Museum.) P. E. I. is on the opposite side of Northumberland Strait; the eastern part of it being 20 miles distant from Arisaig. The geological formations of the Island being Carboniferous, Permian (?) and Triassic, could not meet their wants, and consequently they had to come to Arisaig.

The members of the *upper series* are arranged in a synclinal form, having a northern and a southern side. These are irregularly distributed over the area. Regarding the area as divided into eastern and western by section No. 7, the Arisaig Pier section.

The lower member A is confined to the eastern division, beginning between 3 and 4 and ending with the dividing line. The second B is principally in the eastern division. It begins with section 4 and ends in the western division, between the dividing line and Smith's Brook, section No. 8. It is wholly on the northern side of the synclinal. The third member B' occurs on both sides of the synclinal, in the eastern division. In the western division it occurs on the northern side, beyond Smith's Brook section.

The fourth member C occurs in the eastern division on the southern side of the synclinal, beginning with section 3, McNeil's Brook. It occurs next in section 5. It then occurs on the northern side of the dividing line and extends beyond McAdam's Brook section and beyond Moydart point to the vicinity of McAra's Brook. The fifth member D occurs to the east of the dividing line on the southern side. It occurs in the western division and north side in McAdam's Brook section, and its principal part is in the shore section, between Moydart point and McAra's Brook section. The last member E appears on the south side of the dividing line, the north side of McAdam's Brook section, and in the whole of McAra's Brook section, north and south sides of synclinal.

These facts are important as shewing the irregularity of occurrence and conditions of formations even in a very limited area.

Correlation.

(I).—The *Lower Arisaig series* has its corresponding rocks in the I. C. R. section of the Cobequids.

On the Colchester side the syenites and diorites of the centre are succeeded by petrosiliceous rocks, jaspers, gneisses, diorites (crypto-crystalline) and calcite, to which may be added the marbles of Five Islands. This series has its counterpart on the Cumberland side. Syenites, diorites, porphyries of the centre succeeded by the diorites, porphyries and jaspers of Smith's Brook and section.

These are the undoubted equivalent of the series in question.

The *Middle Arisaig* series has no representative on the *Colchester side.* It is well represented, as has already been observed in the conglomerates, jaspers, slates, shales, diorites and porphyries of the *Cumberland side* of the I. C. R.

(II).—I have elsewhere shown the relationship of George's Mountain (C. B.) rocks to the lower Arisaig series. (Transactions 1872-3.)

In 1860 I found red syenites at the mouth of Louisbourg Harbour, C. B., and along the shores toward Gabarus. The entrance of the magnificent ocean harbour of this once celebrated fortification of Louis XIV, is a break in this syenitic wall.

This syenite was observed as crossed in several parts by dark green homogeneous diorite. These had not been previously indicated in the Geological map.

Mr. Bowser, Halifax, who has been engaged by the Department of Marine and Fisheries in repairing the light-houses of Scatarie Island, which lies to the north of Louisbourg, has presented to the Museum a very interesting collection of rock specimens from the island, which shew that it is composed of rocks of the Middle Arisaig series. The rocks of West Point, as shown by the specimens, are jaspideous conglomerates and diorites. One conglomerate is brown, with crystals of feldspar, like a porphyry. The others are green, with pebbles of brown and red jasper. The diorite is homogeneous and coarsely crystalline. If the syenites of Louisbourg and the carboniferous strata of the Cape Breton County were to be extended eastward, so as to run parallel, the rocks of Scatarie would lie between them. A conglomerate boulder from the beach derived from the rocks on the shore of Scatarie is of peculiar interest. Being polished, it shows an imbedded pebble of many striped jasper, which might be regarded as derived from the striped jasper band associated with the ophicalcites, marbles, &c. of George's Mountain, C. B. (Paper in Transactions 1872-3.) This is admitted by all who have compared the boulder with the specimen of the jasper rock in the Museum. The Scatarie conglomerates very much resemble those of the I. C. R. in the Cobequids. These and other considerations seem to justify the opinion—obliterated by mistake :

1.—That the Lower Arisaig series is distinct from the Middle series.
2.—That by volcanic agency the lower series was elevated above the sea, *prior* to the formation of the middle series. (?)
3.—That while the *latter* is regarded as Lower Silurian the *former* may be regarded as Cambrian (?) or Laurentian, *until* palæontology has decided the question.

In my paper on the I. C. R. section, (Transactions 1873-4), I correlated the Wentworth section with a section of the Wales' Silurian rocks, according to Professor Ramsay's authority. The difference between the Wales and I. C. R. section, now seems to be that the latter seems to have a greater range *downward*.

MORRISTOWN TOWNSHIP.—(*Continuation of Section* 12.)

Traversing the shore of Northumberland Strait, eastward of the Arisaig Township. Before reaching the north side of Cape George we pass out of the metamorphic (?) middle, and upper silurian slates into lower carboniferous conglomerate. This conglomerate varied by a projecting trap-rock (diorite), here and there, especially at the point of the Cape, constitutes the section to the south-east side of the Cape in St. George's Bay. These form the north-east part of the north side of the northern carboniferous area of the County.

The remaining part of this side westward extending to the Arisaig mountain (Sugar Loaf), is separated from the strait by the metamorphic slates and the Lower Arisaig series of the section already described. In the part that overlies the Lower Arisaig series there occurs lower carboniferous limestone. Continuing the section on St. George's Bay we have coarse sandstones, with shrinkage cracks, and sandstones with scales of *palæoniscu*. At Graham's Brook we found flora in the sandstone, casts of lepidodendron, &c.

Between this and the north side of the Morristown lakes there is no outcrop of interest—the ground being flat. From the Cape to Morristown lakes the carboniferous series *ascends*; after that there comes another series which descends. The Morristown lakes' strata include a coal field—*Dawson's Acadian Geology, Ed.* 1867. This coal field has a history.—

As far as I can recollect, in the summer of 1859, one of the McDonalds' of the North Grant, Antigonishe, brought to me a specimen of highly bituminous shale, from an exposure found while searching in the woods for ship timber. At this time I was residing in Antigonishe. I accordingly visited the locality and saw a large outcrop of black shiny bituminous shale, associated with a dark brown shale equally bituminous. In these I found abundance of scales of *palæoniscus* and various forms of *lepidodendra*. (*Dawson's Fossil Plants of Canada. Geological Survey of Canada.*) The discovery of the Fraser Oil Coal in the Pictou Coal Field, and its uses, encouraged the expectation that this shale might be available for the manufacturing of Coal Oil, or that something highly bituminous, or coal itself might be associated with it. This expectation induced the discoverer to undertake the work of exploration, associated with John Campbell, Esq., of Dartmouth, who is well known as an indefatigable and successful explorer of the gold and coal fields of Nova Scotia. This work continues up to the present time, and is to be continued during the coming season. Mr. Campbell reports as having discovered as follows:

5. Coal—4 feet or more. Beds, thickness not ascertained.
4. Coal—4 to 6 feet. Beds, thickness unknown.
3. Coal—3 feet 6 inches. Beds, unknown. 280.
2. Coal—5 feet 9 inches.
1. { Coal—6 feet.
   Shale--3 feet.
   Coal—2 feet. }
   Coal—28 to 30 feet.

Continuing the section we have to the south of Morristown Lakes, Cribbean's Head, a large exposure of Lower Carboniferous strata, containing casts of trees and calamites. Near McIsaac's Point, we have reached the lowest strata of the south side of the carboniferous basin. At McIsaac's Point we have an outcrop of metamorphic slates and diorite (igneous.)

This is the eastern terminus of a formation which extends into the township of Dorchester in the form of an isosceles triangle, its base commencing at a distance of 1½ miles from Antigonishe (Town), and extending to the north a further distance of $4\frac{1}{2}$ miles. About two miles to the west of this base we have what may be *strict'y* regarded as a continuation of the same formation. The intervale is occupied by lower carboniferous conglomerate and grits, which doubtless overlap and obscure the underlying connection. This continuation beginning on the north in the Arisaig mountains, extends southward to a distance of about two miles north-west of Antigonishe, bounding Pleasant Valley and the *north carboniferous area* of Antigonishe on the west.

I observed this continuation to extend to the west of Antigonishe at least a distance of 6 miles in the mountains. The Falls of James' River being formed by a magnificent and on either side towering exposure of these metamorphic olive coloured slates.

About a mile south-west of the *outcrop of the section*, the range of mountains commences and continues to Antigonishe, their culmination being the Sugar Loaf, 760 feet above the sea level. The summit of the Sugar Loaf is an igneous rock—diorite. About $2\frac{1}{2}$ miles north of the Sugar Loaf is another igneous centre. Appearing first on the fields and brooks at Donald McDonald's (Brook), it extends westward, outcropping and joining a lofty bluff on the east of Right's River. Here the rock is *amygdaloidal*. It is uncertain whether the diorite of the *outcrop* is the extension of the first or second, or of both. I have heretofore regarded it as the continuation of the second. I regard this eruption as contemporaneous with that of the diorite of McLellan's Mountain and Sutherland's River as post Upper Silurian and pre-carboniferous—*Devonian*, and the metamorphic slates as metamorphosed Middle and Upper Silurian, according to the analogy of East River, Pictou, McLellan's Mountain, &c.—(*Transactions* 1870-71.)

Continuing the *line of section* on St. George's Bay, we have on the south side of the pre-carboniferous rocks described the lower strata of the north side of the *southern carboniferous area* of the County. These consist of conglomerate, breccia, sandstone and limestone, partly covered by a great bed of drift, containing and discharging large boulders on the shore of strongly characteristic rocks of the Lower Arisaig series of the Northumberland Strait part of the section. Boulders from the bed, lying on the shore had long attracted attention and excited enquiry in reference to their origin. Proceeding, limestone occurs having bold sections, and then we have projecting into the sea lofty cliffs of hard and soft gypsum and beds of clays, with fibrous gypsum, and red in great variety.

The intimate connection manifest between the carbonate and sulphate of lime when the two occur in contact, seems to me at variance with some theories that have been advanced relating to the origin of gypsum. We have now come to the mouth of Antigonishe harbour. Monk's Head beyond the harbour at a distance of ——— miles from Ogden's, shows a continuation of the gypsum deposits. Here there is a section of gypsum, which seems to be the southern limit of these deposits. These limestones with gypsum, are also of great longitudinal extent.

At Ogden's Point they are seen leaving the shore. Their course indicated by a series of elevations of 50 feet on Bayfield Plan of the harbour, run parallel with the mountains described, and show occasionally conglomerate underlying, until we reach North River—the line between Morristown and Dorchester Township. On this river the gypsum is prominent and well exposed. It rises in hills and is also exposed in the river and road sections. It reaches to the mouth of the river and is exposed on the opposite side of the harbour in bold sections. It is not again seen on the north side of the harbour, as it has passed over to the south, appearing on that side of the harbour, extending southward on South River, and crossing the road from Antigonishe to the Strait of Canso. On the south side of the harbour it is associated with syenite and fossiliferous limestone. Sometimes the syenite apparently stands alone—at other times it is in direct contact with the fossiliferous limestone—one instance is notably so. We have an elevation which rises 300 feet above the sea level. I have elsewhere referred to this case as subversive of the theory advanced by some geologists —maintaining that the marbles of Cape Breton are *lower carboniferous limestones*, metamorphosed by the action of syenite. (Transactions 1872–3.) Here the limestone in the closest possible contact with syenite, *so as to form a breccia*," is wholly unaltered, *Entomostraca* even being unaffected.

The reason why is obvious. These syenites existed long before the carboniferous limestones were formed. They were evidently also existing in the bottom of the sea of the carboniferous period. The organic agencies forming the limestone lived and died on and around them. Their remains even until the present period have been totally unaffected by metamorphosing agencies such as those which were at work at Arisaig Pier and elsewhere.

The gypsum re-appears projecting from the bank of Right's River, between Trotter's factory, on the north, and on the bank of West River, south of Antigonishe, on the south. Passing from Right's River, and skirting the overlapping lower carboniferous conglomerates already noticed, that connect the northern and southern carboniferous areas, it meets Brailey Brook, and proceeds along its south side, forming a lofty wall, whose foot is laved by the water of the Brook. This gypsum has the limestones of Purcell's quarry, McIntosh's and Grant's occurring at intervals between the Antigonishe and Malignant Cove road, and the place where Brailey's Brook proceeds from the mountain. These limestones run nearly parallel with the gypsum at a distance of 300 to 500 feet on the north, underlying the gypsum and overlying the conglomerate, which are formed against the metamorphic middle or upper silurian slates of the mountains already described. The limestones contain deposits of brown ochre *calehopyrite*, and occasionally malachite, (ores of copper) in very small quantities. They are used extensively for building purposes. The Antigonishe Cathedral is in large part built of the limestone from McIntosh's quarry. The gypsum proceeds beyond Brailey Brook, westward to the vicinity of James' River, and passes to the south appearing at about a distance of two miles, in a considerable outcrop at Addington Forks.

The limestones proceed westward, after being left by the gypsum at James' River, terminating in this direction with associated conglomerates on the road side at the beginning of the *Big Clearing* 8 miles from Antigonishe.

Southward the lower carboniferous limestones extend on the east side of the Ohio River (a branch of West River), that flows on the east of the Ohio Mountains. One of these limestones is of palæontological interest as containing trilobites (Phillipsia). They reappear at the Lochaber road, having a deposit of beautiful cinnamon coloured ochre. The last of these limestones, as far as we know, is in St. Andrew's Township, where we shall meet them again.

Saline.

The names Saltsprings, Saltpond and Saltworks, are suggestive. These all lie in the gypseous area described. Saltsprings is the name of a settlement on West River. The Saltpond is on the intervale below the Episcopal Church of Antigonishe. The Saltworks are on the intervale below the Town.

History of the Saltworks.

Shortly after I directed the attention of the Institute to the existence of the Saltpond, &c., in 1866, Josiah Deacon, Esq. visited me in Antigonishe, in his search after a proper locality for Saltworks. Encouraged by the indications of salt around Antigonishe, he commenced operations with a magnificent set of boring apparatus, imported from England. Supposing that Town Point, near the mouth of the harbour, would be a point where the supposed flow of the saline waters which supplied the Springs and Pond would be *tapped*, and the salt most conveniently exported, he made a six inch boring, and lined it with iron tubing. At a certain depth in the soil and clay, he entered gypsum—passing through a considerable thickness of gypsum. He came to sandstone without finding any indication of brine, and concluded that farther operation in this locality was useless.

This boring showed that the gypsum bed outcropping on the north or the skirts of the mountain, and the outcrop on the south side of the harbour, were in all probability the edges of a continuous bed of gypsum, and that it was sometimes deposited on the lower carboniferous sandstones without the intervention of the limestone seen elsewhere. It also shewed that the harbour was in an excavated bed of gypsum.

Mr. Deacon next operated on the intervale below the Town, not far from the confluence of Right's River, Brailey Brook and West River. Here salt water and salt occurred on the surface—making the place a favorite resort of the cattle.

Here, after passing through a considerable thickness of clay, impregnated with salt, he came upon gypsum. In this the boring was so dry that it was difficult to work. Suddenly the bore hole was found to be filled to some distance from the top. Mr. Deacon was in transports when he found that the fluid was *brine*. Notwithstanding vigorous pumping, the brine kept up to the mark, with a great discharge of sulphuretted hydrogen. Being now very sanguine in his expectations, he had a steam engine erected for pumping, and furnaces, tanks and evaporating pans of large dimensions constructed for the production of salt. After the manufacture of a considerable quantity of salt, the strength of the brine became very much reduced. Mr. Deacon accordingly commenced another boring at a point near to the evaporating building; after boring through clays, impregnated with salt to a depth of 650 feet, without finding any indications of brine—the brine of the other boring becoming too weak for use, and the working capital exhausted, the work was abandoned.

It is much to be regretted that a greater extent of the saliforous area was not explored by the boring apparatus, especially in the region of the Saltpond. On the south side of this carboniferous area lies Cape Porcupine, on the Strait of Canso. Conglomerates and other lower strata, with limestone advance from this to meet those that I have been describing. Combined they crowd toward the Bay. Higher strata at Pomquet have small coal seams. Near the Forks of Pomquet the sandstones contain deposits of the grey sulphuret of copper, of the usual (?) economic value of such deposits in the Lower Carboniferous Sandstones of Nova Scotia.

I would here observe that the geology of this County, and the physical feature, or hills, lakes, rivers, uplands and intervales, which largely originate from its geology, constitute Antigonishe the finest agricultural county in the Province. Its only drawback is its proximity to the Gulf of St. Lawrence, with its *Glacies* (*Ice*.)

SECTION 8.—*Continued.*

This section from Arisaig Pier to the Mountains extending south-west to the point where the Marshy Hope Road intersects the county line between Antigonishe and Pictou Counties, passes through a table-land which is covered by forest. On the north side of the road at the county line there is a band of strata A of the Upper Arisaig series with characteristic fossils. This outcrops on the side of the road at the place indicated, and also on the road at the coach stables, east. The section has an obscure passage—from this south to the Ohio Mountains above Addington Forks. It then traverses the red syenites which form the western boundary of a considerable part of the southern carboniferous area of Antigonishe. This syenite extends westward into the County of Pictou, and southward into the County of Guysboro. At a distance of about eight miles from Addington Forks—the section now running eastward to Lochaber Lake, at right angles to its former course, crosses the Ohio River, and passes to the Mountain west of Lochaber Lake, with its granitoid diorite. Overlying this is a band of strata A, Upper Arisaig, or (Middle Silurian), having abundance of characteristic fossils.

It is worthy of notice that this was the position where I first discovered this member of the series in 1858. The fossils here are generally casts, some of them are *silicified*. Perfect specimens are occasionally found. Overlying this are strata of C and D, Upper Arisaig (Upper Silurian), having also abundance of fossils. On the side of the lake were found *in situ*, Chonetesi N. Scotica, Crania acadiensis, Dalmania Logani and Clidophori, characteristic of the upper part of D. Lochaber Lake in the line of section lies beautifully between two parallel ranges of hills, its length is 4 miles. The opening which is at the south end conveys its waters to St. Mary's River, which empties into the Atlantic Ocean.

The lake is about half a mile wide. Near the opposite side is an islet, which is formed by tilted shales of red and grey colours. This band of slates is of considerable length and breadth. They form the elevated ridge on the east side of the lake. They are non-fossiliferous. I am disposed to regard these as corresponding with the red and grey band of the Middle Arisaig series, and to regard them and the rocks of the rest of our line of section which extends to South River Lake, and Upper South River, consisting of slates, diorites and quartzites, with cavities lined with large and pellucid crystals of vitreous quartz, as having more resemblance to the middle Arisaig series than to the metamorphic upper. The absence of fossils and the isolation of these rocks, may, however, render their relations and age doubtful.

In the part of these around Polson's Lake, there is evidence of the existence of iron and copper. Excavations have shown the existence of veins of hematite. Masses of micaceous oxide of iron are scattered around, and also oxide of iron with pyrite and calchopyrite. The last have, at various times for a quarter of a century excited interest, as indications of copper ore of economic value. Two great searches had been made over twenty years ago. While I resided in Antigonishe two others were made, and two or three since that time. Considerable excitement was manifest in the summer before last, when D. Donald Fraser of Springville in his excavations, came upon a mass which seemed to be the desired lode.

This excitement subsided when it was found that after all it was only a mass; it is likely however that the search will be resumed.

Polson's Lake is on the border of Guysboro County. It and the South River Lake on our line of section, empty into South River which flows through a long and fertile country and then enters into Antigonishe Harbour, so that the waters of the district flow towards the Atlantic on the south and the Gulf of St. Lawrence on the north.

Terminating our line of section—we have after the quartzite with quartz crystals, *Lower Carboniferous*, unconformable, with sandstone and limestone of *St. Andrew's*, we noticed the latter in connection with the previous section.

The Upper Palæozoic part of the coast section as I have described it seems to throw some light upon the character of the Lower Palæozoic or Eozoic (?).

1.—The Lower Carboniferous formation of Antigonishe Harbour shews limestone in contact with syenite, the connection of the syenite and the limestone being intimate, the latter being unaffected by contact with the former.

2.—The Lower Arisaig series also shows limestone in intimate connection with granitoid diorites. This limestone is crystalline (marble). In some cases it is interbedded (?) with, and penetrated by, green dysyntribite (?) (a serpentine-like rock), leading us to speak of ophite and ophicalcites. There is also a blending of the ophite with the diorites. The associated syenites have, also, in close connection, dark petrosilex, with *veins of quartz containing mica*. The syenites and diorites are also penetrated by *veins of calcite*. The diorites have quartz veins with talc. In the same series there are homogeneous diorites very frequently occurring and seeming to penetrate the syenites, and diorites, and calcites. These seem to be interbedded rocks of igneous origin.

3.—The Section also shews the lower part of the Upper Arisaig series, in contact with diorites of lower carboniferous age, the result of the contact being the conversion of sandstones into porcellaneous jasper—striped and uniform—other strata being converted into yellow, brown, and mottled *dysyntribite* rocks.

4.—I consider that if the cause of metamorphism in the last case, and its action had been brought into association with the syenite and lower carboniferous limestone, specified with an addition of silicious and argillaceous sediment, and accidental elements of syenite and diorite—and also if the cause had been augmented and the action intensified—we should have a reproduction of the characteristics of the Lower Arisaig series, as in the section, and also as in St. George's River, C. B., where we have striped jasper in the place of petrosilex, and (ophite) with calcite, &c.

VOLCANIC.

This county indicates volcanic action :

1. In the Lower Arisaig series, *Cambrian?*
2. In the Middle Arisaig series, *Lower Silurian.*
3. In the Upper Arisaig series (Metamorphic), volcanoes of *Devonian age*, as in Pictou County.
4. In the *Lower Carboniferous.*

TRANSPORTATION.

Post pliocene.

Drift accumulations abound throughout the county. The transportation of the boulders at Ogden's (*vide shore section continued*) from the Lower Arisaig series of the shore section, is in the direction S. 30° E. No glaciation has been observed in the county.

The drift material is to be regarded as to a large extent the product of the action of subaerial agencies, that were at work as now denuding the various formations in the tertiary period, additions being made, and the transportation being effected by special agencies at work during the post tertiary (post pliocene) period, e. g. *ice agency*. Large masses have been transported from Frenchman's Barn (rock) and Arisaig pier of the same section, to elevated positions on the south.

Recent.

The ice in the Gulf of St. Lawrence often takes up rock masses and distributes them along the shore. Numerous examples can be pointed out, illustrating this statement, where carboniferous and other rocks have been taken from their original position some miles distant, and landed on the shore among Arisaig rocks.

A notable instance of ice transportation occured a winter or two ago, when a large addition to Arisaig pier (wooden) with its ballast, was lifted up and landed in the middle of the cove some distance to the south of the pier. This mode of transportation has doubtless been in operation all along the northern shore of Nova Scotia, since the post pliocene period, and it has yet to be proved that the same process was not in operation prior to that period. This may be one reason why rock masses may often be found in the drift out of the regular course of post pliocene transportation.

(*To be continued.*)

ART. VI.—ON THE SERPENTS OF NOVA SCOTIA. BY J. BERNARD GILPIN, A. B., M. D., M. R. C. S.

(*Read April*, 1875.)

FAMILY—COLUBRIDÆ.

Genus—EUTANIA.
Eutania sirtalis. B. & G.
Coluber sirtalis. Linn.
GARTER SNAKE.

Genus—BASCANION.
Bascanion constrictor. B. & G.
BLACK SNAKE.

Genus—Chlorosoma.
Chlorosoma vernalis. B. & G.
GREEN SNAKE.

Genus—Diadolphis.
Diadolphis punctatus. B. & G.
KING SNAKE.

Genus—Storeria.
Storeria occipitomaculata. B. & G.
RED-BELLIED SNAKE.

In the class Reptilia, to which the serpents belong, we find that air breathing is first introduced to life, yet this is not the great air breath of the hot blooded mammals. The reptile has only a single circulation, and though breathing air, can do without it. They live for indefinite periods beneath water, and when in the air, respire about twice in a minute.

From the record of the past, we find nature passing through the early life forms of the Silurian ages, emerging into the fish, (oxygen breathers if not of air) in the Devonian, then producing reptiles whose first life forms are fish, and whose adult forms are air breathers and then the subject of our present paper, the ophidians, or serpents, who commence life as air breathers, but can do without it, and which possess a small degree of parental affection in consequence of it, denied to the others : yet so slow is all this elaboration for the higher life of the hot blooded mammal, that there do exist fish that cannot live without air, and others that can live without air, but do have a parental affection. The young of the dog-fish accompany their parent and are taken into its stomach in time of danger, and a single species of East Indian fish cannot live without air. Fish generally live without air and devour their own spawn, frogs whose early life is fish do the same, but the serpent which commences from an egg in open air regards her young, cares for them, and like the dog-fish, receives them in her stomach as a conveyance, as well as a refuge, from danger.

The curious modiformations, the bone used in the higher form for respiration alone, I mean the rib, undergoes in its progress to higher life, are striking, which must be my excuse for mentioning them in a paper on Nova Scotian Serpents. In fish the rib seems of no use in a respiration which is motionless. In the frog it seems a spinal process, having no attachment to a breast bone, but in the snake it is very numerous, strongly attached to the spine, extending the length of the body, and the free end attached to broad scales on the belly. By these scales moving forwards and backwards the snake glides. He may be said to run upon his ribs. These facts are of great value when we find the rib in the first hot blooded air breathers the porpoise jointed in the middle, and in the birds introduced into life at a contemporary period also jointed, and by the great power of contracting and extending its body adding vastly to its powers of locomotion in body.

The Garter Snake.

Eutania sirtalis. B. & G. Smithsonian. Institute.
Coluber sirtalis. Linn. Storer.
Trophidonatus sirtalis. Holb.
Trophidonatus taenia. DeKay.

This is the most common of our snakes, appearing in open springs, in April, and leaving us in October. I do not recollect ever finding them except alone. Though taking water very readily, we find them in high elevations. The larger specimens attain about eighteen inches in length, according to my own observations, by others much more, and agree with Baird, and Gerard's description; light ashy, or dark reddish brown on back greenish white beneath with three pale stripes from head to tail, on the back and sides, with numerous irregular brown spots. The brown in some runs so reddish as to suppose a new species. They feed upon living food, toads, birds, butterflies, (on Mr. Downs' authority,) and worms. I have frequently seen them swallowing toads, and what struck me more, was the utter indifference of the toad, contrasted with the eager ferocity of the snake. I think the toad becomes benumbed, when rescued will not get out of the way, whilst the snake will fight a fair battle to retain his prize, charging you boldly again and again, that is if you forbear to break with yonr riding whip his beautiful coils, and be content to spoil him of his dinner alone, without taking his life. I found two toads in one that was coiled on the top of a low tree on a rocky islet in the great Fairy lake. His huge size arrested my attention and I had him shot. This fact is opposed to the ordinary belief that they become torpid after swallowing their food until it is digested, as he evidently had swallowed the two after a short interval. On the tenth of August I captured one at Bedford Basin. He bit the glove covering my hand so that I could feel his teeth gritting upon the buckskin. I transferred him to a glass case about two feet square, floored with moss. He made great efforts to escape, heaving himself upright, nearly his full length—about eighteen inches—upon the smooth glass. I have no doubt on a roughened surface he could have moved vertically. He could raise his body six inches vertically without support. His usual attitude was in a coil, his head raised two or three inches, his ever vigilant eye open and bright, and his forked tongue menacing night and day. Yet certain noises or odors seemed to have more effect upon him than objects of sight. In feeding he tracked the earth worms by the slime they left upon the glass, and pounced upon them with a sudden fury that made one thrill. One day he eat twelve earthworms, and after that he allowed them to crawl over him. He took no notice of flies, though I frequently offered them. He would not touch milk, but like others I have had was fond of water, drinking it, and continually gliding through it.

One day I found his whole appearance changed, bright yellow rings of the liveliest colour encircled his body. On close examination I found that the scales which cover the body of all snakes, (except the abdomen and beneath the tail which are covered by scutella) are capable of separation, one from the other, when the skin is distended beneath them, and in this specimen the skin being bright yellow, this caused the yellow ring. Doubtless the puff adders when enraged and swollen owe their brilliant colour to this power. DeKay, speaking of the garter snake, says, it often changes its colours, but does not allude to the cause. In my specimen it was caused by distension from feeding; it returned the next day to its usual coloring. It performed the function of respiration about twice in a minute.

The eggs of this species are found repeatedly under stones and banks, yearly, in the Province. They are dark olive, flattened roundish pellets, soft, apparently glutinous, and attached to each other by the extremities, and forming chains of from twenty-five to thirty and about one-third inch in diameter. On opening them a small snake is found coiled within them already with the typical marks of the adult. These eggs are usually picked up in August, and when kept will hatch out about the middle of that month—a period later than that of other reptiles which spawn in early spring. Three eggs of the garter snake (E. sirtalis) were sent by mail to Halifax; Archdeacon Gilpin, who received them, handed them over to his son. They were placed in a cigar box with gravel and about the middle of August one hatched out, a few days after birth small detached bits of skin were picked up in the gravel, and in a day or two an entire skin everted and perfect to the eyes was found. This analogy with seals and perhaps all mammals including man whose babies shed their hair directly after birth, is striking. This young snake was very lively, ate or drank nothing, began to fade about the end of October, and died in November. This is the most numerous snake of our Province. He affects dry rocky positions, though he may be found in swamps and borders of rivers in search of frogs. He is often seen basking in the sun coiled upon warm rocks, in company with the green snake (C. vernalis).

In my observation they seemingly never recognize each other, even of their own species, when even crossing each other's bodies in confinement, though others have informed me they have seen them coiled together in struggling groups during their breeding season or in torpid masses hybernating. "Two men," says the Kentville Farmer 1875, "ploughing in a field near Kentville, rooted up a large stump, under which they found a coil of snakes numbering forty-five, in a torpid state." Their powers of penetration into the ground are small, nor can they penetrate below "the frost" or 32° Fah., at which temperature the moisture from the surface is frozen to the depth of three or four feet in our climate. They therefore get beneath rocks and old stumps, or choose the soft soil of an old ant-hill. Mr. Stayner of Halifax, informed me that early in October, near town, in passing an ant-hill he pushed his cane into it and forced out a torpid snake. Returning to the spot he turned out above sixty of various sizes and species, including E. sirtalis, C. vernalis, D. punctatus, and E. occipitomaculatus, a common instinct seemingly bringing all species together.

Of this innocent species, it may be said he inhabits our Province in very considerable numbers, that he is seen in April, thawing out his winter's torpid sleep in the warm sun,—in August is seen with his little group of young which accompany their mother, and in danger received into her belly, and coached away—and in October retires again to the earth.

The Black Snake.

Bascanion constrictor. B. & G.

This snake is exceedingly rare in our Province, and I am indebted to Mr. J. M. Jones, F. L. S., for the only adult specimen I have identified. Mr. Downs had recognized it, and the various stories of large snakes from many sources could only have been referred to it. Mr. Jones' specimen was of moderate size, and agreed perfectly with the description of Buird & Girard, (Smithsonian Inst.) in its dark shining black above, bluish black below, and white about the chin and breast. Of its habits or haunts, I have no notes or observations, as in our Province.

Mr. Blackwood, a merchant of Halifax, gave me in August, 1871, three snake eggs out of a chain he had found beneath the root of a tree at Truro. They were double the size of the garter or green snake's eggs. I lined a glass wide-mouthed phial with damp cotton wool, and placed them in it, putting the phial in the sun. On the third day one of them was broken, and a young snake half way through the aperture. By the end of the day he had freed himself from the egg that was sticking to him by a yellowish substance, and was a lively brilliant young serpent. The next day a second came out, whilst the third egg proved dead. They loved the sunlight, tried hard to escape, but survived only a fortnight, daily failing in liveliness before my eyes; as after trying them with milk, sugar and water, flies and egg, I had no means of feeding them—the whole group of an egg still containing its embryo; an egg empty, and the little snakes themselves, in alcohol now, form the proof of a physiological fact that no one may doubt. From their great size, about two inches and a half in length, and their bluish-black colour, I considered them the young of B. constrictor; but having no specimen by me, I will not assert it as a fact. They were the young of no other species inhabiting this Province.

The Green Snake.

Chlorosoma vernalis. B. & G.

Next to the garter snake this beautiful species is the most numerous in the Province. It is most usually seen about half grown, in the grass, of a lively green, but attains to the size of between two and three feet. It is not unfrequently met crossing the wood roads. It produces eggs very like the garter snake, and receives its young in its mouth when in danger. I have identified its eggs.

The King Snake.

Diadolphis punctatus. B. & G.

This species is still more rare. I captured one on the borders of Fairy Lake, Septr. 1870, and sacrificed a small flask of whiskey to preserve him. Mr. Silver of Halifax does not consider them so rare, and has identified their eggs.

Red Bellied Snake.

Storeria occipitomaculata. B. & G.

This, like the preceding, is a small species, but more numerous, frequently coming around inhabited houses. I have no notes of its habits, and have never seen its eggs.

This ends our list of Nova Scotia serpents.

Scanty in species and in individuals, they share their scantiness with the other reptilia, which, with the exception of several species of frogs, are also few. The common toad is scarce, compared with New England. Our situation at the extremity of a continent, and almost insular position, seems the cause rather than our northern climate. According to Agassiz, the common toad attains great size on Lake Superior, and whilst no reptiles are found in Newfoundland, the opposite side of the Straits of Belle Isle are vocal with frogs, according to modern travellers, which is attested to by old Martin Frobisher, who relates of feeding upon them in Hudson's Bay.

As the habits of all our snakes seem alike, and what may be said of one may be said of all, I have left to the last the discussion of one or two subjects which may be general to all. Although Cuvier long ago laid it down that snakes are oviparous, the exception being when the female was constrained to hold her egg beyond the proper time within the ovaria, yet many writers still maintain they are ovoviparous. Of the five species in Nova Scotia, we have personally identified their eggs, deposited beneath stones and hatched some time after deposition.

Leaving then this fact as settled beyond doubt, that some snakes produce their young from eggs deposited in the ground, it leads to another question of great physiological importance as giving to the class Reptilia the highest function of protecting their young—of maternal affection. The tailless batrachians, or frogs, having their eggs or spawn hatched under the water, and having them in their first form as fish or tadpoles, living upon vegetable matter, have no need of maternal instinct. There are a few records of our Salamanders being seen hovering over their eggs, but the numerous stories from persons of every class in life, though doubted by many eminent naturalists, of our snakes being seen with their young during the summer months, and of their young taking refuge within the mother's stomach during danger, render it beyond doubt.

Of instances of the green snake (C. vernalis), Archdeacon Gilpin informed me he passed on the high road of Nova Scotia, a green snake, dead, and of large size. It had been crushed by a wheel and much torn, and lying dead also, within and without the belly were many young ones. Dr. Baird, (Smithsonian Institute) says in his work, "Serpents of New Jersey" he took from a "graved" female of the same species, eighty-three young snakes, six inches long, on the Allegany River. Now in both these instances, we know that the young had been hatched from eggs, and must have entered the mother's stomach after birth. In Dr. Baird's case, though he calls the snake "graved," the great size of the young "six inches," shows they must have been a month old; the size when hatched being one and a half, and the aggregate length of forty-one feet, being too great a bulk for any ovary to hold. Of similar instances in the garter snake—Mr. Stayner, a merchant of Halifax, as well as an observer of nature, and a fine sportsman, informs me he saw during the autumn of 1875, near Halifax, a large garter snake lying dead, much crushed, and many small ones lying dead about. He pushed with his cane others from within her belly—from which there was a chain of eggs also hanging. In a letter Mr. William Gossip of Halifax, gave me from his grandson,—the boy states, he with his companions found a large garter snake near the railroad at Wilmot, Nova Scotia, surrounded by many young ones, when she immediately opened her mouth and they all took shelter within it. They pursued her from under a pile of lumber, beneath which she took refuge—killed her, and forcing thirty live young ones out of her mouth—killed and counted them all. These few instances I have given from hundreds I have heard, from all classes of society. That then our snakes are produced from eggs, need and receive some nourishment and care from the mother during infancy, and are received in times of danger, or perhaps for conveyance, into her stomach, is as well established as any fact in nature. This also gives to the order Reptilia the higher attributes of parental affection.

It would need some apology for enlarging on facts, no doubt old and well known long since, were it not for the persistent disbelief of some eminent British Naturalists—a disbelief to which is added an insinuation of its being a trick or hoax, although they well know that the Squalidæ, a lower order, possess it. This I have verified myself, having cut youug dog-fish from the mother's belly, and keeping them alive some days. Couch "British Fishes" also gives instances, and our own fishermen affirm it. Future observers will be rewarded by witnessing our salamanders as well as our snakes, watching over their chaplet of leathery eggs, feeding their young, and both protecting and coaching them by their own bodies.

I have never identified the power of our snakes in emitting vocal sounds. All observers unite in the mother's giving a warning call to her young; and when camping on long September nights by the lake side, one hears a night long call—very peculiar, very froggy, but elongated. This your Indians tell you is a snake. I have thought this their nuptial call. The wading birds and the frogs are all now silent, their summer gone, whilst the snake season of hatching being deferred to the middle of August, might make this late season their time of pairing.

Our arctic climate but ill accords with this child of the sun. Grey colours deck him, nor can our slanting sun rays nourish him to the huge proportions of the tropic, or concentrate his poison to their deadly power; yet slow as his action comparatively is, deliberate as his rustle through the dried grass is, his old historical name, his obscure attributes, used of old in true religion and false enchantment, as well as his present, extreme abstemiousness joined to an extremer gluttony, and his magnificent repose, the extremities so coiled, that the sleepless eye and forked tongue of the centre guards all, a very type of a citadel, will make him a fascinating study to all for all time.

ART. VII.—THE SOUTHERN SYNCLINAL OF THE PICTOU COAL FIELD. BY EDWIN GILPIN, M. A., F. G. S., &c., &c.

I PURPOSE this evening to draw your attention to a hitherto neglected part of this Coal field, and to add to the arguments already advanced, in favour of the extension of the Albion group across the eastern part of the district, in my papers on the Pictou Coal Field, and the grouping of its seams, read before the Newcastle (England) Institute of Mining Engineers, and before you. The investigations of the structure of the Pictou Coal field during the last few years have not been of importance; but I hope to show from the various available sources of information, that there is a strong probability that the portion now to be described, contains valuable deposits of coal.

It is to be greatly regretted that much of the prospecting done during the early history of this Coal field was entrusted to men little qualified for the task. Borings and trial pits were put down without the slightest regard to the general structure of the field, and in one or two instances based on wonderful ideas of the uselessness of searching for coal seams under conglomerates. These trial openings were seldom connected by surveys, and when records were kept, they generally gave merely so many feet of sandstones and shales as having been penetrated. The consequence of this is, that in spite of the large sums of money spent in explorations, there are many gaps left, of which little is positively known, and the information gathered was in some cases erroneously considered as indicating the absence of coal.

The researches of Sir W. Logan, while Director of the Canadian Geological Survey, have led to the generally received conclusion that the productive strata of the Pictou Coal field are bounded by four great faults, bringing up lower measures on all sides. This eminent field geologist has also determined the positions of various smaller dislocations affecting the different undulations, and repeating the crops of the lower seams.

NOTE.—Reference to Sir W. Logan's map of the Pictou Coal Field will show the position of the seams and faults referred to in this paper.

One of these boundary faults runs from a point above McNaughton's mills on McCullock's Brook, to Parks' mills on Sutherland's River, and has Coal measures to the north, Millstone grit and older rocks to the south—thereby limiting the extension of coal crops in the latter direction. Another fault, or rather succession of faults, forms the western boundary of the Coal field, and produces a similar effect on the coal strata in that locality.

A short distance to the south of the Stellarton Station, Sir W. Logan has laid down what he calls the McLeod fault, and describes as an upthrow to the south pursuing a course roughly parallel to that already mentioned and known as the south fault. The evidence of the presence of this fault on the west side of the East River is not clear; and those best qualified to speak with authority on the subject, tell me that careful search on the line marked by Sir W. Logan has failed to show trace of its passage. On the east side of the River the effects it is said to produce, are not such as to show with certainty that its influence on the configuration of the Coal field is at all equal to that claimed in the report of the Geological Survey. In this paper the fault is retained in all its supposed intensity to show that even under unfavourable circumstances the district to be considered is of great value; the conclusions to be drawn when it is, in my opinion, more justly considered as not present in serious moment, will be given further on. Between these faults no measures of an age older than the productive are known to exist, and the coal strata are with every appearance of reason considered to run across this interval without undergoing disturbance.

The western boundary fault has cut off the southern extension of the Westville seams, broken from their continuity with the Albion seams by the fault at McCullock's Brook, which produces a down-throw to the west. This fault has course N. 22° W., and intercepts the Main seam a short distance to the west of McCullock's Brook. On the down-throw side of the fault going south, the northerly dip at first is not changed, but on the south line of the Acadia area the measures become flat, then dip south, then flatten again, and finally assume a northerly dip as the workings of the

Intercolonial Coal Company are approached. This undulation of the measures, aided by the fault, obscured the crop of the Main seam most thoroughly; and it was long believed that it was thrown out of reach.

The results of the Geological Survey, however, afford ground for the opinion that the crop of the seam known as the Culton, is the continuation of the Main seam—its strike to the westward being intercepted obliquely by the great West fault which it finally leaves for a distance, and is worked under the name of the Acadia seam by the Drummond, Acadia, and Nova Scotia Colleries. This view is supported more by the relative positions of the seam and associated strata, than by any similarity in the coals themselves. The Acadia, Culton, and Main seams have no coal beds immediately overlying them, while coal seams are found beneath them all at equivalent depths. The importance of this conclusion is evident, as the greatly increased extent of the Main or Acadia seams, as well as of the underlying seams, is at once shown.

At present mining operations are confined to the Main or Acadia and the Deep seams, but from practical trials it is known that many of the lower beds are workable, and the amount of coal thus available may be gathered from the fact that there are over 100 feet of coal in the seams of the Albion group, the lowest as yet known in the Pictou Coal field.

The dip of the Culton seam on McCullock's Brook, and the anticlinal structure of the measures of the south-east part of the Acadia area above described, form what is known as the Bear Creek synclinal of the report of the Geological Survey of the Pictou Coal field. This synclinal is continued up to the west side of McCullock's Brook, at which point we leave it at present.

Following the crop of the Main seam, which as it is the highest, may be taken as the exponent of the Albion group, from the Foster pit to the eastward we find it crossing the East River and gradually turning to the east and south, until cut by the McLeod fault. The course of the Main and Deep seams as far as this point, is well ascertained by underground workings, and the pits and boreholes on the Pictou Company's area. The McLeod fault being an upthrow to the south, the continuation of the line of crop beyond the fault must be searched for to the eastward at a distance determined by the amount of dislocation, and the angle of dip of the strata.

We have now briefly sketched the line of this important seam from Westville to the McCullock fault, and thence to the McLeod fault on the east side of the East River. Explorations to settle its position have not yet been pushed beyond this point, but enough has been done to afford a reasonable basis for calculations as to its continuation beneath what are known as the Upper seams, viz: the McBean and Marsh groups as shown in my paper on the Pictou Coal Field.

Underlying the Main seam on Coal Brook are 1286 feet of sandstones and shales, containing no less than 12 seams of coal, varying in thickness from two to twenty feet. The effect of the McLeod fault would naturally be to thrust some of these coals nearly on the line of the Main seam; and we find this to be the case. A short distance to the east of the point where the outcrop of the Main seam is intercepted by the McLeod fault, the crop of an 8 foot seam, known as the McLeod, has been opened and traced, its strike being found to be S. 15° E., at an angle of 15°. Underlying this at a short distance, is reported the crop of a second seam. The strike of the coal and associated strata gradually turns to the south-west, and then bending to the east of south, is abruptly cut off by the great South fault.

The limited explorations that have been made in the vicinity of the McLeod fault are not decisive enough to show which of the Albion group it is identical with, there having been no attempt made to ascertain its relation to over or underlying seams. The crop of a coal seam is known on the bank of a small brook near the house of W. Miller, about one-half mile to the south of the crop of the main seam. It is on the south side of the McLeod fault, and where exposed dips to the east at a moderate angle. The interval between this bed and the McLeod seam shows a considerable extent of ground underlaid by coal.

Between the latter seam and the Culton adit on McCullock's

Brook there has been hardly anything done to show the economic value of the coal measures. It is known that at one or two points reverse or southerly dips are met in the strata exposed, and that indications of coal have been observed—enough to show that the synclinal form is preserved from the Bear Creek area to the McLeod seam. This undulation is a minor one, being nowhere as deep as that to the north, known as the Albion or Middle synclinal, "The deepest point in this trough showing only about 800 or 900 feet from the surface to the Acadia (main) seam." *Geological Survey.*

We have now traced our synclinal as far eastward as the Fulling Mill on McLellan's Brook. A short distance to the westward of this Sir W. Logan has marked on his map of the Pictou Coal Field a fault running N. 25° W., which he calls the Mill Road dislocation, and considers that it produces an upthrow to the westward. The evidence on which it is laid down does not appear quite conclusive, and I have been informed that in consequence of explorations made last summer there is reason to consider it not of so large an extent as anticipated.

Sir W. Logan states that he can find no evidence of any disturbance on the line of the production of the Mill Road fault to the north of McLellan's Brook. Should this be the case, it forms a decided exception to the general rule, affecting the north and south faults of the Pictou Coal field, as proved by underground workings, they increase rapidly as they go to the north, frequently at the rate of one in five.

The large body of shales overlying the Main seam does not appear as persistent as the coal itself. The Foord Pit was sunk 900 feet to the Main seam, through dark shales and ironstone bands only, while the Foster Pit sunk in equivalent measures less than one mile to the westward, passed through large beds of sandstone before reaching 280 feet of shale immediately overlying the same seam. In the pit sunk on the Pictou Company's area, on the east side of the river, sandstones were penetrated, replacing the enormous beds of shale overlying the same seam a short distance to the westward. As these changes in the nature of the strata enclosing the coal seams, occur in so short a distance, I would venture to suggest that they render the theory of the alleged unconformity of the measures lying to the east of the old Mill Road fault of less weight, especially when as in the Geological Survey report, the bend of the measures to the east, and the quick change from shales to sandstones are brought forward in the absence of more definite knowledge, as the signs of an important fault.

At present we are best acquainted with the western side of the black shales, and the experience of the miners shows that the change from the soft carbonaceous black shales to the post and sandstone rocks is very sudden, and may be marked by a line drawn from the mouth of Coal Brook to the old Colin Pits. On the east side of the East River, the thickness and uniformity of the black shales exposed, almost continuously, from the mouth of McLellan's Brook to the Grant farm, coupled with the large beds of sandstone, sunk through one-third of a mile eastward, would allow on the east side an equal sudden change from carbonaceous to arenaceous measures.

Still following the line of synclinal we have next to notice the oil shales opened on McLellan's Brook, one quarter of a mile north of the Fulling Mill. These oil shales are found to occupy the apex of a synclinal with a north-east course, and are considered with every appearance of reason the equivalents of the oil shale opened on the Marsh Brook and also on the property of the Merrigomish Coal Company, three-fourths of a mile to the north-east of the Marsh pit; their dip and strike at these points being conformable to the seams of the Marsh group.

A short distance to the south of the Fulling Mill are a series of faults bringing up lower measures which come abruptly against the seams of the Marsh and McBean's groups. The effect therefore of these faults has been to throw the crops of the oil shales considerably to the north of the position they would naturally occupy at the south-west apex of the McBean synclinal, and to bring into the position formerly occupied by them the series of coal seams known as the McLean and Mountain groups. We are thus enabled to trace this comparatively shallow synclinal from end to end of the coal field, and to show that its presence has a great effect on the probability of he extent of the Albion or Main seams across the whole district.

It is estimated by Sir W. Logan that the McBean 8 foot seam underlies the Marsh group at a vertical depth of 700 to 800 feet. The thickness of the measures between the oil shales and the Fulling Mill being only 437 feet by actual measurement, it would not appear possible to find the outcrop of this seam south of the oil shales on McLellan's Brook, as it probably abuts against the Fulling Mill fault at a considerable depth from the surface.

Were the Mill road fault absent, or of comparatively small extent, the task of comparing the various horizons would be a slight one, as but one set of faults would require to be accounted for. A comparison might then be confidently made between the 3 feet seam and black shales found above the Fulling Mill, and the 3½ feet seam on McLellan's Brook near the Halifax Company's east line, which is also found near the mouth of Coal Brook on the Intercolonial Railway and further to the westward. *The underlying seams of the Albion group would then reach the South fault with a strike to the east of south, and leave the fault again as the measures lying to the south of the McBean seam assume their north-east line.*

This form would show that the eastern half of the district possesses an almost similar structure to that found at Westville, where the interception of an undulation by a fault has hidden the crop of the Main or Acadia seam for a short distance in the vicinity of the Grog Brook.

In a paper read before you about two years ago, I gave what I considered grounds for the equivalence of the Widow McLean and the Albion groups.

The identity of these groups was supported, in addition to other arguments, by the fact, almost too strong to be a coincidence, that both these series of seams are overlaid at a height varying from 1300–1600 feet by a set of comparatively small coal seams, and that as yet no coal has been found in the intervening strata.

During the summer of 1874 another seam has been found in this series overlying the Main seam. Its thickness is about 4 ft. 6 in. which you will observe closely, agrees with that of the Mountain or Haliburton seam. There have not been any attempts yet made to prove its extension east and west, but the fact of its presence in this part of the coal field, helps to support the views previously advanced.

Until the extent to which the crop of the Main seam is thrown to the eastward by the McLeod fault is ascertained, there are not sufficient grounds to determine if it reaches the South fault before being met by the Mill road fault. Should investigations prove this to be the case, the force of the argument is not lost, as the 1200 feet of measures underlying the Main seam are not all intersected by this fault, as its course cuts the measures at a slight angle.

If we consider the McLeod fault as one not of importance, we would find the Main seam crossing to the South fault nearly on the line of the McLeod seam; and then the 3 feet seam above the Fulling Mill would naturally fall into its relation to the Mountain group on one hand, and the seams found overlying the Main seam on the other side.

The extension of the Widow McLean or Main seams behind or underlying the McBean seam, is the only thing needed to demonstrate the fact that from one end to the other of the Coal field along its southern border, is an almost continuous outcrop of a group of large seams. The inferences to be drawn from this need not be extended beyond a thought of the amount of ground that must be underlaid by the seams of the Lower or Albion group.

A careful study of the various faults and dislocations of the southern part of this Coal field reveals in a most striking manner the care and wisdom of the Great Architect of the Universe. Did the strata follow the laws regulating their position in Cape Breton and other Coal fields, we would have had the Albion group, containing two of the largest and finest coal seams in the world, buried hundreds of feet below the surface, and accessible only over a limited area. On the contrary, an examination of the map accompanying my paper, shews the crops of this lower group extending in an irregular form from end to end of the Coal field, affording not only unusual facilities for opening, but also a satisfactory proof of its presence immediately south of the conglomerates.

Returning to the interval between the southern and McLeod faults on the west side of the river, we find a district one and a half miles wide, yet unexplored. The comparison made in the report of the Geological Survey of Canada, of some of the strata in this section, with sandstones immediately overlying the conglomerate below New Glasgow, is not borne out by Prof. Dawson's researches, he being inclined from fossil evidence, as shown by his paper on the transition of the Carboniferous into Permian, read last year before the Geological Society of London, to consider the latter an extension of the upper part of the Middle or Productive coal measures. From the facts gathered relative to the structure of the Pictou Coal field, these measures as suggested by the Geological Survey report, are probably lower than those containing the Albion Main and Deep seams. The fact however of the extension of the Bear Creek synclinal across this district, and that the amount of dislocation caused by the McLeod fault is not of serious moment, are important considerations. The reverse or southerly dips and the presence of coal, point out the existence of seams of the Albion or Lower group at this point, and the width between the two faults would allow of a development, little if at all, inferior to that attained by the seams of the middle or Albion synclinal.

The question then arises why explorations have not been made commensurate with the size of this district, and the importance of ascertaining the presence of workable coal seams. A considerable part of this space between the southern and McLeod fault is owned by a company which naturally is not at present solicitous about its contents, as their valuable working areas in other parts of the field afford it full occupation. The dull state of our Coal trade is also an evident reason why the attempt proposed a short time ago to employ the diamond drill in that part of the district held by other parties was not carried out.

There is, however, as far as our present knowledge extends, no reason to doubt that this will eventually prove a very valuable addition to the present working limits of the Pictou Coal Field, and that its extent is ample enough to afford room for the investment of capital in several large Collieries.

Art. VIII.—On the Analysis of two Spring Hill Coals. By Henry How, Jr. Communicated by Prof. H. How, D. C. L., King's College, Windsor, N. S.

The following brief notes are offered to the Institute as a contribution to the knowledge of the mineral resources of this province. They relate to a coal field about which less is known than of the Pictou and Cape Breton districts, but which presents many interesting features.

Late reports of the Geological Survey contain much interesting information respecting it, but as no analysis of one of the coals now referred to has appeared, I thought it, and a second analysis of one already examined a few years ago, might be acceptable to the members.

My experiments were made in the laboratory of King's College, Windsor, a privilege which I now gratefully acknowledge.

The following brief notice* of the seams of the Springhill Coal Field may be quoted to show their chief features.

"At present the survey is not sufficiently advanced to speak with any degree of certainty regarding the structure of the field or the extent, thickness and position of the several seams. The evidence so far as it goes, appears to show that in a distance of about eight hundred yards horizontal measurement across the strike of the measures, there are eight seams of workable thickness as under, in ascending order:

1	13′	6″
2	6′	0″
3	2′	4″
4	12′	3″
5	2′	6″
6 a crop...	thickness uncertain.	
7	4′	0″ shaly coal.
8	2′	0″
Total	42′	7″

* "Geological Survey of Canada," 1870-71, page 6.

"The average dip is supposed to be about 30°, which would give a vertical thickness of measures from the 13′ 6″ seam to the 2′ seam of about 1200 feet. The dip increases as the seams are followed on their strike to the northward. The country is for the most part level and thickly forested, and the rocks are much obscured by drift, so that it becomes impossible to trace out the seams without the aid of pits and borings."

I. *The so-called* "11 *foot seam*," *or* "*Springhill main seam*"* *or* "*Black seam.*"

This seam of coal, which is according to report just quoted, 12′ 3″ in thickness, is the property of, and worked by the Springhill Mining Company, who have now two slopes, the east and west, distant from each other about ¾ of a mile. The west slope has been driven some 450 feet, with a main level of about ½ mile. The east slope has been driven 850 feet, and will henceforth be the chief output.

The specimens from which the following analyses were made, were got by myself during the summer of 1874, while on a Topographical Survey under Prof. Oram, C. E., and will represent fairly the average quality of the coal exported by this company, at their wharf at Dorchester, N. B.

The analysis gave the following results:—

(I.) Ordinary coking (air-dry specimen).

Hydroscopic moisture	3.86	total vol.	30.32
Volatile combustible matter	26.46		
Fixed carbon	65.23	coke	69.68
Ash	4.45		
	100.00		

Theoretical evaporative power.. 8.858 lbs.
Specific gravity 1.29

Calculated weight of 1 cub. ft. unbroken	80.48 lbs.
" " " " broken	54.08
Space for 1 ton (2240 lbs.) on stowage (economic weight)	41.41 c. ft.

* E. Hartley, in "Notes on Coal from the Springhill Coal Field," who, however, gives the thickness as 11′ 3″. Geological Survey Canada, 1866–69, page 445.

II. Rapid Coking.

Total volatile matters	35.65
Fixed carbon	59.90
Ash	4.45
	100.00
Theoretical evaporative power	8.23 lbs.
Coke, per cent	64.35

For the sake of comparison the following analysis by E. Hartley, Esq., Geological Survey of Canada, may be given, and if compared with II. shows the permanent character of this coal:

	11′ 3″ seam.
Total volatile matters	35.39
Fixed carbon	60.46
Ash	4.15
	100.00
Theoretical evaporative power.	8.37 lbs. (Prof. How.)
Coke	64.60
Sulphur	2.25

This coal breaks with cubical fracture, and for various reasons is very valuable, although its being tender causes a considerable amount of loss to the company by the formation of slack coal. The volatile matter is of such quantity and quality as to recommend this coal in the preparation of gas. It cokes freely with small increase of volume, giving a coherent, compact coke. The amount of sulphur is remarkably small, an important fact as regards domestic use, gas-making and preservation of grate-bars. The ash is grayish-white and bulky.

This company can export about 400 tons daily, from the wharf at Dorchester, N. B. The coal is held in high favour by all who have used it for domestic purposes.

II. *The 6 foot Seam.*

This seam is the property of the General Mining Association.

Only a few tons of this coal have been used by the people living in its immediate vicinity, and it is justly considered by them as a good house coal. The specimens were taken by myself from a heap at the mouth of the pit sunk near the outcrop.

The analysis gave the following results :—

Ordinary coking (air-dry specimen).

Hygroscopic moisture.....	3.47	total vol.	30.45
Volatile combustible matters	26.98		
Fixed carbon	64.48	Coke,	69.55
Ash	5.07		
	100.00		

Theoretical evaporative power ..	8.859 lbs.
Total sulphur per cent.........	.231
Specific gravity	1.30
Calculated weight of 1 cub. ft. unbroken............	81.10 lbs.
" " " " broken....	54.50 "
Space for 1 ton (2240 lbs.) on stowage (economic weight)	41.10 c. ft.

This is a compact, bright, clean coal, breaking with a conchoidal fracture. It has a peculiarly striated, slicken-sided surface. It cokes freely, swelling about ½ its original bulk, giving a firm, compact coke. The ash is white, which in itself is proof of but small amount of sulphur existing in the coal as pyrites. The ash proved to contain by qualitative analysis a considerable amount of insoluble residue; a little soluble silica; notable amount of peroxide of iron and alumina; sulphuric acid and lime decided in quantity; small amount of magnesia; trace of phosphoric acid.

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PROCEEDINGS

OF THE

Nova Scotian Institute of Natural Science.

VOL. IV. PART II.

Provincial Museum, Oct. 13, 1875.

ANNIVERSARY MEETING.

J. B. GILPIN, B. A., M. D., M. R. C. S., in the Chair.

Inter alia.

The following gentlemen were elected office-bearers for the ensuing year:—

President—J. B. GILPIN, B. A., M. D., M. R. C. S.

Vice-Presidents—WILLIAM GOSSIP; F. ALLISON, M. A.

Treasurer—W. C. SILVER.

Secretaries—Rev. D. HONEYMAN, D. C. L., F. G. S., and JOHN T. MELLISH, M. A.

Council—A. P. REID, M. D., J. SOMERS, M. D., A. DEWAR, ROBERT MORROW, J. M. DEWOLFE, M. D., M. R. C. S., Sheriff BELL, Prof. LAWSON, AUG. ALLISON.

ORDINARY MEETING, Nov. 13, 1875.

WILLIAM GOSSIP, Esq., *Vice-President, in the Chair.*

Dr. GILPIN, the President, read a highly interesting and instructive paper "On the Serpents of Nova Scotia."

A number of gentlemen expressed their satisfaction with the treatment of the subject, and several adduced evidence confirmatory of the view that serpents swallow their young on the approach of danger. (*Printed in Transactions* 1874–5.)

ORDINARY MEETING, Dec. 13, 1875.

The PRESIDENT *in the Chair.*

It was announced that the Council had elected Lieut. HOPE EDWARDS, 60th Rifles, and Mr. LEWIS P. FAIRBANKS, members of the Institute; and Mr. WILLIAM MCKENZIE an associate member.

Rev. DR. HONEYMAN read a paper "*On the Geology of Nova Scotia.*

Halifax County—Glacial Period" This paper embodied the results of much painstaking original work. (*See Transactions.*)

Mr. GOSSIP gave some very interesting facts in reference to the transportation of drift by glacial or other action.

Dr. GILPIN exhibited a number of stone arrowheads, found near Lunenburg, and presented to the Institute by the Rev. J. Forrest. The Rev. gentleman who was present described to the Institute the nature of the locality in which he had found them.

ORDINARY MEETING, January 10, 1876.

WILLIAM GOSSIP, Esq., *Vice-President, in the Chair.*

Dr. J. SOMERS read a paper on "*Correspondence between the Floras of Nova Scotia and Arkansas.*" Several gentlemen made inquiries respecting the subjects treated in the lecture, which Dr. Somers readily and satisfactorily answered. (*See Transactions.*)

Dr. A. P. REID also read a paper "*On Natural History in relation to Deep Sea Fishes.*" (*See Transactions.*)

Mr. GOSSIP, Dr. REID, Mr. L. G. POWER, Mr. MELLISH and others, spoke on the subject, and gave facts showing that the cod and others fishes were formerly found in our waters in greater abundance than they are at the present time. It was strongly urged that the study of the habits of our deep sea fishes could be made a specialty with great profit to the country at large, as well as to the student.

ORDINARY MEETING, February 14, 1876.

WILLIAM GOSSIP, Esq., *Vice-President, in the Chair.*

It was announced that Mr. GEO. MATTHEWS of New Brunswick, was elected a corresponding member of the Institute.

A paper was read by EDWIN GILPIN, M. A., F. G. S., "*On Ores and Minerals from East River,*" Pictou, intended for the Centennial Exhibition. (*See Transactions.*)

A paper was also read by Mr. ANDREW DEWAR, "*On the Atomic Philosophy—its past and present.*"

ORDINARY MEETING, March 13, 1876.

WILLIAM GOSSIP, Esq., *Vice-President, in the Chair.*

The SECRETARY announced that J. T. FRASER and ROBERT S. SKIMMINGS, had been elected members of the Institute; and that the Rev. G. PATTERSON, D. D., of Pictou; J. B. CALKIN, M. A., Principal of Normal School, Truro; and JAMES J. KERR, had been elected associate members.

The Rev. Dr. HONEYMAN continued his subject "*On the Geology of Halifax County, Glacial Period.*" (*See Transactions.*)

Mr. GOSSIP mentioned several cases of granite boulders having been found near the city, which could not have been placed in these positions except by icebergs or some similar agency.

Dr. Reid, Mr. A. James, Mr. Dewar, Mr. Poole, Mr. Mellish and Mr. Silver, also made remarks on the subject.

Mr. Robert Morrow read a short paper on the *Caribou,* and referred especially to the peculiarity of its liver and the absence of any gall-bladder.

Ordinary Meeting, April 10, 1876.

Dr. Gilpin, *President, in the Chair.*

The Secretary read a letter from the Rev. E. H. Ball, stating that he (Mr. B.) would be unable to read his paper as announced, on account of indisposition, but that he would willingly propose to read it on the 24th inst., if able, to which the Institute unanimously agreed.

Professor Lawson read a lengthy paper "*On the Flora of Nova Scotia.*" (*See Transactions.*) The subject was beautifully illustrated by specimens of dried plants.

April 24, 1876.

William Gossip, Esq., *Vice-President, in the Chair.*

The Rev. E. A. Ball read an interesting paper "*On new Species of Nova Scotia Ferns,*" illustrating his subject with numerous specimens. (*See Transactions.*) Mr. Ball's paper embodied the results of much original research.

Prof. Lawson spoke at some length on the subject of the lecture.

Ordinary Meeting, May 8, 1876.

J. B. Gilpin, M. D., &c., *President, in the Chair.*

The Secretary stated that the Transactions of a number of Natural Science Societies in Europe and America had lately come to hand, and that our Transactions were in great demand from abroad.

Frederick Allison, M.A., Chief Meteorological Agent, read his Meteorological Report for 1875. He made special reference to the semi-daily fluctuation of the barometer. (*See Transactions.*)

John T. Mellish, M. A., read "*Notes on the Serpents of Prince Edward Island.*" Besides classifying and noting the peculiarities of the Island serpents, Mr. Mellish pointed out the geological conditions necessary to produce the existing differences between the fauna of the Island and the continent. (*See Transactions.*)

Remarks were made by Dr. Gilpin, Lieut. Hope Edwards and others, on the subjects of the papers.

In closing the Meetings for the season the President made appropriate reference to the progress of the Institute, and suggested that if possible some Field Meetings be held in the course of the summer.

[At a subsequent meeting of the Council the Hon. Mr. Greville, 60th Rifles, and Messrs. C. C. Vaux and William Hampton, were elected members of the Institute.]

John T. Mellish,
Secretary.

LIST OF MEMBERS.

Date of Admission.

1873. Jan. 11. Akin, T. B., D. C. L., Halifax.
69. Feb. 15. Allison, Augustus, Halifax.
69. Feb. 15. Allison, Frederick, *Chief Meteorological Agent*, Halifax.
64. April 3. Bell, Joseph, High Sheriff, Halifax.
63. Jan. 8. Belt, Thomas, F. G. S., Newcastle-on-Tyne, England.
73. Jan. 11. Binney, Edward, Halifax.
74. April 13. Black, G. P., Halifax.
64. Nov. 7. Brown, C. E., Halifax.
74. Feb. 10. Brunton, Robert, Halifax.
67. Sep. 20. Cogswell, A. C., D. D. S., Halifax.
74. Apr. 13. Colford, Henry, Halifax.
71. Apr. 4. Compton, William, Halifax.
72. Apr. 12. Costley, John, Halifax.
63. May 13. Cramp, Rev. Dr., Wolfville.
74. Apr. 13. Creighton, Aylwin, Halifax.
70. Mar. 30. Day, Forshaw, Artist, Halifax.
75. Jan. 11. Dewar, Andrew, Halifax.
63. Oct. 26. DeWolfe, Jas. R., M. D., Edin , L. R. C. S. E., *Vice-President*, Dartmouth.
63. Dec. 7. Downs, Andrew, *Corr. Memb. Z. S.*, London, Halifax.
75. Dec. 13. Edwards, Lieut. Hope, 60th Rifles, Halifax.
71. Nov. 29. Egan, T. J., Taxidermist, Halifax.
75. Dec. 13. Fairbanks, Lewis P., Dartmouth.
74. Apr. 13. Forbes, John, Manager of Starr Works, Dartmouth.
72. Feb. 12. Foster, James, Barrister-at-Law, Dartmouth.
76. Mar. 13. Fraser, J. F., Richmond, Halifax.
74. Apr. 13. Frith, G. R., Halifax.
63. Jan. 5. Gilpin, J. Bernard, M. D., M. R. C. S., *President*, Halifax.
63. Feb. 2. Gossip, William, *Vice-President*, Granville Street, Halifax.
76. July 20. Greville, Hon. Mr., 60th Rifles, Halifax.
63. Jan. 26. Haliburton, R. G., F. S. A., Halifax.
76. July 20. Hampton, William, Halifax.
63. June 27. Hill, Hon. P. C., D. C. L., Provincial Secretary, Halifax.
66. Dec. 3. Honeyman, Rev. David, D. C. L., F. G. S., *&c.*, *Secretary, Prov-Museum*, Halifax.
68. Nov. 2. Hudson, James, M. E., *Superintendent of Albion Mines*, Pictou.
72. Feb. 5. Hunt, Rev. A. S., A. M., *Superintendent of Education*, Halifax.
74. Dec. 10. Jack, Peter, Halifax.
73. Jan. 11. James, Alexander, Barrister-at-Law, Dartmouth.
63. Jan. 5. Jones, J. M., F. L. S., Halifax.

1866. Feb. 1. Kelly, John, *Dep. Chief Commr. of Mines*, Halifax.
64. Mar. 7. Lawson, George, Ph. D., L. L. D., *Professor of Chemistry and Natural History*, Dalhousie College, Halifax.
75. Jan. 1. Mellish, John T., M. A., SECRETARY, Halifax.
72. Feb. 5. McKay, Alexander, *Principal of Schools*, Dartmouth.
72. Feb. 12. McKay, Adam, Engineer, Dartmouth.
66. Feb. 3. Morrow, James B., Halifax.
72. Feb. 13. Morrow, Robert, Halifax.
73. Mar. 10. Moseley, E., Dartmouth.
70. Jan. 10. Murphy, Martin, C. E., *Provincial Engineer*, Halifax.
65. Aug. 29. Nova Scotia, the Rt. Rev. Hibbert Binney, D. D., *Lord Bishop of.*
74. Mar. 9. Pitts, D. H., Halifax.
63. Jan. 16. Poole, Henry, M. E., Derbyshire, Eng.
72. Nov. 11. Poole, H. S., F. G. S., *Inspector of Mines*, Halifax.
70. Jan. 20. Power, L. G., Barrister-at-Law, Halifax.
66. July 28. Reeks, Henry, Manor Hall, Truxton, Hamp., England.
71. Nov. 29. Reid, A. P., M. D., Halifax.
74. Nov. 9. Robertson, Thomas, Halifax.
66. Jan. 8. Rutherford, John, M. E., Halifax.
64. Mar. 7. Silver, W. C., TREASURER, Halifax.
68. Nov. 25. Sinclair, John A., Halifax.
76. Mar. 13. Skimmings, Robert, Halifax.
75. Jan. 11. Somers, J., M. D., Halifax.
74. Apr. 11. Stirling, W. Sawers, Halifax.
73. Jan. 13. Waddell, W. Henry, Fort Massey Academy, Halifax.
74. Nov. 9. Walker, John McAra, Saint John and Halifax.
66. Mar. 18. Young, Sir William, Knt., *Chief Justice of Nova Scotia*, Halifax.

ASSOCIATE MEMBERS.

1863. Oct. 6. Ambrose, Rev, John, A. M., Digby.
76. Mar. 13. Calkin, J. B., M. A., *Principal of Normal School*, Truro.
73. Apr. 11. Gilpin, Edwin, M. E., F. G. S., Springville, Pictou.
75. Nov. 9. Kennedy, Professor, Acadia College, Wolfville.
76. Mar. 13. Kerr, James J., Amherst.
75. Jan. 11. McKay, A. H., A. M., *Principal of Academy*, Pictou.
75. Nov. 9. McKinnon, Rev. John, Hopewell, Pictou.
75. Dec. 13. McKenzie, William, Surveyor, Moncton, N. B.
65. Dec. 28. Morton, Rev. John, Trinidad.
72. Mar. 27. Moseley, E. T., M. P. P., Cape Breton.
76. Mar. 13. Patterson, Rev. George, D. D., Greenhill, Pictou.

CORRESPONDING MEMBERS.

1871. Nov. 29. Ball, Rev. E., Springhill.
68. Nov. 25. Bethune, Rev. J. S., Ontario.
66. Sep. 29. Chevalier, Edgecumbe, H M. Naval Yard, Pembroke, England.

1871.	Nov.	1.	Cope, Rev. J. C., *President of New Orleans Academy of Science.*
70.	Oct.	27.	Harvey, Rev. Moses, St. John's, Newfoundland.
66.	Feb.	6.	Hurdis, J. L., Southampton, England.
73.	Jan.	5.	Jones, J. M., F. L. S., Bermuda.
71.	Nov.	1.	King, Dr. V. O., *V. P. New Albans Academy of Science.*
71.	Jan.	10.	Matthew, G. M., Saint John, New Brunswick.
70.	Jan.	16.	Poole, Henry, M. E., Derbyshire, England.
72.	Feb.	5.	Tennant, Professor J., F. G. S., F. Z. S., &c., *Mineralogist to H. M. the Queen, and the Baroness Burdett Coutts.*
72.	Nov.	11.	Turner, Jabez, Madden Grange, Peterboro, England.

LIFE MEMBER.

Hon. Dr. Parker, M. L. C., Nova Scotia.

TRANSACTIONS

OF THE

Nova Scotian Institute of Natural Science.

ART. I.—NOVA SCOTIAN GEOLOGY—SUPERFICIAL. BY REV. D. HONEYMAN, D. C. L., F. G. S., &c. *Director of the Provincial Museum.*

(Read before the Institute, Dec. 13, 1875; and March, 1876.)

PART I.

TO ILLUSTRATE a course of investigations in the Superficial Geology of Nova Scotia, I shall make a kind of *General Section* of the Geological Formations as they occur along the Meridian of Halifax, 63°. 36′. 40″ W., from the Atlantic to the Gulf of St. Lawrence, with offsets.

From Sambro Head to the North West Arm, we have 11 miles of *granite*, overlaid on the east at York Redoubt, Falkland Village, and Purcell's Cove, by quartzite and gneiss, (Menevian or Lower). From this point, along the line for 35 miles the same formation continues. The line passes through the gold fields of Waverley and Renfrew. These formations conjointly extend the entire length of Nova Scotia. The rocks are granites, gneisses, schists, quartzites, argillites and siliceous limestones. Continuing the line of Section to the Cobequid Bay we have carboniferous 16 miles. This band extends to the west of the line about 40 miles. To the east it extends in varying width to the Strait of Canseau.

The rocks of this band are conglomerates and grits, sandstones and shales, having carboniferous *flora*, limestones and gypsums. Limestones of Windsor and Kennetcook are often largely fossiliferous.

NOTE.—Read also before the American Philosophical Society, Philadelphia, May 16, 1876.

The line then crosses the Cobequid Bay a distance of 4 miles. It is presumed that the formation underlying the Bay is new red sandstone, of Permian (?) and triassic age.

On the north side of the Bay the line passes through this formation to the length of 3½ miles. The formation extends to the east of the line about 20 miles, and to the west about 130. The rocks are coarse red conglomerates and red sandstones. Associated with these is a great dyke and outliers of homogeneous and amygdaloidal dolerite (Trap.) This is the great depository of Nova Scotian Trap minerals, e. g. Zeolites, chalcedony, agates, jaspers, amethysts.

About 10 miles W. of the line Bass River, these traps have their beginning.

Bass River.—*This is a point of interest* in connection with my investigations, as I will show in a subsequent part of this paper. West of this are Five Islands, Two Islands and Partridge Island, celebrated for their *trap minerals*. Cape D'Or, known on account of its *native copper*. Blomidon, North Mountain, Digby Neck, &c. All celebrated on account of their trap minerals.

From Bass River to Briar Island, the two extremities, the distance is about 160 miles. This is the only trap having zeolites to be found in Nova Scotia. *This is another interesting fact to be particularly attended to.* The line then traverses the carboniferous band on the south side of the Cobequid Mountains, a distance of 2¾ miles. This may be regarded as a part of the Section of the I. C. Railway, through the Cobequid Mountains, as this section now approximately coincides with our line of section. This carboniferous band extends to the west of our line about 63 miles (to Cape D'Or), to the east about 45 miles (to the coal fields of Pictou) on the side of the Cobequid Mountains. The part of the band west of our line of section, which interests us more particularly at present, corresponds with the character of the formation generally. It has sandstones, shales and clays with *flora*, small coal-seams, limestones, and conglomerates. The conglomerates are largely composed of boulders of the underlying crystalline rocks, which may be readily appropriated by the formations of succeeding periods. On the line of railway a continuation of the line section, we have — feet of middle silurian. In another paper I have regarded this as the lower part of a middle and upper silurian band, having the upper part denuded and obscured by the preceding lower carboniferous conglomerates. This band extends east and west of the line of section, possibly as far west as Cape Chiegnecto, and to the east as far as the Pictou County line.

This band is chiefly remarkable for the iron deposits of Londonderry.

The line then passes through a band of Cambrian (?) Laurentian (?) strata, a distance of — miles.

This band also extends west of the line beyond (?) as far as Five Islands; and east?

The rocks of this band are gneisses, diorites, quartzites and crystalline limestones, e. g., marble of Five Islands.

Along the line is a width of — miles granitoid rocks. The band extends to the west of the line as far as Cape Chiegnecto, and to the east.

The rocks of this band are syenites, granites, diorites and porphyries. The line then passes through a Huronian and lower and middle silurian series, whose extent east and west of the line is obscured by denudation, and the over-lapping of lower carboniferous conglomerate, &c. On the line of railway the rocks are 1. Diorites, porphyries, jaspers, conglomerates. 2. Diorites, shales (fossiliferous). 3. (Middle silurian) slates (fossiliferous), diorites, porphyries. The width of these on the line is ——

The line then traverses the carboniferous formation a distance of 22 miles to the Strait of Northumberland, which bounds Nova Scotia on the north. This carboniferous band extends west of the line into New Brunswick, and east as far as Arisaig, 20 miles from Cape St. George, the eastern extremity of Nova Scotia. This includes the coal fields of Nova Scotia—Pictou, Springhill, and Joggins.

The line then crosses Northumberland Strait, a distance of 26 miles, and reaches the S. side of Prince Edward Island. The formation traversed through the Strait is in all probability the carboniferons. It passes through the Permian (?) and triassic formations of Prince Edward Island, a distance of 26 miles, and reaches the Gulf of St. Lawrence, at New London, the position of the bed of the dendrerpeton triassic reptile, bathygnathus borealis (Leidy), Permian, theriodont (Owen.)

We have thus traversed the meridian of Halifax, a distance of 150 miles, indicating the different geological formations occurring in our course, their relations and characters.

I regard this as necessary for the right understanding of the observations which I am going to make on the Superficial Geology of a part of the County of Halifax. I consider that my field of observation is admirably situated. In consequence of this the material and deposits to be examined are well exposed by coast, harbour, road and railway sections, and as the geological formations indicated by the line of sections have a distinct and regular sequence, and are interrupted to a great extent by complications which prevail in the east and west of Nova Scotia. We have thus a fair and open field in western Halifax and Hants, Colchester and Cumberland counties, to the north of it. I shall now examine the coast and shores, commencing at our meridian line of section at Point Pleasant, Halifax harbour.

At the Point at the entrance to the N. W. Arm, we find on examining the beach that the great proportion of boulders and pebbles, are quartzites, argillites, gneisses and granites, from the first band of the line of section, or that which underlies and surrounds the beach which I am examining. Mixed with these we find boulders and pebbles of amygdaloids, with amygdals of zeolites, chiefly *heulandite*. The source of these cannot be mistaken. They are without hesitation referred to Blomidon. On examining the adjoining bank section we find them falling out of the drift. Here then is the secondary source of these triassic boulders, the primary being at least 58 miles N. W. Equally abundant with the amygdaloids are boulders of syenites, diorites and porphyries. These crystalline rocks, also derived from the drift bank, have their nearest primary source in the central band of the Cobequid Mountains, the shortest distance being 80 miles. This is another striking fact. Passing eastward we cross the harbour to McNab's Island. On its western side are abundance of triassic amygdaloids with Leolites, *heulandite* and *stilbite*. These have all come from the drift bank, and originally from the Bay of Fundy or Minas Basin. We have here also abundance of syenites, diorites and porphyries. These have come from the Cobequid Mountains. In addition to these are conglomerates and sandstones of carboniferous origin. These have been derived from the carboniferous of our line of section. The nearest primary source of these is 33 miles N. W.

Crossing the Eastern passage, we find on the shore boulders of triassic amygdaloid, having besides zeolites, amygdals of chalcedony, and also limestone boulders, which have the appearance of lower carboniferous limestones, although they do not show fossils. Limestone boulders were also observed at our starting point at the N. W. Arm, but as the bank is the site of a Battery, I did not attach special importance to their occurrence.

Still farther to the East is Cow Bay. On the extensive and beautiful beach beautifully rounded boulders of quartzite are very abundant. Some of these contain groups of large cubical crystals of *iron pyrites*. Interspersed with these are boulders of triassic amygdaloid. These first attracted my attention on June 24, 1873, the Queen's Birth Day.

When wandering on the beach on a holiday excursion, Mr. Stirling and I observed the amygdaloid boulders. I at once expressed the opinion that some vessel from the Minas Basin had discharged them in the offing. As we proceeded eastward the abounding amygdaloids, with the addition of syenites, diorites, gneisses, limestones with fossils, sandstones with fossils, at once rendered the opinion advanced improbable. Reaching the east part (Red Head) the immediate source of the supply of strange boulders was at once apparent. This lofty clay bank (50 feet in height) was replete with amygdaloids, and all the variety of boulders observed on the beach. Enormous masses of quartzite were also discharged. Many of these were strikingly furrowed and striated on varying sides. The aid of the photographer was desiderated to picture the phenomena. An interesting geological problem thus presented itself for solution, and no time was lost in beginning the process.

In the clay bluff many interesting specimens were collected of representative boulders, e. g. syenites, gneisses, diorites and amygdaloids. A fine specimen of agate jasper was found embedded in the clay, whose triassic-trappean origin was readily recognized. Specimens in the Provincial Museum, collected at Blomidon by the late Dr. Webster, are strikingly similar. On the beach east of the bluff boulders abound—gneisses, granites, diorites, amygdaloids, porcellaneous jaspers, the collection on trying to make a selection is sufficiently puzzled and perplexed.

On this beach Mr. Stirling found an agate jasper of considerable size; on the same beach Mr. A. James, barrister-at-law, found a large and very beautiful specimen of one of these jaspers, the previous summer. I would here particularly notice the fact, that the granites and gneisses referred to as occurring among the boulders to the east of the harbour are peculiar. They are different from the known granites and gneisses of the band No. 1 of our section. The granites are the same as I found at Maccan Mountain in the Cobequid Mountains, associated with the syenites. The gneisses are of the Laurentian (?) of the Cobequids—*Vide Five Islands and Acadia Mines sections*, in my paper of last Session, Transactions 1873—4.

There are also many porphyries and jaspers, which I cannot refer to their original rocks. It is possible, however, that even these may have their home in the Cobequid Mountains.

On the same beach and at the same time, I found a boulder of yellowish grit, perforated in a singularly regular manner. After a little puzzling I recognized it as the bed of *stigmaria*, the perforations having been the beds of the rootlets. Here was a carboniferous boulder which had travelled from the carboniferous band to the north, a distance of at least 35 miles.

Not far from this was found another perforated boulder. This was of olive green quartzite, the perforations were casts of *crinoidal* columns. This doubtless belonged to the silurian formations of the Cobequid Mountains. I should only have been too glad to have been able to refer it to the silurian of band No. 1, as this would have been a notable discovery. The lithology of the boulder attested to its distant extraction.

This had travelled at least 60 miles. I would observe here that it is either in *Red Heads*, *vide* Admiralty Charts, or red banks, or the adjoining beaches, that the greatest number and variety of boulders are to be found. These Heads and Banks are sections of *boulder clay or drift.*

Passing eastward to the next head, Lawrencetown, we have fine beaches, with great abundance and variety of boulders.

Here we found as before—syenites, diorites, porphyries. A new feature here was the occurrence of granites of band No. 1. These come from granite, which occurs to the north of Lawrencetown. Inland large boulders of these granites occur as *roches perches*, on polished and striated surfaces. These beaches are remarkable for their *abundance* of lower carboniferous limestone boulders. These are large and small and in sufficient numbers to be of some service to the farmer.

Some of these are bituminous, emitting a strong odour when rubbed; others of them are highly fossiliferous, producing fine specimens of *fenestella.*

Another remarkable boulder which I found here contained a fine though somewhat rubbed cast of a lepidodendron. This, with the boulders of limestone, had travelled 35 miles at least.

Still another remarkable boulder which I found was an agate, size, $2\frac{1}{2}$x2x$1\frac{1}{4}$. It is largely composed of cacholong, and has numerous small cavities with quartz crystals, some of these are amethystine—the sides show that the matrix was trap.

Farther east in the extensive and lofty banks of boulder clay of *Half Island* and their beaches, we found abundance of massive and small boulders of granites, syenites, diorites and amygdaloids, and at Three Fathom Harbour we noticed particularly that triassic amygdaloids were still of frequent occurrence.

The nearest point whence these amygdaloids and agates could come to Lawrencetown and Three Fathom Harbour—are Bass River, Five Islands, Two Islands and Blomidon, respectively 68, 70, and 69 miles distant.

Three Fathom Harbour is 15 miles east of our starting point, Point Pleasant. This was the farthest point of our investigation in this direction in 1873. My associates up to this point were Messrs. Jones, Stirling and H. Waddell.

From Point Pleasant, on our line of section, I now turn inland, on the same side of Halifax Harbour. Mr. Waddell found specimens of syenites and triassic amygdaloids, in an excavation at Fort Massey. I found syenites, diorites, porphyries and amygdaloids, with zeolites, in cuttings of the drift of the Citadel Hill.

From George's Island, in the middle of the harbour, I received in the museum a large and beautiful boulder of amygdaloid, with amygdals of *heulandite*. On the eastern side of the harbour at the Eastern Passage, Mr. Stirling found specimens of syenite and amygdaloid, with chalcedonic amygdals, having beautiful *moss-like* figures (moss agates.)

In the clay banks and beach between Mount Hope asylum and Dartmouth, I found numerous boulders of syenite, diorite, and amygdaloid.

In one of the same banks Mr. Stirling found a large boulder of *Maccan* Mountain granite, about 30 lb. weight. In an excavation on the hill he also found a boulder with a beautiful calamite, from the carboniferous formation in the north.

We see on the road sides in Dartmouth several immense syenite boulders, whose home is the Cobequid Mountains.

Mr. James has found a large boulder of amygdaloid, pophyritic diorite, similar to that of Wentworth conglomerate (No. 1) I.C.R. —*Vide* paper on the I. C. R., in the Cobequids, 1875.

In an excavation on the side of the Lawrencetown road, near its junction with the Preston road, I found large and fine boulders of amygdaloid. This point is about 5 miles N. of Point Pleasant.

In the road cuttings at the Richmond Station of the Railway, I found several boulders of syenite.

On Navy Island, Bedford Basin, near Dartmouth side, syenites, diorites, porphyries and amygdaloids are abundant. 1875.

At Hammond's Plains a large and beautiful specimen of limonite was found in the drift by a man when digging a well. It is supposed that this was transported from the Cobequid Mountains, (Londonderry Mines.)

Passing on to the Station of the Railway at Bedford, about 9 miles N. W. of Point Pleasant, I was joined by Mr. Frank West. We examined the road cuttings around Bedford, and found abundance of boulders of syenite and amygdaloid. We did not find any granite boulders.

I then made an examination of several drift cuttings on the lines of railway, commencing at the Windsor Junction. In this examination I was accompanied by Mr. Andrew Jack.

In the extensive cuttings of drift at the Junction we found abundance of syenites, diorites, porphyries, and amygdaloids. The amygdals were of considerable variety of zeolites. I found a piece of brown agate jasper, with cacholong. This is like specimens in the museum from Parrsboro. I also found a boulder of a *strange* granite—it is red and the mica beautifully green. Farther east on the line near Fletcher's, are deep drift cuttings. In these were found massive boulders of amygdaloid. Still farther to the east, in the clay of Enfield Pottery yard, we also found syenites and amygdaloids. This was our *ultima thule* in this direction in 1873.

The point reached on the line of railway is on the line of section 22 miles N. of Point Pleasant; 25 miles N. W. of Three Fathom Harbour; and 43 miles from Five Islands. This consequently is the nearest point from which the amygdaloids of the brick clay could come. From Windsor Junction I examined the drift cuttings as far as Beaver Bank Station. In these the amygdaloids were remarkably abundant. In one of these the amygdals were of beautifully radiated *mezotype*.

This was the farthest point that I reached on the line of railway in 1873, a distance of about 15 miles N. W. from Point Pleasant, and 45 miles from Blomidon.

Blomidon is consequently the nearest point from which the amygdaloids of Beaver Bank could come.

We have thus overwhelming evidence of extensive transportation from north to south, from the Cobequid Mountains to the Atlantic coast, a distance of at least 78 miles.

The accumulations of drift on the Atlantic coast have been largely derived from every formation intervening.

We have found that there is no difficulty in referring the greater proportion of the boulders in the drift to an approximate source.

We have also found that the transported material has been deposited over the intervening surface as well as on the extreme coast.

The enquiry now comes by what means was the drift material transported and distributed as we have found it.

INFERENCES.

1.—The collector of rock specimens who may not consider it necessary that these be collected from the original rocks *in situ*, can readily and easily be supplied from the boulders on the beaches, or from the sections of drift described.

2.—A better collection can be made in this way than by exploring the Cobequid Mountains, as the rocks are there so much obscured by forests.

3.—The drift has added to our knowledge of the lithology of the Cobequid Mountains by furnishing interesting specimens of metamorphic rocks allied to the known rocks, but not yet found in the mountains.

4.—Ores of metals and economic minerals may be found in the drift, far removed from their original position. This inference is of importance in a practical point of view, e. g. the iron ores of the Cobequid Mountains and the trap rocks.

PART II.

TRANSPORTATION. — COURSE.

At the Cow Bay Red Head, are seen massive quartzite boulders fallen from the drift and projecting from it; similar boulders are found at other Red Heads. These often have their sides strikingly grooved and striated. There is no hesitation in associating the *grooves* and *striae* with those of the solid strata which are seen on the removal of the overlying drift. These phenomena are the results of action and reaction, the boulders having formed an acting part of the great machine which grooved, striated, ground and polished the surfaces of the hard rocks over which it passed. The striation of the rocks is there readily associated with the transportation of the quartzite and other boulders contained in the overlying drift.

Returning to the meridian of Halifax, we find at Point Pleasant, (*Vide preceding Paper*,) great quartzite boulders, grooved and striated, associated with amygdaloids, syenites, diorites, porphyries, &c. This point is also remarkable for its *roches moutonées*. One of these, which is the site of the Prince of Wales Tower, is remarkably striking and instructive. Its ruts distinctly indicate that the grooving and transferring agency advanced from north to south.

This rutted *roche moutonée* is the exposed edges of hard metamorphosed slaty strata. These have been much crumpled and faulted. The polished rock shows these crumples and faults very beautifully. The crumpled lines run east and west like the general strike of the strata. The ruts commencing near the north end of the exposure, continue in all their width and depth until they are intercepted by a set of these crumpled lines, which offer unusual resistance. Here the graving point is pictured beyond the crumples, and two or three small diverging lines have been made which continue a few inches and disappear. Other ruts proceeding in the same direction have had a like termination. These ruts sometimes are ragged, like a furrow made by a sharp point drawn across a pine board. The largest of these runs about 50 feet, a part of it has been diverted from the regular course. A large proportion of the ruts and striae run S. 20 E. magnetic; numerous *striae* run S. 30 E.—many intermediate.—*See Table.*

Exposed striated surfaces are very numerous in the Halifax peninsula. There are but few of these and unimportant, which I have not examined. With exceptional variations, the principal directions of the striae may be regarded as above. This is also their direction on the Dartmouth side, at the windmill and on the common.

I would now take the chart. On it I extend the Point Pleasant lines of striation northward.

We find that S. 20 E. and N. 20 W. lines pass through and cross the Minas Basin, impinging the point of Blomidon, and passing a little to the W. of Cape Sharp, cut the Cobequid.

Again we find that the S. 30 E., N. 30 W., passes through Cornwallis, crosses the N. Mountain, west of Blomidon, crosses the Minas Basin, and passes near Cape Spence, and cuts the Cobequid Mountains to the east of Cape Chiegnecto.

The Dartmouth lines of striation extend in the same direction.

Dr. Dawson, in his Table of Striation, Acadian Geology, Ed. 1855, gives lines farther east at Petite Riviere, Rawdon, and the Gore Mountain.' The first of these extended northward, passes through the Minas Basin, and then passes through a break in the Cobequid Mountains.

The line of the Gore Mountain extended in the same direction, passes through Minas Basin and then cuts the Cobequid Mountains.

While we extend the lines observed by Dr. Dawson, northward, without any apparent difficulty, as we did the Halifax and Dartmouth lines, I find that I cannot in like manner run them parallel to the latter as far as the Atlantic, without obstruction.

Last autumn when prosecuting my observations, I found extensively exposed striated rock surfaces in the vicinity of the Wellington Station of the Halifax and Truro Railway, opposite the lower part of Grand Lake. I was astonished to find that the general striation here ran S. 25 W. and N. 25 E. About the same time in the preceding year, I had observed near Fletcher's, on the Truro side of the incline a striated surface, whose striae was in the same direction, S. 25 W., N. 25 E., and also at Beaver Bank station, on the Windsor side of the Junction, a striated surface was examined about the same time, having striae running S. 25 E. and S. 25 W. *i. e. converging.*

The lines at Wellington Station, if extended northward, cross the Minas Basin, and pass through the Cobequid Mountains along the hollow through which the Folly River flows and the I. C. R.

runs, through Folly Lake and through the valley of Wentworth and Wallace Rivers.

The lines of Fletcher's and the S. 25 W. and N. 25 E. lines of Beaver Bank if produced parallel to those of Wellington strata would cut the S. 20 E. and N. 20 W. lines observed by Dr. Dawson. The striation of the two extremes, Point Pleasant and Wellington Station, when extended (S. 30 W. and N. 25 E.) have an *árc* of 55° and include the Cobequid Mountains, from near Cape Chiegnecto to Folly Lake, a distance of — miles.

I would also direct attention to the *striation* east of Halifax.

Near the English Church, at the Eastern Passage, a striated surface showed a direction of S. 5 E., corresponding with part of the striation of Beaver Bank Station. On the Cole Harbour Road *striae* were observed having the same course. At Cole Harbour *striae* were observed having the same direction. A striated surface at Lawrencetown, with a granite *roche perché* also gave striation, having a direction S. 6 E. Dr. Dawson observed striation with nearly the same direction at Musquodoboit Harbour, 20 miles east from Halifax.

From these observations it would appear that at the point of convergence of the easterly and westerly striation, the one defined or *resultant* course became the regular southerly course of the striating and transporting agency, as all the shore lines of strata east of the Halifax Harbour, run approximately in this direction.

The distribution of amygdaloids and limestones (?) seems to indicate the S. 30 E. to S. 20 E. as the oldest *track*, as the *resultant* S. 5 E. could not convey the amygdaloids even of Bass River, the extreme east of the triassic trap, to such points as Lawrencetown Head, on the shore where they are remarkably prevalent, much less to Three Fathom Harbour or beyond.

The rareness of the occurrence of amygdaloids beyond Fletcher's on the line of railway, also seems to indicate that at the line of the distribution of the drift, at and beyond Fletcher's, the force moving in a south-west direction was an influential force. The striation all running in one direction, S. 25 W., indicates the same influence.

2ND AGENCY.

We are familiar with water and ice as transporting agencies. the former exercised in various ways, the latter as ice sheets in the Bay of Fundy and the Gulf of St. Lawrence. In Alpine regions ice in the form of glaciers is well known as a transporting agent.

The deposits which we have been examining as a class, are known by the names diluvium, drift. Parts of these are also distinguished by the qualifying adjective, *glacial* (deposit). The striation is also called glacial or glaciation, while others retain the term drift, e. g. gravelly deposit.

The term Diluvium refers us to early geology, when the deluge of Scripture was regarded as the great cause that produced these accumulations. This view is now, however, regarded as untenable.

The term Drift refers to another early view, which is still maintained by some in reference to the gravelly deposit,—that the northern hemisphere had been scoured by broad waters and currents which had extensively transported material from north to south, and left the banks of drift as monuments of the dreadful catastrophe.

The banks and their derivations, with the striation which we have been examining, are distinguished as glacial, and bring us to existing views and disturbances, the agency being as respectively, ice sheets, ice bergs, and glaciers. Heretofore in the field of our observation we have been dealing with incontrovertible facts, now we meet with in our field, controvertible opinions,—we meet with the advocates of ice sheets, and icebergs.

(To be continued.)

ART. II. — ON A CORRESPONDENCE BETWEEN THE FLORA OF NOVA SCOTIA, AND THAT OF COLORADO, AND THE ADJACENT TERRITORIES. BY. JOHN SOMMERS, M.D., *Prof. of Physiology in the Halifax Medical College.*

(Read before the Institute of Natural Science, Feb. 14, 1876.)

WHILE engaged recently in looking through a Synopsis of the Flora of Colorado and the adjacent Territories, appended to the admirable report of the U. S. Geological and Geographical Survey of the Territories, by Dr. F. V. Hayden, I was deeply interested in finding described there many species identical with those of our Provincial flora.

I was therefore led to institute a comparison between these floras, for which purpose I prepared a list of Provincial species, making it as complete as circumstances would permit; contrasting this latter with the synopsis, I was enabled to observe the amount of correspondence between them; this, in its result served to reveal a much closer alliance than a casual study seemed to show, a circumstance which induced me to bring the subject before the Institute.

Inasmuch as the Coloradian Flora presents us with many truly boreal species and a few maritime plants indigenous to our locality, whose origin, so far as we are enabled to understand it, has been in the northern portion of our continent, we are led thereby to a consideration of their migration thither.

Considering the respective localities of the two regions, we find a difference which is in favor of Colorado; its geographical position may be roughly stated as being on the thirty eighth degree of north latitude, while that of Nova Scotia is on the forty-fifth, or a variation of seven degrees, sufficient on this side of the continent to produce that diversity of climatic conditions which exists between Nova Scotia and those Middle States that lie under the same degree of latitude as Colorado.

As these conditions influence plant life very materially, since we find the Middle States Flora deviating considerably from our own, how much more would we expect finding a wider variation in the flora of a region so far to the west of us, which from this latter circumstance had its difference of climate increased by that peculiarity of the isotherms or heat lines seeking on this continent a much higher latitutude on its western side than that which they occupy to the east; the isotherm of Nova Scotia, "speaking without book" finding its western extremity some ten or fifteen degrees north of it, that of Colorado arising very far south of it on our side of the Continent. This phenomenon presenting to us a very wide departure between the mean annual temperatures of regions situated directly opposite on either side, constitutes a very important factor when we wish to form an estimate of the relative physical peculiarities or conditions of such places.

Notwithstanding what has just been stated, and the proof which the synopsis gives of a more copious Flora to Colorado than our own, a flora too which numbers southern species exotic to us, it yet includes nearly one-third of our indigenous species, also many genera which have closely allied species.

Taking the position that every boreal species in southern situations must have passed thence, as every southern species found north must have migrated there, we may justly claim these boreal species in the Coloradian flora as our own, and endeavour to account for their emigration to that locality as well as for their maintenance or continuance outside of their proper zone.

To this end I will ask you to follow me for a short space into the region of theory, since the elucidation of these points in our discussion can be arrived at in no other way.

Taking first the question of continuance we find the species referred to confined more or less to the elevated parts of the region which they inhabit, these regions are from the peculiar physical conditions before mentioned exposed to greater vicissitudes of climate than that of our own, the climate there being excessive, having great extremes. Our extremes being less gives us a more moderate condition of climate, the probabilities are however, that between the extremes of the excessive climate of the elevated regions of Colorado we have a mean or middle condition, corresponding more or less to our own, and therefore offering favourable conditions for the growth and continuance of such boreal species as have there established themselves.

In addition to this we have the inherent property existing in many plants of living under conditions which, though apparently nnfavourable, are yet not too far removed from those of their original surroundings.

The problem of plant dispersion while highly interesting, is yet surrounded by difficulties of such a nature as would at the first glance seem to render its elucidation impossible. Nevertheless, many of these difficulties have been surmounted, and if we are yet very far from a thorough comprehension of the subject, it cannot be said that we have no data upon which we may construct hypotheses more or less reasonable. We are in this respect following the proceedings of the geologist, who supposes the dispersion of inorganic matter to have been produced by certain physical agencies acting upon it. Nor can we do better than to accept his theories as explanatory of our subject.

The glacial theory which accounts for the phenomena of the drift may afford an insight to the distribution of plant life upon this continent; it is said that the North American continent was more recently glaciated than those of the Eastern hemisphere. Without accepting this, we have evidence that the recession of this period is more recent here, since its northern extremity is yet glaciated down to the 70° of N. latitude at least. The physical condition of the continent as low as the 36° of North latitude, i. e. from ten to twelve degrees south of our present position, during the glacial period, was such as exists now on the shores of the Arctic Ocean; the then existing climate of Colorado and the adjacent zone being like that of Greenland in our epoch.

Supposing the existence of plant life in abundance in our northern region previous to the drift, a supposition which our coal measures, &c. prove, we can easily estimate the influence of the wave of congelation passing down from the north, would be to disturb the atmospheric conditions to the extent of destroying the flora in every locality invaded. But this process of ice formation was no doubt like the other processes of nature, slow in growth, not to be counted by decades or centuries, but by ages. Hence its effects upon plant life were gradual in their development; thus the hardier species would remain for a time to struggle with ever increasing adverse conditions, to be eventually destroyed or forced to emigrate with their weaker brethren, being pushed forward by every advancing wave of cold, so that in the final state of things which obtained at the point of recession of the glacial era, the boreal flora of America escaping annihilation, must have been driven toward that portion of the continent which afforded the conditions for support.

Following the gradual withdrawal of the ice the face of the continent assuming more or less the condition which it now presents, had time to rehabilitate itself. Our northern species being pushed out by the southern forms which aided by the increasing heat began to dispute the possession of the soil forcing them to migrate northward. But not alone to this process may we attribute the reappearance of plant life in the northern portion of our continent, we must recollect that through the various stages of the glacial period, many species or individuals of species previous to their demise, had deposited germs; these from adverse circumstances, being unable to germinate, would remain imbedded in the drift, and recollecting property which many such possess of retaining their germinating power for lengthened periods, even under adverse conditions, observing as we may the immunity of the innumerable germs scattered over our soil annually, from the effects of our rigorous winters, we can easily assume that the conditions which the drift afforded for the preservation and dissemination of those germs were not more unfavorable than that of a lengthened hybernation.

Hence we find the southern part of our continent supporting in their elevated positions species not found in the intervening plains and valleys, but having their true habitat in our northern regions, they, no doubt are boreal forms driven south in a former age, when the conditions necessary to existence were denied them in their own regions, otherwise they may have sprung from germs transported with the drift, and germinating in favorable situations. Either way the hypotheses started, may, in a measure, account for the correspondence which the list here annexed exhibits.

List of Species and allied genera,* common alike to Nova Scotia and Colorado:

Ranunculaceæ.
Clematus, Virginiana. Linn.
Thalictrum, cornuti. Linn.
Anemone, Pennsylvanica. L.
Ranunculus, aquatilis. L.
R. Flammula. Var reptans. G.

*Genera having closely related species indigenous east, though not Nova Scotian as ar as is known.

R. Cymbalaria. Pursh.
R. Multifidus. Pursh.
R. Repens. L.
R. Pennsylvanicus. L.
R. recurvatus. Poir.
R. abortivus. Linn.
Aquilegia vulgaris. L.
A. canadensis. L.
Actœa, spicata. L. var Rubra Bigl.

Nymphœaceœ.
Nymphæa, odorata., ait.
Nuphar, sp———

Rapaveraceæ.
Sanguinaria, canadensis. L.

Fumariaceœ.
Dicentra, cucullaria. D. C.
Corydalis, sp———

Cruciferœ.
Nasturtium, Officinale. R. Br.
Cardamime, hirsuta. L.
Sisymbrium. sp——
Sinapis nigra. L.
Lepidium ruderale. Linn.

Violaceœ.
Viola, cuculata. Ait.
V. Canadensis. L.
V. tricolor. L.

Caryophyllaceœ.
Saponaria sp———
Cerastium, viscosum. L.
C. vulgatum. L.
Stellaria, longipes. Goldie.
Arenaria, lateriflora. L.

Portulacaceœ.
Portulaca, oleracea. C.
Claytonia, virginica. Linn.
C. Caroliniana, Michx.

Hypericaceœ.
Hypericum. sp——

Geraniaceœ.
Geranium, maculatum. Linn.
G. Carolinianum. Linn.
Impatiens, fulva. Nutt.
Oxalis, stricta. L.

Anacardiaceœ.
Rhus, glabra. Linn.
R. toxicodendron. L.

Vitaceœ.
Ampelopsis quinquefolia. Mx.

Sapindaceœ.
Acer, rubrum. Linn.
A. Saccharinum. Wang.

Polygalaceœ.
Polygala. sp———

Leguminoseœ.
Vicia, sp———
Lathyrus palustris. L.
Trifolium pratense. L.
T. Repens. L.
Apios tuberosa. Mænch.

Rosaceœ.
Prunus, Pennsylvanica. L.
P. Virginiana. L.
P. serotina. Ait.
Spiræa sp———
Rubus triflorus. Rich.
R. strigosus. Mich.
R. villosus. Ait.
Agrimonia, Eupatoria. L.
Geum macrophyllum. Willd.
G. Strictum. Ait.
G. rivale. D.
G. Album. Gmel.
Fragaria, vesca. L.
F. Virginiana. Ehrh.
Potentilla, Norvegica. L.
P. Canadensis. L.
P. anserina. L.
P. fruticosa. L.
Rosa, blanda. Ait.
R. lucida. Enrh.
Pyrus, sambucifolia. Cham & Sche.
Amelanchier, Canadensis. Torr & Gr.

Saxifragaceœ.
Ribes hirtellum. Mich.
R. lacustre. Poir.
R. prostratum. L. Her.
R. aureum. Pursh.
R. floridum. L.

Crassulaceœ.
Sedum, rhodiola. D. C.

Halorageœ.
Hippurus, vulgaris. L.

Onagraceæ.
Epilobium, palustre. L.
E. angustifolium.
Œnethera, biennis. L.
Ludwigia, palustrus.
Circæa, alpina. L.
C. Lutetiana. L.
Cucurbitaceæ.
Echinocystis, lobata. T. & G.
Umbelliferæ.
Cicuta, maculata. L.
Sium, lineare. Mx.
Osmerrhiza, brvistylis. D. C.
Sanicula, Marilandica. L.
Heracleum, lanatum, Mx.
Araliaceæ.
Aralia, nudicaulus. L.
Cornaceæ.
Cornus, Canadensis. L.
C. Stolonifera.
Caprifoliaceæ.
Linnæa borealis. Grono.
Lonicera ciliata. Muhl.
Sambucus, pubens. Michx.
S. Canadensis. L.
Rubiaceæ.
Galium trifidum. Linn.
G. triflorum. Michx.
Compositeæ.
Eupatorium, purpureum. L.
E. perfoliatum. L.
Aster lævus. L.
A. Cordifolius. L.
Erigeron, Canadense. L.
Solidago, virga-aurea. L.
S. Canadensis. L.
S. Gigantea. Ait.
S. lanceolata. T. & G.
Rudbeckia, hirta. L.
Bidens, frondosa. L.
Bidens, Connata. Muhl.
B. Chrysanthemoides. Mx.
Anthemis, arvensis. L.
Achillea milefolium. L.
Antennaria, biennis. Willd.
Gnaphalium decurrens. Ives.
Senecio, aureus. L.
Var obovatus. T. & G.
Var Balsamitæ. T. & G.
Mulgedium pulchellum. Nutt.
Sonchus, asper. Vill.
Lobeliaceæ.
Lobelia inflata. L.
Campanulaceæ.
Campanula, rotundifolia. L.
Ericaceæ.
Arctostaphylos, Uva-ursi. Sprn.
Chimaphilla umbellata. Nutt.
Kalmia, glauca. Ait.
Pyrola, rotundifolia.
P. secunda. L.
Monesis, uniflora. L.
Plantaginaceæ.
Plantago, major. L.
Primulaceæ.
Primula farinosa. L.
Lysimachia, ciliata. L.
L. stricta. Ait.
Glaux, maratima.
Serophulariaceæ.
Linaria, Canadensis: Spreng.
Chelone, glabra. L.
Mimmulus, ringens.. L
Veronica. Americana. Schwtz.
V. serpyllifolia. L.
V. scutellata. L.
Rhinanthus, crista-galli. L.
Pedicularis. Canadensis. L.
Melampyrum, Americanum. Michx.
Verbenaceæ.
Verbena, hastata. L.
Labiatæ.
Mentha Canadensis. L.
Lycopus, Europeus. L.
Brunella, vulgaris. L.
Teucrium, Canadense. L.
Scutellaria, galericulata. L.
S. parvula. Michx.
Stachys, palustris. L.
Borraginaceæ.
Mertensia, sp ——
Myosotis sp——
Convolvulaceæ.
Calystegia, sepium. R. Br.

Solanaceæ.
Solanum, nigrum. L.
Apocynaceæ.
Apocynum, androsæmifolium. L.
A. Cannabinum L.
Oleaceæ.
Fraxinus, Americana. L.
Chenipodiaceæ.
Chenipodium, album. L.
Atriplex, patula. L.
Salicornia, herbacea. L.
Suæda, maratima. Dumont.
Polygonaceæ.
Rumex, acetosella. L.
Polygonum, incarnatum. Ell.
P. Pennsylvanicum. L.
P. aviculare. L
P. dumetorum. L.
Euphorbiaceæ.
Euphorbia, polygonifolia. L.
Urticaceæ.
Urtica, gracilis. Ait.
U. Dioica. L
Ulmus, Americana. L.
Humulus, lupus. L.
Cupuliferæ.
Quercus, rubra. L.
Corylus, rostrata. Ait.
Betulaceæ.
Betula sp———
Alnus, viridis. Ait.
A. incana. Willp.
Salicaceæ.
Salix, chlorophylla. Andr.
S. sericea. Marshall.
Populus, tremuloides. Mx.
P. Balsamifera. L.
Coniferæ.
Juniperus, communis. L.
J. Virginiana. L.

The Genera, Pinus, and Abies represented in both Floras. The species are, however, far removed.

Araceæ.
Arisæma (Arum) triphyllum. Torr.
Typhaceæ.
Typha, latifolia. L.
Sparganium, ramosum. Huds.
S. Simplex. Hudson.
S. angustifolium. Englem.
Naiadaceæ.
Potamogeton, natans. L.
P. perfoliatus. L.
Alismaceæ.
Alisma, plantago. L.
Triglochin, maratimum. L.
Sagittaria, variabilis. Engl.
Orchidaceæ.
Habenaria, obtusata. Lind.
Goodyera sp———
Spiranthes, cernua.
S. Romanzoffiana. Cham.
Listera, cordata. Rr. Br.
Coralloriza, multiflora. Nutt.
Cypripedium, pubescens. Willd.
C. acaule. Ait.
Iridaceæ.
Iris, versicolor. L.
Sisyrinchium, Bermudiana. L.
Liliaceæ.
Trillium sp———
Streptopus, amplexifolius. A.C.
Smilacina, racemosa. Desf.
S. Stellata. Desf.
Lilium, Canadense. L.
Erythronium, Americanum. Smith.
Juncaceæ.
Juncus, Balticus. Willd.
J. tenuis. Willd.
Cyperaceæ.
Eleocharis, palustris. R. Br.
Scirpus, validus. Vahl.
Eriophorum, polystachion. L.
Carex, stellulata. L. Var. scirpoides. Carey.
C. vulgaris. Fries.
Gramineæ.
Alopecurus, geniculatus. L.
Agrostis, seabra, Willd.
A. vulgaris. With.
Calamagrostis, Canadensis. Beauv.
Festuca, ovina. L.
Var. duriuscula. Gr.

Poa, pratensis. L.
Triticum, repens. L.
Hordeum, jubatum. Ait.
Hierochloa, borealis. R. & S.
Setaria, viridis. Beauv.

Equisetaceæ.
Equisetum, arvense. L.
E. pratense. Ehrh.

Filices.
Polypodium, vulgare. L.
Pteris, aquilina. L.
Adiantum, pedatum. L.
Aspleuium, Trichomanes. L.
A. Felix-fœmina. Bernh.
Phegopteris, Dryopteris. Fee.
Aspidium, Filix-mas. Swartz.
Cystopteris, fragilis. Bernh.
Botrychium, Virginicum. Swartz.

Lycopodiaceæ.
Lycopodium, annotinum. L.

Musci.
Sphagnum, acutifolium. Ehrh.
Dicranum, varium. Hedw.
Ceratodon, purpureus. Brid.
Funaria, hygrometrica. Hedw.
Bryum, cæspiticium. Linn.
Mnium, cuspidatum. Hedw.
M. punctatum. Linn.
Polytrichum, juniperinum. Hedw.
Fontinalis, antipyretica. L.
Hypnum, lætum. Brid.
H. cupressiforme, Hedw.
H. molluscum. Hedw.

Lichenes.
Cetraria, Icelandica. Ach.
Sterocaulon, paschale. Linn.
Cladonia, pyxidata. Fr.

Fungi.
No N. S. collection.

An analysis of the Nova Scotian Flora derived from species under observation, yield the result given below in tabular form. It is but just however, to explain, that owing to deficient representation of cyperaceæ gramineæ, and of all the cryptogamous orders outside of Filices and Lycopodiaceæ. "There being no list of fungi," the result is vitiated to a considerable extent.

TABLE I.—FLORA OF NOVA SCOTIA.

	Nat. Orders.	*Genera.*	*Species and var.*
Exogens	71	244	518
Endogens	14	59	116
Acrogens	5	50	114
Thallogens	1	14	26
Total	91	367	774

A simular tabulation of the foregoing list of species gives the following results, viz.:

Exogens	48	127	178
Endogens	10	34	44
Acrogens	4	19	24
Thallogens	1	3	3
Total	63	183	249

Thus of the seven hundred and seventy-four species constituting the Nova Scotian flora, two hundred and forty-nine, or nearly one-third of the whole are common to it and the Coloradian flora. These are collected into one hundred and eighty-three genera, or one-half that of Nova Scotia.

Comparing these species by their divisions, we find the closest alliance between the flor-exists in the Exogens and Endogens, of which considerably over one-third of each division is fonnd. Of the Acrogenous less than one-fourth are present; of the Thallogenous a little less than one-eight; this, however, may be owing to deficiency in our collection of Thallogens.

ART. III.—NATURAL HISTORY AND THE FISHERIES. BY A. P. REID, M. D., &c.

(*Read before the Institute Jan.* 10, 1876.)

IN this Province we have as a people been always so engaged in efforts that tend directly to increase pecuniary gain, that any study or pursuit that did not very clearly point in this direction got quietly shelved, unless by the few, who had an ardent desire to become acquainted with the operations of *nature* which surround us; and this is the more to be deplored since all our industries are so closely connected with what is revealed by the study of Natural Science.

The products of the sea are our main source of wealth, and yet how very very few, have the slightest scientific knowledge of *Marine Fauna*. The practical man says what use is it, will it teach how to catch cure or sell the fish any better than we now do by following the old *rule of thumb*, whose maxims are the result of lengthened experience? As to the sale it is of course regulated by the demand, the method of curing a matter of taste, convenience and demand, but as to the *catch* it is quite a different thing.

In this a knowledge of the life history of the different species of fish, would not only lend more certainty to the present pursuit, but also continue in coming years an undiminished abundance of this our prime necessity.

The coal fields of England may give out, and Scientists be unable to increase the amount, but it is not so with our staple. The abundant hand of nature multiplies it from year to year with lavish extravagance, and did we not know her laws as they may be found out by studying the life *history* of each species we could deal with certainty instead of chance or luck. We must however know when where and how they obtain their food; and when, where, and how they avoid their natural enemies, the cause of their migrations, and such like, and then we would not fear a *failure* in the *catch* with the significance it implies. That this does often happen is not to be wondered at, for our ignorance is supreme; the best naturalists know so very little about those animals whose habitat is in the deep sea, because few scientists are favorably situated for this variety of study.

The education of our fishermen does not fit them for research, and besides neither their merchants nor the Government give encouragement to induce them to do one bit more work than they can get along with, or to lay themselves out to observe systematically the phenomena that from time to time occur.

Had we an Academy of Science under the patronage of the Government,—or an independent one of sufficient wealth such as exists in the older countries,—annual prizes for the best essays on the natural history of the marine food fishes, would ere long not only increase our scientific knowledge, but in time greatly eliminate the theory of chance and the so called bad years from the list of probabilities. We would learn why fish frequent certain grounds at certain seasons and why they leave for other localities, with the best way to guard their food supply and spawning seasons and so increase their numbers. Even small prizes to amount to no more than $100 per year, would before long prove of general public benefit; but into the details I have not at present time to enter.

If the schools that are now scattered all around the coast were properly utilized, every child would soon learn the known natural history of those animals that their daily life makes them familiar with; and would in addition to knowledge gained, have their powers of observation utilized. Thus before many years the errors that now prevail (and no doubt there are many) would be corrected and the great deficiencies gradually supplemented, until in time an army of fishermen would surround our coasts, who were well educated in their calling.

Then give them facilities for making known the facts gleaned during their lonely watch and work on the deep sea, and prosperity would continually attend instead of either a feast or a famine.

Continued supply would extend the demand, and a good and cheap food make an independent, happy, wealthy, and numerous population.

It would neither be costly nor difficult to initiate this improvement, for there is a series of school books that treat on this subject, that should be placed in the hands of every scholar who has learned to read. A Hugh Miller is wanted to do for Marine Zoology what has been by him so efficiently done for Geology, and since Nova Scotia has produced naturalists, whose fame is not confined to this hemisphere, we need not fear but a fair opportunity alone is needed to bring forth other minds who can by observation in their every day labour, enrich science, their country, and themselves, by teaching us that of which we now know but little.

The United States Government, following in the track of that of France and England, have in late years devoted much attention to the food fishes that live in the inland waters and rivers, and as a result of the increased knowledge, means have been taken to fill the depleted waters and keep them continually stocked. The success has been so great, that the Dominion Government, following in their wake, has energetically set to work to repair the ravages that ignorance has made in what was at one time a very large source of income, and plentiful tables; and before many years we confidently hope that a salmon will not be a curiosity, nor prohibited article of diet to the mass of the people. A fish requires no expense to fit it for use but that alone of catching it; an ox or a sheep demands continued care and attention for years, and at a great cost for food—yet 20 cents per pound is rather a common price for salmon, and from 5 to 10 cents per pound for what really costs the most for its production. The reason is evident—the natural history of the latter has been long and carefully studied, is more easily acquired, and has received (and justly so) the most fostering care of Governments and Societies. The other we would know nothing about unless for the energy of some gentlemen who at great inconvenience, time and labour (for which they receive no remuneration) have gathered a few facts, meagre indeed, but all we have. In this Province we are greatly indebted to Dr. B. Gilpin, who in a series of papers read before this Society on the *food fishes of Nova Scotia* has given us the result of his observations and that of those who have preceded him, making a valuable contribution to our knowledge.

It is high time that government should essay some practical assistance to the *deep sea* as well as inland fisheries, for it is indeed the main stay, the great export of this country.

There is another subject that most pressingly demands our attention in the furtherance of the ideas referred to, and which so far has not received even the semblance of care. I refer to Marine Aquaria, a living museum of the objects we desire to study.

To learn the history of plants, and for our convenience, we need to place them in artificial surroundings; but the objects of our solicitude must be situated as far as known, in their natural relations, and to do so we have conservatories where this can be carried out, and as a result our knowledge is nearly perfect. As to the result of this long continued and daily expense, it would take volumes to describe the benefits accruing to agriculture and every other industry in which the products of the soil receive attention.

To illustrate the advantage of this kind of artificial study. The cinchona bark and quinine (its product), without which life would be impossible in some countries, to strangers, was nearly becoming extinct, and likewise the ipecacuanha plant, of nearly as much use; and what was to be done? They grew in distant and almost inaccessible parts of Central and South America, and but little could be found out about them. After a great deal of difficulty, Mr. Hooker, of Kew Gardens, London, England, got some cuttings and seeds, and set to work to unravel their history. He produced numerous plants, and concluded that the Hill country in India would give the conditions necessary to successful growth. They were by dint of great exertion, after repeated partial failures, reduced to a commercial success; and quinine has fallen in price owing to this new source of supply, with the certainty now that it will not be exterminated.

Many gentlemen here have conservatories, and in so far tend to further our knowledge of Natural Science; and the commissioners of the Public Gardens are also laudably engaged in the same most necessary work, and they know that their efforts are appreciated. I also trust, since they have one of the finest public gardens in the Dominion, that they will at once set about a marine aquarium, a most necessary, and withal an inexpensive improvement, and one that would be by far the most attractive, and in full vigour all the year round, and besides it would be the first of any moment in the Dominion.

It is pleasant to enter a conservatory and see the quaint luxurious vegetation of the tropics, and thousands of flowers of every shade and size; but this pales at once before the interest and beauty that attracts and rivets attention when standing before an aquarium well stocked with the living representatives of the fishes that inhabit our littoral waters, and much more so could we visit the famous Brighton Aquarium, with its assembly of *deep sea species*. I will not dwell longer on this part of the subject, for the suggestion will call up the appropriate ideas.

But the aquarium has its use, it teaches in language understood by the lowest intelligence, and proposes problems which the brightest mind has yet to carefully study ere there is a prospect of solution.

How appropriate that the rising youth of Halifax should practically know something of those really strange animals that contribute to the prosperity of his country. Practical natural history could thus be inculcated, and a foundation would be laid of more than provincial greatness.

As to the cost. This can be completely governed by the extent, and can be enlarged as circumstances would warrant. We are so near the sea, that there would be but trifling expense in supplying with water, and only sufficient would be required to make up for waste and leakage, evaporation being supplied by fresh water, because a proper proportion of marine plants would purify the water for the respiration of the fishes. No high temperature is necessary, hence the cost for heating would be small. The cost of attendance also would be limited, and did specimens die, it would be very easy to replace them.

With this as an initiative, it would not be long before natural history would be studied and understood, and then in addition to the culture of our people, would we find the economic advantage, for knowledge will always be of practical service. I will give an illustration: I was invited some years ago by a friend of mine, Mr. S—— in London, Ontario, to pay him a visit, and he introduced me to a room filled with little boxes. On close examination I found thousands of insects, of every variety, all alive and in different stages of growth. I could not but admire the extent of his collection, and his knowledge of their habits, but said I, Mr. S——, "apart from the pure scientific aspect of this subject, of what practical use is the study of the vast majority of these species." He replied that perhaps no subject of natural history was of more service to man than this science of Entomology, and in going over his collection, he, in pointing out the life history showed that almost every one deserved careful attention. This species devoured the cabbage plant—another the potato—another wheat—and so on until there was very vividly brought to my recollection the more than half forgotten fact, that almost every vegetable has a form of animal life that preys on it, and in many cases brings famine or great want on large sections of peoples. That all had natural enemies which curtailed their numbers, but that this required great time and study to ferret out.

He pointed out many species about which enough was known to control or prevent their ravages, but yet a large number of species remained whose history needed to be worked up. He spoke of the Colorado potato bug, that had not then reached Canada, but which advent was expected, and the Entomological Society were busy searching into its life history, so as to be able to check its hitherto unobstructed career, and with what success we now can judge.

Neither the Government, the City, nor private gentlemen can make any mistake by encouraging in every way any branch of Natural Science; but pre-eminent above all I think to dwellers near the sea, is by a thorough study of marine fauna and flora, to feed our people by removing good fish from the list of luxuries, and to keep the balance of trade in our favor.

ART. IV.—NOTES ON SPECIMENS OF IRON ORES, ETC., COLLECTED IN PICTOU COUNTY FOR THE PHILADELPHIA EXHIBITION. BY EDWIN GILPIN, M.A., F.G.S., ETC.

(*Read February 14th*, 1876.)

MY purpose this evening is not to enter upon an elaborate scientific discussion of the minerals found in the district, but to show the relation they bear to the industrial development of the county. The first resources of a new country and those most readily drawn upon are the products of the waters and the forests, and such minerals as are most easily extracted for exportation in a raw state. These alone are insufficient for the permanent development of a country, fishing towns and villages grow slowly, and the yield of the forest diminishes in an increasing ratio. The census, our most reliable teacher of political economy, shows the simple fact that wherever coal and iron exist together, there the most flourishing populations are concentrated; that the commercial prosperity of every country is in direct ratio to the quantity of coal employed within its territory for the smelting and working up of *iron* and allied minerals.

Bearing these facts in mind, we will now briefly pass in review the various ores of iron that surround one side of the Pictou Coal Field; first glancing at the earliest information we have on the subject.

The indications of iron ore in the vicinity of the East River of Pictou, attracted early attention, and the General Mining Association of London, in 1828, or shortly after they opened their Pictou Collieries, endeavored to turn it to practical account. They quarried a considerable quantity of red hæmatite from the Blanchard bed, and collected many tons of drift limonite on the banks of the East River. A blast furnace was erected at the Albion Mines for the purpose of smelting these ores, but the experiment was not satisfactory.

I am unable to get precise information on the subject; but it can be readily understood that at that date a man accustomed to English fuel and ores could easily fail in smelting, when introduced to fuels and ores of a totally different character. This is borne out by the appearance of the iron made before the furnace was closed by scaffolding. The failure of the Association to discover the limonite in situ, caused them to totally abandon the idea of repeating the experiment.

From 1830 up to 1870 several accidental discoveries of ore were made in the district, but no work was done to ascertain their value, and it was not until the recent expansion in the iron trade that the question of the profitable smelting of iron ore in Pictou County again came up.

In 1873 extensive explorations, extending from Glengary on the Intercolonial Railway to French River, were conducted under Dr. Dawson's superintendence; while I was at the same time engaged in testing the property of the Albion Mines company at Springville, already mentioned as the scene of a former unsuccessful search. The following season I took up the work where Dr. Dawson left it, and the results of our explorations constitute all that is practically known about the district.

Beginning at French River, we have first to notice a large deposit of clay iron stone in strata of Lower Carboniferous age. The beds vary from one to eight feet in thickness, and occupy a vertical height of several hundred feet. I am not aware of any analysis having been made of this ore; from its appearance and specific gravity, it is certainly equal to the average of its class. Phillips in his treatise on Metallurgy, gives the percentage of metallic iron in Yorkshire and Staffordshire clay ironstones, as varying from twenty-eight to forty per cent.

The Carboniferous Conglomerate at one or two places in this locality contains large numbers of rounded pebbles of a hard jaspedeous red hæmatite of a very pure quality. As yet, however, the parent bed has not been found, but probably exists in the underlying Upper Silurian strata, at this point almost immediately beneath the Conglomerate.

Passing to Sutherland's Brook, at a point about three miles distant from Merigomish harbour, we have to notice a valuable deposit of spathose ore, found as a bed among strata considered of the Millstone Grit age. The ore has been opened only on the property of the Pictou Coal and Iron Company. Spathose ore is considered valuable when met in quantity, and is chiefly valued for the production of spiegeleisen. The chief foreign localities are, in England, Perran and Marazion in Cornwall, and Weardale in Durham. The Rhenish provinces have furnished the greatest supply, but the ores there are controlled by Bessemer steel manufactures, which reduces the quantity offered in the open market. In the United States I am aware of only two furnaces, in New Jersey, using it. The limited occurrence therefore of this ore makes the fact of its discovery in strata so wide spread in Nova Scotia, of much importance. The ore opened at Sutherland's Brook varies in thickness from six to fourteen feet. The following is an analysis by Dr. S. Hunt:

Sesquioxide of Iron.		20.52
Carbonate of Iron		57.40
" " Manganese		8.29
" " Magnesia		4.02
Silica		2.38
Sulphur		undetected
Phosphorus		"
Moisture		1.43
		99.70
Metallic Iron	42.00	

Passing to the Upper Silurian district lying between Sutherland's and East Rivers, we come to an enormous development of hæmatite ore—the variety being that known as red hæmatite or anhydrous peroxide of iron.

There are three great lines of out-crop of this ore, belonging, as far as at present known, to one large bed, thrown into its present form by undulations of the strata. There is moreover a higher horizon of similar ores opened by myself during the two past seasons. The most northerly of these outcrops, beginning near the spathose ore, crosses to about the centre of the west line of the Wentworth grant, extending a long distance as shown by surface indications. No openings have yet been made on it, but from the associated strata its dip would be to the north. The rocks between this point and the summit of Webster's Mountain are much twisted into undulating forms, and the connection between this exposure and those to the south still requires examination. The Webster bed has been carefully trenched and traced for several miles. It is an enormous deposit varying in width from fifteen to thirty feet, and dips generally to the North, and is found at an elevation of four hundred feet above Sutherland's River. Its position allows of the extraction of millions of tons of ore above water level by the simplest operations of the miner; and it is worthy of the remark of an eminent engineer, who, when shown its extent exclaimed that it should be called the back bone of Pictou County.

We now pass to Blanchard, about two miles from the East River, and here we have the third outcrop of this ore, on what Dr. Dawson considers the opposite side of an anticlinal. This has already been referred to as the Blanchard bed, from which the General Mining Association formerly quarried ore, and is now the property of James Hudson, Esq. It has never been traced any considerable distance, but is known to extend about one half mile, varying in width from thirty to one hundred feet, and lies about three hundred and sixty feet above the East River at its nearest point.

The presence of fossils and of an underlying seam of limestone, affords room for an interesting sketch of the conditions under which it was accumulated, but it would pass the limits of this paper. All these ores resemble each other strongly, and are compact with uneven fracture—the colour varies from steel grey to red and brown. Their composition may be gathered from the following analysis of the Webster ore, by Dr. Stevenson Macadam:

Oxides of iron,	75.67
Oxide of manganese,	.52
Carbonate of lime,	2.44
Phosphoric acid,	.22
Sulphur,	.29
Silica,	19.43
Alumina and magnesia,	1.43
	100.00

Equal to metallic iron, 54.36

Overlying the Blanchard bed, at a vertical height of several hundred feet, are a series of beds, varying in thinkness from three to fourteen feet, forming two sides and an end of a synclinal trough, as proved by my investigations during the past season. The ore is similar to those just described, and on assay gave 42.5 per cent. of metallic iron. The Pictou Coal and Iron Company own well selected areas in this district, covering large quantities of these ores.

Still passing to the Westward, the next ore that claims our attention is the Limonite, found in the valley of the East River. In 1873 I opened the vein on the property of the Albion Mines Company, already referred to, and found it to be twenty-one feet wide, and it was proved the same year one mile to the south. From the data thus acquired, the passage of the vein has been traced several miles up the river, and it finally crosses to the west bank, where immense surface boulders mark its presence on the property of the Messrs. Primrose of Pictou. As far as investigations have been carried, the ore has been found at the point of contact of Lower Carboniferous and Upper Silurian strata. It is of the finest quality, as shown by the following analysis, and varies in width from five to twenty-one feet.

Analysis of Limonite from area of the Pictou Coal and Iron Co:

Oxide of iron,	88.92
Oxide of manganese,	.78
Alumina,	.71
Carbonate of lime,	1.44
Carbonate of magnesia,	.82

Phosphoric acid.	.34
Sulphur,	.24
Titanic acid,	Trace
Silica,	2.14
Moisture,	4.61
Percentages,	100.00
Percentage of Metallic Iron,	62.24

Parts of the vein contain notable percentage of Manganese. The Limonite has a very fine variety of the Red Hæmatite mixed with it at several points, at one place the Limonite appears to be replaced by it for some distance. The ore is of a deep red colour and of the finest quality, containing but a small admixture of foreign matter. As yet it is known only in small quantity in the form of surface boulders, but would amply repay a careful search for it.

About one mile to the West of the East River we meet the Specular vein. This is a very pure anhydrous peroxide of iron, having a metallic lustre and steely black colour. This vein has been carefully examined and traced on the properties of the Pictou Coal and Iron Company, where trenches and pits have shown it to extend over two miles,—its width varies from five to twenty feet. The vein follows the course of a high hill and is accessible by levels at several points. At one or two points a side vein, two feet wide, contains Magnetic oxide? and Limonite of a nearly black colour. I believe Dr. Dawson considers this vein to belong to the same Geological horizon as that holding the Londonderry ores of Colchester County.

The following analysis is by Dr. Thorpe of Glasgow:

Protoxide of Iron,	.89
Peroxide of Iron,	96.63
Sulphide of Iron,	.06
Phosphorus,	none
Insoluble,	3.2
	100.78
Percentage of Metallic Iron.	68.3

Following the strike of the vein to the westward the same company have opened a vein of Limonite near Glengarry Station. At this point the ore is more compact than that found on the East River but of equal purity. The range of ferriferous rocks continues into Colchester County, but no explorations have been made beyond this point, altho' small veins of specular ore are known to crop on the head waters of the Middle and West Rivers.

There are undoubtedly other ores of iron in the district yet undiscovered, for I have in my possession varieties of hæmatite and spathose ores the localities of which are unknown.

These brief notes show that from Glengarry to Merigomish, a distance of 40 miles, there extends a series of iron ore deposits of good quality and more than usual dimensions. No less than six varieties of ore are known, which in itself is of unusual occurrence in one district. Bands of clay ironstone are known to occur in the Pictou coal measures, but there is no information at present available with regard to their quality, etc.

In the manufacture of iron, the presence of a cheap flux is of great importance; in this district limestone is very abundant, nearly every farmer has his own limekiln. The quality of the limestone is as varied as the beds themselves. As far as my observations have gone, the lower part of the carboniferous marine formation, as developed at Springville, contains three horizons of limestone. The lowest a strong dark limestone frequently resting on metamorphic silurian slates and containing sometimes notable percentages of iron and manganese. Above this comes a set of beds of compact white limestone, containing crinoids and other characteristic lower carboniferous fossils. One of these beds on analysis at the Durham College of Science gave over 96 per cent of calcium carbonate. The third series consists of dark bluish and gray limestones, sometimes argillaceous and arenaceous, giving a total thickness of over one hundred and seventy five feet from actual measurement. Still higher in the formation are other beds, some highly valued for local uses. These beds of limestone extend in bands roughly parallel to the lines of crop of the iron ores, so that every road from the ore to the fuel must pass over them.

Fire Stone. Some of the metamorphosed Upper Silurian clay slates near the East River, have been used to some extent as furnace linings to boilers, cupolas, etc. and are found very satisfactory. Their cleavage is at right angles to the bedding, and the stones can be laid as evenly as brick work. These slates are of great thickness and can be cheaply quarried.

Fireclay. There are three geological horizons in Pictou county which yield this material: the Upper Coal Measures, the Middle or Productive Coal Measures, and the Lower Carboniferous. On the shores of Merigomish harbour, beds of fireclay are frequently found in the Upper Coal Measures. One of these beds, seven feet thick and overlaid by fifteen inches of coal, has been partially tested with success, and is free from pyrites and calcareous matter, and resists heat well. Several attempts on a rude scale have been made to manufacture fire brick from the Coal Measures clays; but owing to a want of proper system, they have not been successful. The supply is unlimited and cheaply extracted, and in many cases the clay is very free from deleterious ingredients. The following is a partial analysis of a fireclay from the Pictou Coal Measures:

Silica,	58.00
Alumina,	32.00
Iron oxide,	4.00
Lime,	1.00

There has as yet been no trial made of the Lower Carboniferous fireclays; two samples that have come under my notice, contain considerable quantities of calcareous matter, others again appear to be of good quality. Enough however has been done to show that the Pictou fireclays are valuable; the quantity of the material, and the cheapness of fuel, make it matter of surprise that no attempts have been made to manufacture an article that we are content to import at a heavy cost.

Gypsum. This mineral crops at several places through the county, but owing to the distance from shipment, in the presence of the large deposits in Cape Breton and on the Bay of Fundy, it is not probable that it will prove of much value. A very fine class of this mineral has been worked for local use, at Irish Mountain.

The outcrop is extensive; the best beds are two in number, and twelve feet each in thickness.

Moulding Sand. This adjunct to iron smelting is very abundant on the East River and its tributaries. The best known deposit is near the mouth of McLellan's Brook, and has supplied the local foundries for many years.

Manganese. The presence of the oxides of this metal were detected by me when examining the property of the Albion Mines Company, already referred to. No attempts have yet been made to see if the quantity be of economic importance. The age of the strata, Lower Carboniferous limestone shale, in which it occurs on the East River, is the same as that in which it is found on the shore of the Basin of Minas. It is stated by some to have a beneficial effect on certain ores during the process of smelting, and in this connection its presence among the iron ores is of importance.

Large and characteristic samples of all the minerals noticed above have been collected for the Philadelphia Exhibition; and it is to be hoped that when they are exhibited together, a favourable opinion will be formed of the district.

I have now briefly given you a list of the ores of the only district in Pictou County that has had its metalliferous wealth tested to any extent.

It may appear strange that in these notes reference is so frequently made to the Pictou Coal and Iron Company, and that the greater number of the specimens of iron ores come from their properties. The reason is that they are the only people who have practically looked into and prospected the ore district, and certainly their investigations have disclosed deposits better suited for the metallurgist's art, than any yet discovered in the Province; and as their operations will materially aid all the interests of the County, it is to be hoped that their own advantage will be commensurate with the importance of the undertaking.

Specimens of iron ore have been brought to me from every part of the County, and the evidence of such wide spread deposits of iron ore exhibiting every variety and condition of formation that characterize the more valuable combinations of iron, sanctions the anticipation of a prosperous future for this part of the Province. Pictou Coal is now practically used with success for iron smelting, and is within four miles of some of the deposits, and is carried across the iron district by the Pictou branch of the Intercolonial Railway.

We must now regard Pictou County as possessing in abundance those gifts of nature, which, when properly combined are the foundation stones of empires. The future of Nova Scotia is limited and easily foreseen as long as we continue the present system of selling our raw material for bread. When we assume the position intended for us by nature, and manufacture and work up the treasures of the rocks, we enter upon a boundless career.

NOTE.—Hand specimens of the samples collected for the Philadelphia Exhibition, were shown by the writer, to illustrate the paper.

ART. V.—THE INDIGENOUS FERNS OF NOVA SCOTIA. BY REV. E. H. BALL, *Corresponding Member of the Institute of Natural Science, Halifax.*

(Read before the Institute, April 24, 1876.)

AMONGST the different branches of the study of Nature, none perhaps is more charming and edifying than Botany. It gives a wholesome and pure delight to those who have taste for it. And so generally inherent is this taste, that the botanist, or aspirant botanist, will usually find his own enthusiasm quite catching by the circle of friends amongst whom he moves, if he will only demonstrate it a little. And thus he will see that it only needs a greater active interest to be taken, in order to awaken the same in others; and by so doing promote the science, and give a pleasure, as truly *sui-géneris*, as it is gratifying and lasting.

From its necessary tendency to call for walks and rambles into the country, in the woods and open fields, Botany is essentially a healthful study; and from the ardour with which it inspires its student, it gives an untiring interest. Everything green speaks to the botanist. Flora, if I may be allowed the personification, is a companion that is ever by his side; and if but an attentive ear be turned towards much that she has to impart—for she is a holy handmaiden—she will teach (as the lilies of the field are being considered) that "the works of the Lord are great, *sought out of all them that have pleasure therein*."—Ps. cxi. 2. But many shrink from this delightful study by the Latin nomenclature which is necessarily adopted, and by the broad scope which the science takes. I confess the influence of this upon myself, but the circumstances of little spare time, and the being in a neighbourhood rich in ferns (*) induced me to take up one of the branches, Native Filices, as a specialty.

From the comparative simplicity of their structure when compared with that of phænogams or flowering plants, Ferns, which belong to the second series, (the cryptogams or flowerless plants), require much less study to understand them. And from the fact that here in Nova Scotia at least, and generally in the north temperate zone, the proportion of ferns to the phænogams is not perhaps more than 1 to 20, this branch of the study is of much narrower scope: whilst with such facility for study as is given in the opening chapters of Moore's shilling edition of British Ferns, the science of Pteridology is easily mastered.

And well indeed does the pleasure of seeking for, finding, and examining the rarer species and varieties repay the trouble of mastering the technical terms by which the plants are described. Some mental application to this point is absolutely necessary; and without spending some pains in this, the pleasing conviction will never be gained of how almost perfect is Botany as a science of description.

The Indigenous Ferns are graceful in habit of growth, they give charm to the landscape and have peculiarities of beauty and elegance which do not belong to flowering plants. Who has failed to notice the exquisite beauty of light and shade which towards sun-set characterize the small hillocks of Dicksonia punctilobula so

(*) Canterbury, Kent, England.

common generally along our road sides: how that the boldest dark shade is seen side by side with suddenly and almost inperceptibly blended lights, which, to an almost transparent whitish green, touch up the tips of the tufts when Sol's rays are nearly horizontal! I say Who has not? and yet I must own that to admire nature and to thoroughly appreciate its beauties, is as truly a matter of education as it is to become proficient in mathematics. But no one can fail to see that the foregrounds in our landscapes derive many of their charms from the presence of ferns. And in many instances this is so with the distance as well, where, as is not unfrequently the case, the brightly tinted light green of the Osmunda Claytoniana adds a pleasing feature to many a moistened hillside. Amongst other ferny delights, but to be rarely met with in Nova Scotia, may be mentioned the beautiful symmetrical growth of the Struthiopteris Germanica, with its fronds all of equal size arranged in a perfect circle, sufficiently stiff and perpendicular to enable the plant to make a bold stand, and yet plumosely graceful so as to give it elegance, and tall enough to make it necessary to seek the kind friendship of a close neighbouring log or boulder, that by mounting you may get the best view, almost directly downward, of this beautiful plant.

With these introductory remarks I will proceed to give a list of such of the Nova Scotia ferns, as have up to this date (*) been found, making such notices as may dictate themselves, but taking some care not to repeat again what has already been published by Dr. Asa Gray in his Manual, and by Dr. Lawson in his Synopsis of Canadian Ferns. This latter work was published before the days of Confederation, and consequently does not touch upon Nova Scotia Ferns specially.

Ferns are the "Order Filices", belonging to the Class Acrogens, and to the Second Series, which consists of the Cryptogams or Flowerless Plants. Up to the present time as many as 31 genera have been discovered as Indigenous.

(*) April, 1876.

SUB-ORDER. POLYPODIACEÆ.

Tribe I. *Polypodieæ.*

Polypodium vulgare. (Lin.) This is commonly known as the rock-fern, a name which its habitats fully authorize: for it is uncertain if it has ever been found growing elsewhere than on rocks. I once thought I had found an exception; but upon removing the thin coating of mould in which it grew, *there*, sure enough, were the rocks. From this peculiarity, and from its much smaller size than the British species (which grows under hedges and on banks), our indigenous P. Vulgare is looked upon as a variety by Hooker, and called Americanum. It is of very general distribution throughout the Province, abounding on shaded rocks and boulders. It is an evergreen.

Tribe II. PTERIDEÆ.

Adiantum pedatum. (Lin.) This plant is the pride of indigenous Fernists, and is our only representative of the Maiden-hairs. Its only known habitat in this Province at present is Newport, Hants Cy., where it was first found by Mrs. Bennet. It can be seen growing at Mr. Harris' Gardens. There is scarcely one of the world-wide spread species of Adiantum which can be preferred before it, the only regret being that it is not an evergreen.

Pteris aquilina. (Lin.) The common brake is widely distributed over the world. Common and hardy though it appears to be it is the only indigenous species which seems to defy all efforts to transplant it either into an artificial fernery, or for pot culture. The nearest successful attempt which can perhaps be made is to dig up very carefully some of the soil in spring where the old fronds mark its habitat, and then being careful having once potted it or placed it in the fernery not to again move it.

Tribe III. ASPLENIEÆ.

Woodwardia Virginica. (Smith.) This one only indigenous representative of the Woodwardias is evidently quite rare in the Province, having as yet been found only in two habitats, on other side of N. W. Arm opposite the penitentiary, in a swamp; and at Dartmouth, (latter hab. Mr. Harris, Jr.)

Asplenium trichomanes. (Lin.) This evergreen, rare, and graceful little fern which retreats to sheltered nooks in the rocks, if it be kept for pot culture is indeed a pet to be admired and cared for, and well worthy of the special favour of an ornamental glass shade, by which means alone can it be successfully coaxed to live and grow away from its native birthplace. For a constantly moist *atmosphere* is essential to its existence.

Habs.—Hartley water-fall, Pirate harbour, Strait of Canso, 1869; and rocks on banks of Gold River, near Chester, Lunenburg, 1875, (last 2 Rev. E. H. Ball); near Three Mile House, Halifax, (John Sommers, M. D.)

Asplenium thelypteroides. (Michaux.) Rather rare, being only scarce even where local, though widely distributed over the province. Though not remarkable for elegance of growth, the fronds have a rich dark green colour which is well preserved in an herbarium.

Habitats—Windsor, (Professor How, D.C.L.) Halifax (A. W. D. Lindsay, M. D.,) (Professor Sommers, M. D.); Pt. Dalhousie (Prof. McKay, B. A.,); Port Mulgrave commons high up, and by a brook-side, Strait of Canso; Broad Cove fall, and Atwater's, fall, Boylston, Guysboro County; by a brook near the church, Rawdon, Hants County; (last 4 habs. Rev. E. H. Ball.)

Asplenium filix-fœmina. (Bernhardi.) Quite common and widely distributed throughout the province.

Tribe V. Aspidieæ.

Phegopteris polypodioides. (Fée.) It is rather to be regretted that Dr. Gray has not given this fern its more usual name, which is Polypodium phegopteris, in agreement with Moore and Dr. Lawson. This fern also is common and very generally distributed.

Phegopteris dryopteris. (Fée.) This too is usually grouped with the genus Polypodium. Not one of the commonest of our ferns though very generally distributed and to be met with in most localities. Being small it can best be found in the spring when its delicate and bright green colour renders it conspicuous, before it has become dull and hidden by ranker vegetation.

Aspidium thelypteris. (Swartz.) Perhaps the least elegant of all the Indigenous Ferns. Quite common in swamps.

Aspidium Nov-Eboracense. (Swartz.) One of the most delicately tinted of all our ferns, retaining throughout maturity a very light green colour which makes it valuable in an artificial fernery from the contrast which it makes with other dark greens. Common in swamps and moist places.

Aspidium fragrans. (Swartz.) Perhaps the most rare of Nova Scotia Ferns, as only one habitat, Hartley water-fall, Pirate Harbour, Strait of Canso (Rev. E. H. Ball,) is as yet known for it and where it is quite scarce. Its existence in Canada is queried in Dr. Lawson's Synopsis, 1864. I was fortunate enough to find this fern in October, 1869; a very fine root of it (the fronds 10 inches long) which I procured in 1874, literally perfumed the room in which it was kept with sweetest fragrance. But my prize went the way of so many pets, and was killed with care and kindness; for it is very hardy and should have been kept out-of-doors. It grows on the spot above mentioned, on the face of a perpendicular rock, which is upwards of sixty feet high. Pteridologists who may visit this most charming and interesting nook where nature draws curtains around and over the rock which bears (in *their* eyes) at least *three* precious treasures (including Aspl. trich., and Cystop. Bulbifera), must please bespeak the assistance of some such cicerone as an opera glass or pocket telescope, if they would wish to descry this rare species. And with that they must be content: for it is beyond reach. Still it can but afford them true satisfaction in another way, in the fact that there it is reverently kept from rude hands and uninitiated minds who know not the sacredness with which a botanist regards the one, perhaps only habitat of a valued species. The fragrance of this fern can perhaps be best compared to that of mignionette, but it is milder, being without that unpleasantness which arises from the latter when in close proximity. A microscopic examination of the reniform indusium of this fern, at least when young, fringed as it is all round with glands, is a rich treat.

Aspidium spinulosum. (Swartz.) Only varieties of Gray's typical Aspid. spin. are to be found in Nova Scotia. But we have at least five varieties, though I would wish to insert a query after this statement as being doubtful of their constancy. But as we find them abroad in their natural habitats there can be no doubt about this.

Var. *intermedium*. This is well described in Gray's Manual, and is to be commonly met with about Halifax, and in Guysboro Co., and in fact all over the province.

Var. *dilatatum*. Native plants of this variety differ from the British Lastrea dilatata specially, and from the United States variety less so, in that it has scarcely any deeper brown in the centre of the scales than at the margin, for in Nova Scotia plants the variety intermedium has the darkest scales and fronds. Dilatatum is known from intermedium by its broader, more drooping and lighter coloured frond and lighter scales, as well as from its peculiarity in the early autumn of being mottled with spots as though decaying.*

It is more generally constant than the latter variety in having the pinnæ markedly broader near their centres than at their bases, (except in the basal pinnæ) whilst too, the rhizome is several times larger than that of the equally aged intermedium (side by side with which it frequently grows), being creeping also where intermedium is upright, and having the further additional distinction of shooting off young rhizomes from the parent one.

Var. dilatatum. Habs. Atwater's fall, Boylston; ravine near mouth of brook that runs under road between residence of S. Hart, Esq., J. P., and Boylston School house, Guysboro County; along road between Margaret's Bay, and Hubbard's Cove, Lunenburg County; (Rev. E. H. Ball). It is rather common.

Var. *obliquum*. Very nearly approaches Gray's typical aspidium spinulosum, but differs in having more plentiful supply of scales which are *not deciduous*. The oblique setting of pinnæ and pinnules, more upright growth and the *distinctly elongated triangular form of all the pinnæ* (not merely the basal ones) are points which distinguish this from the two foregoing varieties.

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* The indusium is smooth and without glands, whilst in var. intermedium it is irregularly notched and glanduliferous.

Hab. Along main road from Margaret's Bay to Mahone Bay. (Rev. E. H. Ball.)

Var. *recurvatum*. This variety is recognized by Moore, but not named. It is very readily distinguished from the forementioned varieties by the recurved, convex growth of the frond, the pinnæ and pinnules.

Var. *recurvatum*. It is frequently tinged with a brownish colour, and is found in exposed places. Habs.—Woods of Mr. Frank Marshall, Boylston, Guysboro County; road between Blockhouse and Maitland, Lunenburg County; the Parade, Mahone Bay, Lunenburg County. (Rev. E. H. Ball.)

Var. *dumetorum*. This variety is chiefly characterized by its dwarfish size. The fronds are less than 12 inches long, but abundant in fruit, and when young glandulous all over from stripe to apex, both on the upper and under surfaces. The indusium is specially glandulous. The glands disappear from the face of the frond first, remaining longest on the rachis and sub-rachis, the back of the mid-veins and on the indusium. Habitat, near Bedford, where it has been found by Peter Jack, Esq. These varieties are all evergreen.

Aspidium cristatum. (Swartz.) A common well known swamp fern, though frequently found growing in much dryer spots.

Aspidium filix-mas. (Swartz.) This fine fern so common in Great Britain is but very rare in America. It has recently been discovered by A. W. H. Lindsay, M. D., at Whycocomah, Cape Breton. It is described in Gray's Manual. In Dr. Lawson's Synopsis there is a double query put against its existence in Canada, so that our neighbouring Island may be proud of having this rare species of our Indigenous Ferns.

Aspidium marginale. (Swartz.) This fern is very generally distributed throughout the province, and is to be met with on most rocky banks. It is specially abundant and of fine growth on Pomquet Island, off Bayfield, Antigonishe County. As an indoor winter evergreen it is much to be prized.

Aspidium acrostichoides. (Swartz.) This fine evergreen fern is to be found in all our forests of hardwood and elsewhere, being quite common. One specimen of this fern found at Rawdon (Rev. E. H. Ball) had between 12 and 20 pinnæ on each frond bifurcated.

Aspidium aculeatum, var. *Braunii*. (Rock.) One of our choicest evergreens. It is of very graceful form and very hardy. But it is rare even where local in Nova Scotia. Its known habitats are Marble Mountain, Bras d 'Or Lake, (Prof. How, D.C.L., 18) Sherman's Mountain, Port Mulgrave, Strait of Canso; Ehler's water-fall, near Guysborough, (Rev. E. H. Ball, 1867), at the latter habitat it is not 20 feet above sea level, though growing high up the ravine, also Hills above Mabou, C. B.

Cystopteris bulbifera. (Bernh.) Perhaps the most delicate as well as at least one of the most rare of our indigenous ferns. The only known habitat for it at present is the famous rock already spoken of in connexion with aspid. fragrans and aspl. trichomanes, where it grows most luxuriantly within the spray of the little fall. Some of the fronds are upwards of three feet in length. Gray's Manual speaks of it as common in the Northern U. S., and Dr. Lawson's Synopsis gives a good number of habitats for Canada West.

Cystopteris fragilis. (Bernh). Also a delicate fern; generally distributed through the province, though not common. It is to be found on rocky river-banks and in shaded ravines. Habs.—Springville and West River, (Prof. McKay, B. A.), Clam Harbour River, near the bridge; Broad Cove fall, Ehler's fall, Atwater's fall, last 4 habs. near Guysborough. (Rev. E. H. Ball).

Struthiopteris Germanica. (Willd.) Already referred to in the introduction. Not common in Nova Scotia. Habs. Pictou, (Prof. McKay, B. A.); home field of Styles Hart, Esq., J. P., near Guysborough; head of mill pond, between Waterville and Falmouth, Hants County; side of old corduroy road, between Windsor and Brooklyn, Hants Co.; brook-side, near the Church at Rawdon, Hants Co.; (last 4 habs. Rev. E. H. Ball.)

Onoclea Sensibilis. (Lin.) Quite common in swamps and wet places, and to be ranked amongst the delicate looking ferns of our province.

Woodsia obtusa. (Torr.) One of our rarest ferns, the only habitat as yet known for it being the Windsor Falls. (Prof. How, D. C. L.

Woodsia Ilvensis. (R. Brown.) Interesting when placed in a growing collection of Indigenous Ferns, from the contrast which its dull green makes with the brighter green of other species. Habs.—Wycocomah, Cape Breton, (A. W. H. Lindsay, M. D.,); rocks on banks of Gold River, near Chester, where it is very abundant. Rev. E. H. Ball.)

Tribe V. Davallieæ.

Dicksonia punctilobula. (Kenuze.) Interesting as the only indigenous representative of this genus, and as having a pleasant perfume, which is quite perceptible as the plant approaches maturity. Very common.

SUB-ORDER III. Osmundaceæ.

Osmunda regalis. (Lin.) This large and beautiful fern is also common, delighting to grow in running water, its roots being often quite submerged; but it also abounds in swamps and other moist places.

Osmunda claytoniana. (Lin.) The specific name *interrupta* very aptly describes this most beautiful fern which is quite common. Its glory is but short-lived however; for at the end of June the decayed shrivelled appearance of the fruitful portions of its fronds makes it as disappointing as it is up to that time pleasing. Quite common in moist places.

Osmunda cinnamomea. (Lin.) A little earlier in springing than claytoniana, and specially to be admired for its reddish brown upright, central, fruitful fronds. But here too, the fruitful fronds soon decay. Very common in swamps and wet places.

O. C. var. frondosa. Found by Prof. How, D. C. L., near Windsor, whose specimen is in the Herbarium of Halifax Museum.

SUB-ORDER IV. Ophioglossaceæ.

Botrychium simplex. (Hitchcock.) In the earlier editions of Gray's Manual this is given as a variety of *Botr. virginicum*, but in later editions as a distinct species, and apparently very correctly so, for two fronds could scarcely be more distinct than are the very simple barren segment of this fern and the extremely pretty highly decompound segment of Viriginicum. It is very rare in this province, having been found only by Prof. How, D. C. L., of Windsor.

Botrychium Virginicum. (Swartz.) This fern is also rare and is the finest species of Botrychium. It is highly compound in its divisions, the barren segment being sub-quatrepinnate. As yet only two habitats for it have been made known, Pictou (Prof. McKay, B. A.); and back of lower part of Port Mulgrave commons, Strait of Canso. (Rev. E. H. Ball.)

Botrychium lunarioides. (Swartz.) By no means an ostentatious looking fern, being the smallest of our Indigenous species, The barren segment is evergreen. It is not uncommon, though from its being generally found in old pastures, from its dull green colour and dwarf nature it is apt to escape observation. On this account some habitats are here given. Lower and cultivated parts of Cape Porcupine; in woods near Clam Harbour bridge, and along road thence to the Guysboro River; Field at Head of Broad Cove, Boylston, Guysboro Co.; along road from Cornwall to New Germany, Lunenburg Co.; low narrow marsh on outskirts of town, near Holy Trinity Church, Bridgewater; Oakland's Lake, Mahone Bay, Lunenburg Co.; very common in churchyard and adjoining lands, Rawdon, Hants Co. (All these habitats Rev. E. H. Ball.)

B. L. var. obliquum. (Botr. obliquum, Muhlenberg.) Differs from typical plant in being much larger, the sterile segment being about three times the size and tri-pinnate instead of only bi-pinnate. Habs.: New Germany along roadside from Barss' Corner to the Lahave; and Oakland's Lake, Mahone Bay. (Rev. E. H. Ball.) In the latter habitat I found a specimen with the barren segment having two fruitful segments growing from it low down near its connexion with the principal fruitful segment. Gray's Manual records the finding of a specimen of the typical plant somewhat akin to this.

Var. *dissectum.* (Botr. dissectum, Muhl.) A very interesting and distinct variety, about the size of obliquum but having the pinnules laciniately divided into narrow teeth. Habs.—Mt. Uniacke, (Rev. J. B. Uniacke); New Germany, roadside between Barss' Corner and the LaHave, Lunenburg Co., (Rev. E. H. Ball.) The two varieties seem to be rare.

ART. VI.—THE SEMI DAILY FLUCTUATION OF THE BAROMETER. BY FREDERICK ALLISON.

(Read before the Institute, May 8th, 1876.)

BEFORE proceeding to an investigation of this phenomenon—well known to observers—I wish to offer a few remarks upon the weather of last year, a summary of which you have in the General Register before you.

In 1875 we had a cool year—the coldest at least since 1859, if not for a longer period. The normal temperature in Halifax is 42°. 66. This year was 40°. 23. We may notice here the very small difference in yearly mean heat. However great may be the ranges in the twelve months—last year they extended over 99° and sometimes they reach 104°, as in 1866—so well balanced are the several months and seasons that 4°. 27 will cover the means of the last 16 years. August was the only month which ran above its normal, and was much the hottest month of the year. The maximum heat also occurred in this month 85°. Many months were cold, but January was excessively so; its mean 14°. 99 being 7°. 7 below its normal, and this was the coldest month I ever experienced in Nova Scotia. February—mean 17°. 99 was also very cold; and then we touched the minimum—14°. The 15th of August was the warmest day; and the day exactly six months earlier, the 15th of February was the coldest. The 3rd of June was a very remarkable day in temperature. At 4 a. m., the thermometer was 34°. 5 and before noon had mounted to 72°. 8—giving the enormous range of 38°. 3 within 8 hours. The pressure was a little more than usual, slightly exceeding the normal in every month, but especially in August. The maximum was on the 23rd of November, at 9 in the morning—30.666—clear with a light west breeze; and we had a snow storm from east that evening, and a S. E. gale with rain the next morning; the barometer falling an inch in 18 hours. 30.666 is a high barometer at any time of year in Halifax, but has frequently been exceeded. Notably when we passed under the enormous pressure of 30.956 at 6 p.m., of 15 January, 1873; and again last February 30.992 at midnight of the 5th. It is worth remarking that although we had a stiff S. W. wind and a little snow and rain on the 6th and 7th we got down from this great height without any serious storm. The least pressure of 1875 was 28.601 on the 17th November—only six days previous to the greatest. We have gone below this several times in the last few years; 28.455 on 30th January, 1870, being the lowest. The minimum of last November was in the midst of a rain storm and gale from S. E. to W. Thus we varied 2.065 inches of barometrical whole pressure in 1875, oscillating nearly equally on either side of the proper 29.779.

The mean pressure of vapour was .248 and relative humidity 80.71—elements too often omitted from the consideration of the weight of the atmosphere. The former of these two steadily increased to its maximum of .551 in August, and as steadily fell to the close of the year. The latter was greatest (as is also customary) in July—84.94—and the colder months were generally less—though May, with 76.70 was least of all.

The year was neither very cloudy nor very bright. The mean obscuration of sky was a little over one-half, viz., 5.58. The normal I find to be 5.95. October, with 6.34, was the most cloudy month; and June 4.57 the least so. The summer was more dull, both absolutely and relatively to the normal, than the winter.

The prevalent direction of our winds from the west quarter was almost constantly marked throughout the year, and the result was nearly due west. A wind east of south not obtaining the supremacy until July denotes the lateness of the spring. These winds from the cooler ocean generally assert themselves in May or June, but their season depends upon the rate at which the water takes in heat.

The velocity of the wind exceeded the normal rate in each month excepting March and April; in the former of which it fell considerably, and in the latter slightly below the average. None of the excesses were large, and consequently the whole year's mean of 8.67 miles per hour was but .83 over the average mean. November was absolutely the most windy month in 1875; which result accords with my previous 13 years observations, although the normal of March approaches very closely. But last year as noticed that was comparatively a quiet month. August was, as usual, the month of least wind.

While from the large rain-fall of the summer 1875, may be remembered for its wetness, the total precipitation of the year was in reality very close to the average 52 inches of Halifax. The whole rain was nearly an inch deficient, owing to the abnormal scarcity in January, March, September and December, which the excess in June and July, and, remarkably, in October did not compensate. Snow, on the contrary was very plentiful in January and February, but scarce in March and notably wanting in December. The whole depth exceeded 87 inches dry, being 5. 5 above the normal; this when melted raised the total precipitation to 51.480. The number of days of rain was 134. Snow fell on 54 days, while 198 days were completely dry—a dry day is that on which the precipitated moisture does not reach; .01 of an inch is in fact inappreciable; of such days 204 is the normal annual allowance in Halifax, 10 days more than the average number in London, about the driest district of Great Britain.

The aurora borealis was seen much less frequently than usual. Since October, 1874, there has been a remarkable scarcity of these displays, which still continues. Several years ago I laid before this Institute what I believed to be the causes of the visibility of this phenomenon, noting that it was invariably accompanied by a fall in temperature, generally great and frequently sudden. Longer experience has confirmed this belief. I have said that the display is not simply electric; because, however, the existence of the aurora is due to electric force, we on this earth can only know of its existence—can only see it, in short—when a lately decreased temperature of our atmosphere brings the display to our vision. In how far this wonderful power, which we call electricity, is the cause of every movement of our atmosphere I am not prepared to say to-night; nor do I feel sure that I know what electricity is; but I am convinced that there is a force, (call it electric, or magnetic, or what you will), continually controlling aud regulating [even perhaps originating] not only the life of the atmosphere, but similarly of the vegetable and the animal. I cannot now dwell on this important subject, which is beyond the scope and intention of this brief paper; but I wish not to be misunderstood to refer at all in the foregoing remarks to the knowledge of the origin and existence of the immortal soul of man and his responsibility as revealed to us by the one true God.

The total number of gales in 1875 was 19—thus distributed,—January 3, February 3, March 3, April 0, May 2, June, July and August 0, September 2, October 3, November 3, December 0—this is about the usual total, but the 2 in May were rather due to December. A gale in Canadian Meteorology requires 30 miles per hour of velocity—a pressure of 4½ lbs. per square foot; 52 Fogs were noted—the greatest number but one in ten years. July was particularly a foggy month. In other occasional phenomena I find nothing peculiarly remarkable. Though not a purely Meteorological point I note the number of days when runners are more suitable than wheels, as a matter of interest. In 1875 then we had 92 days sleighing, more than for many years; it being unbroken, with the exception of one day, from the new year to 29 March; and again having 5 days in December. 1872 is the only recent year to equal this; then we had 98 days sleighing, being half of January, all February and March, 4 days in April and 19 in December.

We now proceed to the more immediate matter of this evening, the double maximum and minimum of the whole atmospheric pressure, each 24 hours. But time warns that I must be brief. An observer watching the action of his barometer constantly during the day will always notice, should no irregular disturbance affect the atmosphere at his station, a steady rise, a fall, a second rise and again a gradual fall; the same movement continuing more or less while ordinary weather lasts. Beginning, say at midnight, some clear steady night, at any time of year, he will see the column decline till about $3\frac{1}{2}$ a. m.; about 4 a. m. a movement upwards from this minimum begins and continues till full 9 a.m. when a maximum height is attained. In 15 or 20 minutes again the column sinks till $3\frac{1}{2}$ p. m., once more to ascend till 9. p. m., when the second fall sets in; which decline continues, as said above, until after 3 o'clock next morning. This action is certain and well known. Briefly we will discuss the reasons for it; and first I think we will find at the bottom of our investigations, the great controller of our atmosphere, heat. Indeed we need go no farther than this agency for the direct cause of the second minimum and maximum of the Barometrical column. A mere superficial glance at once leads us to a correct conclusion that as the heat increases during the forenoon, after 9 o'clock the air becomes lighter, and pressure is taken off the cistern, and this will continue till after 3 p. m., when the greatest heat of the day having been reached, the gradually cooling atmosphere grows more dense and presses the mercury up the tube.

But while the one wave is thus sufficiently accounted for, other causes must interfere about 9 o'clock in the evening, or the upward tendency would remain till the sun of the next day had restored the heat and lightened the atmosphere. In short if we look to direct heat alone, we have as an effect but one fluctuation during the whole day. I have been careful to use the phrase "direct heat" as I believe it may be proved that heat, though acting indirectly, is the root of the second wave also. Now we imagine ourselves at 9 p. m., on any day, and looking to the diminution of heat alone the barometer should still be rising; as, speaking broadly, cold air is more dense than hot air.

But the column has reached its greatest height for the present, and in a few minutes begins to descend. Why? Because in addition to the gradual cooling of the atmosphere above mentioned a force of descending vapour has been at work in the early hours of the night pushing down upon the cistern of the barometer, and greatly aiding in the elevation of the column thus doubly effected. And soon after 9 p. m. this second force ceases; the earth becoming cooled to equal the temperature of the air, or nearly so. This fact is again shewn by the deposit of dew being greatest in the early hours of the evening, between sundown and 9 p. m., when the humid vapour of the atmosphere descends most rapidly and forms in drops of visible water upon the ground and other material substances as they cool. The most energetic force then being at an end, the mercury about $9\frac{1}{2}$ p. m., again gradually retires down the tube till 3 a. m., or a little after. But why should this second descent not continue, at least till the rising sun rarifies the atmosphere by heat, when the downward tendency would be accelerated, as we have seen that it is after 9 a. m.? Because as daylight approaches, and the earth is at its coldest, the expansion of the vapour, which we have noted as condensing and pushing downwards at the beginning of night, re-commences. The earth which parts with heat less readily than does the atmosphere, is also more loth to take it in, and now about $3\frac{1}{2}$ in the morning (as an average hour for the twelve months) is most cold. Then the layer of atmosphere immediately on the earth's surface is the next deficient of heat, and the higher strata (I speak within limits proximate to our planet) are the warmer. So the night vapour rises, but not only does it rise, but with its "quasi explosive force," as says Sir Henry James in commenting upon Professor James Espy's interpretation of this phenomenon, it presses upon the delicate barometer and the mercury rises, till our starting point of 9 a. m. is again reached, when the atmosphere being heated and dried and the ground warmed, the fluctuation again begins its diurnal career. This motion is known to be constant in regular weather, so much so as to be spoken of as "Diurnal Atmospheric Tide"; but while proved to take place on all the continents (which it will be remembered are chiefly inhabited on their shores, or at comparatively small distances from the oceans) it becomes very obscure in the interiors of large land tracts. This is well marked in our own country. Even in Ontario these tides are not so great as here beside the sea. In Manitoba still less. And when we have got a sufficient number of observations from that district, between Winnipeg and the Rocky Mountains, I shall not be surprised to find the double fluctuation almost obliterated; and but one well defined maximum and minimum of pressure corresponding to the least and greatest heat of the day.

The point that I wish especially to urge, as bearing upon nearly all the inhabited portions of the globe, is the dynamic force of vapour affecting the atmosphere at fixed hours of the day, acting independently although it may be at times assisting the static density of the air. In storms and any atmospheric disturbances these regular tides disappear—shrouded by the greater temporary forces then at work —but at those periods they are of great use to the observer in his forecasts. For instance should they still be appreciable in bad weather, the disturbance is certainly local and short lived. On the other hand, should the barometer fall, even slowly and to a small extent during the morning—say between sun rise and 9 o'clock—a serious disturbance will surely ensue, while if the barometer rise during midday, between 9 a. m. and 3 p. m., you may count at least on a fine night, with the sole exception of the accompaniment of an east wind, which fair or foul raises our Atlantic coast barometers. This, in itself, is a subject worthy of investigation; but to-night I will not longer try your patience, but conclude with thanks for your attention.

ART. VII.—NOTES ON THE SERPENTS OF PRINCE EDWARD ISLAND. BY JOHN T. MELLISH, M. A.

(*Read May 8th*, 1876.)

FAMILY-COLUBRIDÆ.

Genus—EUTÆNIA

Eutœnia Sirtalis. Baird and Girard.

Coluber Sirtalis. Linn.

GARTER SNAKE.

Genus-BASCANION.

Bascanion Constrictor. B. & G.

BLACK SNAKE.

Genus-STORERIA.

Storeria occipitomaculata. B. & G.

RED BELLIED SNAKE.

THE Fauna and flora of Prince Edward Island are different in some respects from those of Nova Scotia and New Brunswick. This can be accounted for in part at least by the insular character of the Island, and also by its geological formation, the latter being carboniferous and triassic—much more recent than the older formations which so largely predominate on this side of the Strait. If the Island always was an island and not a peninsula joined to the main by a neck of land of which Cape Tormentine and Cape Traverse are the only visible remnants, we may find it difficult to trace the introduction of all the varieties of fauna found there. If on the other hand the Island was formerly joined to the continent, we can readily account for the fauna being nearly identical with what we have here in Nova Scotia. No animals of the deer species are to be found on the island, nor is there reliable evidence as far as I know, that there ever were any. In a diary kept on the Island about a hundred years ago by a gentleman who evidently relished a good dinner, I find many entries of moose having been included in the bill of fare, but at the same time I find in the scant lists of freight conveyed in the small craft of that day from Baie Verte or Tatmagouche to Charlottetown, frequent mention of moose or moose-meat—a fact which would argue that there were then no moose on the Island, and that the meat was imported for use. Foxes have been known to cross the Strait of Northumberland at its narrowest part (about nine miles) in winter. Bears have been known to swim several miles voluntarily, and it is not improbable that they have crossed the Strait by swimming in summer. In regard to snakes, however, the notion that they would cross either by ice or water is untenable.

THE GARTER SNAKE.

Eutænia Sirtalis. B. & G. Smithsonian Institute.
Coluber Sirtalis. Linn. Storer.

Trophidonatus Sirtalis. Hol.
Trophidonatus tœnia. DeKay.

This snake, so common in almost all countries in the temperate zones, is found on the Island in large numbers. It seems to attain to a much greater size than in Nova Scotia. I have frequently seen them from $2\frac{1}{2}$ feet to $3\frac{1}{2}$ feet in length; and from $2\frac{1}{2}$ inches to 5 inches in circumference at the thickest part. I think the colour too is generally darker than that of the Nova Scotia Garter Snake, although in some cases the belly is nearly white. They often resist when attacked. The largest one I have seen measured 4 feet 9 inches in length, and was $4\frac{1}{2}$ inches in circumference. It was beautifully coiled up beside a decayed tree, enjoying the afternoon sun of an August day. It is believed that they receive their young in their stomachs, on the approach of danger. I have seen them with toads in their stomachs; in one instance the snake had three toads in his stomach at once, and was almost completely torpid. These snakes have frequently been seen swimming across the Hillsboro, near Charlottetown, where the river is over a mile in width. They look very pretty in the water—the head erect several inches above water, and moving about from side to side with the motion peculiar to the serpent, and the body and tail sweeping behind.

The Black Snake.

Bascanion Constrictor. B. & G.

This snake is not as rare on the Island as it is in Nova Scotia. Dr. Thomas Dawson, of Charlottetown, informed me that he once found four together in the woods. They seemed to be very torpid, and were just recovering from their long winter sleep. It is generally much smaller than the Garter Snake, although in a few cases I have known them to exceed three feet in length. One of these, which was accompanied by several young ones, became very furious when struck, and actually sprang several yards at its assailant, who succeeded in killing it, but not without considerable effort. The epidermis (of all the varieties I presume) is frequently found entire, as if the snake had crawled out of it, and sometimes apparently as if burst asunder and dropped off.

The Red Bellied Snake.

Storeria Occipitomaculata. B. & G.

This variety is numerous, is smaller in size, and seems to be less courageous than some of the other species. It is generally found near woodpiles and old buildings. It is of a dusky brick color, the belly being of a lighter shade than the back.

I do not think the King Snake (*diadolphis punctatus*, B. & G.) is to be found on the Island. The Green Snake (*Chlorosoma vernalis*) so common on the continent, is entirely unknown there.*

The Striped Snake.

Coluber lineatus? Mellish.

I have frequently seen a small snake striped with black, white and dark green. This I have not been able to identify; and I regard it as a new species. It is found in the grass and among bushes, but not in the vicinity of dwellings. I have not seen any of them as small as the smallest of the red bellied snake, nor yet any as large as the largest of the garter snake and black snake. It is suggested that the name *Coluber lineatus* be given to this species provisionally, until it be more fully described.

A gentleman who saw a snake charming a bird, told me that the sight was very interesting, if one could forget the bird's fate. The snake held the bird's eye, and moved forward almost imperceptibly, the bird being motionless, with its head stretching forward towards its destroyer. Stronger the attraction grew, nearer the snake approached, until suddenly his red jaws closed on his prey.

Several years ago, I saw a singular looking creature which more nearly resembled a snake than anything else. It was killed in harvest-time by a mower in an oat-field. It was of yellow or straw color, and was about 21 inches in length, and 2½ inches in circum-

*Since this Paper was read I have learned from James L. Mellish, Esq., of Pownal, P. E. I., that the *chlorosoma vernalis* was sometimes to be seen on the Island forty or fifty years ago.

ference, being of even thickness from the head to the tail. The tail ended abruptly as if cut square off. The form was not perfectly round, but the back and belly as well as the sides were somewhat flattened, the eyes were black, in striking contrast with the colour of the creature. It was not smooth, but was surrounded by raised rings of about a quarter of an inch in width. The colour, however, was uniform.

ART. VIII.—NOTES ON SOME NOVA SCOTIAN PLANTS. BY GEORGE LAWSON, Ph. D., Ll. D., *Professor of Chemistry, Dalhousie College, Halifax.*

CALLUNA VULGARIS.

IT may be recollected by some members of the Institute, that a patch of Scotch Heather (*Calluna vulgaris*) was found about fourteen years ago in the State of Massachusetts, and that a good deal of discussion ensued as to whether the plant was really indigenous to the American soil, or had been intentionally planted, or accidentally introduced. One set of American botanists held to the belief that the plant was not native in Massachusetts, whilst Professor Gray and others believed that the evidence was so far, in its favour. This latter view was strengthened, and the favourable evidence increased by a circumstance that occurred in London. The Linnean Society had in course of many years accumulated in their rooms a large quantity of bundles of dried plants. These were cumbrous to move into the Society's new quarters, and it was therefore determined to select from them what appeared to be necessary for the Society's Herbarium; and all that were regarded as duplicates or rubbish, were sold off at auction. Amongst these was a parcel of Newfoundland plants, collected by Mr. Cormack, the first scientific explorer of that Island, and that had long lain neglected. The parcel was purchased, with others apparently as valueless, by Mr. Hewett Cotterell Watson, a veteran botanist, residing at Thames Ditton, who in early days explored the Azores, and who has devoted a large portion of his life to collecting and digesting materials for the development of a system of Geographical Botany. In this parcel Mr. Watson found amongst other plants, a specimen of *Calluna vulgaris*, and called attention to the fact in the Scientific Journals.

There was likewise a vague tradition in Nova Scotia, that the calluna had been found within our borders, but as we have two plants, *Corema Conradi*, and *Empetrum nigrum*, that might easily be mistaken for it, botanists did not pay much attention to the rumour. However, in August, 1864, whilst travelling through the island of Cape Breton, I heard at North Sydney that Mr. Robertson, a farmer at St. Ann's, had found the Heather on his farm, and that as he had come from Mexico to Cape Breton, it was very unlikely that he could have brought the plant with him. I visited St. Ann's, saw the Heather growing in small quantity in a wet spot among native spruce trees, and on my return showed specimens to the Institute. This seemed to settle the question, every one believed that the Heather was a native American plant, and the small quantity found seemed to favour the view of Professor Gray, that these patches were the mere remnants of what had at one time been a more abundant and more widely diffused plant on the American Continent, that in fact the calluna was becoming extinct on this side of the Atlantic. The St. Ann's specimens which I sent to England were regarded as slightly different from the European plant, and the late Dr. Seeman, editor of the Journal of Botany, gave the new name *Calluna Atlantica*, to distinguish the American form.

Several other stations became known. In the first place, Mr. Murray, the Provincial Geologist, found the plant growing in Newfoundland, thus silencing the doubts that had been expressed in regard to Cormack's specimen. Then a lady in Halifax produced a specimen which she had gathered some years before, somewhere on the Dartmouth hills; and another lady searched and found where it had been gathered, and brought a fresh specimen, with the information that there was only one plant. It subsequently became known that there were several patches of Heather at a particular spot in Point Pleasant Park, and, although too much of it has already been taken away by inconsiderate persons, yet it still exists there. Numerous explanations have been offered as to how the Heather got there, most persons assuming apparently that it could not be indigenous. One suggestion was that the Highland soldiers encamped there some thirty or forty years ago, used heather brooms for sweeping out their camps, and that the seeds had dropped from the brooms, and given rise to the heather patches.

However, a careful examination of the locality by Mr. Jack and myself, led to the conclusion that the Point Pleasant heather was not only not indigenous, but had apparently been intentionally planted, in fact that the place had been a garden or cultivated plot, the ground being quite level, free from cradle hills, with few native plants, and the marks of cultivation not yet entirely obliterated. All this suggested a more careful consideration of the other stations. A new one, near East Bay in Cape Breton, where the heather is said to exist in considerable quantity, was made known to me some years ago by the Hon. Mr. Ferguson, then a member for Cape Breton County. The traditional history of it there is that the early emigrants from the West Highlands brought heather beds with them, and when these beds were in due course exhausted, and the *debris* scattered around their dwellings, a profuse crop of heather came up. This account seemed plausible, and it seemed to show that the heather was certainly not indigenous at East Bay; and, taking the alleged facts in connection with the obviously artificial nature of the locality in Point Pleasant Park, I began to doubt seriously whether the heather was not after all a plant foreign to the American Continent.

Last fall, I met with the Rev. Mr. Harvey, of St. John's, Newfoundland, as a fellow-passenger across the Atlantic, on board the "Nova Scotian," and, in talking over the productions of the Island, we came upon the heather. I suggested to him my doubts of its nativity, and asked him on his return to Newfoundland, to make special enquiry with the view of ascertaining, if possible, whether it was really indigenous. He has most obligingly done so, and his report is rather unfavourable. He writes in the following terms: "I have made careful inquiries regarding the heather in

Newfoundland, and find that at a place called Caplin Bay, two miles from Ferryland, which is about thirty-five miles south of St. John's, there is a bed of heather, of no great extent, but healthy and flourishing. Ferryland is one of the oldest settlements in the island. There Lord Baltimore built a house two hundred years ago, and made it the seat of Government. The tradition is that some Scotch settlers, or possibly Irish, brought out beds filled with heather, and the seeds produced the present growth. At all events, it has been growing there for some generations. At Renews, about twenty or thirty miles from Ferryland, there is also a quantity of heather, supposed to have been derived from the Caplin Bay growth. but this is only conjecture. I am told that the heather is as fine as any on the hills of Scotland, and shows no signs of degeneracy. A few sprigs of it were brought here this summer. It is said that attempts have been made to transplant heather, but without success. Possibly the seeds alone will grow."

I visited, with Mr. Jack, another locality on the Peninsula, where the heather was reported to grow. After a slight search we found it growing on a piece of wild land within the cemetery fence, but that had never been cultivated in any way, and was still covered with the alders, kalmias, ledum, blueberry, cranberry, and other genuine native plants. I cannot see any reason to doubt the heather plants being native in that particular place. Another fact is specially worthy of note. Mr. Robert Boak, senr., recently informed me that he had seen the heather growing in a particular spot in the Tower Woods thirty-five years ago. The place is quite wild, distant from any dwelling or camp. The original cradle hills are intact, covered by their characteristic native plants, and the heather must have been native there.

In consideration of all the facts above detailed, and others to which it is not necessary to allude, I have arrived at the following conclusions:

That *Calluna vulgaris* has been originally a native indigenous plant, and still exists as such in very small quantity on the Peninsula of Halifax; that it is probably indigenous also to other parts of Nova Scotia and Newfoundland; that in Point Pleasant Park, at Dartmouth, and possibly other places, the stations for the plant are artificial, but the plants are probably native, having been transferred from one spot to another, or grown from seed dropped by plants that were so transferred; and, lastly, that the various traditions as to the foreign origin of the heather, are not unlikely to have been suggested by the desire to account for the presence of what was regarded as necessarily a foreign plant, rather than by actual historical facts. I think it not at all improbable that the Newfoundland and Cape Breton heathers may in reality be perfectly wild (indigenous), although popular local traditions attribute to them a foreign origin.

SAROTHAMNUS SCOPARIUS.

Whilst making enquiries respecting the alleged occurrence of heather in various places, Professor Lawson obtained information regarding several other interesting plants. One of these is the English Broom, (*Sarothamnus Scoparius)*, which Professor McDonald informed him grew in some abundance on Boularderie Island, Cape Breton, on the property of Mr. Gemmell, at Little Bras d'Or. He subsequently heard from Judge Smith and Mr. Stephens of Halifax, of its occurrence to the westward, either in Queen's County or Shelburne. Judge Smith had seen it growing, and Mr. Stephens had seen bunches of it brought to Halifax on board the "M. A. Starr." Prof. Lawson's latest informant was Mr. Peter Jack, who has visited the place, aud has kindly furnished the following particulars:

"Having heard that Broom was growing rather plentifully in the neighbourhood of Shelburne, I took the opportunity of visiting the place last fall when waiting for the steamer for Halifax. The place is about two miles from Shelburne on the road to Halifax. The property is owned by a colored man who was from home, but his wife, Mrs. Jackman, took me to the spot. She takes a great pride in the broom, and is well pleased to show it to visitors, of whom there are several each year, for its fame has gone abroad. It grows principally in one place, at some distance from the road, and in a sheltered position, covering about a quarter of an acre.

The cellar of the house of the original settler, by whom the broom is said to have been planted, and who had been dead about seventy years, still remains, and in it the broom was growing. It evidently has fallen on congenial soil, for some of the clumps measured about four feet across and were fully that in height. It had also taken full possession of this spot, from which it passed to a considerable distance, now in large patches, now in small ones. There are numbers of last year's seedlings growing, showing that it is not likely to die out. The colored lady says that it has spread fully four miles off in the direction of Jordan River Mills. Mr. Cunningham—evidently a Scotchman—is supposed to have planted the broom some 80 years ago. Whether he was one of the original settlers I could not learn. The old colored lady said that when in flower the broom was a beautiful sight, that she frequently went to where it was growing to look at it, and that she would stand for a long time admiring it. Her son, a young lad, also took a great interest in it, as well as in the trees growing around. He had a very good idea of how the broom grew, and spoke of the plants as tame or wild according as they were transplanted or not.

"Shelburne also is noted for two large fine Willow trees. They are growing in the streets—each of them measures about 15 feet in circumference and the spread of the branches is about 80 feet. They were planted by the late Mr. Cockaigne, Collector of Customs there, and are about 80 years old."

Rhododendron maximum.

Professor Lawson then gave an account of the discovery, near Sheet Harbour, of *Rhododendron maximum*, of which Robert Morrow, Esq., had obtained a living plant. An extensive correspondence on the subject was laid on the table, which is here printed, as it appears desirable to place on record in a permanent form, all the facts connected with the history and discovery of a plant of so much interest:—

To the Editor of the Herald:

"HONOR TO WHOM HONOR IS DUE."

In reference to the botanical discovery in this morning's *Herald*, allow me to say that the Rhododendron at Sheet Harbor was discovered many years ago by the early Gold Hunters of Nova Scotia, who were strongly impressed with the idea that gold was indicated by a certain evergreen plant. The Indians at Sheet Harbor had known of these trees; thither they led the explorers. Though disappointed and disheartened then, gold has since been discovered in near proximity to the locality of "the evergreen trees."

Ten years since, the late Captain Chearnley went to see these trees, of which he had heard so much, and pronounced them the Irish Holly, and had with great care a fine specimen transferred to his garden in Halifax; but I understand, at the time, he was unsuccessful in its cultivation. I am much pleased to hear of Mr. Morrow's success, and hope others may be as fortunate, though, from frequent removals, I noticed when last there, that the specimens were becoming very scarce.

Yours, &c.,

J. D. VANBUSKIRK.

Dartmouth, Jan. 5th, 1876.

KING'S COLLEGE, WINDSOR,
Jan. 8th, 1876.

To the Editor of the Herald:

DEAR SIR,—I was particularly interested in the notice of Mr. R. Morrow's discovery of *Rhododendron maximum* in the wild country in Sheet Harbour, contained in the "Agricultural Journal," and copied into the Halifax papers, as the identification of the plant confirms a notion I have had for many years, that it grows in parts of the Province near that mentioned, and possibly others not very much visited by Botanists. As long ago as 1860, when returning from the Gold Expedition to Old Tangier (Mooseland) with the Hon. Joseph Howe, then Provincial Secretary, I heard of a plant known to my informant as "Green Bushes." We came out of the woods striking the Sheet Harbor Road, near the Beaver Dam, or midway between the Upper Musquodoboit and the sea; we travelled through by roads to Welsford, and the Shubenacadie Railway Station I think was where we took the cars for Halifax. The description of the plant interested me much. I afterwards spoke of it, I am pretty sure, to Mr. Herbert Harris, of Halifax, and it seems to me that Captain Hardy mentioned having seen or heard of the plant, which I put down as that now announced. At any rate, I have had, for years, a note in my copy of Gray's Manual of the Botany of the Northern United States, in the margin opposite *Rhododendron maximum* indicating "Stewiacke" and "Wine Harbor" as possible stations for the plant. The discovery of it not very far off is an agreeable circumstance, and I hope the Public Gardens of the city will soon contain numerous specimens of this magnificent wild plant of Nova Scotia, which is an "evergreen from six to twenty feet high, with leaves from four to ten inches long, with carolla one inch broad, pale rose colour or nearly white, greenish in the throat on the upper side, and spotted with yellow or reddish"

Perhaps you can find space for this in your journal, and oblige,

Yours truly,

HENRY HOW.

To the Editor of the Morning Herald:—

SIR,—Having laid aside the watering pots, and taken my eye off the thermometer, will you allow me to add my little contribution to your horticultural column concerning Rhododendron maximum.

I beg to state that the late Dr. Forrester had in his Herbarium a specimen of the plant in question. It was marked as found in Halifax County, but the date of finding I fail to remember. Mr. Hutton, Senior, also informs me that the small withered branch shown him by the late Captain Chearnley was a Rhododendron, but it was impossible to be positive concerning the species, and from the nature of his duties, he had no time to look the matter up.

That it is scarce in Nova Scotia there can be no doubt, and the question opens, can it be cultivated? With Hollies (Ilex opaca) in various parts of the Province, Heather in the Park, Broom at Shelburne, Rhododendron at Sheet Harbor, and many other plants comeatable, some ardent blue apron, enterprising nurseryman, or zealous botanist, has here an opportunity afforded to change the aspect of our gardens, parks and promenades.

Yours, &c.,

A SPADE

To the Editor of the Morning Herald:

SIR,—In your correspondence by Spade, he asks the question, "Can it (R. m.) be cultivated?" I have no doubt but it can. Rhododendron maximum, also Catawbiense, Ilex opaca, Kalmia latifolia (American Laurel,) will all stand our climate.

To grow these plants in our gardens and shrubberies, there should be a dry location and proper composts. As some people may think they can grow them because they are hardy, they may procure plants and plant them in their gardens, enriched by ordinary stable and cow manure. When these plants are planted under such conditions they make a miserable existence for a short time, and finally die.

The Rhododendron naturally delights in peat, having delicate wiry roots. It feeds on decomposed leaves and fibre accumulated for years, the under soil being generally a red, sandy loam. To cultivate them the beds, or (for single specimens) holes, should be dug from 15 to 18 inches, and removed, to be replaced by the following compost: Take peat, which can be procured beyond the N. W. Arm, somewhere near the Pipe-house, or in Dartmouth; also some nice sandy loam; mix an equal part of each with a part of sand, fill up the beds or holes some six or twelve inches above the garden soil, according to size, so as to throw off the spring and fall rains, and put in the plants,—slightly protect them the first winter.

As the above plants are North American, and some are found in our own Province, they are quite hardy. But as they are scarce here they cannot easily be obtained from the woods. For the information of our amateurs I may be allowed to mention that good plants can be procured from Hovey & Co., of Cambridge, near Boston, or from W. C. Strong, of Nonatum Hill Nurseries, Boston.

R. POWER,
Public Gardens.

To the Editor of the Morning Herald:

SIR,—In associating Mr. Morrow's name with this plant, it was not meant to claim for him any exclusive right of discovery. The notice in the "Agricultural Journal," copied into the papers, was merely preliminary. In the full history of the plant, I shall try to give the credit that is due to every one connected with it. Colonel Chearnley appears to have been the original discoverer. The following correspondence will show what Mr. Morrow has done. I shall feel obliged to any one who may communicate any additional information, either through the Press or privately. I doubt whether this is the "Gold Plant" of the Miners, as it is so rare, and does not grow on the rocky barrens where gold is found. I fancy also that the plant referred to by Mr. Buskirk, as called "Holly" by Colonel Chearnley, must have been the Ilex opaca, which I believe was discovered by him, and is almost as interesting as the Rhododendron, but no one now knows where it was found. It is the American Holly, and closely resembles the Irish one.

I am, Sir,
Your most obd't serv't.,
GEORGE LAWSON.

Dalhousie College, Jan. 10, 1876.

HALIFAX, Jan. 7th, 1876.

MY DEAR DR. LAWSON,—

The following is all I can tell you about "Green Bushes":

When I was hunting in the Musquodoboit district with Mr. E. G. Stayner, in September, 1864, we were one day talking with the Indians who were with us about some plants. One of them mentioned a plant, "green bushes" he called it, which grew in the woods over towards Sheet Harbor; but he said only in one spot, and that it was not then so abundant as it had formerly been. From the Indian's description I thought it must be a Rhododendron, and agreed with him that he should go, and, if possible, get me a plant. He did not go until the summer of 1866, and when he returned he told me that they had all perished, and he did not know where to find any more. Being firmly persuaded that the plant, if existing at all, must be a Rhododendron (as I remarked to you some years ago), I continued making enquiries of both Indians and white settlers without success, until the last day of May, 1875.

In September, 1874, I was in the woods with two Indians (father and son), and one day, lamenting the disappearance of the "green bushes" (the father had been previously looking for the plant at my request), the son told the father, who interpreted to me, that he knew where a few of the plants still grew. I bargained with them to go and get me some, and, if they found them to give them to Mr. D. W. Archibald, Sheet Harbor, who would forward them to me. It being possible that they might forget, I wrote to Mr Archibald, who saw that they went; and, shortly after, he informed me that fire had been through the small peaty place where the boy had seen the plants, and there were none left. Hoping against hope, that there might be some shoots from the burnt wood, I wrote to Mr. Archibald in the latter part of May, 1875. He being absent, my letter was handed to Mr. J. H. Balcom, who sent the Indians seeking again; and on the last day of May they handed him *one* small plant, which was all they could find, "and they searched carefully;" it reached me in June, on the day upon which you left for England, and, before taking it home, I asked Mr. Jack, as well as Mr. Barron, to come and see it. The latter gentleman told me he had been looking for it a long time, without success,—more than seventeen years.

In the autumn—I think about the last of October—Mr. Falconer, with whom I was talking of the plant, told me that the late Colonel Chearnley had given the Horticultural Society's Garden one about ten years ago; but Mr. Falconer's impression was that it had not sufficient roots, and was never planted; and, also, that Colonel Chearnley did not then know the name of the plant, but he (Mr. F.) knew it to be Rhododendron maximum, from specimens of the same plant which he had in his garden, imported from the United States.

The plant has been known to the Indians and to many of the settlers for a long period, as "Green Bushes," and is not therefore *newly* discovered, or discovered by me; and Mr. Archibald, who identified the plant at my house, tried to cultivate it some years ago as "Green Bushes," but without success; he had also expressed the opinion to me some time previously that it had died out. All that I have to do with it may be summed up in few words. I sought for it from September 1864, to May 1875, without knowing that it had been seen by the late Colonel Chearnley or recognized by Mr. Falconer, or by any one else, but knowing from you that it has not been scientifically recognized and recorded, and that you, as well as others, doubted its existence, I fortunately have been able to set the matter at rest by showing you the living plant.

I am, my dear Dr. Lawson,
Yours truly,
ROBT. MORROW.

HALIFAX, Jan. 8th, 1876.

MY DEAR SIR,—

According to promise, I to-day called upon Mr. Barron and Mr. Hutton about the "Green Bushes." Mr. Barron says that mine is the only specimen of native Rhododendron maximum that he has ever seen, but that, about ten years ago, the late Colonel Chearnley described a plant which the Indians had made known to him, and which, from an imported specimen in his garden, he (Mr. B.) knew must be Rhododendron maximum.

Mr. Hutton said that the late Colonel Chearnley brought him, ten or twelve years ago, not a plant but a branch, and asked him its name. He told him it was a Rhododendron, but did not know the variety, as he had then not seen the "Rhododendron maximum."

I am, my dear Sir, yours truly,
ROBT. MORROW.

Dr. Lawson, &c., &c.

To PETER JACK, ESQ.,

Dear Sir,—

My knowledge of these bushes goes back as far as thirty-five years. When a boy at my grandfather's in Upper Musquodoboit, old Peter Cope and his Squaw Molly, came to our house one night for lodgings, having just come through the woods from Sheet Harbor. They brought with them some very fine branches of these green bushes, and, it being winter, the green leaves were new to us; they said that they had found them on their way, that quite a number of the bushes were growing in one place only, but appeared averse to describing the locality. They remained at my grandfather's over night, received two pork hams, and left before daylight, leaving us the green branches. Shortly after that I moved to Halifax, and by degrees forgot the ham and bush story. Coming to Sheet Harbor about eighteen years ago, and finding the descendants of the old Copes here, the pork and green bush vision of my youth was revived. I found that most of the Indians knew the whereabouts of the bushes, but no white man that I could find had ever seen them, and but few had ever heard of their existence, though I think that some old white hunters from Musquodoboit had been to them. I determined to see them, and induced Joe Paul and Peter Francis, (Indians who still live here) to guide me to them in the winter of 1858. At that time there were some twelve or fifteen bushes visible above about a foot of snow, the largest being about four feet high; they pointed out dead stalks of what they said had been green bushes, some of these were about seven or eight feet high, and of four inches diameter at the ground; these they said, had, when green, borne white flowers in summer, but did not speak of the small ones bearing flowers. At that time I brought several specimens to the Harbor, and showed the locality of them to many of our loggers. The Indians took Captain Chearnley to the ground about ten years ago, and told me that the Captain had taken some to Halifax to plant in his garden. More recently, some gold hunters, supposing that the bushes indicated gold, dug a few small holes upon the ground, but without success. Fire passed over one corner of the ground a few years ago, previous to which, they had about disappeared, and I have thought that the Indians destroyed them; or might it be that the seed comes from the white flower, and that whites and moose destroyed them before getting large enough to bear flowers. I will get my friend Balcom (deputy surveyor) to draw me a rough sketch of the locality, and take it to you when I go to Halifax this week.

Yours very truly,

D. W. ARCHIBALD.

Sheet Harbor, 17th Jan., 1876.

[Since this paper was read to the Institute, the following communication from Dr. Asa Gray, has appeared in "The Garden," an English periodical, for which I am indebted to Mr. Jack's kindness:]

The Ling or Heather (*Calluna vulgaris*) re-discovered in Massachusetts. The now well-known patch of Calluna in Tewkesbury, which was discovered by Mr. Jackson Dawson, nine or ten years ago, was then the only one known in the United States, or indeed on the continent. Up to this time the only contradiction to the current aphorism, "there are no Heather in America," came from Newfoundland, where Calluna was known to occur, although few botanists had ever seen specimens of it. It required some hardihood, as well as a clear conception of the causes which have ruled over the actual distribution of our species in former times, to pronounce that this Tewkesbury patch of Heather was indigenous. The discoveries soon afterwards in Nova Scotia and Cape Breton still left a wide hiatus. This was partially bridged over by the detection by Mr. Pickard, a Scotch gardener, of a similarly very restricted station in Maine, or Cape Elizabeth, near Portland. We have now the satisfaction of recording a second station in Massachusetts, not far from the former one. Mr. James Mitchell, of Andover, is the present discoverer, and the station is in the western part of Andover, half mile north-east of Haggett's Pond, and five miles north of Tewkesbury station. Mr. Mitchell accidentally met with this patch last summer when berrying, and being a Scotchman, recognized it, took home a sprig of it, and at a subsequent visit, grubbed up one or two small plants, which a neighbor still has in cultivation. A fresh branch taken by him from the wild plants this summer is now before me. It proves to be of the green and smoothish variety of Calluna, precisely like the Tewkesbury plant. Small as the new patch is said to be, it will serve to confirm the opinion long ago expressed, for a second station greatly diminishes the very small chance of its having been casually or in any way introduced through human agency. It should also be noted, that this station, as I am informed by Rev. Mr. Wright, is near an extensive glacial moraine which traverses that district, and which he has traced for a great distance northward.

ASA GRAY.

It will be observed that we have now knowledge of six stations in Nova Scotia, two in Newfoundland, two in Massachusetts, and one in Maine, making in all eleven stations on the Atlantic seaboard of North America.

G. L.

ART. IX.—A NOTE ON THE CARIBOU. BY R. MORROW.

(*Read March 13th*, 1876.)

IN Captain Hardy's "Forest Life in Acadia," page 125 is the following:

"With regard to the barren ground Caribou (*R. grœnlandicus*) "being distinct from the larger animal of the forests, the separation "of the two as species by Professor Baird, of the Smithsonian Insti- "tution at Washington, * * * * * * joined with the "opinion expressed by Sir John Richardson * * * * * * "and the further testimony of Dr. King, surgeon to Back's expedi- "tion, appears to leave no room for doubt;" and again, "Dr. King "mentions that the barren ground species is peculiar not only in "the form of its liver, but in not possessing a receptacle for bile."

Referring to the above, I would like to record in our Transactions the following note:

Our Caribou (woodland var.) has a peculiar liver, rather small, ovate, long diameter nine inches, short diameter six inches, (from an animal supposed to be about eighteen months old,) situated on the right side, long diameter nearly parallel with the back bone, divided almost in the centre by a shallow sulcus, and having a protuberance, or small somewhat conical lobe, which the butcher calls a button, upon the upper part of the concave side with a broad base, and another very small one like a flat teat,* in the same line as the large one, one and a half inches below it, in size about half an inch long, three eights of an inch wide, and about one eighth of an inch thick; and it has no gall bladder. It is more than probable that this form of liver and absence of the gall bladder is common to the deer tribe: Goldsmith says "all the deer tribe want the gall bladder."

I have never seen a barren ground Caribou, nor any description of the animal giving the peculiarity in the form of the liver of this species, so called; but the structure of the barren ground and woodland varieties of Caribou is most likely the same, and the difference in size and horns is probably due to climate and food, while the migrations in contrary directions of the two "varieties in the barren grounds" and "woodland districts" of Sir John Richardson, may be accounted for by the fact that each is taking its nearest course to the sea coast.

Our worthy President, Dr. Gilpin, in a paper read before the Institute, February 11, 1871, and published in the Transactions, says, speaking of the varieties, "Reindeer, Caribou, and Woodland Caribou, are their local names. In addition to this the extreme north possesses a deer smaller than any of those, with much larger horns, and with no gall bladder; otherwise the same. Sir John Richardson calls them a permanent variety, naming them Barren Ground Caribou. The absence of the gall bladder seems a very great divergence; yet can any one tell me has our Caribou one?" With regard to the gall bladder I know that Dr. Gilpin has been for some time aware that our Caribou does not possess one, but he has not mentioned the peculiar form of the liver, nor do I think that it has been previously noticed.

* This is not always present.

APPENDIX.

Introduction to a Synopsis of the Flora of Nova Scotia.

By J. Sommers, M. D., *Prof. of Physiology, &c., Halifax Medical College.*

The catalogue of Nova Scotian species presented, is published by the Institute for the purposes of affording information and opportunity for comparison to Botanists in other localities.

Without pretensions to more than a check list of native and naturalized plants so far described, it may be accepted as the most complete synopsis of the Nova Scotian Flora yet offered.

It has been compiled with care from materials supplied by several observers working independently in different sections of the Province; corrections and additions have been made previous to placing it in the hands of the publisher, and a further guarantee of its accuracy will be found in the correspondences existing between the different observers.

While claiming so much for it we are not unmindful of what the scientific Botanist will learn from a glance, viz., its imperfectness; since he cannot fail to notice that while the Penerogamia exclusive of Cyperaceæ, and Graminæ are nearly complete, the Cryptogamia, excepting Filices and Lycopodiace, are but sparingly represented, the deficiency being owing to want of application, rather than the want of material upon which to work.

It is hoped, that the success which has attended the investigations, " of the Rev. E. Ball, a member of the Institute" into the number and variety of our native ferns, will serve to stimulate those who have the requisite skill and leisure, to attempt the same for the remaining orders of this division of our Flora, nor will the labor so applied yield less gratifying results.

The subarctic character of our flora will be observed from a study of our list. Another feature deserving attention is the preexistence of ancient forms, " also characteristic of our fauna," and probably owing to our woodlands consisting largely of coniferous trees, having served as an asylum, preserving them in situ not unlikely since the recession of the glacial period which scattered their congeners and descendants over the vast expanse of the

American continent in so much that our provincial flora presents as it were an epitome of the subarctic species found in the south and west.

The presence of common heather in our flora is interesting from affording an additional link to the chain of evidence which is indicative of relationship with the flora of northern Europe. It has been affirmed that true heath, calluna vulgaris, is not indigenous to America. Prof. Asa Gray, who is universally regarded as an authority, entertains a contrary opinion, and Prof. George Lawson in a former vol. of the Society's Transactions has afforded sufficient evidence of its existence in Cape Breton and Newfoundland, to strengthen the foundations of this opinion. Later still a new locality has been found in the vicinity of Halifax. Taking these with its existence in New England, where it was first discovered, we have sufficient grounds for claiming it as a native species.

The argument against its nativity, and in favor of its being introduced is founded upon its sparcity, but it may be said of this as of other rare species,—they are the remnants of more extensive communities, which, owing to unfavorable conditions have been caused to disappear, so that their present localities may be regarded as their final strongholds in our continent.

That the circumstance of rare occurrence does not always militate against the spontaneity of a species, is exemplified in our list by the presence of the Rhododendron Maximum, whose northern limit was confined to the New England States; yet one locality here has lately yielded specimens of this plant, which up to the present time, has been discovered no where else in the Province. Amongst our ferns also we find, asplenium, trichomanes, woodsia ilvensis, and aspidium, fragrans, rare, and confined to few localities, yet we doubt not of their being indigenous.

We need but make mention of the operations of the agriculturist and lumberman in a country like ours, to have them recognized as effective causes, ever tending to change the character of our flora by producing the elimination of native, and affording favorable condition for the naturalization of foreign species. If we add to these influences the destructive fires which ravish our woodland annually, we find in them sufficient reasons for the supposition that species found, rare, and in sequestered places, are more probably native forms seeking refuge from extinction, than immigrants seeking establishment on a new soil.

'Tis true some introduced plants possess remarkable powers of spreading, and will sometimes be found in places very remote from civilization; nevertheless in the vast majority of instances these species are found only in the vicinity of human habitations, i. e. cleared lands and pastures where they have room to spread, and dispute the soil with native plants but even here they do not always obtain exclusive possession; many native plants possess such vigorous powers of reproduction that they very often compete so successfully with the immigrants as to obtain the mastery in the occupation of cleared lands, which are neglected by the husbandman.

ABBREVIATIONS USED IN THE CATALOGUE.

H.=Herbarium (Prov Museum) Prof. How, D. C. L., Kings' College, Windsor, N. S.

Ln.= " Prof. Lawson, Ph. D., L.L.D., Dalhousie Coll., Halifax, N. S.

S.= " Prof. Sommers, M. D., Halifax Medical College.

K.= " A. H. McKay, B. A., Principal Pictou Academy.

B.= " Rev. E. H. Ball, (St. Luke's) Halifax, N. S.

C.= " D. A. Campbell, M. D., C. M., Halifax Medical College.

Ly.= " A. W. H. Lindsay, M. D., Halifax, Nova Scotia.

n means near.

A CATALOGUE OF THE FLORA OF NOVA SCOTIA,

Arranged according to Gray's Manual of Botany for the N. United States of America. By A. W. H. L.

EXOGENS.

	Hants Co.	*Halifax Co.*	*Pictou Co.*	*Et Al.*
RANUNCULACEÆ.				
Clematis Virginiana, L.	Falmouth, H.	Bedford, Ln.	Pictou, K , Ly	Wilmot. Annap H. Whycocomah, C.B., Ly
Anemone Pennsylvanica, L.				n Truro, Colchester, C.
Hepatica triloba, Chaix.	Falmouth, H.			Bridgewater, Lunen., B.
Thalictrum Cornuti, L.	Windsor, H.	n Bedford, Ly., Ln. Halifax, S.	Pictou, K.	Str. Canso, Guysb., B.
T. Cornuti L. var?		Bedford, Ln.		
Ranunculus aquatilis, L. var. trichophyllus, Chaix.				n Truro, C.
R. multifidus, Pursh.	Windsor, H.			n Sydney B..r, C.B., H.
R. Flammula, L. var. reptans		Dartmouth, Ly. Ln. Hx S		
R. Cymbalaria, Pursh.	Avon Riv., H.	Musquodoboit River, Ly Bedford, Ly., Ln., S. Sable Island	Pictou, K.	
R. abortious, L.			Pictou, K.	n Truro, C.
R. recurvatus, Poir.			Pictou, K.	
R. Pennsylvanicus, L.			Pictou, K.	
R. repens, L.		Halifax, Ln., S. Ly.	Pictou, K.	Port Mulgrave, B.
R. acris, L.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	Port Mulgrave, B.
Caltha palustris, L.				Mahone Bay, B
Coptis trifolia, Salisb.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	Manchester, Guysb., B.
Aquilegia Canadensis, L.		N. W. Arm, Halifax, S.		
A. vulgarus, L. (garden escape)		n Princes Lodge, Ln., Ly.	n Pictou, K.	
Actæa spicata, L. var. rubra Michx.	Windsor, H.	Halifax, Ln., Ly.	Pictou, K.	Str. Canso, Guysb., B. Truro, Colchester, C.
A. alba, Bigel.	n Windsor, H.		n Pictou, K.	Strait Canso, B., Truro, C.
NYMPHÆACEÆ.				
Brasenia peltata, Pursh.		Rocky Lake, Ln. Ly.		
Nymphæa odorata, Ait.		n Halifax, Ln., S., Ly.	Pictou, K.	
Nuphar advena, Ait.		Halifax, Ln., Ly. S.,	Pictou, K.	Cape Breton, H.
SARRACENIACEÆ.				

			Pictou, K.	Manchester, Guysb., B.
Coptis trifolia, Salisb.	Windsor, H.	Halifax, Ln., S. Ly.		
Aquilegia Canadensis, L.		N. W. Arm, Halifax, S.		
A. vulgarus, L. (garden escape)		n Princes Lodge, Ln., Ly.	n Pictou, K.	{ Str. Canso, Guysb., B.
Actæa spicata, L. var. rubra } Michx.	Windsor, H.	Halifax, Ln., Ly.	Pictou, K.	{ Truro, Colchester, C.
A. alba, Bigel.	n Windsor, H.		n Pictou, K.	Strait Canso, B., Truro, C.

NYMPHÆACEÆ.				
Brasenia peltata, Pursh.		Rocky Lake, Ln. Ly.		
Nymphæa odorata, Ait.		n Halifax, Ln., S., Ly.	Pictou, K.	
Nuphar advena, Ait.		Halifax, Ln., Ly. S.,	Pictou, K.	Cape Breton, H.
SARRACENIACEÆ.				
Sarracenia purpurea, L.	n Windsor, H.	Halifax, Ln. S. Ly.	Pictou, K.	{ Cape Breton, H. { Mahone Bay, B.
PAPAVERACEÆ.				
Papaver somniferum, L.		{ n dwellings, Ln. { in some places escaped.		
Sanguinaria Canadensis, L.			Pictou, K.	n Truro, C. Ly.
UMARIACEAE.				
Diceutra Canadensis, D.C.				
D. Cucullaria, D.C.				n Truro, C. Ly.
Corydalis glauca, Pursh.	Windsor, H	N.W. Arm, Halifax, S. Ly	Pictou, K.	
CRUCIFERÆ.				
Nasturtium officinale, R. Br.	{ Bet. Wind. { & Newpt. H			Truro, C.
Cardamine rhomboidea, D. C.			Pictou, K.	
C. hirsuta, L.	n Windsor, H.		Pictou, K.	n Truro, C. Ly.
Barbarea vulgaris, R. Br.		n 4 mile Ho., Halifax, Ln	Pictou, K.	
Sisymbrium officinale, Scop.			Pictou, K.	
Sinapis nigra, L.		Halifax, Ly.		
Lepidium intermedium, Gray.			Pictou, K.	Parrsboro, Cumb., H.
L. ruderale, L.	Windsor, H.			Sydney Bar, C. B., H.
Capsella Bursa-pastoris, M.	Introd.	{ near dwellings. { Halifax, Ln., Ly., S.	Pictou, K.	Introd.

	Hants.	Halifax Co.	Pictou Co.	Et. Al.
CRUCIFERÆ.				
Cakile Americana, Nutt.		Halifax, S.	Pictou, K., Ly.	Oyster Pond, Guysb., B.
Raphanus Raphanistrum, L.				Annapolis, K.
Dentarea diphylla, L.			Pictou, K.	
VIOLACEÆ.				
Viola rotundifolia, Michx.	Teny, Cape H.			
V. lanceolata, L.		n Halifax, Ly., Ln., S.		Annapolis, K.
V. blanda, Willd.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	Truro, C.
V. cucullata, Ait.	n Windsor, H.	Halifax, Ln , S. Ly., Musquodoboit, Ly.	Pictou, K.	Truro, C.
V. sagittata, Ait.		n Halifax, Ly., S.		
V. ovata, Nutt.		N. W. A., Halifax, Ly. Pt. Pleasant, " Ln.		
V. pubescens, Ait.			Pictou, K.	n Truro, C. Ly., Strait Canso, B.
V. tricolor, L.		Rocky Lake, Ln.		
V. odorata, L.			Gard, esc. K.	
CISTACEÆ.				
Hudsonia ericoides, L.		McNab's Isd., H. S.		
H. tomentosa, Nutt.		N. W. Arm, Halifax, S.		
DROSERACEÆ.				
Drosera rotundifolia, L.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	Oyster Ponds, Guysb., B.
D. longifolia, L.		Halifax, Ln., S. Ly.		
HYPERICACEÆ.				
Hypericum perforatum, L.	Windsor, H.	Halifax, S.	Pictou, K.	

HYPERICACEÆ.				
H. corymbosum, Muhl.		Halifax, Ln., Ly.		
H. ellipticum, Hook.				
H. mutilum, L.	Windsor, H.	Dartmouth, Ly.		Wilmot, Annap., H.
H. Canadense, L.	Windsor, H.	Halifax, Ly. S.		
Elodes Virginica, Nutt.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	
CARYOPHYLLACEÆ.				
Saponaria officinalis, L.		12 M. Ho., W. Road, Ln.		
Silene noctiflora, L.		Aweed, Lucyfield, Ln.		
Lychnis vespertina, Sibth.				
L. Githago, Lam., (introd.)		Halifax, S.	Pictou, K.	Annnapolis, K.
L. dioica, L., (introd.)				Str. Canso, Guysb., B.
Arenaria serpyllifolia, L.		Halifax, Ln.		Kentville, Ln.
A. lateriflora, L.	n Windsor, H.	{ Cow Bay, Halifax, Ly., n. Halifax, S.	Pictou, K	
Stellaria media, Smith, (intro.)	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	
S. longifolia, Muhl.				
S. longipes, Goldie.		Halifax, Ln., Ly.		Margaretville, H.
Cerastiumvulgatum, L.		Halifax, Ly., Ln. S.	Pictou, K.	
C. viscosum, L.		Halifax, S. Ly.	Pictou, K.	
C. nutans, Raf.		Win. Junction, Ln., Ly.		
C. arvense, L.			Pictou, K.	
Sagina procumbens, L.		Bedford, Ln., Ly.	(Pictou, K. ?)	
S. nodosa, Fenzl.		Halifax, S.	Pictou, K.	
Spergularia rubra, Presl. var. campestris. }	Windsor, H.	Halifax, Ln., Ly. S.	Pictou, K.	
Var. Marina.		Pennant, S.		
S. media, Presl.			Pictou, K.	
Spergula arvensis, L., (intro.)	Windsor, H.	Halifax, S.	Pictou, K.	
Honkenya peploides, D. C.		Pennant, S.		

	Hants.	Halifax Co.	Pictou Co.	Et. Al.
PORTULACACEÆ.				
Portulaca oleracea, L.				Com. in Cornwallis, Ln.
Claytonia Virginica, L.			Pictou, K.	n Truro, C. Ly.
C. Caroliniana, Michx.			Pictou, K.	Hall's Harb., Kings' Co. Sherbrooke, Guysb., H. Port Mulgrave, B.
MALVACEÆ.				
Malva rotundifolia, L.	Windsor, H.		Pictou, K.	Kentville, H. C. Bretn, H, Mr Poole coll
M. moschata, L.				
M. borealis, Wallm.		Sackville, Ln.		
TILIACEÆ.				
Tilia Europaæ		Planted, Halifax, Ln.		
LINACEÆ.				
Linum usitatissimum, L.		In cultivated ground, Halifax, Ln.		
GERANIACEÆ.				
Geranium maculatum, L.	Windsor, H.	In fields, Halifax, Ly.		
G. Carolinianum, L.		Elmsdale, K.		
G. Robertianum, L.	n Windsor, H.		Pictou, K., Ly	Manchester, Guysb., B., Whycocomah, C.B., Ly.
Impatiens fulva, Nutt.	Windsor, H.	Halifax, S. Ln. Ly.	Pictou, K.	Whycocomah, C.B., Ly. Oyster Ponds, Guys., B.
Oxalis Acetosella, L.		Halifax, Ln., S. Ly.	Pictou, K.	Str. Canso, Guysb., B.
O. stricta, L.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	Str. Canso, Guysb., B.

Impatiens fulva, Nutt.	Windsor, H.	Halifax, S. Ln. Ly.	Pictou, K.	{ Whycocomah, C.B., Ly. { Oyster Ponds, Guys., B.
Oxalis Acetosella, L.		Halifax, Ln., S. Ly.	Pictou, K.	Str. Canso, Guysb., B.
O. stricta, L.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	Str. Canso, Guysb., B.
ANACARDIACEÆ.				
Rhus typhina, L.	{ cultivated, { Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	
R. Toxicodendron, L.		Bedford Basin, Ln., Ly.		{ Cumberland, K., { Whycocomah, C.B., Ln.
R. glabra, L.		n Chain Lakes, S.		
VITACEÆ.				
Vitis cordifolia, Michx.				Annapolis? Ln.
Ampelopsis quinquefolia, Micx.		Cultivated, Ln.		
SAPINDACEÆ.				
A. Esculus Hippocastanum, L.		Commonly planted, Ly.	Planted, K.	Annapolis, K.
Acer. Pennsylvanicum, L.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	
Acer. spicatum, Lam.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	
A. saccharinum, Wang.	Windsor, H.	Halifax, Ly.	Pictou, K.	Cape Breton, Ly.
A. rubrum, L.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	
POLYGALACEÆ.				
Polygala polygama, Walt.		Dutch Village, S.		
LEGUMINOSÆ.				
Cytisus Scoparius, Link.				{ naturalized, Shelburne, { (Mr. P. Jack, coll.)
Trifolium arvense, L.		Halifax ? Ln.		
T. pratense, L., introd.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	Str. Canso, B.
T. hybridum, L.		{ Fields and pastures, { Lucyfield, Ln.		
T. repens, L.		Halifax, Ly., Ln.	Pictou, K.	Str. Canso, B.
T. agrarium, L., introd.		Fields, Bedford, Ly.		(Sydney, C.B., K)?

	Hants Co.	Halifax Co.	Pictou Co.	Et. Al.
LEGUMINOSÆ.				
T. procumbens, L., intr.	Windsor, H.			
Melilotus officinalis, Willd.	Windsor, H.	N. W. Arm, S.	Introd.	
M. alba, Lam., intro.		Bellahill farm, Sackville, Ln.		
Medicago lupulina, L., intro.	Windsor, H.	Halifax, Ln. S.	Pictou, K.	
Robinia Pseudacacia, L.	Windsor, H.		Pictou, K.	
R. Viscosa, Vent.	Windsor, H.			
Vicia sativa, L., intro.		Elmsdale, K.		Parrsboro'—indig? H.
V. tetrasperma, L.	Windsor, H.	Halifax, S.		
V. sativa, L.		n Halifax, S., intro.		
V. cracca, L.		n Halifax, Ly. S., Hammonds Plains, Ln.		
Lathyrus maritimus, Bigelow.		Bedford, Ln., Ly., S.	Pictou, K., Ly.	
L. palustris, L.	Windsor, H.		Pictou, K.	
Apios tuberosa, Mœnch.			W. River, Ly.	
ROSACEÆ.				
Prunus Pennsylvanica, L.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	
P. Virginiana, L.	Falmouth, H.	Halifax, Ln., S., Ly.	Pictou, K.	
P. serotina, Ehrhart.		N. W. Arm, Hx., Ly., S.		
Spiræa salicifolia, L.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	Str. Canso, B.
S. tomentosa, L.	Windsor, H.	Halifax, Ly., S., Ln.	Pictou, K.	
Agrimonia Eupatoria, L.	Windsor, H.		Pictou, K., Ly	Truro, C.
Alchemilla arvensis, L.		Lucyfield, Ln.		St. Paul's, C.B., K.
Poterium canadense.				
Geum album, Gmelin.	Windsor, H.			Truro, C.
G. Virginianum, L.			Pictou, K.	
G. macrophyllum, Willd.				Middletown, Guysb., B., n Truro, C., Ly.

Poterium canadense.				Truro, C.
Geum album, Gmelin.	Windsor, H.			
G. Virginianum, L.			Pictou, K.	
G. macrophyllum, Willd.				Middletown, Guysb., B., n Truro, C., Ly.

Rosaceæ.				
G. rivale, L.	Windsor, H.	Dartmouth, Ly.	Pictou, K.	Str. Canso, Guys., & near Lunenburg, B.
Strictum.	Windsor, H.			
Potentilla Norvegica, L.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	Kentville, Kings Co., & Whycocomah, C B, Ly
P. Canadensis, L.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	
P. argentea, L.	Windsor, H.			n Truro, C. Margaretville, H. Kentville, Ly.
P. anserina, L.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	Bear River, Digby, H.
P. tridentata, Ait.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	
P. tormentilla.				
P. palustris, Scop.		C. Bay, Dartmouth, Ly.		St. Ann's, C.B., Ln.
P. Fruticosa, L.	Windsor, H.			C. B., K.
Fragaria Virginiana, Ehrhart.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	Cape Breton, Ly.
F. vesca, L., intro.	Windsor, H.	Halifax, Ln.		
Dalibarda repens, L.		(n Halifax, Ly ?)	Pictou, K.	Wilmot, Annap., H., Bloomfield, Digby, B.
Rubus odoratus, L.				Manchester, Guysb., B., cult'ed at Annaps., pos'bly fm. w plants, Ln
R. Chamæmorus, L.		Halifax, Ly., S.		Cape Breton, H., (Mr. Poole, coll.)
R. triflorus, Richardson,	Windsor, H.	Halifax, Ln., Ly.	Pictou, K.	
Rubus strigosus, Michx.	Windsor, H.	Halifax, Ln., Ly., S.	Pictou, K.	Cape Breton, Ly.
R. villosus, Ait.	Windsor, H.	Halifax, Ln., Ly., S.	Pictou, K.	
R. Canadensis, L.		Halifax, Ln., Ly., S.	Pictou, K.	
R. flacidus,		Great Beaver Bank, Ln.		
R. hispidus, L.		Halifax, S.	Pictou, K.	

	Hants Co.	*Halifax Co.*	*Pictou Co.*	*Et. Al.*
ROSACEÆ.				
Rosa Carolina, L.	Windsor, H.	Halifax, S., Ly.	Pictou, K.	Cape Breton, H., (Mr. H. Poole, coll.)
R. lucida, Ehrhart.		Halifax, Ly.	Pictou, K.	
R. blanda, Ait.		Halifax, Ly.	Pictou, K.	
R. rubiginosa, L.		n Bedford, Ln., Old Windsor Road.		Cumberland, K.
Cratægus Oxyacantha, L.		Halifax, Ln., Ly.		
C. coccinea, L.	Windsor, H.	Halifax, S.	Pictou, K.	
Pyrus arbutifolia, L.	Windsor, H.			
Var Erythrocarpa,		Bedford, Ln., S., Ly.	Pictou, K.	Str. Canso, B.
Var melanocarpa.		Rocky Lake, Ly.		
P. Americana, D C.	cultivated. Windsor, H.	Halifax, Ln., Ly , S.	Pictou, K.	
P. sambucifolia, Cham. & Sch.			Pictou, K.	
Amelanchier Canadensis, Torr. & Gr.	Windsor, H.	Halifax, Ln., Ly , S.	Pictou, K.	
A. Canadensis, var oblongifolia	Windsor, H.			
SAXIFRAGACEÆ.				
Ribes hirtellum, Michx.		Halifax, Ly., S.	Pictou, K.	
R. rotundifolium, Michx.	R. Avon, H. Windsor.	Halifax, S.	Pictou, K.	
R. lacustre, Poir.	R A von, H. Windsor.		Pictou, K.	
R. prostratum, L'Her.		Halifax, S., Ly.	Pictou, K.	
R. floridum, L.	n Brooklyn, H			
R. rubrum, L.	R. Avon, H. Windsor.			

SAXIFRAGACEÆ.				
R. aureum, Pursh.			Cultivated, K.	
R. nigrum, L.	Garden escape, H.			
Mitella nuda., L.	Windsor, H.			
Tiarella cordifolia, L.			Pictou, K.	
Chrysosplenium America-			Pictou, K.	n Truro, C., Ly.

R. floridum, L.	n Brooklyn, H			
R. rubrum, L.	R. Avon, H. Windsor.			

SAXIFRAGACEÆ.				
R. aureum, Pursh.			Cultivated, K.	
R. nigrum, L.	Garden escape, H.			
Mitella nuda., L.	Windsor, H.		Pictou, K.	
Tiarella cordifolia, L.			Pictou, K.	n Truro, C., Ly.
Chrysosplenium Americanum, Schwein.				Tatamagouche, K.
CRASSULACEÆ.				
Sedum acre, L.		n Bedford, Ln., Ly., Dutchville, S., introd.		
S. Telephium, L.			Garden es, Ly.	
S. Rhodiola, D. C.				Cape Breton? Ln.
HAMAMELACEÆ.				
Hamamelis Virginica, L.		n Halifax, Ln., S., Ly.	Pictou, K.	
HALORACEÆ.				
Hippuris Vulgaris, L.		Dartmouth and Cow Bay, Ly.		
ONAGRACEÆ.				
Circæa Lutetiana, L.			Pictou, K., Ly	
C. alpina, L.	Windsor, H.	Pennant, Hx., S., Cow Bay, Ly.	Pictou, K.	Str. Canso, Guysb., B.
Epilobium angustifolium, L.	Windsor, H.	Halifax, S., Ln., Ly.	Pictou, K.	
E. palustre, L., var. lineare,	Windsor, H.		Pictou, K.	
Var. albiflorum, intro.		Pennant, S.		
E. molle, Torr.				n Truro, Ly.

	Hants Co.	Halifax Co.	Pictou Co.	Et. Al.
ONAGRACEÆ.				
E. coloratum, Muhl.	Windsor, H.	Dutchville, S.	Pictou, K.	Parrsboro', H.
Œnothera biennis, L.	Windsor, H.	Halifax, Ln., Ly., S.	Pictou, K., Ly	
Œ. fruticosa, L.		{ Lucyfield, Ln. { Grand Lake, S.	Pictou, Ly.	
Œ. chrysantha, Michx.	Windsor, H.	N. W. Arm, Halifax, Ly.		
Œ. pumila, L.	Windsor, H.	Halifax, S.	(Pictou, K ?)	Str. Canso, Guysb., B.
Ludwigia palustris, Ell.				Wilmot, Annap., H.
CUCURBITACEÆ.				
Echinocystis lobata, Torr. & Gr.		Dartmouth, Ln.		
UMBELLIFERÆ.				
Hydrocotyle Americana, L.		n 3 Mile House, Halifax, Ln., Ly.		
Sanicula Marilandica, L.	n Windsor, H.			Truro, C.
S. canadenses, L.				Cape Breton, K.
Heracleum lanatum, Michx.			Pictou, K.	Margaretville, H.
Ligusticum Scoticum, L.		Halifax, Ln., S., Ly., int.	Pictou, K.	
L. actæifolium, Michx.				Parrsboro', H.
Cicuta maculata, L.		Halifax, Ln., S., Ly.	Pictou, K.	Truro, C.
C. bulbifera, L.			Pictou, K.	
Sium lineare, Michx.		Halifax, Ln., S.	Pictou, K.	{ Truro, C. { Wilmot, Annap., H.
S. latifolium, L.	Windsor, H.	Pennant, S.		
Osmorrhiza brevistylis, D.C.				East Mt. Onslow, C. Kentville, Kings, Marble Mt., C.B. } H.
Carum Carui, L.		An escape, Ln., Ly.	Truro, C.	Truro, C.

Osmorrhiza brevistylis, D.C.				Kentville, Kings, Marble Mt., C.B.	H.
Carum Carui, L.		An escape, Ln., Ly.	Truro, C.	Truro, C.	
UMBELLIFERÆ.					
Authriscus vulgaris, Pers.		introduced n Bedford, Ly.			
ARALIACEÆ.					
Aralia racemosa, L.		n Halifax, H.			
A. hispida, Minchx.	Windsor, H.	Halifax, S.	Pictou, K.	n S. River, Colch., Ly., Str. Canso, Guysb., B.	
A. nudicaulis, L.	Windsor, H.	Halifax, Ln., Ly., S.	Pictou, K.	Str. Canso, B.	
A. trifolia,		Cow Bay, Halifax, Ly.	n Dalhousie, K	n Truro, C.	
CORNACEÆ.					
Cornus Canadensis, L.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	Guysborough, B.	
C. circinata, L'Her.	n Windsor, H.				
C. stolonifera, Michx.	n Windsor, H.				
C. paniculata, L'Her.		Halifax, Ln., Ly.			
C. alternifolia, L.		Halifax, S.	Pictou, K.		
CAPRIFOLIACEÆ.					
Linnæa borealis, Gronov.	Windsor, H.	Halifax, Ln., Ly., S.	Pictou, K.	Guysboro' B. Cape Breton, Ly.	
Symphoricarpus racemosus, Michx.			Pictou, K.		
Lonicera ciliata, Muhl.	Windsor, H.	n Halifax, S.	Pictou, K.	n Truro, C., Ly.	
L. cærulea, L.		Pt. Pleasant, S., Ly., Oldham, K.			
Diervilla trifida, Mœnch.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.		
Sambucus Canadensis, L.	Windsor, H.	Bedford, Ln., n Halifax, S., Ly.	Pictou, K.		
S. pubens, Michx.		Halifax, Ly., S.	Pictou, K.		
Viburnum nudum, L.	Windsor, H.		Pictou, K.		

	Hants Co.	Halifax Co.	Pictou Co.	Et. Al.
CAPRIFOLIACEÆ.				
Viburnum Lentago, L.		Halifax, S.		
V. acerifolium, L.				Horton Mt., Kings, H.
V. Opulus, L.		n Halifax, S.	Pictou, K.	
V. lantanoides,	Windsor, H.	Halifax, S.	Pictou, K.	n Truro, C., Ly.
RUBIACEÆ.				
Galium asprellum, Michx.	Windsor, H.			Canso, B., intro.
G. trifidum, L	Windsor, H.	Halifax, S., Ly.	Pictou, K.	
G. triflorum, Michx.	Windsor, H.	Halifax, Ly., S.	Pictou, K.	
Sherardia arvensis, L.				Tatamagouche, Colch., K.
Mitchella, repens, L.	Windsor, H.	Halifax, Ly., Ln., S	Pictou, K.	
Houstonia cærulea,		Halifax, Ln., H., S., Ly.		
COMPOSITÆ.				
Eupatorium purpureum, L.	Windsor, H.	Bedford, S., Ln., Ly. Pennant River, S.	Pictou, K., Ly	Truro, C.
E. purpureum, L., Var?	Windsor, H.			
E. perfoliatum, L.	Windsor, H.	Beaver Bank, Ln., Bedford, S., Dutchville, S.	Pictou, K., Ly	
Nardosmia palmata, Hook.				Isle Madame, C.B., B.
Aster macrophyllus, L.	Windsor, H.			
A. lævis, L.		Halifax, S.		
A. cordifolius, L.			Pictou, K.	
A. Tradescanti, L.			(Pictou, K?)	
A. miser, L.		Halifax, S.		
A. simplex, Willd.	(Windsor, H?)	alifax, S.	Pictou, K.	
A. carneus, Noes.	(Windsor, H ?)			
A. longifolius, Lam.	Windsor, H.	Halifax, Ly , S.		

COMPOSIEÆ.				
A. puniceus, L.	Windsor, H.			
Var vimineus,		n Halifax, S.		
A. acuminatus, Michx.	Windsor, H.	Halifax, S.		
A. nemoralis, Ait.		Halifax, S.		
Erigeron Canadense, L.	Windsor, H.	Halifax, Ly., S.		
E. bellidifolium, Muhl.				

A. miser, L.		Halifax, S.	Pictou, K.	
A. simplex, Willd.	(Windsor, H?)	alifax, S.		
A. carneus, Noes.	(Windsor, H?)			
A. longifolius, Lam.	Windsor, H.	Halifax, Ly, S.		
COMPOSITÆ.				
A. puniceus, L.	Windsor, H.			
Var vimineus,		n Halifax, S.		
A. acuminatus, Michx.	Windsor, H.	Halifax, S.		
A. nemoralis, Ait.		Halifax, S.		
Erigeron Canadense, L.	Windsor, H.	Halifax, Ly., S.		
E. bellidifolium, Muhl.		Halifax, S.		
E. annuum, Pers.	Windsor, H.		Pictou, Ly.	
E. strigosum. Muhl.	Windsor, H.			
Solidago bicolor, L.			Pictou, K.	
S. bicolor, L., var. concolor,			Pictou, K.	
S. latifolia, L.	Windsor, H.	Halifax, S.		Str. Canso, B.
S. cæsia, L.		Halifax, S.		
S. Virga-aurea, L.	Windsor, H.	Halifax, S., Ly.		
Var?	Windsor, H.			
Var?	Windsor, H.			
S. sempervirens,		n Halifax, H.	Pictou, K.	
S. stricta, Ait.		Dutchville, S.		
S. altissima, L.		Halifax, S., Ly.		
S. Canadensis, L.	Windsor, H.	Halifax, Ly., S.		Str. Canso, Guysb., B.
S. serotina, Ait.	Windsor, H.			
S. gigantea, Ait.		Grand Lake, S.	Pictou, K.	
S. lanceolata, L.	Windsor, H.	Halifax, S.	Pictou, K.	Str. Canso, Guysb., B.
S. odora, Ait.		n Grand Lake, S.		
Inula Helenium, L.	Rawdon, B.			Horton, Kings, & Wilmot, Annap. } H.
Ambrosia artemisiæfolia, L.	Windsor, H.	Halifax, S.	Pictou, K., Ly.	
Xanthium strumarium, L.			Pictou, K., Ly.	
Rudbeckia hirta, L.				Tatamagouche, K.
Helianthus annuus, L.			Ab. dwel'gs. K.	

	Hants Co.	*Halifax Co.*	*Pictou Co.*	*Et. Al.*
COMPOSITÆ.				
Helianthus tuberosus, L.		An escape, Ln.		
Coreopsis discoidea, Torr. & Gray., (Sp.?)			Pictou, K.	
Bidens frondosa, L.	Windsor, H.		Pictou, K.	
B. connata, Muhl.	Windsor, H.		Pictou, K.	
B. cernua, L.	Windsor, H.	Halifax, Ly.		
B. chrysanthemoides, L.		Halifax, S.		
Maruta Cotula, D. C.	Windsor, H.	Halifax, S., Ly.		
Anthemis arvensis, L.		Halifax, S.		
Achillea Millefolium, L.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	Guysborough, B.
Leucanthemum vulgare, Lam.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	Guysborough, B.
Matricaria inodora, L.			Pictou, K.	
Tanacetum vulgare, L.		Halifax, Ln., Ly., S.		Kentville, H.
Artemisia caudata, Michx.			Pictou, K.	
A. vulgaris, L.				Annapolis, Ln.
A. biennis, Willd.	Windsor, H.			
A. Absinthium, L.			Pictou, K.	5 Islds., Cumb., H.
Gnaphalium decurrens, Ives.	Windsor, H.			
G. uliginosum, L.	Windsor, H.	Halifax, S., Ly.	Pictou, K.	
Antennaria margaritacea, R. Brown,	Windsor, H.	Halifax, S., Ly.	Pictou, K.	Wilmot, Annap., H., Canso, Guysb., B.
A. plantaginifolia, Hook.		Halifax, Ln., S., Ly.	Pictou, K.	
Erechthites hieracifolia, Raf.	Windsor, H.		Pictou, K.	
Cacalia suaveolens, L.	Windsor, H.			
Senecio vulgaris, L.		Dartmouth, Ly., Dutchville, S.	Pictou, K.	
S. palustris, Hook.				Mahone Bay, Lunenb., B.
S. aureus, L.		Halifax, S., Ly.		

Senecio vulgaris, L.		{Dutchville, S.	Pictou, K.	
S. palustris, Hook.				Mahone Bay, Lunenb., B.
S. aureus, L.		Halifax, S., Ly.		

COMPOSITÆ.				
Var. Balsamitæ.		Halifax, S.		
Var. lanceolatus, Oakes.	Windsor, H.			
Var. obovatus,		Halifax, S.		
S. viscosus, L.		Windsor Junction, Ln., Ly	Pictou, Ly., K.	
S. Jacobæa, L.			Pic. Ln Ly. K.,	n Whycocomah, C.B., Ly.
Centaurea nigra, L.		n Halifax, Ln., Ly., S.	Pictou, K.	Port Mulgrave, Guys; B.
Cirsium lauceolatum, Scop.	Windsor, H.	Halifax, Ln., Ly., S.	Pictou, K.	Canso, Guysb., B.
C. arvense, Scop.			Pictou, K.	
C. muticum, Michx.			Pictou, K.	
Onopordon acanthium, L.			Pictou, K.	
Lappa officinalis, Allioni.			Pictou, K.	
Var. major.		Halifax, S.	Pictou, Ly.	
Var. minor.			Pictou, K.	
Cichorium Intybus, L.		Halifax ? Ln.		
Leontodon autumnale, L.	Windsor, H.	Halifax, Ln., Ly., S.	Pictou, K.	Bayfield, Antig., B.
Hieracium scabrum, Michx.	Windsor, H.	Halifax, S.	Pictou, K., Ly	
H. Canadense, Michx.		Halifax, S.		
Nabalus albus, Hook.		Halifax, S., Ly.	Pictou, K.	
N. altissimus, Hook.	Windsor, H.			
N. Fraseri, D. C.	Windsor, H.			
Taraxacum Dens-leonis, intro.		Halifax, Ln., Ly., S.	Pictou, K.	Common everywhere.
Lactuca elongata, Muhl.	Windsor, H.	Halifax, S.		
Mulgedium leucophæum, D. C.			Pictou, K.	
M. pulchellum, Nutt.			Pictou, K.	
Sonchus asper, Vill.	Windsor, H.	Halifax, Ln., Ly., S.	Pictou, K.	
S. oleraceus, L.		Pennant, S.		
LOBELIACEÆ.				
Lobelia inflata, L.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	Truro, Colch., and Whycocomah, } Ly?

	Hants Co.	*Halifax Co.*	*Pictou Co.*	*Et. Al.*
Lobeliaceæ.				
L. Dortmanna, L.		n Halifax, Ln., Ly., S.		Mahone Bay, Lun., B.
Campanulaceæ.				
Campanula rotundifolia, L.		n Bedford, Ln.	Pictou, K.	Parrsboro', Cum., H., Truro, Col., Ly., C.,
Ericaceæ.				
Gaylussacia dumosa, Tr. & Gry.		N. W. Arm, Halifax, Ly. S		
G. resinosa, Torr. & Gray.		Halifax, Ly., Ln., S.	Pictou, K.	Mahone Bay, Lun., B. Kentville, Kings, H.
Vaccinium Oxycoccus, L.		n Halifax, Ln., S.	Pictou, K.	Cape Breton, H.
V. macrocarpon, Ait.		Halifax, Ln., S., Ly.	Pictou, K.	Parrsboro, Cumb., H.
V. Vitis-Idæa, L.		n Halifax, Ln., H., S., Ly.		Mahone Bay, Lunen., B.
V. Pennsylvanicum, Lam.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	
V. Canadense, Kalm.			Pictou, K.	
V. vacillans, Solander.		Halifax? S.		
V. corymbosum, L.		Halifax, Ln.		
Chiogenes hispidula, Tr. & Gr.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	Cape Breton, Ln.
Arctostaphylos Uva-ursi, Sprg.		near Rockhead, S.	Pictou, K.	
Calluna vulgaris, Salisb.		Pt. Pleasant, Halifax Harb., Ln. Ly.		Str. Canso and South side Bras d'or, Cape Breton. Ln
Epigæa repens, L.	Windsor, H.	Hifaax, Ln., S. Ly.	Pictou, K.	
Gaultheria procumbens, L.	Windsor, H.	Halifax, Ln., Ly., S.		Guysborough, B.
Cassandra calyculata, Don.	Windsor, H.	Elmsdale, K., Halifax, Ln., Ly., S.		
Andromeda polifolia, L.				Cape Breton, H.
Kalmia angustifolia, L.	Falmouth, H	Halifax, Ln., S., Ly.	Pictou, K.	

		Halifax, Ln., Ly., S.)		
Andromeda polifolia, L.				Cape Breton, H.
Kalmia angustifolia, L.	Falmouth, H	Halifax, Ln., S., Ly.	Pictou, K.	
ERICACEÆ.				
K. glanca, Ait.		Halifax, Ln., Ly., S.		Colchester, Kings; Mahone Bay.
Rhododendron Maximum, L.		n Beaver Dam Gold Mines, Sht. Harb., Ln. Mr. Archibald, coll.		
Rhodora Canadensis, L.	Windsor, H.	Halifax, Ln., Ly., S.	Pictou, K.	Str. Canso, Guysb., B.
Var. (white flowers.)		Col. Hardey, coll.		
Ledum latifolium, Ait.	Falmouth, H.	Halifax, Ln., S. Ly.	Pictou, K.	Str. Canso, Guysb., B.
Pyrola rotundifolia, L.		Bedford, Ly., Halifax, S.	Pictou, K.	Wilmot, Annap H. Canso, Guysb., B.
P. elliptica, Nutt.	Windsor, H.	Halifax, S. Ln. Ly.	(Pictou, K ?)	
P. secunda, L.	Windsor, H.	C. Bay, Dartmouth, & N. W. A., Hx., Ly., S.	Pictou, K.	Whycocomah, C.B., Ly; Oyster Ponds, Guys., B.
Moneses uniflora.	Windsor, H.	Cow Bay, Ly., Halifax, Ln., S., Ly.	Pictou, K.	Wilmot, Annap., H.
Chimaphila umbellata, Nutt.	Windsor, H.	Halifax, S., Ly.	Pictou, K.	n Salmon R., Col., Ly.
Monotropa uniflora, L.		Halifax, Ly., S.	Pictou, K.	Wilmot, Annap., H., Oyster Ponds, Guys., B
M. Hypopitys, L.			Pictou, K.	
AQUIFOLIACEÆ.				
Ilex opaca, Ait.		(Sheet Harbor, Ln?)		
I. verticillata, Gray.	Windsor, H.	Halifax, S., Ly.	Pictou, K.	Cape Breton, Ly.
I. glabra, Gray.		Halifax, S.		
Nemopanthes Canadensis, D.C.		Halifax, S. Ly.	Pictou, K.	
PLANTAGINACEÆ.				
Plantago major, L.		Halifax, Ly.	Pictou, K.	
P. maritima, L.	Windsor, H.	Halifax, Ln., S.	Pictou, K.	
Var. Juncoides.		Halifax, S.		

	Hants.	*Halifax Co.*	*Pictou Co.*	*Halifax Co.*
PLANTAGINACEÆ.				
P. lanceolata.		Lucyfield, Ln.		
PLUMBAGINACEÆ.				
Statice Limonium, L.	River Avon Windsor, H	Halifax harb., Ln., S. Ly.	Pictou, K.	
PRIMULACEÆ.				
Primula farinosa, L.				n Annapolis, K. Hall's Harb, Kings, H. n Truro, C.
P. Mistassinica, Michx.				
Trientalis Americana, Pursh.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K , Ly	Fort Mulgrave, Guysb, B.
T. Europæa, L.		Halifax ? Ln.		
Lysimachia stricta, Ait.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	Str. Canso, Guysb., B.
L. ciliata, L.		Elmsdale, K.		Wilmot, Annap., H.
L. thyrsiflora.			Pictou, K.	n Truro, Col. C., Ly.
Glaux maritima, L.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	Digby, H.
Anagallis arvensis, L.				
LENTIBULACEÆ.				
Utricularia vulgaris, L.		C. Bay, Dartmouth, Ly.		Lunenburg, B.
U. cornuta, Michx.		n Bedford, Ly., S., Ln.		
U. (sp.?)		Dartmouth, Ly.		
OROBANCHACEÆ.				
Epiphegus Virginiana, Bart.		n Bedford, Ln.	n Bedford, Ln.	
SCROPHULARIACEÆ.				
Verbascum Thapsus, L.	Falmouth, H.	n Halifax, Ln., S. Ly.	Pictou, K., Ly	

Epiphegus Virginiana, Bart.		n Bedford, Ln.		
Scrophulariaceæ.				
Verbascum Thapsus, L.	Falmouth, H.	n Halifax, Ln., S. Ly.	Pictou, K., Ly	

Scrophulariaceæ.				
Linaria Canadensis, Spreng.		Halifax, H.		
L. vulgaris, Mill.		Halifax, Ly., Ln.	Pictou, K.	Mahone Bay, Lun, B., Kentville, Kings, H.
Chelone glabra, L.	Windsor, H.	Halifax, S., Ln., Ly.	n Pictou, K.	Truro, C. Str. Canso, B.
Mimulus riugens, L.	Windsor, H.		Pictou, K.	Truro, C., Ly.
Veronica Anagallis, L.		Dartmouth, Ly.	Pictou, K.	
V. Americana, Schweinitz,	Windsor, H.		Pictou, K.	Mahone Bay, Lun, B., Kentville, Kings, H.
Var. Officinalis.		Halifax, S.		
V. scutellata, L.	Windsor, H.	Halifax, S.	Pictou, K.	
V. chamædrys, L.	Windsor, H.	Halifax, Ln., Ly.		
V. serpyllifolia, L.	Windsor, H.	Halifax, Ln , S., Ly.	Pictou, K.	
V. agrestis, L.	Windsor, H.			
Euphrasia officinalis, L.		Halifax, Ln., S. Ly.	Pictou, K.	Sydney Bar, C. B., H.
E. Odontites, L.	n Windsor, H.		Pictou, K.	Whycocomah, C.B., Ly.
Rhinanthus Crista-galli, L.		Halifax, Ly., S., Ln, intro	Pictou, K.	Oyster Pouds, Guys, B.
Pedicularis Canadensis.		Halifax, Ly., Ln., S.		
Melampyrum Americanum, Mx	Windsor, H.	Halifax, Ln., Ly., S.,	Pictou, K., Ly	Str. Canso, B. Truro, Col,. C.
Verbenaceæ.				
Verbena hastata.	Windsor, H.		W. River, Ly.	Whycocomah, Ly., Truro, C.
Labiatæ.				
Teucrium Canadense, L.			W. River, Ly.	
Mentha viridis.		Halifax, S.		
M. piperita, L.		Halifax, S., intro.	Pictou, K.	
M. aquatica, L.				n Truro, Ly.
M. sativa, L.			Pictou, K.	
M, Canadensis, L.	Windsor, H.	Halifax, S.	Pictou, K. Ly.	Colchester, Ly.

	Hants Co.	Halifax Co.	Pictou Co.	Et. Al.
LABIATÆ.				
Lycopus Europæus, L.	Windsor, H.	Halifax, S.	Pictou, K.	n Truro, C. Ly.
L. Virginicus, L.	Windsor, H.	Halifax, S.	Pictou, K.	
Calamintha Clinopodium, Bth.			Pictou, K.	
Hedeoma pulegioides, Pers.			Pictou, K.	
Nepeta Cataria, L.			Pictou, K.	
N. Glechoma, Benth.		Halifax, Ly., S. intro,		
Physostegia Virginiana, Benth.			Pictou, K?	
Brunella vulgaris, L.	Windsor, H.	Halifax, Ln., Ly., S. intr	Pictou, K.	Str. Canso, B.
Scutellaria parvula, Michx.		Halifax, S.		
S. galericulata, L.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	
S. lateriflora, L.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	
Galeopsis Tetrahit, L.	Windsor, H.	Halifax, S., Ly., intro.	Pictou, K.	Str. Canso, Guysb., B.
Stachys palustris, L.		Halifax, S.		
Leonurus cardiaca, L.			Pictou, K.	
BORRAGINACEÆ.				
Echium vulgare, L.			n N. Glas., H.	
Mertensia maritima, Don.		Halifax, Ln., Ly.		Parrsboro', Cumb., L.
Myosotis palustris,	Windsor, H.	Halifax, Ln., Ly., S.		
Var. laxa.	Windsor, H.			
Myosotis cæspitosa, Schultz,		n Halifax, Ln., Ly.	Pictou, K.	
M. arvensis, Hoffm.				Parrsboro', Cum., H., intr
Cynoglossum (sp ?)			Pictou, K.	
Borrago officinalis, L.		A garden escape in some places, Ly.		
CONVOLVULACEÆ.				
Ipomæa purpurea, Lam.			n dwellings, H	

CONVOLVULACEÆ.				
Convolvulus arvensis, L.			Pictou, K.	
Calystegia sepuim, R. Br.		n Halifax, Ln., Ly. S., Pennant, S.	Pictou, K.	Parrsboro', Cum., H.
C. spithamaeus, Br.				
SOLANACEÆ.				
Solanum nigrum, L.		Pt. Pleasant, H..		

CONVOLVULACEÆ.				
Convolvulus arvensis, L.			Pictou, K.	
Calystegia sepuim, R. Br.		n Halifax, Ln., Ly. S.,	Pictou, K.	Parrsboro', Cum., H.
C. spithamaeus, Br.		Pennant, S.		
SOLANACEÆ.				
Solanum nigrum, L.		{ Pt. Pleasant, H., McNab's Island, Ly.		
S. Dulcamara, L.		{ Hx. Willow Park, S., not climbing, introd.		
Lycopersicum esculentum, Mil.		{ spontaneous in one or two places, S., Ly.		
Hyoscyamus niger, L.		A garden escape, S.		
Datura Stramonium, L.				{ escaped from gardens, Mahone Bay, B.
GENTIANACEÆ.				
Menyanthes trifoliata, L.		Halifax? Ln.		
APOCYNACEÆ.				
Apocynum androsæmifolium, L	Windsor ,H.			
A. cannabinum, L.	Windsor, H.		Pictou, K. W. River, Ly.	Colchester, Co., C.
OLEACEÆ.				
Fraxinus Americana, L.	Windsor, H.	Halifax, S.		
F. sambucifolia, Lam.	Windsor, H.		Pictou, K.	
F. pubescens, Lam.		Halifax, Ln.		
CHENOPODIACEÆ.				
Chenopodium album, L.		A weed in gardens, Ly.	Pictou, K.	Canso, Guysb., B.
C. Botrys, L.		Sea shore Pennant, S.		

	Hants Co.	*Halifax Co.*	*Pictou Co.*	*Et Al.*
CHENOPODIACEÆ.				
Atriplex patula, L.				
Var. hastata,	Windsor, H.	Halifax, S., Ly.		
A. rosea, L.		n Halifax, Ln. S. Ly.		
Salicornia herbacea, L.	R. Avon, Windsor, H	Bedford Basin, Ln., Ly. S	Pictou har, K.	
S. Virginiea, L.		Halifax, S.		
Suæda maritima, Dumortier.		Bedford, Ln.	Pictou, K.	
Salsola Kali, L.		Halifax Harb., H., Cow Bay, Dart, Ly.	Pictou, K.	
POLYGONACEÆ.				
Polygonum Persicaria, L.	Windsor, H.	Halifax, S., Ly.	Pictou, K.	Canso, B.
P. Pennsylvanicum, L.	Windsor, H.			
P. incarnatum, Ell.				Strait Canso ? Guys., B.
P. Hydropiper, L.	Windsor, H.		Pictou, K.	Str. Canso, B.
P. aviculare, L.	Windsor, H.		Pictou, K.	Str. Canso, B.
P. maritimum, L.		Halifax, S.		
P. arifolium, L.		Halifax, Ly.		
P. sagittatum, L.	Windsor, H.	Halifax, S., Ly.	Pictou, K.	Oyster Pond, Guysb., B
P. Convolvulus, L.	Windsor, H.	Halifax, S.	Pictou, K.	
P. cilinode, Michx.		Halifax, Ly., S.		
P. dumetorum, L.		Halifax, S.		
Fagopyrum esculentum, Mœnc.		escaped from fields, Ly.	Pictou, K.	Guysboro' B.
Rumex verticillatus, L.			n Pictou, K.	
R. crispus, L., intro.		Halifax, S.		
R. obtusifolius, L.		Halifax ? Ln.		
R. Viridis,		n 3 mile Ho., Halifax, Ln., Ly.		
R. acetosella, L.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	Canso, Guysb., B.
CALLITRICHACEÆ.				
Callitriche verna, L.		Halifax, Ln.		
EUPHORBIACEÆ.				
Euphorbia Helioscopia, L.			Pictou, K.	
E. Cyparissias, L.		escaped from gardens, Ln.	Pictou, K.	
E. polygonifolia, L.			Pictou, K.	
EMPETRACEÆ.				

R. obtusifolius, L.		Halifax ? Ln.		
R. Viridis,		n 3 mile Ho., Halifax, Ln., Ly.		
R. acetosella, L.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	Canso, Guysb., B.
CALLITRICHACEÆ.				
Callitriche verna, L.		Halifax, Ln.		
EUPHORBIACEÆ.				
Euphorbia Helioscopia, L.			Pictou, K.	
E. Cyparissias, L.		escaped from gardens, Ln.	Pictou, K.	
E. polygonifolia, L.			Pictou, K.	
EMPETRACEÆ.				
Empetrum nigrum, L.		n Bedford, Ly., Lucyfield, Ln., Pennant, S., Win. Junction, &c., Ln.	Pictou, K.	Sherbrooke, Guysb., H. Mr. Poole, coll.
Corema Conradii, Torrey.		n Bedford, Ly., N. W. Arm, Hx., S.		Wilmot, Annap., H.
URTICACEÆ.				
Ulmus Americana, L.	in cultiva'n. Windsor, H		Pictou, K.	
Urtica gracilis, Ait.			Pictou, K.	Whycocomah, C.B., Ly.
U. dioica, L.			Pictou, K.	
U. urens, L.		n Bedford, Ln.,		
Humulus Lupulus, L.			Pictou, K.	Sydney, C.B., H.
CUPULIFERÆ.				
Quercus rubra, L.	Windsor, H.	Halifax, S. Ly.	(Pictou, K. ?)	
Fagus ferruginea, Ait.	Windsor, H.	Halifax, Ly. S.	Pictou, K.	
Corylus rostrata, Ait.		Dartmouth, S.	Pictou, K.	
Carpinus Americana, Michx.		Halifax, S.		(n Moose River, An., H ?)
MYRICACEÆ.				
Myrica Gale, L.		n. Halifax, S.	Pictou, K.	Kentville, Kings, Ly., Wilmot, Annap. and Sydney, C.B., H.

	Hants Co.	*Halifax Co.*	*Pictou Co.*	*Et. Al.*
MYRICACEÆ.				
M. cerifera, L.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	Str. Canso, B.
Comptonia asplenifolia, Ait.	Windsor, H.	Halifax, Ln., Ly., S.	Pictou, K.	
BETULACEÆ.				
Betula alba, var populifolia, Sp	Windsor, H.	Halifax, Ly., S.	Pictou, K.	
B. papyracea, Ait.	Windsor, H.	Halifax, S.	Pictou, K.	
B. nigra, L.		Halifax, S.		
B. excelsa, Ait.	Windsor, H.	Halifax, Ln., S., Ly.		
B. lenta, L.			Pictou, K.	
B. lutea, Michx.			Pictou, K.	
Alnus incana, Willd.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	Str. Canso, B.
A. viridis, D.C.		Halifax, Ln., S.		
A. serrulata,		Halifax, S.		
SALICACEÆ.				
Salix tristis, Ait.		Halifax, S.		
S. humilis, Marshall,		Halifax, S.		
S. Muhlenbergiana,		Halifax, S.		
S. sericea, Marshall,		Halifax, S.		
S. alba, L.		Introduced, Ln.		
S. Chlorophylla, Anders.			Pictou, K.	
Populus tremuloides, Michx.		Halifax, S.	Pictou, K.	
P. balsamifera, L, var candicans		Halifax, Ln. S.	Pictou, K.	
P. dilatata, Ait.			Introduced, K.	
CONIFERÆ.				
Pinus Banksiana, Lambert.		{ Elmsdale, K., N. W. Arm, Hx., Ln.		

CONIFERÆ.				
Pinus Banksiana, Lambert.		Elmsdale, K., N. W. Arm, Hx., Ln.		

CONIFERÆ.				
P. resinosa, Ait.			Pictou, K.	
P. Strobus, L.		Halifax, S.		
Abies balsamea, Marshall,		n Halifax, S.		
A. nigra, Poir.		n Halifax, S.		
A. alba, Michx.		Pennant, S.		
A. Canadensis, Michx.		n Halifax, S.		
Larix Americana, Michx.		n Halifax, S.		
Thuja accidentalis, L.			(Pictou, K ?)	Cumberland, H. Cape Breton, Ln. Sydney, C.B., H. Patridge Is., Parrsboro', H Arisaig, H.
Cupressus thyoides, L.		3 Mile House, Halifax, Ln		
Juniperus communis, L.		Halifax, Ln., S., Ly.		
J. Virginiana, L.				
J. Sabina, L., var. procumbens,				
Taxus baccata, L., var. Canadensis,	Windsor, H.	Halifax, S.	Pictou, K.	Colchester, C.

ENDOGENS.

ARACEÆ.				
Arisæma triphyllum, Torr.	Hantsport, H.		Pictou, Ly.	Middletown, Gb., B., n Truro, Ly, Dr. Muir, col
Calla palustris, L.	Windsor, H.		Pictou, K., Ly	
Acorus Calamus,		Pennant Harb., S.		
TYPHACEÆ.				
Typha latifolia, L.		Halifax, S.	Pictou, K.	
T. angustifolia, L.		Beaver Bank, Ly.		
Sparganium eurycarpum, Eng. (Ramosum Huds,)		Halifax, S.	Pictou, K.	Oyster Ponds, Guysb., B.

	Hants Co.	*Halifax Co.*	*Pictou Co.*	*Et. Al.*
TYPHACEÆ.				
Sparganium simplex, Hudson.	Windsor, H.		Pictou, K.	
Var. augustifolium,		Halifax, S., Ly.		
NAIADACEÆ.				
Zostera marina, L.		Halifax, S., Ly.		
Potamogeton natans, L.		Cow Bay, Halifax. } Ly		
P. perfoliatus, L.		Cow Bay, Ly.		
P. lucens, L.			Pictou, K.	
ALISMACEÆ.				
Triglochin maritimum, L.	Windsor, H.	Halifax, Ln., Ly.	Pictou, K.	
Alisma plantago, L.	Wind so H	{ Halifax, Ln., Grand Lake, S.	Pictou, K. Ly	n Truro, Ly.
Sagittaria variabilis, Engelm.	Windsor, H.	Halifax, Ln., Ly.	Pictou, K.	{ Mahone Bay, Lun., B.; Truro, C.
HYDROCHARIDACEÆ.				
Vallisneria spiralis, L.		n Princes' Lo, Hx, Ln, Ly		
ORCHIDACEÆ.				
Habenaria tridentata, Hook.	Windsor, H.	Halifax, Ln., Ly., S.	Pictou, K.	Str. Canso, Guysb., B.
H. obtusata, Richardson,				n Truro, Ly
H. Hoskeri, Torr.	Windsor, H.	{ Dartmouth, Ly. Elmsdale, K.		
H. orbiculata, Torr.		Halifax ? Ly.	Mt Dalho'ie, K	{ n Truro, Colch., Ly., Clam Harb., Guysb., B.
H. blephariglottis, Hook.		Halifax, S.		Str. Canso, B.
Var. holopetala,		Bedford, Ly.		

H. orbiculata, Torr.		Halifax ? Ly.	Mt Dalho'ie, K	Clam Harb., Guysb , B.
H. blephariglottis, Hook. Var. holopetala,		Halifax, S. Bedford, Ly.		Str. Canso, B.

ORCHIDACEÆ.				
H. lacera, R. Br.	Windsor, H.	Halifax, S., Ly.	Pictou, K.	
H. psycodes, Gray	Windsor, H.	Bedford, Ln., Ly., Dutchville, S.	Pictou, K., Ly	Canso, B. Truro, C.
Goodyera repens, R. Br.			Pictou, K.	
G. pubescens, R. Br.				Salmon Riv., Truro, Ly. Canso, Guysb., B.
Spiranthes latifolia, Torr.	Windsor, H.	Halifax, S		
S. Romanzoviana, Chamisso.			Pictou, K., Ly.	Truro, Colch., and Whycocomah, C.B., Ly. Sandpoint, Guysb., B.
S. cernua, Richard.		Dartmouth, Ly. Halifax, S.	Pictou, K.	
S. gracilis, Bigelow.	Windsor, H	Halifax, S., Ly., Ln.	Pictou, K.	Oyster Ponds, Guy., B. n Truro, Col., Ly.
Listera cordata, R. Brown			Pictou, K.	n Truro, Ly., C. Breton, K
L. convallarioides, Hook.			M Dalh'sie, K	
Arethusa bulbosa, L.		Halifax, Ln., Ly., S.		Mahone Bay, Lunen., B.
Pogonia ophioglossoides, Nutt.		Halifax, Ln., Ly. S.	Pictou, K.	Cape Breton, H , Mahone Bay, B.
Calopogon pulchellus, R. Br.		Halifax, Ly., Ln. S.	Pictou, K.	Cape Breton, H. Mahone Bay, B.
Microstylis monophyllos, Lindl.		n Bedford, Ln., Ly., Halifax. S.		
M. ophioglossoides, Nutt.		n Bedford, Ln., Ly., Halifax, S.		
Corallorhiza innata, R. Br.	Windsor, H.		Pictou, K.	Canso, Guysb., B., Truro, Col., C.
C. odontorrhiza,		3 Mile Ho. Woods, S.		
C. multiflora, Nutt.		Halifax, S.		
Neottia Nidus-avis, L.		n Dartmouth, Ln., Ly.	Green Hill, Ly M Dalh'sie, K	Salmon River, Colch., Ly.

	Hants.	Halifax Co.	Pictou Co.	Et. Al.
ORCHIDACEÆ.				
Cypripedium pubescens, Willd.				Port Mulgrave, Guys., B.
C. spectabile, Swartz.			Pictou, K.	Hab? Ln.
C. acaule, Ait.	Windsor, H.	Halifax, Ly., Ln., S.	Pictou, K.	Guysborough, B.
Var. (white.)		N. W. Arm, Halifax, } Ly.		Truro, C.
IRIDACEÆ.				
Iris versicolor, L.		Halifax, Ln., S. Ly.	Pictou, K.	{ Sydney, C.B., H. { Canso, Guysb., B,
Sisyrinchium Bermudianum, L.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	
LILIACEÆ.				
Trilllium erectum, L.		Halifax, S., n Rockhead.		Hall's Harb., Kings, H.
T. cernuum, L.			Pictou, K.	
T. erythrocarpum, Michx.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	Pirate Harb., Guysb., B.
Medeola Virginica, L.	Windsor, H.	{ Dartmouth, Ln., Ly., { n Halifax, S.	Pictou, K.	
Uvularia sessilifolia, L.				n Truo, C., Ly.
Streptopus amplexifolius, D.C.	Windsor, H.		Pictou, K.	
S. roseus, Michx.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	Canso, Guysb., B.
Clintonia borealis, Raf.	Windsor, H.	Halifax, Ln., Ly., S.	Pictou, K.	Canso, Guysb., B.
Smilacina racemosa, Desf.		{ Dartmouth and { Bedford, Ln., Ly., { n Halifax, S.	Pictou, K.	Truro, C.
S. trifolia, Desf.	Windsor, H.		Pictou, K.	
S. bifolia, Kerr.	Windsor, H.	Halifax, Ln., Ly., S.	Pictou, K.	Guysborough, B.
S. stellata, L.			Pictou, K.	Truro, C.
Polygonatum biflorum, Ell.		n Halifax, Ly.	Pictou, K ?	

S. bifolia, Kerr.	Windsor, H.	Halifax, Ln., Ly., S.	Pictou, K.	Guysborough, B.
S. stellata, L.			Pictou, K.	Truro, C.
Polygonatum biflorum, Ell.		n Halifax, Ly.	Pictou, K ?	

LILIACEÆ.				
Lilium Canadense, L.				{ Whycocomah, CB., (Mr RG Fraser) Truro, Col C
Erythronium Americanum, Sm				Colchester, C., Ly.
JUNCACEÆ.				
Luzula campestris, D.C.		Halifax, Ln., Ly., S.		
Juncus effusus, L.	Windsor, H.	Bedford, Ly., S.	Pictou, K.	
J. filiformis, L.		Bedford, Ly.		
J. Balticus, Willd.			Pictou, K.	
J. Garardi, Loisel.	Windsor, H.			
J. acuminatus, Michx.		n Bedford, Ly., S.	Pictou, K.	
J. Marginatus, Rostkow.		n Halifax, S.		
J. ternuis, Willd.		n Halifax Common, S.		
PONTEDERIACEÆ.				
Pontederia cordata, L.	n Windsor, H.	Halifax, Ln., Ly., S.	Pictou, K.	{ Mahone Bay, B. Truro, C.
XYRIDACEÆ.				
Xyris bulbosa, Kunth.		Halifax, S.		
ERIOCAULONACEÆ.				
Eriocaulon septangulare, Witg.		Halifax, Ln., Ly., S.		Mahone Bay, B.
E. decangulare, L.		{ Withrod Lake, Ly., n Halifax, S.		
CYPERACEÆ.				
Dulichium spathaceum, Pers.		Halifax, S.		
Eleocharis tenuis, Schultes.		Halifax, S.		

	Hants Co.	*Halifax Co.*	*Pictou Co.*	*Et. Al.*
CYPERACEÆ.				
Scirpus validus, Vahl.		Moser's Lake, Cow Bay, Hfx., } Ly.		
Eriophorum vaginatum, L.		Halifax, Ly.		Truro, Col., Ly., Cape Breton, H, Mr Poole col Mahone Bay, Lun., B.
E gracile, Koch.	Windsor, H.	Halifax, S.		Cape Breton, H.
E. Alpinum, L.				Cape Breton, H., Mahone Bay, B.
E. polystachyon, L.				
Rhynchospora alba, Vahl.		N. W. Arm, Hfx., Ly.		
Carex Crus-corvi, Shuttleworth		n Bedford, Ln., Ly.		
C. stellulata, L., var. scirpoides,		Halifax, S., Ly.		
C. vulgaris, Fries.		Halifax, Ln., Ly.		
C. torta, Boot.		Halifax, S.		
C. fulva, Good.		Bedford, Ln.		
C. folliculata, L.		Halifax, S., Ly.		
C. pendula, Huds.		n Bedford, Ln., Ly.		
C ovalis, Good.		Halifax, Ln , Ly.		
C. Lupulina.		Halifax, S.		
C. dubitata, Dru.		Halifax, S.		
C. angustata, Boot.		Halifax, S.		
C. setacea, Dru.		Halifax, S.		
GRAMINEÆ.				
Alopecurus pratensis, L.		Bedford, Ln., Ly.		
A. geniculatus, L.		Pt. Pleasant, Ln. Ly.		
Phleum pratense, L.		Cultivated.		
Sporobolus (sp?)		n Prince's Lod., Ln., Ly.		

GRAMINEÆ.				
Agrostes, scabra, Willd.		Halifax, Ly., Ln. S.		
A. vulgaris, With.		Halifax, Ly., S. Bedford, Ln.		
Cinna arundinacea, L.		n Bedford, Ln., Ly.,		
Calamagrostis Canadensis, Bea				
Glyceria Canadensis, Trin.		[illegible]	Pictou, Ly.	

Alopecurus pratensis, L.		Bedford, Ln., Ly.		
A. geniculatus, L.		Pt. Pleasant, Ln. Ly.		
Phleum pratense, L.		Cultivated.		
Sporobolus (sp?)		n Prince's Lod., Ln., Ly.		

GRAMINEÆ.				
Agrostes, scabra, Willd.		Halifax, Ly., Ln. S.		
A. vulgaris, With.		{ Halifax, Ly., S. { Bedford, Ln.		
Cinna arundinacea, L.		n Bedford, Ln., Ly.,		
Calamagrostis Canadensis, Bea			Pictou, Ly.	
Glyceria Canadensis, Trin.		Prince's Lod., Ly.		
Poa pratensis, L.		Bedford, Ln., Ly.		
Poa alsodes, Gray.		Dartmouth, Ln., Ly.		
Festuca ovina, L.		Bedford, Ln., Ly., intro.		
F. arenaria.		n Bedford, Ln.		
F. duriuscula.		Pennant, S.		
Triticum repens, L.		N. W. Arm, Hfx., Ly.		
T. maritimum.		n Bedford, Ln., Ly.		
Hordeum jubatum, L.		Bedford, Ly.		
Elymus mollis, Trin.			Pictou, Ly.	
Aira flexuosa, L.		n Bedford, Ly., Ln.		
Hierochloa borealis, Ro. & Sch.		Bedford Basin, Ln., Ly. S		
Authoxanthum odoratum, L.		Bedford, Ln., Ly.		
Setaria verticillata.			W. River, Ly.	
S. viridis, Beauv.		Grand Lake, S.		

ACROGENS.

EQUISETACEÆ.				
Equisetum arvense, L.	Windsor, H.	Halifax, S.		
E. pratense, Ehrh.	Windsor, H.	Musquodoboit, Ly.	Pictou, K.	
E. sylvaticum, L.	Windsor, H.	Fields, Kempt Road, S.	Pictou, K.	n Truro, Ly. Dr. Muir col.
E. palustre, L.		n Bedford, Ln., Ly.,		

	Hants Co.	*Halifax Co.*	*Pictou Co.*	*Et. Al.*
EQUISETACEÆ.				
E. limosum, L.				Antigonish, K.
E. scirpoides, Michx.			Pictou, K.	
FIC S.				
Polypodium vulgare, L.	Windsor, H.	Halifax, Ln., Ly., S.	Pictou, K.	Str. Canso, Guysb., B.
Adiantum pedatum, L.	{ Newp't, Mrs Bennett? col			
Pteris aquilina, L.	Windsor, H.	Halifax, S., Ly., Ln.	Pictou, K.	Port Mulgrave, Guys., B.
Woodwardia Virginica, Sm.		{ N. W. A. & Dartmouth Mr. Harris coll.		
Asplenium Trichomanes, L.		n 3 mile Ho., Halifax, S.		Pirate Cove, St Canso, Gs, & Gold R, Chester } B.
A. thelypteroides, Michx.	{ Windsor, H Rawdon, B.	Halifax, S., Ly.	Mt Dalho'ie, K	Sherman's Mt., P Mulg., & Manchester, Guysb., B.
A. Filix-foemina, Beruh.	Windsor, H.	Halifax. Ln., Ly., S.	Pictou, K.	Str. Canso, Guysb., B.
Phegopteris polypodioides, Fée.	Windsor, H.	Halifax, S., Ln., Ly.	Pictou, K.	Port Mulgrave, Guys., B.
P. Dryopteris, Fèe.	Windsor, H.	Halifax, Ln., S. Ly.	Pictou, K.	Port Mulgrave, Guys., B.
Var ?	Windsor, H.			
Aspidium Thelypteris, Swartz.	Windsor, H.	{ Dartmouth, Ly. Halifax, S.	Pictou, K.	{ Port Mulgrave, B. Truro, C.
A. Novaboracense, Swartz.	Windsor, H.	Halifax, Ln., Ly., S.,		Port Mulgrave, B.
A. fragrans, Swartz.				Hartley's Waterfall, Pirate Cove, St Canso } B.
A. spinulosum, Swartz.	Windsor, H.	Halifax, S., Ly.	Pictou, K.	Port Mulgrave, Guys., B.
Var. intermedium,				Str. Canso, B.
Var. dilatatum,		Halifax, Ln., S., Ly.		Mahone Bay, Lunen., B.
Var. obliquum,		St. Margarets' Bay, B.		

Filices.				
Var. recuvatum,				Mahone Bay, Lun., B.
A. cristatum, Swartz.		n Halifax, Ly., S.	Pictou, K.	Port Mulgrave, Guysb, B.
A. Filix-mas, Swartz.				Whycocomah, C.B, Ly. K
A. marginale, Swartz.	Windsor, H.	N. W. Arm, Halifax, Ly / n Grand Lake, S.	Pictou, K.	Str. Canso, Guys., B. / Truro, C.
A. acrostichoides, Swartz.	Windsor, H.	Halifax, Ln., S., Ly.	Pictou, K.	Oyster Ponds, St Canso, B.
A. aculeatum, Swartz, / Var. Braunii, Koch				Ehlar's Waterfall, Guys, & Sherman's Mt. Pt. Mulgrave, B. / M'ble Mt, Bras d'or Lake, C. Breton. H.
A. lonchitis, Willd.				Cape Breton, K.
Cystopteris bulbifera, Bemh.				Hartley's Waterfall, Pirate Cove, St Canso, B.
C. fragilis, Bemh.			Springfi'ld & W. River, K	LaHave falls, N Gr, Lun Clam Har Riv & Reserve L, Manchester, Gus, B.
Var. McKayii, Lawson.			n M Dal'sie, K	
Struthiopteris Germanica, Wild	n Windsor n Falm'th Rawdon, B.		Pictou, K.	Truro, C.
Onoclea sensibilis, L.	Windsor, H.	Halifax, Ln., Ly., S.	Pictou, K.	Mahone Bay, Lunenb., B.
Woodsia obtusa, Torr.	Windsor fls, H			
W. Ilvensis, R. Brown.				Gold R, n Chester, Ln, B / Salt Mt Whycocomah, Cape Br. Ly. / n Truro, C.
Dicksonia punctilobula, Kunze.	Windsor, H.	Halifax, Ln., Ly. S.	Pictou, K.	Port Mulgrave, Guys, B.
Osmunda regalis, L. / Var. spectabilis,	Windsor, H.	n Halifax, Ln. S. Ly.	Pictou, K.	Prt. Mulgrave, B., Cape Br, H, Mr Poole, coll.

	Hants Co.	Halifax Co.	Pictou Co.	Et Al.
FILICES:				
O. Claytoniana, L.	Windsor, H.	n Bedford, Ln., Ly. Halifax, S.	Pictou, K.	Port Mulgrave, Guys., B.
O. cinnamomea, L.	Windsor, H.	Halifax, Ln., Ly,. S.	Pictou, K.	Port Mulgrave, B.
Var. frondosa,	Windsor, H.			
Botrychium simplex, Hitchk.	Windsor, H.			Cape Breton, K.
B. Virginicum, Swartz.			Pictou, K.	Sherman's Mt., Port Mulgrave, B.
B. lunarioides, Swartz.		n Princes' Lo., Hx., Ln.		
Var. obliquum,				Oakland's Lake Mahone Bay, B.
Var. dissectum,				New Germany, Lun., B.
LYCOPODIACEÆ.				
Lycopodium lucidulum, Michx	Windsor, H.	n Halifax, S., Ly.	Pictou, K.	
L. inundatum, L.		n Bedford, Ln., Ly. N. W. Arm and Pt. Pleasant, Ly.	n Pictou, Ly K	
L. annotinum, L.	Windsor, H.	Dartmouth, Ly. Halifax, S.	Pictou, K.	
L. dendroideum, Michx.	Windsor, H.	Halifax, S., Ly.	Pictou, K.	
L. clavatum, L.	Windsor, H.	n Halifax, S., Ly.	Pictou, K.	Truro, C.
L. complanatum, L.		Halifax, Ly., S.	Pictou, K.	Truro, C.
MUSCI.				
Sphagnum cymbifolium, Will.			Pictou, K.	
Sphagnum rubrum,		Halifax, Ln., Ly.		
S. acutifolium, Ehrn.			Pictou, K.	
Sphagnum, (sp ?)		N. W. Arm, Halifax, Ly.		

Musci.				
Polytrichum commune,		Halifax, Ly., Ln., S.	Pictou, K.	
Polytrichum juniperium,		Halifax, S.		
Atrichum undulatum,			Pictou, K.	
Bartramia pomiformis,			Pictou, K.	
Mnium punctatum,		n Bedford, Ln., Ly.		
M. Drummondii, Br. & Sch.				
M. cuspidatum, Hedw.			Pictou, K.	
Hypnum splendens,		Halifax, Ln.,	Pictou, K.	
Hypnum (sp ?)		Halifax, Ly.		
Pogonatum brevicaule,			Pictou, K.	
Dicranum polycarpon, Ehrh ?			Pictou, K.	
D. heteromallum,			Pictou, K	
D. undulatum, Turner.			Pictou, K.	
D. scoparium ?		Halifax, Ln., Ly.	Pictou, K.	
D. varium, Hedw.			Pictou, K.	
Funaria hygrometrica,		Halifax, Ln , Ly.		
Phascum subulatum,		n Halifax, S.		
Buxbaumia aphylla,		N. W. Arm, Halifax, } Ln.		
Leucobrium glaucum,		Halifax, Ln., Ly.		

MUSCI.—Additional,—Collected by A. H. McKAYE, Pictou Academy.

Ceratodon purpureus, Brid.
Leucobryum glaucum, Hempè.
Fissidens taxifolius, Hedw.
Fissidens (sp ?)
Trichostomum torlile, Schrad.
Tetraphis pellucida, Hedw.
Orthotricum Ludwigii, Schrad.
O. Crispum, Hedw.
O. crispulam, Hornsch.
Pogonatum brevicaule, Brid.
Atrichum angustatum, Beauv.
Aulacomium heterastichum,
Bryum pyriforme, Hedw.
B. annotinum, Hedw.
B. nutans, Schreb.
B. Capillare, Hedw.
B. cæspiticium, L.
Cylindrothecium seduatrix ?
Neckera pennata, Hedw.
Climacium Americanum, Brid.

Hypuum gracile, Brosch.
H. triquetrum, L.
H. Brevirostre, Ehrh.
H. Schreberi, Wild.
H. Cordifolium, Hedw.
H. Crista-castrensis, L.
H. Molluscum, Hedw.
H. Cupressiforme, L.
H. salibrosum, Hffm.
H. lætum, Brid.
H. elegans, Hooker.

HEPATICÆ.—A. H. McKaye.

Jungermania bicuspidata, L.
Frullania Grayana, Monta.
Madotheca platyphylla, Dum.
Ptelidium ciliare, Neez.
Trichocolea tomentella, Neês.
Mastigobryum trilobatum, Nees.

	Hants.	Halifax Co.	Pictou Co.	Et. Al.
Hepaticæ.				
Marchantia polymorpha, L.		Halifax, S., Ly.	Pictou, K.	
Jungermania sphagni, Dicks.		Halifax, S.		

THALLOGENS.

	Hants Co.	Halifax Co.	Pictou Co.	Et. Al.
Lichenes.				
Usnea barbata,		Halifax, Ln., S. Ly.	Pictou, K.	
U. plicata,		Halifax, S.		
Alectoria jubata,		Margaret's Bay, Ly.		
Cetraria Islandica				

Marchantia polymorpha, L.		Halifax, S., Ly.	Pictou, K.	
Jungermania sphagni, Dicks.		Halifax, S.		

THALLOGENS.

	Hants Co.	*Halifax Co.*	*Pictou Co.*	*Et. Al.*
LICHENES.				
Usnea barbata,		Halifax, Ln., S. Ly.	Pictou, K.	
U. plicata,		Halifax, S.		
Alectoria jubata,		Margaret's Bay, Ly.		
Cetraria Islandica,		Halifax, S.		
Scyphopherus cocciferus,		Halifax, Ln., S., Ly.		
S. pyxidatus.		Halifax ? Ln., S.		
Variolaria communis,		Halifax, S.		
V. amara,		Halifax, S.		
Peltidea horizontalis,		Halifax, S.		
Stereocaulon (sp ?)		Halifax, Ly.		
S. paschale,			Pictou, K.	
Parmelia parietina,		Bedford, Ly.		
P. olivacea,		Halifax, S		
P. herbacea,		Halifax, S.		
Umbilicaria pustulata,		N. W. Arm, Halifax, Ly.	Pictou, K.	
U. Muhlenbergii,		n Bedford, Ln., Ly.		
U. Dillenia,		n Margaret's Bay, Ly.		
Cornicularia jubata,				
Ramalina fraxinea,				
Sticta pulmonaria,		Halifax, S.	Pictou, K	
S. scrobiculata,			Pictou, K.	
Bæmocyes roseus,			Pictou, K.	
Cladonia extensa,			Pictou, K.	
C. bellidiflora,			Pictou, K.	
C. pixidata,		Halifax, S.	Pictou, K.	
C. rangiferina,		Halifax, Ln., S., Ly.	Pictou, K.	

	Hants.	Halifax Co.	Pictou Co.	Et. Al.
LICHENES.				
C. gracilis,			Pictou, K.	
Cladonia (sp ?)			Pictou, K.	
Cenomyce alicornis,		Halifax, S.		

ALGÆ.

*Alaria esculenta, Grev.	Rocks at low water mark ; Nova Scotia and S. to Cape Cod, Ln.
*Laminaria Fascia, Ag.	Rocks and stones near low water mark, Halifax Harbor, Ln.
*L. longicruris, Pylaie.	Abundant Halifax Harbour, below low water mark, Ln., Ly.
*L. digitata, Lam.	At and below low water mark, Halifax; common as far S. as Cape Cod, Ln.
*Agarum Turneri, Post & Rupr.	Below low water mark, off Point Pleasant, Halifax, Ln.
*Chorda Filum, Stack.	Abundant Bedford Basin, Halifax, between tide marks and extending into deep water, Ln.
*C. lomentaria, Lyngbye.	Coast of Nova Scotia and S. to Charleston, S. C., Ln.
Rhodymenia palmata.	Halifax Harbour, Ln., Ly.
Fucus vesiculosus.	Common on rocks and stones near low water mark, Ln., Ly.
Ptilota (sp ?).	Cow Bay, Halifax, Ly.

*Laminariaceæ of the Dom. of Canada, etc., by PROF. LAWSON, Trans. ; N. S. Inst. Nat. Sc , Vol. II., Part 4, Art. XI.

FIELD DAY.—INSTITUTE OF NATURAL SCIENCE.

THE Institute of Natural Science, pursuant to notice to its members, had an interesting Field Day, on Thursday, the 24th, August.

It happened on this occasion that pressing avocations on the part of some, and absence from Halifax on the part of others, prevented a general attendance; but fourteen gentlemen assembled, making a fair representation of the Sections which compose the Institute. They left for Grand Lake by the 8 a. m. train, and commenced explorations on their arrival at the Wellington Station. These were chiefly Geological, led by the Rev. Dr. Honeyman, the Honorary Secretary of the Institute. Several places were visited, where the smooth surfaces of the Lower Silurian, or even Lower Rocks, were exposed, and the glacial striation very plainly marked, the direction of which was S. 30°. W. by compass, with some slight variation caused probably by erratic movement of the abrading glacier, by which the country at one time must have been entirely covered. This course differs somewhat from the more plainly marked striæ of Point Pleasant, close to Halifax, where with slighter variation, it is about S 30°. E. The Lower Silurian is here, (coasting the Grand Lake,) entirely metamorphosed clay slate, penetrated by small bands or veins of quartz. It is the Gold district Onward, on the opposite side of the road, at a short distance, is the remarkable phenomenon of a *knoll* of carboniferous conglomerate, the remains possibly, of a carboniferous beach, lying on the upturned edges of the older strata, the intervening formations being all absent; but this being left, shows the changes our solid earth must have undergone during the past, almost unlimited, period of its eventful history. Other places were visited of Geological interest. Indications of travelled drift were frequent—syenite, greenstone, porphyries, and further onward, amygdaloid and other trap,—all serving to illustrate the conclusion of Dr. Honeyman, of their passage in one direction from the Cobequid range, in another from the region of Blomidon, and the Trap District of the Bay of Fundy.

Dr. Sommers, of the Botanical Section of the Institute, made an interesting collection of plants for his herbarium, assisted by other members of the Institute.

The Zoological Section had very little to do in the way of observation or collection, so far as wild nature was concerned. Some beautiful butterflies disported in the summer sunshine. The snakes, frogs and toads made themselves very scarce on this occasion.

In this way the time passed, until near 1 p. m., the party arrived at Oakfield, the extensive estate of Colonel Laurie, where they were met by the hospitable proprietor, and conducted to the top of his mansion, to view a splendid panorama of the surrounding country, embracing the

Grand Lake and other waters, in a ring of deciduous forest, forty or fifty miles in circumference. The estate is admirable for situation—apparently a peninsula bordered by the Grand Lake, and with the improvements that have been made, presenting a landscape eminently English in its aspect of green fields and cultivation—a worthy example to the Province at large. Col. Laurie's herd of domestic cattle, chiefly pure Devons, were a pleasing sight to all present. They are just admirable, and Nova Scotia will greatly benefit by their introduction. They ought to be, and are probably, well known to our Agricultural Associations, and to farmers and graziers throughout the country. It is a well recognized fact, that the Devon breed, of which Col. Laurie has so largely availed himself, is unsurpassed both for beef and the dairy, by any other description of horned cattle.

We shall not attempt to do justice to the generous hospitality with which Col. Laurie and his excellent lady welcomed the Institute. Suffice it that all were highly gratified. At length, in accordance with precedent, after the thanks of the Institute were accorded, through its representatives present, to Col. Laurie and Mrs. Laurie, for the attention so graciously bestowed, such of the members as had treasured observations on the route were called upon to give them utterance; when Dr. Honeyman produced a geological map of Nova Scotia, and showed therefrom very conclusively, by the evidence of stubborn facts, that during the glacial period there must have been an ice movement in the direction of the Atlantic coast, from the Cobequids on the one hand, and the Trap district on the Bay of Fundy on the other, each perceptibly traced, and to which were owing the travelled boulders, drift material and clay, now settled along the shores of Halifax Harbor, and the southern coast, etc.—probably the estate on which they stood owed its formation to such deposits. Several other members also made observations on matters with which they were conversant, and the guests arose.

After a further ramble through a shady avenue of trees to the beach of the Grand Lake, where a beautiful view was afforded of the entrance to the Shubenacadie, leave was taken of the generous host and hostess, and the Institute returned to town by the 7, p. m. train, well pleased with the day's excursion, the beautiful weather being an additional charm.

W. G.

ANNIVERSARY ADDRESS, 1876.

BY WM. GOSSIP, VICE-PRESIDENT.

IT is a duty imposed by the rules of the Institute, that at every recurring Anniversary Meeting the President shall deliver an Address, which shall embody some account of its present circumstances and future prospects. I did not expect that our worthy President, Dr. BERNARD GILPIN, would be in Halifax upon this occasion, and as the next in office, I prepared to comply with the requirements of the rule that imposes the duty. I am very glad that he has arrived in time to preside at this Annual Meeting, although I am not so well pleased that he persists in devolving upon me a duty of his office which he is so much better able to perform.

There may have been very little to communicate that was new or of much interest, at preceding anniversaries; and so far as I know there is little of importance to communicate now. But occasional non-observance of rules begets a general looseness of practice, which at length must have injurious effect upon the working of any institution. A short address, therefore, at our annual meetings, will not be at all inappropriate, and may help to create an interest in our proceedings; and this rule, which has not hitherto been carefully observed, being a good one, we should probably suffer, sooner or later if we forgot it entirely, from the absence of that systematic operation, wisely marked out for us by those who framed it, who took great pains, and followed the best examples at their command, to make the Institute thoroughly efficient.

I do not intend to occupy your time with scientific topics. Our concern, this evening, is more with matters connected with the management of the Institute. Even on these my knowledge is not so intimate or complete as it ought to be, and what I have to offer will be more suggestive than dogmatic.

It happens unfortunately, that our able Secretary, upon whom the chief burden of the work of the Institute rests, is at the Philadelphia Centennial Exhibition, in charge of the Nova Scotian contingent of that immense display of the ingenuity and labour of the nations of the world; and therefore some information must necessarily be omitted which otherwise would have been placed before you. It remains, however, in good hands. Further, with the opportunities he has enjoyed of being acquainted with the Exhibition, we may expect at some one of our ordinary meetings after his return, an animated description of much that was important and interesting there,—so that those of us who have not visited Philadelphia on this occasion, may have less reason to regret that we have remained at home.

To members present, unacquainted with the rules which govern the proceedings of the Institute, I may observe that our Annual or Anniversary Meeting takes place on the second Wednesday of October in every year. The outstanding accounts of the previous year are then submitted, examined and passed; the Treasurer's statement laid before you, and audited; also the state of our funds and their sufficiency to meet expenses incurred, and that have to be incurred. The officers for the ensuing year are then ballotted for and elected; new members proposed, and so far as possible the papers to be read at the ordinary monthly meetings, commencing on the second Monday of November, and ending May of the following year, provided for. All this business has been carefully attended to at previous anniversaries, by the Council of the Institute, and you will find that body ready to give any explanation that may be asked of them with reference to these or other matters that have come under their supervision. They meet every fortnight during the Winter session.

I am glad to say that our onward progress, if not all that could be desired, has been steady and assured. We are continually receiving accessions to the roll of membership. As to our finances, we have hitherto, and with the help of the Legislature, which has annually for some years past, voted us a small sum of money to enable us to publish our Transactions, kept out of debt. That assistance, which is amply repaid by the information we are thus enabled to send abroad of the natural resources of Nova Scotia, has become almost indispensable, inasmuch as it never has been very easy, although our books show the large number of some seventy members, to collect the full amount of subscriptions Means will, however, be adopted whereby it may be hoped such liabilities will be made more available for the support of the Institute. We may safely assert then, that our finances, if not flourishing, are in a satisfactory state, and that in so far we can go on our way rejoicing.

We are the more encouraged in our work, which is entirely disinterested, by the estimation in which the Institute is held by sister societies abroad. With some of the most celebrated among them we exchange our "Transactions," in which they evidently take a special interest. From Australia, from Canada, from most of the Scientific Associations of the United States; from Denmark, from Italy, from Germany, from Russia, from England and Scotland—we receive their publications. We also, occasionally, find in scientific periodicals, favorable notice of the work of our Institute. I may mention that we have published three bound volumes of our Transactions, covering twelve years of our existence, and can refer to them with some degree of pride, as the best works on the various sciences of Geology, Zoölogy, Botany, and Meteorology, &c., so far as Nova Scotia is concerned, that have ever issued from the Provincial press. And the fourth volume (making sixteen years work) goes bravely on, and will appear in due course of time.

That the small income of the Institute cramps its usefulness and prevents its expansion, must, I think, be evident to all. The insufficiency is felt in various ways. We want a more convenient place for our winter ordinary meetings, which cannot be had without trenching upon funds required for other necessary purposes. For our present accommodation we have been indebted principally to the Local Government, and next, to the kindness of Dr. Honeyman, our Honorary Secretary. Much as we desire to value the privileges so enjoyed, it would still be better, I think, if we had a convenient room we could call our own, in a central part of the city; and I venture the hope that some practical suggestion, that carried out may accomplish the result, will be made. We shall not affect to despise any assistance that may be afforded us, pecuniary or otherwise, in this behalf. In the meantime, we owe the Provincial Government thanks for its appreciation of the objects of the Institute, manifested in this and other modes in its behalf; and to Dr. HONEYMAN, for doing all in his power to make the Museum a convenient place for our meetings.

Our want of means also prevents us from adding to the Institute a library of publications on Natural Science, which would not only be a source of profitable amusement and intelligence to those of our members who are interested in such pursuits, but a great assistance to such of us as may feel inclined to take the trouble of composing papers on subjects which come within our knowledge, on which we may have arrived at some degree of proficiency. We already possess some valuable books of this description, but the want of many more is being felt continually.

We would also like to be able to invite to Halifax, occasionally, men celebrated in various walks of science, who might communicate by papers read before our Institute, or otherwise, some of the knowledge they themselves possessed. Such incentives to progress could not fail to be of service to the Institute, and valuable to the whole community.

It would likewise be pleasing to many of us if more of our members would furnish papers for the Ordinary Meetings. Accident ofttimes, and careful observation frequently, elicit facts and discoveries, which help to settle doubtful points of science, and all such would be very interesting at those meetings. At present, valuable as our monthly papers may be, and we believe are, we depend nearly altogether upon a stereotyped list of authors. We beg, however, to state, lest there may be some misapprehension on this head, that it is not because the papers read have been superior to others at our disposal, but because none other are submitted, that the same names are so often announced. We do not know of more than one instance where a paper written with fair grammatical accuracy, and treating of any branch of Natural Science, has been withheld. It might have been as well, perhaps, on occasion, that all had not been printed; but whenever there has been a question of orthodoxy, or a doubt of usefulness, or propriety, they have not been published without a reason given for their becoming a part of our Transactions. I mention this, because a periodical of this city is said to have contained some depreciatory observations on a paper of Mr. Dewar's, so published. Not having seen the critique, I am unable to judge whether, as respects the article in question, it was just or unjust; but the writer, whoever he may be, if disposed to find a reason for printing that paper, could not have failed to find it in the book of Transactions itself; and we hope we may be allowed to be the best judges of the most judicious mode of conducting our own affairs.

It would have given me much pleasure to state that we had observed the prescribed number of Field Days during the past summer. We have again fallen short of our rules in this particular. At the formation of the Institute it was supposed that those excursions would be generally taken advantage of, as pleasing and popular features of our proceedings. In no one year, however, since that time, has there been found much enthusiasm in their behalf, or willingness to engage in them. This may be attributed to the fact that each member of the Institute considers his public or private business of paramount interest, and the pursuit of science in this way quite a secondary object. I often think it a pity that it should be so at all times, and that we lose a large amount of knowledge and of profitable recreation by not attending to those pleasant meetings. I am glad however to record, that we have had one field excursion during the past summer, attended by thirteen members. The country explored lies between Wellington Station and the Grand Lake. Some interesting facts were pointed out by Rev. Dr. Honeyman, corroborative of the sequence of geological formations, and of a long continued ice drift of the glacial period, from the Cobequids. All present appeared highly delighted with the excursion; and on arriving at Oakfield, the estate of Colonel Laurie, we were handsomely entertained by the hospitable Colonel and his estimable lady.

That the Nova Scotian Institute, cramped as are its means and resources, has done and is doing a good work in and for the Province, it is impossible to deny. It is making us better known at home and abroad, creating an interest in our natural resources, active and inert, that is assisting their development, and paving the way for the introduction of capital and enterprise. Let us not, therefore, remit our exertions. Every member of the Institute can help the cause, — I may be pardoned in saying, can do more for it than he has hitherto done. There is no royal road to the acquirement of science. It demands to some extent self-sacrifice on the part of all who may profess a desire to encourage it. Dry as may be some of its details, they lie at the foundation of the wealth of nations, and its active votaries are all the better for the stimulus of judicious approval. There ought, gentlemen, to be a much larger attendance at our monthly Ordinary Meetings. Those who take the trouble to prepare papers for our instruction and amusement, and who find some eight or ten out of seventy members assembled to listen to them, cannot feel much inclination to repeat the task, or recommend it to others. Some of those papers have settled questions which concern our own Province in Geology and Zoölogy, in Botany and Meteorology, for all time to come. But there is a large amount of talent in this community, and amongst our own members, which has never yet engaged itself in our behalf, and from which good may be yet expected. We await with patience its development under favorable auspices. Meanwhile, with Rev. Dr. Honeyman in our Geological section, Dr. Bernard Gilpin, J. M. Jones and others in the Zoological; Professor Dr. Lawson, Rev. Mr. Ball and Dr. Somers in the Botanical; Frederic Allison, the Dominion Meteorologist, and others in cognate departments of Natural Science, we maintain and uphold our standing very well with kindred Institutions elsewhere; and our publications, to which I have before alluded, show that these gentlemen have not spared themselves in the service of the Institute, for the promotion of the laudable objects in which it is engaged.

I feel assured that we are all glad to know that Dalhousie College has come to the aid of Physical Science, and that there is every prospect of its becoming a permanent feature in her course of instruction. A shining light of Nova Scotia, Dr. McGregor, one of her Alumni, comparatively young in years, but who has already made his mark in the Universities of the world, is to be the first occupant of the new Chair. I can not affirm that the example of our own Institute has had any weight with Dalhousie in the determination—most probably none at all,—but of this I am sure, that the University is entering upon a course of study which, so far as the training of our youth is concerned, is second to none in importance in her whole curriculum, and which, if zealously persisted in, will place her higher than ever in the estimation of all orders of the community. We may, I hope, expect from the liberal character of the learned Professor, and also from the Alumni of his department, much assistance in our own work.* Our members cannot all be students of Dalhousie, but she may do herself honour beyond College bounds by lending her aid to the public enlightenment. Nay, this is part of the work to which she is appointed, and in its accomplishment she will best fulfil her destiny.

In conclusion of this general but imperfect summary of the doings of the Institute, I may as well say that I have been far from intending to deal harshly with shortcomings. These may be easily avoided or amended, and there is a bright side to the prospect, to which I would shortly advert. I remember that at our first Ordinary Meeting, fifteen years since, the present Provincial Secretary, still a member of the Institute, delivered the Inaugural Address. Then, the Marquis of Normanby, at that time our Lieutenant Governor, attended our meetings, and gave us in his plain, unvarnished but forcible style, a word of encouragement. After him Sir Richard McDonnell, another Lieutenant Governor, would have done us more honour than our conduct towards him deserved at his hands. I am compelled, in mentioning his name, to make this acknowledgment. Our Governors have invariably been our patrons, and have been pleased to preside whenever we have held a conversazione. We should like them to go a little farther than this, as some of their predecessors did not think it

* Which has since been rendered in an excellent Paper on Electricity delivered at one of our Ordinary meetings.

unwise to do,—but this also is quite capable of amendment. Chief Justice Sir William Young, a consistent member of our Institute, has frequently attended our meetings. The Bishop of Nova Scotia is also one of our members. A goodly list from among the clergy and the bar follow in their wake. We may hope soon to be an Incorporate Society, a status which we believe the Legislature will concede to us whenever we think proper to make the claim.

Upon the whole, then, there appears to be nothing that we can reasonably desire, that is not attainable by active and judicious management; and I express my perfect conviction that the Officers and Council of the Institute, whom you may elect to-night, will do their utmost to promote its efficiency in every way that may be desirable, that approves itself to their judgment.

Trusting that you will pardon me for occupying so much time with matters which principally concern ourselves, with which we are all more or less familiar, but which are not without a certain degree of significance to the community at large; and that you will excuse my rather lengthy performance on the ground of its infrequency,—we may now, with the sanction of the President, proceed with the election of officers for the ensuing year.

PROCEEDINGS

OF THE

Nova Scotian Institute of Natural Science.

VOL. IV. PART III.

Provincial Museum, Oct. 11, 1876.

ANNIVERSAY MEETING.

J. B. GILPIN, B. A., M. D., M. R. C. S., *President, in the Chair.*

Inter alia.

The following gentlemen were elected office-bearers for the ensuing year:—

President—J. B. GILPIN, M. D., &c.

Vice-Presidents—WILLIAM GOSSIP, F. ALLISON, M. A.

Treasurer—W. C. SILVER.

Joint Secretaries—Rev. D. HONEYMAN, D. C. L., &c.; J. T. MELLISH, M. A.

Council—A. P. REID, M. D., G. LAWSON, LL. D., &c.; Sheriff BELL, J. M. DEWOLFE, M.D., &c., J. SOMMERS, M D., L. G. POWER, ROBERT MORROW, AUGUSTUS ALLISON.

ORDINARY MEETING, November 13, 1876.

Dr. J. B. GILPIN, *President, in the Chair.*

The SECRETARY announced that the Council had elected Mr. GEOFFREY MORROW a member of the Institute.

The PRESIDENT exhibited a sketch of a piece of carved stone or rock which he had found near Digby. He thought that the characters were Aztec rather than Runic. Dr. Gilpin also exhibited a beautiful Indian pipe.

J. SOMMERS, M. D., then read a paper on the "*Compositæ of Nova Scotia*," and exhibited several preserved specimens of Asters, which he very minutely described. (*See Transactions.*)

ORDINARY MEETING, Dec. 11, 1876.

The PRESIDENT *in the Chair.*

The SECRETARY stated that Dr. DEWOLFE, of London, Eng., had been elected a corresponding member of the Institute.

The President, Dr. GILPIN, made some highly interesting and instructive observations on specimens laid on the table :—

1. On a specimen of the Head of a dead Pelican, found lying on the shore at Upper Prospect.

2. On a Stone Axe found in Dartmouth, and presented to the Museum by Mr. DONALD ROSS, of Dartmouth.

Mr. A. DEWAR then read a paper entitled: "*A New Theory of the Descent of Man*," after which a discussion took place in which the PRESIDENT, Dr. REID, Dr. SOMMERS, Honble. L. G. POWER, and Dr. J. G. MCGREGOR, took part.

ORDINARY MEETING, January 13, 1877.

The PRESIDENT *in the Chair.*

It was announced by Mr. MELLISH that Dr. J. G. MCGREGOR and Mr. J. P. HAGARTY had been duly elected members of the Institute.

The Rev. Dr. HONEYMAN read a printed communication from PRINCIPAL DAWSON, giving an account of a recent discovery of Fossil Batrachians in the Coal Formation of the South Joggins. This discovery added new Reptiles to the list already recorded as found at the Joggins by the author, and also threw new light on the whole subject. The communication is to be found in *Silliman's Journal.*

DR. A. P. REID then read a paper "On the Rates of Mortality in Ancient and Modern Times." The observations in the paper were general in character, and distinctly exhibited facts in favour of the view that the death rates have been much lower in modern than in ancient times. (*See Transactions.*)

ORDINARY MEETING, Feb. 12, 1877.

The PRESIDENT *in the Chair.*

The SECRETARY announced that he had received the Transactions of the Academy of Sciences of Davenport, Iowa, and also the first number of a similar publication from the National Historical Society of Brazil.

The Rev. Dr. HONEYMAN read a paper "On Nova Scotian Geology at the Centennial." After reading his paper, Dr. H. made some observations on the "*Eozoon Canadense*," (Dawson). Its nature was illustrated by beautiful microscopic sections prepared with great care by T. Weston, Esq., of the Geological Survey of Canada, and by *nummulites* partially and entirely filled with *glauconite*. Its foramenifera relations were illustrated by foramenifera from dredgings from H. M. S. *Challenger*. Dr. H. stated that there was difference of opinion in regard to the true nature of the *Eozoon*,—some regarding it as an organic and others as a mineral structure, while yet others were undecided. (*See Transactions.*)

ORDINARY MEETING, March 12, 1877.

The PRESIDENT *in the Chair.*

W. GOSSIP, Esq., Vice President, having taken the Chair, Dr. GILPIN read an interesting paper "On the Indians of Nova Scotia." The subject was illustrated by sketches and pictures by different writers. (*See Transactions.*)

ORDINARY MEETING, April 9, 1877.

The PRESIDENT *in the Chair.*

ROBERT MORROW, Esq., read a highly instructive paper "On the Anatomy of the Cariboo." The subject was illustrated by a number of specimens of the limbs, skin, head and other parts of the animal. (*See Transactions.*)

A paper was then read "On a new method of Measuring the Resistance of Electrolytes," by J. G. MCGREGOR, M. A., D. Sc., (Lond.) In this paper a new method was described combining the advantages of both Kohlrausch's method and of that described by Mr. EWING and the author in the Transactions of the Royal Society of Edinburgh (vol. xxvii.) The author had submitted his method to various tests, and had found that "polarization" had been eliminated, at least in so far that its effects could not be observed even with the most delicate instruments. The measurement of the resistance of electrolytes is thus rendered as easy as that of metallic conductors.

At the close of the lecture, Mr. MELLISH proposed some questions respecting lightning and the conducting power of the atmosphere, which Dr. McGregor satisfactorily answered.

ORDINARY MEETING, May 14th, 1877.

The PRESIDENT *in the Chair.*

It was announced that THOMAS WESTON, Esq., of the Geological Survey of Canada, had been elected a corresponding member; also, that the Rev. JOHN BURWASH, of Sackville, N. B., had been elected an associate member.

PROFESSOR LAWSON read a paper by Professor How, replete with scientific information, "On the Botany of Nova Scotia." (*See Transactions.*)

FREDERICK ALLISON, Esq., M. A., Chief Meteorological Agent, read his Report for the year 1876. The results of Mr. ALLISON'S services in the work of recording facts and determining laws respecting the meteorology of the Province are certainly of a most useful and valuable character. (*See Transactions.*)

J. T. MELLISH, M. A., communicated a paper by Professor Burwash, "On the Albertite Mines at Belliveau, New Brunswick." (*See Transactions.*)

LIST OF MEMBERS.

Date of Admission.			
1873.	Jan.	11.	Akin, T. B., D. C. L., Halifax.
69.	Feb.	15.	Allison, Augustus, Halifax.
69.	Feb.	15.	Allison, Frederick, *Chief Meteorological Agent*, Halifax.
64.	April	3.	Bell, Joseph, High Sheriff, Halifax.
63.	Jan.	8.	Bell, Thomas, F. G. S., Newcastle-on-Tyne, England.
73.	Jan.	11.	Binney, Edward, Halifax.
74.	April	13.	Black, G. P. Halifax.
64.	Nov.	7.	Brown, C. E., Halifax.
74.	Feb.	10.	Brunton, Robert, Halifax.
67.	Sep.	20.	Cogswell, A. C., D. D. S., Halifax.
74.	Apr.	13.	Colford, Henry, Halifax.
71.	Apr.	4.	Compton, William, Halifax.
72.	Apr.	12.	Costley, John, Halifax.
63.	May	13.	Cramp, Rev. Dr., Wolfville.
74.	Apr.	13.	Creighton, Aylwin, Halifax.
70.	Mar.	30.	Day, Forshaw, Artist, Halifax.
75.	Jan.	11.	Dewar, Andrew, Halifax.
63.	Oct.	26.	DeWolf, James R., M. D., Edin., L. R. C. S. E., *Vice-President*, Dartmouth.
63.	Dec.	7.	Downs, Andrew, *Corr. Memb. Z. S.*, London, Halifax.
75.	Dec.	13.	Edwards, Lieut. Hope, 60th Rifles, Halifax.
71.	Nov.	29.	Egan, T. J., Taxidermist, Halifax.
75.	Dec.	13.	Fairbanks, Lewis P., Dartmouth.
74.	Apr.	13.	Forbes, John, Manager of Starr Works, Dartmouth.
72.	Feb.	12.	Foster, James, Barrister-at-Law, Dartmouth.
76.	Mar.	13.	Fraser, J. F., Richmond, Halifax.
74.	Apr.	13.	Frith, G. R., Halifax.
63.	Jan.	5.	Gilpin, J. Bernard, M. D., M. R. C. S., *President*, Halifax.
63.	Feb.	2.	Gossip, William, *Vice-President*, Granville Street, Halifax.
76.	July	20.	Greville, Hon, Mr., 60th Rifles, Halifax.
63.	Jan.	26.	Haliburton, R. G., F. S. A., Halifax.
76.	July	20.	Hampton, William, Halifax.
63.	June	27.	Hill, Hon. P. C., D. C. L., Provincial Secretary, Halifax.
66.	Dec.	3.	Honeyman, Rev. David, D. C. L., F. G. S., &c., *Secretary, Prov. Museum*, Halifax.
68.	Nov.	2.	Hudson, James, M. E., *Superintendent of Albion Mines*, Pictou.
72.	Feb.	5.	Hunt, Rev. A. S., A. M., *Superintendent of Education*, Halifax.
74.	Dec.	10.	Jack, Peter, Halifax.

1873. Jan. 11. James, Alexander, Mr. Justice, Dartmouth.
63. Jan. 5. Jones, J. M., F. L. S., Halifax.
66. Feb. 1. Kelly, John, *Dep. Chief Commissioner of Mines*, Halifax.
64. Mar. 7. Lawson, George, Ph. D., L. L. D., *Professor of Chemistry and Natural History*, Dalhousie College, Halifax.
75. Jan. 1. Mellish, John T., M. A., SECRETARY, Halifax.
72. Feb. 5. McKay, Alexander, *Principal of Schools*, Dartmouth.
75. Feb. 12. McKay, Adam, Engineer, Dartmouth.
66. Feb. 3. Morrow, James B., Halifax.
72. Feb. 13. Morrow, Robert, Halifax.
73. Mar. 10. Moseley, E., Dartmouth.
70. Jan. 10. Murphy, Martin, C. E., *Provincial Engineer*, Halifax.
65. Aug. 29. Nova Scotia, the Rt. Rev. Hibbert Binney, D. D., *Lord Bishop of*
74. Mar. 9. Pitts, D. H., Halifax.
63. Jan. 16. Poole, Henry M. E., Derbyshire, Eng.
72. Nov. 11. Poole, H. S., F. G. S., *Inspector of Mines*, Halifax.
70. Jan. 20. Power, L. G., Senator, Halifax.
66. July 28. Reeks, Henry, Manor Hall, Truxton, Hamp., England.
71. Nov. 29. Reid, A. P., M. D., Halifax.
74. Nov. 9. Robertson, Thomas, Halifax.
66. Jan. 8. Rutherford, John, M. E., Halifax.
64. Mar. 7. Silver, W. C., TREASURER, Halifax.
68. Nov. 25. Sinclair, John A., Halifax.
76. Mar. 13. Skimmings, Robert, Halifax.
75. Jan. 11. Sommers, J., M. D., Halifax.
74. Apr. 11. Stirling, W. Sawyers, Halifax.
73. Jan. 13. Waddell, W. Henry, High School, Halifax.
74. Nov. 9. Walker, John McAra, Saint John and Halifax.
66. Mar. 18. Young, Sir William, Knt., *Chief Justice of Nova Scotia, Halifax.*
77. Jan. 13. McGregor, J. G., M. A., D. Sc., Bristol, Eng.
77. Jan. 13. Haggarty, J. P., Halifax.
77. Jan. 13. Morrow, G., Halifax.

ASSOCIATE MEMBERS.

1863. Oct. 6. Ambrose, Rev. John, A. M., Digby.
66. Mar. 13. Calkin, J. B., M. A., *Principal of Normal School*, Truro.
73. Apr. 11. Gilpin, Edwin, M. E., F. G. S., Springville, Pictou.
75. Nov. 9. Kennedy, Professor, Acadia College, Wolfville.
76. Mar. 13. Kerr, James J., Amherst.
75. Jan. 11. McKay, A. H., A. M., *Principal of Academy*, Pictou.
75. Nov. 9. McKinnon, Rev. John, Hopewell, Pictou.
75. Dec. 13. McKenzie, William, Surveyor, Moncton, N. B.
65. Dec. 28. Morton, Rev. John, Trinidad.
72. Mar. 27. Moseley, E. T., M. P. P., Cape Breton.
76. Mar. 13. Patterson, Rev. George, D. D., Greenhill, Pictou.
May 14. Burwash, Rev. J., Sackville, N. B.

CORRESPONDING MEMBERS.

1871.	Nov.	29.	Ball, Rev. E., Springhill.
68.	Nov.	25.	Bethune, Rev. J. S., Ontario.
66.	Sep.	29.	Chevalier, Edgecumbe, H. M. Naval Yard, Pembroke, England.
76.	Dec.	11.	Dr. DeWolf, Tintern, England.
77.	May	14.	Thomas Weston. Geol. Survey of Canada.

"ngland."

TRANSACTIONS

OF THE

Nova Scotian Institute of Natural Science.

ART. I.—NOTES ON NOVA SCOTIA COMPOSITÆ,—ASTERS. BY J. SOMMERS, M.D., *Prof. Physiology, Halifax Medical College.*

(*Read before the Institute, November* 13, 1876.)

THE genus Aster being a natural division of the order Compositæ, attracts our attention, because of the beauty and variety of its forms. It is interesting also, because it supplies the botanist with the latest floral treasures which our short season affords for his study and subsequent reflection ; with the golden-rods they light up our autumnal landscape, like a lingering ray of our departed summer.

The generic characteristics of this group are exceedingly well marked, none others in the whole botanical classification being so separated from their congeners by natural distinctions.

Their specific diagnosis is, however, exceedingly difficult, as is acknowledged by the diversity of nomenclature and doubtful separations of species, the elevations of varieties into species, and of individuals into varieties, by different authorities, leading to much confusion, so that in many cases, named species are but examples of a single form, these names being truly synonyms, and not patronymics. An example is here furnished by the form designated Aster lævis, *Linn* lævigatus, Willd, cyaneus, Hoffm and Pursh described as separate species, now recognized as varieties of an amorphous species, connected by many intermediate variations. Any one of the three may be regarded as the parent stock. Taking the intermediate series we find apparent variations, which, on close examination, fail to establish a well-marked specific distinction. We are justified, therefore, in designating this form by a specific title, which includes the whole group, as is done by Prof. Gray in his Manual, in which priority is given to the Linnæan term lævis, the others representing varieties under this head.

Circumstances like the above are more or less characteristic of all the native species which I have so far examined. I have concluded, therefore, that all well-defined species,—or perhaps I should say true species, —must be looked upon as so many groups, varying individually, yet possessing within each group certain characteristic peculiarities, which, being common to members of each, are sufficient to relegate them from the members of other groups.

I am inclined also to the opinion, "the correctness of which I leave for future determination," that more species are described than have an existence in nature. Observations prove that when passing from the generic diagnosis of the asters, we have, on the whole, few genuine and really natural specific characteristics separating its members.

The difficulty of marking the dividing lines between species in this group of plants arises from their inherent plasticity. Of all feral plants, they have the greater tendency to vary in their natural positions; apparently the slightest change in their physical surroundings tends to produce changes in form, which, though not sufficiently marked to furnish specific distinctions, are yet perplexing enough to severely tax the diagnostic skill of the Botanist who attempts to separate them.

Having on many occasions experienced this difficulty, I have in the following notes attempted to characterise such of our native asters as appear to possess definitive specific peculiarities, and have in the case of each endeavored to relegate them to the group or species described in the Class Book. In this attempt I have relied principally upon the character of the achænia, pappus, and scales of involucrum, and upon the inflorescence, leaves and axis when admissible, the former being in general more reliable for distinctive diagnosis, the latter not so reliable, since, in the very many cases their characteristics are so indefinite as to prove perplexing and abortive as distinctive evidence of specific difference.

The labor may, after all, prove to be a work of supererogation;

nevertheless, any Botanist who undertakes the study of this and some other genera of the great natural order Compositæ, will, I am sure, sympathize with the effort and condone its errors.

ASTER RADULA, Ait.

Stem, 1° to 2°. Angular striate; smooth, purple, shining, branching at the top into a loose corymb; simple below; branches purple, pubescent about three flowered, heads pedunculate large, peduncle naked, involucrum imbricated, five rowed; scales all squarrose, with scarious margins, green centres and tips; obtuse not as long as the disk; rays deep violet, spreading thrice longer than the disk, from ten to fifteen in number; leaves lanceolate, acuminate, sessile, scarcely clasping; alternate remote subserrate dentate; margin scabrous, upper surface dull, dark green, rugous and scabrous; under surface paler; venation reticulated, the veins well marked; pappus simple clubshaped. A fine showy Aster, flowering in July and August, in moist places; varies in its foliage, but the flowers are constant; involucrum bell-shaped; scales regular, close pressed with spreading tips. A distinct specific form, but superficially resembles the next.

A. SPECTABILIS. Ait.

Resembling the above in height, foliage and inflorescence. The scales of the involucrum are however different, being spatulate and obtuse, their margins glandular hairy, giving them the appearance of being finely dissected or fringed. The leaves are narrower, lighter colored, and although netveined, are not rugous. Both species may be easily separated from other forms. They vary less than our other species.

A. PUNICEUS L. VAR VIMINIUS. Willd.

Stem glabrous, paniculate furrowed, or striate 2° to 3°; green or reddish on one side; stem leaves narrow; lanceolate taper pointed, remotely serrate dentate; reticulate veined; somewhat auriculate amplexicaul; smooth above and below; edges scabrous; upper surface dark green glaucus, lower paler, $1\frac{1}{2}'$ to $2'$ smaller and entire on the branches; branches one or two flowered, heads large, rays about twenty-five, spreading purple, twice or thrice larger than the disk; pappus copious, simple; achænia smooth, scales of involucrum two rowed, outer longer and lax, all green lanceolate acute, as long or longer than the disk, the outer sometimes bract like. A rather handsome species, growing in dark, shady woods or by watercourses, varying much in robustness and foliage according to its situation. In some the branches are supplied with very small leaves, in others they are nearly naked; diagnosis doubtful; answers to puniceus of Linn., but absence of hairs and different character of scales and number of rays, separates it from the typical species; corresponds to A vimineus described in Wood's Class Book.

A. LONGIFOLIUS. Lam.

Smooth stem; terete striate purple; very much branched; branches spreading; many flowered leaves; linear acute entire; the edges scabrous; scales lanceolate, broad, acute, equalling the disk; irregularly two-rowed, loosely squarrose, herbaceous, often bract-like; rays violet, twenty to thirty, showy, very long; pappus simple; achænia smooth; a handsome aster in fields and on road-sides; flowering in September and October; remarkable for its very long, narrow, and acute leaves, which measure from $4'$ to $6'$ in length by $\frac{1}{3}'$ in width; the scales cause it to approach the above, but the entire, very long, narrow, and acute leaves, the longer, narrow, and more abundant ray-florets, and the absence of small leaves on the stems, afford points for differential diagnosis. Synonymous with A. laxus Willd. A. elodes. Torr. & Gr.

ASTER.—Sp.?

Stem striate, simple, leafy, branching at the top; the branches glandular, hairy, and forming a compound corymb; heads numerous, medium sized; involucrum closely imbricated; scales in three rows, erect, narrow, acute, much shorter than the disk, rays all white, twice longer than the disk; fifteen to twenty, disk yellowish or purple brown, pappus equal copious; leaves broad, lanceolate, taper pointed; acuminate gibbous, smooth, with margins scabrous, gradually tapering to a short petiole, entire, imperfectly three-veined, somewhat coriaceous, dark green above, and paler below. A fine, robust plant, very abundant in hilly pastures, forming communities, the only native species observed, with pure, white rays, never varying, except in robustness; the largest of our asters, so far as stem and foliage are concerned; often attaining a height of four or five feet. Although very distinct in form and appearance from the others of this genus, I am unable to affix its specific name, inasmuch as it does not correspond to any species described either in Gray's or Wood's Manuals. It might pass for A. solidaginoides, W. in Eaton's Manual, except for its leaves, which are rather broad, lanceolate, not linear as in the description of solidaginoides, which has only five ray florets; in height and robustness also, it does not approach to our plant. Aster S., of Eaton's Manual is, I suppose, identical with seriocarpus solidaginoides, of Gray's book. I would feel no difficulty in naming it Diplopappus umbellatus, Torr & Gr., to the description of which it corresponds in the characters of its height, foliage, form of inflorescence, scales, and rays, but the pappus of our plant is simple, a character which, it seems to me, would preclude our placing it in a genus, the name of which denotes the presence of a double pappus in its species.

ASTERMISER. L. Ait.

Stem hairy, terete channelled, reddish purple, from 1° to 3°, branching from below upwards, the branches green, hairy, heads pedunculate racemose secund, sometimes sessile, racemes leafy, stem leaves lance-linear acuminate, dentserrate, feather veined, margins scabrous, $1\frac{1}{2}'$ to $2'$ leaves of branches, mostly entire, very small ovate lanceolate involucrum, two rowed; scales erect, lanceolate acute, having scarious margins green centres and tips as long as the disk; rays scarcely longer than disk, varying in colour from white to light violet; heads numerous, occupying the whole length of the branches, a very variable species. "And may include distinct forms." Sometimes simply racemose, or paniculate, or compound. In some the leaves are very small, in others large; the stem simple or much branched; all have dentserrate leaves, minute flowers, and a general resemblance, which enables us to separate them from other asters.

A. Miser. Simply racemose or paniculate.

—— *Var.* Diffusus compound racemose. Mostly inhabitants of dry hill pastures; flowering in Sept.

Aster. *acuminatus.*—Michx.

Stem 1° to $1\frac{1}{2}^\circ$, simple flexuous, somewhat irregular, hairy; branching paniculate corymbose above; branches almost naked; one or more flowered; pedicels having a midway bract; heads large, involucrum, single rowed, often an irregular outer one; scales linear acute, erect channelled; margins and tips scarious; rays about twelve, twice longer than the disk, white with a purple or roseate tinge; achænia smooth; leaves mostly below or at origin of branches, in some appearing to be rosulate, broad lanceolate, feather veined, remotely and irregularly serrated near the long acuminate point, entire towards the cuneate base. Sessile, $2'$ to $2\frac{1}{2}'$, veins with scattered hairs; upper surface rough, dull green; inhabits wooded hills, dry and shady places, flowers early—July, August; a species easily distinguished by the characters of its stem leaves and flowers, yet it has apparently three rather distinct forms, one with a zigzag stem, leaves regularly alternate, numerous heads on simple branches, another with the stem also flexuous, but the leaves are crowded at the centre, appearing whorled or rosulate, with simple single or twin-flowered branches springing from the leaves, giving an umbellated appearance, a third more robust than the two former, leaves arranged in general like the second var., but more abundant and scattered; the leaves are also somewhat coriaceous, rugose shorter and narrower than in the others, the heads more numerous and corymbose, the rays more numerous, purple or slaty in color, it flourishes in clearings or exposed situations, while the others flourish best in the shade.

ASTER, NEMORALIS. Ait.

Stem simple or corymbose at the top, leafy, the leaves crowded below the branches, or midway on the simple axis, which is often single-flowered; heads few, branches when present usually single-flowered and naked; stem and branches having short hairs; scales lance linear acute squarrose, margins and tips scarious; rays pale purple or roseate, never white, 15 to 25 in number; leaves narrow, lanceolate, entire sessile; upper surface rugous and scabrous, edges scabrous and revolute, "more revolute in the upper than in the lower leaves; 1′ to 1½′ in some subdentate, lessening from below upwards, an inhabitant of swampy pastures, rather a pretty Aster, generally the first to put forth flowers—July; with a resemblance to the above, it is sufficiently distinct for easy diagnosis from it; they are both included in the div. scariosa or orthomeris, Torr & Gray, differing from Asters proper by their membranous scales.

ART. II.—MORTALITY RATES OF ANCIENT AND MODERN TIMES.

BY A. P. REID, M. D., L. R. A. S., etc., etc., *Professor of Medicine, etc., Halifax Medical College.*

(*A Paper read at the Institute of Natural Science, Halifax, N. S., Canada, Jan. 8th,* 1877.)

THE idea of our great recent progress is so generally received, that it may be well to take a retrospective glance and see how much in reality has been accomplished.

To get a fair understanding of our subject, let us revert to the period when natural laws were untrammelled, and we had the best examples of health, which, without doubt, prevailed in a very early period of history. We may conclude that the Pastoral Life furnished every sanitary requirement,—good drainage and ventilation, and temperate and sufficient exercise and diet, without facility for effeminate habits. Under these circumstances, it is safe to conclude that, excepting accidents, death resulted from old age.

We must also premise that every individual is at birth endowed with a prospective length of life under favorable conditions, which is measured by the vigor obtained from the parents, modified by a special individuality (for no two members of the same family are alike.)

This natural life may be prolonged or shortened, owing to the conditions to which it is exposed. One person may naturally die at fifty years, from the wearing out of the mechanisms of life. Another dying at fifty may have prolonged his term five or more years by extra care and judgment; and others dying at sixty or eighty may have brought on death prematurely, by five, ten, or more years, owing to debilitating influences.

To take up individual cases as illustration, would far transcend my limited time, and I must deal in generalities.

Presuming, then, that we have a sufficient knowledge of the most favorable conditions of health, we will compare the present with the past.

We find by historical evidence that partly owing to increase of numbers, as well as to the fertility of certain districts, population become more dense, and a nomadic merged into a fixed population.

Deficient drainage and ventilation can scarcely take place when the tent is shifted at frequent intervals; but it is far different with a stationary house, and the gradual collection of excreta and decomposing material, which, conspiring with war or famine, or both, were sufficient to explain the epidemics which have afflicted humanity from very early dates.

As wealth increased so did the desire for conveniences and luxuries, and in time distant countries were laid under tribute to satisfy the demand. This gave rise to the middlemen or *merchants* that increased in numbers and influence as wealth and ability to pay increased.

Arising from the same cause, *manufactures* began to exercise a similar influence, and at the present these combined have massed very numerous populations about convenient centres or cities, giving conditions the very opposite of what prevailed during the nomadic period.

As a result of this, we would anticipate a great increase of disease and death, and such has been the case in every instance where no special means have been used to ward off the ills resulting from a very large population.

These evils are of two kinds, the social and the physical, and though we do not intend to devote attention to the former, yet it must be alluded to, for there can be no doubt but disease is greatly modified by social conditions at either end of the scale; at the upper end by habits of fashion, ease and effeminacy, and the lower by filth, squalor and poverty.

The physical evils are those induced by an insufficient removal of the gaseous, liquid and solid excreta that are necessarily the result of animal life, and which are the most active agents in producing disease and death in the proportion of their accumulation.

Hence it is not their formation that is prejudicial, but their inadequate removal. By the operation of natural agencies this is easily accomplished in what we may conceive as the natural mode of life—the moveable scattered habitations referred to above.

When artificial customs prevail, so in proportion must artificial means be adopted to carry out the indications of nature, and since we have in latter years gained much knowledge it is to be presumed, if this be turned to account, there should be an amelioration of the general health. Experience has proved the accuracy of this deduction, and the lowered death rate of some cities, notably London, is the best proof, as the very high rate in others shows conversely a deficient attention to sanitary requirements.

One law is thoroughly established, "That the products of animal life are in course of time resolved into inorganic substances which become the pabulum for the growth of vegetable life. But during the transformation above referred to, the compounds that are formed are poisonous to the life of animals unless present in extremely minute quantities. It is necessary that there should be a tolerance of these poisons in the case of animals, or general disease and death would result, and as different species and individuals have different powers of resistance we find that the resulting disease varies very greatly in its types and results, and also that strong vitality may confer comparative health under very unfavorable conditions.

Another powerful influence that tends to this favorable result is that of *habit*, for we know that so great is the elasticity and endurance of the vital economy that long exposure to a deleterious influence does appear to modify and even arrest its virulence, but in the majority lowered vitality is to be expected with its common result, disease and high death rate.

In comparing the influence of modern civilization on the *General Health* we have two previous eras to consider—the *Ancient* and *Middle ages*.

Our knowledge of ancient times in this particular is very limited, and if what we have received, be correct, they were more favourable than the present. In ancient times, we have three periods—the first when nomadic life prevailed, and we have reason to believe, the best condition were present. Second, that of the Assyrian and Persian Empires.

At these times, we have the gradual accumulation of numerous populations at political centres, with a very high average of health, as a rule, if the Chronicles are to be believed; and this is easily understood, for the great cities of *Nineveh* and *Babylon* were totally unlike those that have succeeded them, for they covered a vast area of territory in comparison with population.

The original founders also devoted great attention to a complete system of drainage and public baths, as well as the perfect cultivation of the soil, with separate location of the domiciles and very wide streets—precisely those conditions that our most recent knowledge would dictate. These methods, no doubt, prevailed then, more from *military* than *sanitary* reasons, but it would be scarcely just to say that their educated men had not accurate powers of observation, and were not guided by the experience of life that they must have had even then, although their theoretical explanation might not be so accurate as we can give to-day. It is only fair to assume that, at a time when the health and energy of every individual was necessary to the formation of armies, whose success was in proportion to the physical health and endurance of each unit.

(The training of the Persian soldier under Cyrus was perfection as far as our present knowledge teaches.) All reasoning, I repeat, would confirm the idea that the phenomena of health were very closely studied and all arrangements made subservient thereto. Hence it is more than probable that during this long period the standard of general health approached very near perfection, and that our progress at present would be more assured did we very closely copy the methods that prevailed for so many ages long since passed away.

Third, the area of the ancient Roman Empire. Here we had conditions not unlike those that preceded except that there was more crowding with its attendant evils, and we read of plagues that produced great havoc more frequently than in more ancient times. These were generally the accidental results of war, siege, famine and great overcrowding, from the concentration of armies and the inhabitants of the surrounding country, and should not be included in the general health rate which was comparatively high.

The Grecian and Egyptian customs were very similar, and we need not comment on them.

The Middle Ages we may consider as coming down to a late period in the last century, with a health rate comparatively very low in all the great centres of population.

The crowded quarters and ignorance of the most elementary hygienic laws, produced decimating plagues with marked regularity.

The great fire in London in 1666 cut short the epidemic at that time prevailing, by scattering the dense population and perfectly disinfecting the polluted domiciles.

Great wars are always attended by disease, and leave famine and sickness as their result, but in estimating the general health rate this should not be considered, for the unhealthy period just referred to was not very clearly traceable to war but rather to the habits of the times.

During the century just elapsed there are many modifying influences that must be considered in estimating our modern condition.

Commerce and Manufactures, or TRADE, has obtained a pre-eminent position, and controls the massing of populations to a far greater extent than *politics*, *nationality*, *or political geography*.

The study of the science of *Hygiene* has made very great progress, and has been able to influence the deliberations of the national as well as the municipal governments, so that the march of improvement is now going on actively, but the course is yet both difficult and long.

Within the past fifty years *trade* has inclined to populate the cities at the expense of the farms, and war has tended so little to diminish numbers, that we have very many centres very thickly inhabited, which, from the vicissitudes of *trade* are alternately in affluence and poverty, and either extreme tends to produce disease.

Hence, we have all that is required to give a very high death rate; and that it is not worse, we must thank the labours of those who, for very many years, have striven to inculcate the requirements of health.

It would be theoretically possible to have most thickly populated and perfectly healthy districts, but since the natural depurating agencies are then insufficient, artificial means must be adopted, proportional to the artificial condition.

Every individual should have abundance at all times of *pure air*, *pure water*, *good food*, *regular exercise*, and no less regular *sleep*, with as far as possible, restriction from indulging the appetite for excesses of every kind.

Sewage, (a convenient term for classing,—the solid liquid and part of the gaseous excreta), cannot be too perfectly attended to, for its influence in poisoning the air and water is supreme.

To accomplish this it is necessary to have perfect removal of dirt of every kind, with such a disposal of the liquids and solids as will enable them to be utilized in nature's way, by vegetable growth, or at least to be disinfected by some means, artificial or natural.

Ventilation is equally as urgent to remove the gaseous excreta of respiration as well as the products of manufactures and sewage decomposition, which must to some extent, obtain, no matter how well their removal may be managed.

As to food, labor, rest and restriction from excesses, they are so mixed up with the conditions of TRADE that at present it is not possible to regulate them by any form of parliamentary legislation. And again they are by no means so prejudicial to the general health rate if perfect cleanliness could be made obligatory.

Zymotic.—Preventable disease, such as Fevers, Dyphtheria, &c., &c., chiefly swells our death rate, and it could be eradicated by cleanliness or perfect ventilation and drainage. While as well those debilitating influences would be avoided that tend so largely to increase the mortality of infant life and those endemic diseases, consumption, malaria and other maladies which are peculiar to certain countries and localities.

To go into the details of these requirements would occupy too much of your time at present, and I will merely refer to the methods sketched by Dr. B. W. Richardson, of London, a most advanced sanitarian, for his model "City of Hygeia," where the most practical indications would be carried out. Its foundation, however, is yet to be commenced.

In conclusion let me say that we have not yet accomplished in any of our cities that which is quite possible, viz., drainage and ventilation, and that our practical sanitary works and general health rate cannot compare with the very ancient and more populous cities of Nineveh, Babylon, or ancient Rome.

It is probable, however, to expect that the vicissitudes of trade will prevent numbers from leaving the pursuit of agriculture and crowding the cities, which vocation alone is practically capable of giving the highest health rate when ordinary common sense and intelligence directs its operation.

ART. III.—NOVA SCOTIAN GEOLOGY, AT THE CENTENNIAL EXHIBITION — INTERNATIONAL EXHIBITION OF 1876. BY REV. D. HONEYMAN, D. C. L., *Representative of Nova Scotia.*

(Read February 12th, 1877)

ABSTRACT.

Nova Scotian Geology was illustrated by my own collection,—altogether Nova Scotian,—and a number of maps.

It was also illustrated in the Stratigraphical collection of the Geological Survey of Canada, and by a sketch map of Nova Scotia, New Brunswick and Prince Edward Island, by Mr. Ells, under the direction of A. R. C. Selwyn, F. R. S., Director of the Survey, and Photos, by T. Weston, Esq., Geological Survey.

I. The collection of Rocks which I exhibited were representative :—

1. Of the "Lower Arisaig Series." *Trans. of the Institute.*

CRYSTALLINE ROCKS.

Laurentian. *Transactions.*
Archæan. *Dana's. Manual.*

Syenites,	From Arisaig, N.S.
"	Mts. George's River, C.B.
"	Cobequid Mountains, N.S.
Diorites,	Same localities.
Granites,	Cobequids.
Gneisses,	"
Petrosiliceous,	"
"	Arisaig.
Jaspideous,	Mts. George's River.
Ophite,	Arisaig.
"	Mts. of George's River.
Ophicalcites,	Arisaig.
"	George's River.
Marbles,	Arisaig.

Marbles,	Mts. of George's River.
"	Cobequids.
"	Five Islands.
Porphyries,	Cobequids.
Amygdaloid,	Mts. George's River.
Diorite,	Arisaig.
"	Mts. George's River.

2. Of the "Middle Arisaig Series." *Trans.*

MIXED CRYSTALLINE.

Cambrian (?). *Trans.*
Lower Silurian (?). *Trans.*

Jaspideous Rocks,	Cobequids.
Petrosiliceous,	Arisaig.
Conglomerates (Ash),	"
"	Cobequids.
"	Scatarie Island, C.B.
Diorites,	"
"	Cobequids,
"	Arisaig.
Porphyries,	"
"	Cobequids.
Amygdaloid,	"

3. Cambrian.

Quartz, etc.,	Halifax.
Slates,	"
Auriferous Quartz,	Waverley.

4. Lower Silurian (?).

Granites,	Cobequids.
Slates (with Fossils), *Strophomena alternata.*	Wentworth, I.C.R.
Porphyries,	"
Diorites,	"

5. Of the "Upper Arisaig Series."

Jaspideous Rocks,	Arisaig Pier.

Aluminous Silicates,	"
Fossiliferous Iron Ore,	Arisaig Brook.

6. Lower Carboniferous.

Limestone (Fossiliferous) with Laurentian Syenite,	Antigonish Harbor.

II. Boulders from drift of Halifax County. *Transactions.* 1875-6 :—

1.	Granites,	Cobequids.
	Syenite,	"
	Diorites,	"
	Gneisses,	"
	Porphyries,	"
	Quartzite (olive, with Crinoids),	"
2.	Amygdaloids (Triassic) with	
	Zeolites,	Five Islands.
	Amygdaloids,	Two Islands.
	"	Bass River,
	"	Parrsboro'.
	"	Blomedon.

MINERALS.

Heulandite.
Stilbite.
Natrolite.
Agates.

3.	Limestones (Carboniferous),	Windsor and other localities.	
	" (Bituminous),	"	"
	" (Fossiliferous),	"	"
	Stigmaria Ficoides,		
	Lepidodendron.		
	Calamites.		

This collection was supplementary to the collections which I had in the London Exhibition of 1862, Dublin, 1865, and Paris, 1867. It was intended to illustrate investigations made by myself since the Exhibition of 1867. They have all been submitted to the Institute.

(*Transactions*, 1869-76.)

I also illustrated the Geography of Nova Scotia by a portfolio of maps.

1. A new geological map of Nova Scotia and Cape Breton.
2. Map of Cape Breton showing localities examined.
3. Geological map of Antigonish County.
4. Geological map of Arisaig.
5. Map shewing the arrangement and character of the pre-carboniferous rocks of East Pictou.
6. Geological map of the pre-carboniferous rocks of East River, McLellan's Mountain and Sutherland's River.
7. Map of Colchester County, chiefly illustrating the geology of the I. C. R. and Cobequid Mountains.
8. Map of Cumberland County, chiefly illustrating the geology of the I. C. R. and Cobequid Mountains.
9. Map, showing the geological formations on the Grand Lake and Railway.
10. Admiralty Chart of Halifax Harbour, geologically coloured.
11. Map, illustrating the superficial geology of Halifax.

Stratigraphical Collection of the Geological Survey.

I.—In the *Laurentian*, divisions No. 199, 277, are specimens from George's River, Kelly's Cove and Cape Dauphin, in Cape Breton.

The specimens from George's River are like those in my own collection, excepting the ophites, ophicalcites and jaspideous rocks, which are wanting in this collection. I regard these as a characteristic part of the series. I have referred to St. Ann's in more than one of my Papers to the Institute, as showing by specimens that the Laurentian existed there as well as at Arisaig. This is connected with Kelly's Cove and Cape Dauphin. In regard to the age of the Cape Breton representatives of my "Lower Arisaig Series," the views of the survey collection correspond with my own.

II.—In the *Huronian* and Lower *Cambrian* divisions are, first: Nos. 395, 416, from Louisbourg, C. B., and second: Nos. 417, 425, from Jebogue Point, Yarmouth, N. S. The Louisburg specimens, correspond with the Scatarie Island specimens of my collection. They are regarded by the survey as of Huronian age. I have regarded my specimens from Scatarie, C. B.,—the rocks being a part of the Louisbourg series—as corresponding with my "Middle Arisaig Series," of Arisaig and the Intercolonial Railway. The I. C. R. rocks I have regarded as corresponding with certain Lower Silurian rocks of Wales, described by Professor Ramsay. Trans. 1874–5.

In the Catalogue of the Geological Survey, we have a note on the Jebogue rocks:—"The rocks of Jebogue Point and Cape St. Mary seem to be lower than the gold-bearing slates and quartzites (whin) in the same neighbourhood. Catal. 141.

Lower Cambrian.

Atlantic Coast, specimens 426, 450. These are from the auriferous rocks of Nova Scotia.

Note.—"Supposed to represent either the base of the Premordial or the Lower Cambrian series." Catal. 141.

III.—Lower Silurian, No. 461. From the Granite Junction, Halifax. Nos. 462, 476; Bras d' Or and Cape Breton.

The specimens from Bras d' Or contain Lingulæ. They are considered by Mr. Selwyn to be of Potsdam Sandstone age.

IV.—Middle and Upper Silurian, Nos. 736, 53, are from Arisaig, Frenchman's Basin, East River, Malignant Cove, Doctor's Brook, McLellan's Brook.

I would observe that the rocks of Arisaig Pier and Cove, Frenchman's Barn and Doctor's Brook correspond with No. 5 of my collection; *i. e*, with A. of my "Upper Arisaig Series," viz: Jaspideous rocks and Aluminous Silicates. These were first recognized at Lochaber and then at Doctor's Brook, by my own observations. They are older than the *Lower Arisaig or Clinton of Dawson*. Others are pre-carboniferous.

The rocks, at East River, are Middle and Upper Silurian, at

McLellan's Brook, they are of same age. The rocks at Malignant Cove are Lower Carboniferous, conglomerates with intrusive Trap. Laurentian lies east of Cove. *Vide* sections in "Geology of Antigonish Co." Trans. 1874–5.

V.—Devonian. Iron ore with Fossils. Nictaux Granites, Nos. 781, 804.

The Fossils in the iron ores of Nictaux are considered by Mr. Selwyn, Dr. Dawson, Prof. Hartt and others, to be of lower Devonian age. In fact the rocks containing these ores are at present regarded as the only unquestioned representatives of the Devonian Formation in Nova Scotia.

The relation of the Granites, occurring at Nictaux, to the supposed Devonian Formation is considered as demonstrating the Upper Devonian age of the former, and also of the Granites associated with the Gold Fields of Nova Scotia. Accordingly specimens of these granites were arranged in this division of the collection.

VI.—Carboniferous. Lower Carboniferous, 805 to 821. Mill stone Grit and Coal Measures, 225 to 839. Upper Coal Measures, 840 to 843.

This extensive, interesting and beautifully prepared collection, with the exception of the first 138 specimens, has been presented to the Smithsonian Institute at Washington. A geological map of the Lower Provinces, coloured by Mr. Ells, of the Survey, under the direction of Mr. Selwyn, was also exhibited, showing the supposed course of the Laurentian axis from Cape North, through Cape Breton, through Arisaig, N. S., Pictou, and the Cobequid Mountains, and through New Brunswick; also the supposed Devonian Granitic axis from Cape Canso through Guysboro' Co., Halifax Co., Lunenburg, and Shelburne, Annapolis, &c.

PHOTOGRAPHS.

There were also exhibited 21 beautiful photographs from well-selected positions, illustrating the geology of the "Upper Arisaig Series" and the succeeding Lower Carboniferous Formation, as exposed in sections on the shore on either side of the Antigonish and Pictou County line, *i. e.* from Doctor's Brook to Mill Brook. These were photographed by Mr. Thomas Weston, of the Geological Survey.

ADDENDA.

Geological Gleanings from the Economics.

1. Laurentian.

Syenite from George's Mountain, C. B. Exhibitor—James McQuarrie.

Syenite from Campbelltown, C.B. Exhibitor—C. J. Campbell.

Marble--polished; white and mottled, from Marble Mountain, C.B. Exhibitor—J. Silver.

Green Breccia, polished; from Scatarie Island, near Louisbourg, C.B.

2. Cambrian.

Block of Gneiss (Ironstone) from Halifax.

Auriferous Quartz collection. Honorable Robert Robertson, exhibitor.

3. Lower Silurian?

Blocks of Granite. Halifax—Shelburne.

Lower Silurian.

Iron Ore from Whycocomah, C. B.; Red Hematite, East Bay, C.B.; Calchopyrite, Copper Ore, Polson's Lake. W. Ross, exhibitor.

Calchopyrite, from Lochaber Lake, N. S. James Hudson, exhibitor.

Middle Silurian.

Fossiliferous Iron Ore, Blanchard, East River, Pictou, N. S. Crawford and Gilpin, exhibitors.

Fossils *Athyris* in this ore, characteristic of the Mayhill sandstone, *Salter* or *Medina* sandstone, U. S., have led me to regard the bed as lower than *Clinton;* but as this member of the "Upper Arisaig Series," at Arisaig, and other localities, has only a thickness of 250 feet, I am disposed to regard the bed as lying in the *Clinton* and to regard the *athyris* as ranging higher than A of the Upper Arisaig Series.

Limonite, East River, Pictou; Specular Iron Ore, East River, Pictou. Exhibitors—Crawford and Gilpin.

These Pictou ores seem all to be confined to the *Clinton*. *Vide Transactions of Institute.*

MIDDLE AND UPPER SILURIAN.

Brown Hematite, Londonderry Mines, N. S.
Red Hematite, " "
Specular Ore, " "
Yellow Ochre, " "
Ankerite, " "

Exhibitors—Steel Company of Canada.

The Strata containing these ores belong to the " Upper Arisaig Series," but do not seem to contain fossils. They may therefore be either Middle or Upper Silurian.

Limonite, Brookfield, N. S. Exhibitors—Advisory Board of Nova Scotia.

Devonian?

Iron Ores, Cleveland Mountain, Annapolis, N. S. Exhibitors—Stearns and Page.

5. Carboniferous.

Gold in carb. conglomerate on slate, from Gay's River. Exhibitor—H. S. Poole.

Building Stones. Exhibitors—Advisory Board.

Grindstones and Whetstones. Exhibitors—Seaman & Co.

Gypsums. Exhibitors—Advisory Board.

Limestone.

Blocks of Coal. Nova Scotia and Cape Breton.

Pyrolusite Manganese Ore, Tennycape, N. S.

Spathic Iron Ore, Sutherland's River, N. S.

The Manganese ore is from Lower Carboniferous Limestone. It occurs in large *pockets, masses* and *nodules* in the Limestone.

Triassic?

Magnetic Iron Ore. Exhibitor—D. Chipman.

This occurs in the Triassic trap at Five Islands, Blomedon, North Mountain, Digby.

It contains Amethystine veins, Jasper, &c. In the mineralogical collection exhibited by H. S. Poole, Esq., were specimens of native copper, which also occurs in veins in the same trap rocks. These metallic deposits have not been found to be of economic importance. The trap of this Formation is celebrated on account of its cabinet minerals. Every museum of importance in the United States has specimens of the trap minerals of Nova Scotia.

Art. IV.—Indians of Nova Scotia. By J. Bernard Gilpin, B. A., M. D., M. R. C. S.

(*Read 12th March*, 1877.)

I have thought it desirable to put upon record in the Transactions of the Natural History Society, all the facts I could obtain, either personally or from old and living authors, concerning our native Indians. The time is rapidly passing,—indeed, has now passed, for such a purpose. I may not produce any thing new; but if I only put old things, scattered in many books, manuscripts, or in traditions, into one record, I shall have done as much as I expected to do. The books I have had access to, by the kindness of my friend, Dr. Akins, have been early copies of Cartier, Champlain, and LesCarbot, and Charlevois,—all eye-witnesses, except the last. I have also had access to all the manuscript documents belonging to the Record Commission of Nova Scotia, from seventeen hundred and twenty-four, nearly to our present time, including the Indian book of the late Hon. Joseph Howe. These, with occasional pamphlets issued from time to time, my own personal recollections, traditions, and Murdock's History of Nova Scotia, are the sources from which I have drawn. This latter gentleman has drawn largely from "Relations of the Jesuits, Quebec."

Our first exact account of the Indians of Nova Scotia is found in Les Carbot, 1609. Earlier mention is made of them, however, in Jacques Cartier, whose first voyages were in 1534. We find that as early as the sixteenth century the shores of Nova Scotia were frequented by fishermen of various nations, and in greater numbers than is usually supposed. Baron de Lery visited Sable Island as early as 1518. Savelet in 1604, had made forty voyages from France; a voyage and home being then about one year. Thus, when Les Carbot gives us his minute descriptions, from two to three generations must have passed since the Iron age had commenced its operations on the races of the Stone period. Iron knives and axes, the steel and flint, with its great powers of carrying fire everywhere, and coarse potteries and beads, must have begun already to modify their habits. The ancient arrow-maker must have ceased his art; the son must have used an axe foreign to his father, and the squaw to ornament her skins with French beads instead of small shells. The first name by which they were called by the French is Souriquois or Sourique. This name seems almost identical with Irequois, Arromouchequois and Algonquin. It is probable the Mic-Macs, as we now call them, were a set-off from the great Algonquin race, who extend from Canada to the extreme West; but set off for so long a period of time as to lose a common dialect. Whilst our Indians from the earliest date used the language common to Canada, they could not understand the Armouchiquois, or those who lived in what is now called New Hampshire and Massachusetts. In the year sixteen hundred and nine, the French living at Port Royal, Nova Scotia, estimated their numbers between three and four thousand souls. This included Cape Breton and Prince Edward Island. This, by the usual calculations, would make between five and six hundred adult or fighting men. They were clothed in skins of bear, otter, beaver and fox, and the larger skins of elk and deer. They had learned the art of softening and taking the hair off the larger ones. In Summer their clothing was a girdle around their waists, on which was fixed a skin that went betwixt the legs, and was attached again to the girdle behind. A cloak of skins was hung around the neck, with a loose cape hanging back from the shoulder. Usually the right arm was exposed. In winter they made sleeves of beaver skins, tied at the back, and long hose of the same, tied to the girdle around the loins, and their feet were covered with a buskin of untanned leather drawn into plaits in front, the present mocasin. The women wore the same dress, with the exception of a tight girdle around the cloak. In camp the men wore nothing but the waist leather. They had no covering for their heads, using the loose cape of their cloaks as shelter in winter. The hair was worn long, cut short in front and sometimes trussed on the top or behind by a feather or pin. For ornaments they seem to neither have been painted or tatooed, but to have made strings of black wooden beads and pieces of white shells. The quills of the porcupine were also dyed with bright colours and formed into plats and squares. The men cared but little about these things, but they wore knives at their breasts. These people, thus clothed, lived in movable wigwams, a conical tent made of birch bark fastened around poles tied at the top, and at the bottom encircling an area of about twelve feet diameter. During summer they pitched them at the sea side or on the lake borders; in winter they retired to the forest. In the short summer they lived upon fish, and during the long winter when the fish had retired from the shore, they hunted the elk and reindeer. They, when at war and expecting an attack made a pallisaded fort, by taking a square of living trees, thickening up the spaces with poles and brushwood and leaving but one place of entrance, and building their camps or wigwams within it, thus contriving a rude fortification. In a print of the period from Champlain, of the pallisaded forts in Canada, the structure is much more elaborate, and built of hewn timber, but LesCarbot distinctly asserts that our Indians never felled trees, not even for fire wood. The few household utensils they possessed were of wood, stone and horn, or bone. They had pots of a very coarse baked pottery, and stone axes and mallets, knives and gouges. Deers' horn and bone were also used, and from a recent deposit at Lunenburg we find copper knife blades and needles made from the native copper of the Bay of Fundy, hammered into shape. They also had the beautiful racquet or snow shoe, that has come down to us unaltered. These simple utensils, with their skins and furs and the boat, or canoe, that transported them from sea coast to lake side, formed all their wealth. They had already acquired the habit of smoking, and though they did carve their pipes sometimes into forms of animals, yet the usual pipe was a stone hollowed at one end into a pan, into which they stuck a quill or hollow reed. In their wars they used clubs, bows and arrows, and shields, and lances or spears headed with stone. These wars were carried on with much forethought and energy. Membertou, the old Sagamos, at Port Royal, brought men from Miramichi and St. John's river, and made a rendezvous with his own from Nova Scotia, at Grand Manan, before attacking the tribes that resided in what is now called Massachusetts. They brought home the heads of their enemies, which they enbalmed and hung them about their necks in triumph, but there is no mention made of scalping.

As they had no letters they could have had no laws, save traditions. The Sagamos usually settled all disputes. A man of many friends was unmolested, for he had many to avenge him, but a slave or a prisoner with no friends fared badly. Polygamy was allowed rather than practiced, and though they had little regard for chastity yet there seems to have been no jealousy among them. Their care for their parents, fondness for their children and general hospitality must make all amends.

As regards religion, an obscure belief in some future state was their only creed, some Medicine men their only priests. And now we can form some idea of these men of the stone period as they were about insensibly to fall beneath the iron age. A well fed, light footed, clay-red race, with beardless face and shock of black hair, fish and flesh eaters, reaping no harvest save from forest and sea, having neither letters or laws or settled habitations, yet either in friendship or war having relations five hundred miles at least with their neighbors on either side.

This is not an unpleasant picture of man in his stone period. With no laws but those of superior strength, they got on very fairly in their social relations. With no church or religion they were hospitable to their neighbors, kind to their wives and children, and very careful of the old. "One thing I will say," says Mark LesCarbot, "that belongeth to fatherly piety, that the children are not so cursed as to despise their parents in old age, but do provide for them with venison." But it strikes one through all these narratives that life was hard to keep up. The severity of the climate, the long winter for which they could make no provision, and their inability to cultivate the soil, always kept their numbers few. They made no accumulations, and have left no records of the past save a few stone weapons and shell mounds.

Further south where a sunnier sky brought forth the maize and the bean, there the same race grew in numbers and strength, and became so powerful as to repel the Frenchmen who themselves would gladly have made their settlements to the southward of Nova Scotia.

This ends the first stage, the stone period, or prehistoric age of our Mic-Mac. About two hundred and seventy years ago, or the beginning of the seventeenth century, the age of Iron came down upon them. They came under the influences of the French, who held them for one hundred years, and whose kind and mild Government may be called their French age. During this period they must insensibly have cast off their coats of skin and clothed themselves in woollen clothes. They ceased to war with themselves, they pointed their weapons with iron instead of stone, or exchanged them for muskets, but they still remained living in wigwams, wandering from sea to forest, and generally connecting themselves with the French fishing stations and ports, where they bartered skins and furs for bread and tobacco, and other things which they were fast learning to call the necessaries of life

We have no records of this period, but from incidental remarks from time to time of various writers, we learn that the kind relations existing from the first betwixt them and their masters, never altered.

When a female prisoner stole from the Sagamos, Membertou, an axe and tinder box to facilitate the escape of another captive, she was condemned to die. The women of the tribe led her to the forest and there killed her, the king's daughter, a comely maiden, striking the first blow. The French officers, to show their disgust, ever afterwards refused her as a partner at the dance. This anecdote shows the iron age as a reformer, yet something may be said for the stone, where men would not kill women. They may be said to have accepted the Christian faith rather than to have been converted. They had no faith to turn from. The Fathers of th Recollet and the Jesuits vied with each other in teaching the doctrine of the Roman Catholic Church. On St. John's Day, June 24, 1610, twenty-four or five of the Indians were baptized at Port Royal, among whom was Membertou, then one hundred years old,—his great namesake, Henry of Navarre, having fallen but a few weeks before under the assassin's blow. To the present day they have been faithful to that church whose simple dogmatic teaching and splendid exterior so well supplies their religious wants. Of such importance was this event considered, that a special messenger was sent to France to announce it; and again we meet with a royal letter of the great Louis XIV.'s, enjoining upon the governor, their religious care.

Baron de la Honton, 1696, says (Murdock): "The French neglect nothing to secure the Indians, giving some notable men pay as a lieutenant or ensign, and giving them rewards for mischief to the English, or to the Indians in the English interest, paying them for scalps, sending the Canadian youth with them, or giving them commissions,—taking Indians to Europe to show them the glories of the French Court and armies. There are now at Versailles six Sagamos from Canada, Hudson's Bay, and Nova Scotia."

Thus, kindly and gently the French held our Mic-Macs for one hundred years. In seventeen hundred and ten, Soubercase, the French Governor at Port Royal, now Annapolis, surrendered it and all Acadie to the English. From that date French government ceased, as regards our Mic-Macs, from amongst them. The cruel Indian wars that had been raging for more than fifty years so near them, and so cruel, that it has been said that there was no man of forty but had seen twenty years service on the borders of New England, was now to set in upon Nova Scotia.

After the conquest of Nova Scotia, the English Governors held but feeble sway at Annapolis, and their out-ports at LaHave, Horton, and Canseau. The neutral French played into the hands of the openly hostile Indian, and they were both influenced by the French Governor of Quebec. The lives of the English governors seem to have been perpetually harrassed by the Indians, who were excited to their acts by emissaries, chiefly from Quebec. M. Gaulin, missionary, (letter from Placentia, 5th September, 1711, Murdock), boasts, "To take away all hope of an accommodation, he induced the savages to made incursions upon the English." During this same year an ambuscade of Indians destroyed the whole force of eighty men, killing outright thirty men, the fort-major and engineer, and making the rest prisoners. This happened twelve miles up river from the fort, and so encouraged Gaulin that he immediately invested the fort (Port Royal) so closely that the garrison could not appear upon the ramparts. This garrison is said to have lost in seven months, by sickness and sorties, three hundred and fifty men. Surprisals also were made by the Indians on fishing vessels and fishermen on the sea coast,—at Yarmouth, at LaHave, and at Canseau. Few people now imagine the terror of their name at that date, or fancy that a few scattered savages could do so much mischief. "Queen Anne may have the meadows, but we have the forest, from which nothing can drive us," was their open boast, as well as the reason of this power.

Their inroads seem to have been made from with varying frequency, from seventeen hundred and ten to seventeen hundred and sixty-one. They languished for awhile; but when it was seen by the French that England, by the founding of Halifax, was in earnest in settling the Province, they seem to have increased. Annapolis was again invested by the Indians, and a sergeant and two men killed. Another missionary, not Gaulin, but Lalouttc, the darkest figure of the many dark men that vexed the times, boldly led the assault of his French and Indians, against the crumbling walls of old Port Royal, then defended by the veteran Mascarene. Unsuccessful, stained by the murder of Captain Howe, denounced by the French officers, and by his superior, the Bishop of Quebec, he disappeared from the scene, tradition says, to die a life-prisoner in an English fortress.*

* It must be confessed as a strange irony of the times, that the grand wars of the French were fought over in the pine forests of Nova Scotia between Huguenot and Catholic. Whilst Gaulin and the Jesuit Laloutte led on their petty tribe of savages, the Huguenot Mascarene stayed up his ragged soldiery. This gentleman, banished by the revocation of the edict of Nantz whilst yet a child, from France, found himself

Dartmouth was also assaulted, and murders and robberies committed at Windsor and other parts. The Governors were of late in the habit of taking hostages for their good behaviour, which kept them quiet for some time. One of these poor fellows, who had been a hostage for two years about the fort, was shot and scalped by an order in council, amongst whose members sat that merciful officer, Major Mascarene. This cruel anecdote shows strongly the dread and fear these Mic-Macs must have caused in those times, as well as their power.

Haliburton says of these times: "The number and ferocity of the Indians, and the predatory habits in which they indulged, rendered them objects of great attention and concern to the local government."

In seventeen hundred and sixty one a formal treaty of peace with the Indians was signed at Halifax, and the hatchet buried. Quebec having already fallen, the Treaty of Paris (seventeen hundred and sixty-three), crushed for ever these bloody scenes.

In looking over the manuscript documents relating to the Indians, now in the Record Office, we find the several treaties at Casco, Maine, at Halifax, and again at Halifax, with one Francis Mius, who held the chieftdom of LaHave, under brevet of Chevalier Duguesnol, Governor of Cape Breton. In these the Indians are treated as powerful bodies, presents are made and hostages exacted. A few years pass, and treaties change to humble petitions. They are beggars now,—wandering families, and the principal papers are certified accounts of powder, shot, tea, tobacco, pipes, blankets and meal, supplied them by government, from time to time.

In eighteen hundred and one, in reply to a committee of the House of Assembly, a return of their number was sent in as eight hundred and fifty. These returns are incomplete, not including Cape Breton, Yarmouth, and Annapolis. These manuscripts are

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a soldier of fortune and Captain of Grenadiers in a New Hampshire regiment, entering, as he himself says, Port Royal at the breach. His after command of that place shows him a fair match to his enemies, in courtesy, in courage, and craft, and in good French. Now nearly taking off Laloutte's head by a lucky cannon shot: now allowing provision to be sent to the starving garrison at Louisbourg, (he had had a butt of claret from old Dugnesnol), and then answering the Archbishop of Quebec in French as fair as his own.

varied by the different writers' remarks. Edward Irish, Dorchester, says: "In getting new blankets, they made breeches and stockings by cutting up the old ones." This fact was verified by Charles Glode, about eighteen hundred and thirty-three, using strips of blanket for stockings, when in the woods with myself. G. Oxley, Cumberland, says: "I knew no heads of families addicted to drunkenness to any remarkable degree, nor any but will be drunk when opportunity affords." This truthful remark remains good yet. Joseph Marshall, Guysborough, says: "Very little in their huts to subsist on, and as little on their persons to shelter them." The government had spent £550 in one year upon them; but two years afterwards we find them curtailing their grants "to the young Indians roaming to Quebec, when hard-working white men at Halifax were supporting families at three or four shillings a day." In eighteen hundred and seven, the year of the *Chesapeake*, American frigate taken by the *Leopard* in time of peace, on an alarm of an American invasion, these wandering beggars were again the objects of alarm.

The Province was divided into twelve Indian districts. Mr. Monk, afterwards Justice Monk, was appointed Chief Indian Commissioner, who communicates to the twelve deputies, whom he hopes will give gratuitous information "in the hour of alarm." He had also the power to send confidential agents or spies to live among the Indians.

In Judge Monk's report to government, he places the fighting men at between three and four hundred, says there is much war talk, among them; that deputations had been sent to Canada, and that American agents were making great war talk about them; that generally the feeling was neutral; that they would wait to join the strongest party; except the Indians of Pictou, who would accept nothing from government, but would scalp all the pale-faces in two nights; and those of Sable River, who had assembled in large numbers, had menaced the Shelburne Indians, and insolently refused to explain their meetings; that in Cumberland they would fight for King George, and that in Cape Breton the feeling was similar with Nova Scotia. He also suggests that the twelve districts should choose a chief who would communicate with the government, and that the influence of the Catholic clergy, who were very well disposed, should be sought.

These various papers, all much decayed, and many dirty and pocket-worn, are endorsed by Governors Wentworth, Prevost, and Sherbroke. The strong, bold hand-writing of the latter, with the initials J. C. S., are very characteristic. Louis Toney and Peter Maurice, to their honor be it told, offer to fight for King George. This petition is dated eighteen hundred and twelve.

From memoranda of Sir John Sherbroke, we gather that they were never called into service. He orders them to be clothed, but arms and rations are nowhere to be issued. There are persons still living who remember seeing two hundred in one body at Shubenacadie at that time, and Indians not long dead who boasted of being captains then. To us in the nineteenth century, their being cause of alarm seems more strange than their ingratitude, after being fed for one hundred years. Petitions for grants of land now appear. Reserves of one thousand acres in various parts of the Province and in Cape Breton were surveyed. The Francis Xavier settlement at Bear River, Annapolis, seems to have been the most successful, under the joint care of Mr. Justice Wiswell and the Abbe Segoigne, in eighteen hundred and thirty-one. There are several letters of this excellent gentleman preserved.

In eighteen hundred and forty-two a commission was issued by the Lieutenant-Governor, Lord Falkland, appointing the Hon. Joseph Howe, Indian Commissioner; and from his report, dated eighteen hundred and forty-two, we learn their numbers at that time to have been fourteen hundred and twenty-five.

Mr. Howe, from statistics received, says the numbers at Pictou in seventeen hundred and ninety-eight, were eight hundred, and calculates their decrease by it; but Mortimer's list to House of Assembly for eighteen hundred, makes them only one hundred and thirty-six. Mr. Howe's book contains his own report, a separate plan of each reserve of land for the Indians, being in Nova Scotia proper, ten thousand and fifty acres, and in Cape Breton, twelve thousand; numerous letters from various individuals, and ends in eighteen hundred and forty-two. He seems to have entered into the work with his characteristic force and with personal observation.

Here ends the records; but doubtless there are other papers between this date and the confederation of the Dominion, at which time Indian affairs were handed over to it, still in the public offices.

My first knowledge of the Indians began in eighteen hundred and thirty-one. At that period they all lived in neat birch-bark wigwams,—a house was a very rare exception; and they all, both women and men, were clothed in coarse blue cloth. The men in blue frocks with scarlet edges upon the shoulders and on the arms. A scarlet or gay-colored sash bound this to their waist, at the back of which hung a tobacco pouch of moose skin. They wore also knee-breeches and long gaiters of the same blue, with the selvage edge left long, and ornamented with scarlet. The stocking was a long roller of blanket, wound from the toe to the knee. A large silver brooch of the size of a large watch, usually held the frock at the neck; and the foot was covered by an untanned mocassin. The hair was worn very long. A beaver hat on great occasions, but usually a straw hat or red cap surmounted a huge mass of unkempt locks.

The women wore a high-pointed cap of blue cloth, often ornamented with scarlet cloth and white beads; a short gown and petticoat reaching to the knee, with a gaiter trowser, and the selvage left loose to the ancle. In cold weather a blanket was worn over the head, and always brought square across the back.

This pleasing dress, in which we recognize the hunting frock of all North America, whether it be the deer-skin shirt and leggins, with their fringes of the far west Indians, or the frock of the old continental rifleman, we infer was their habit from the time they ceased to wear skins. The continual mention of coarse scarlet and blue serges by the French, the bales of blue cloth in the English treaties, and the bills of the same furnished to them by government in our own times, are ample proof.

The gaiter is the old housen of Les Carbot with its uncut fringe, and the scarlet epaulet or wing the "Matachias" of the same author; or ornaments of quills, where the "good beaver slieves" goeth into the cloak of skin.

In "The Frontier Missionary" we have a graphic sketch of the Indian of his day, 1779, at Halifax: "He had many Indians in his train," speaking of Lieutenant-Governor Franklin, "arrayed in all their tinsel finery, amongst whom was a Sachem, who wore a long blue coat adorned by a scarlet cape and bound closely about his loins by a girdle." This is proof of his dress one hundred years ago.

In 1831, when I first made acquaintance with them, this blue hunting frock, scarlet epaulet, and gaudy girdle, and long gaiter for the men, with blue pointed cap, short petticoat, and gaiter, with blanket always worn *square* on the back, for the women, was their universal wear. Les Carbot says expressly, the skin cloak was worn square, so they have adhered to this form through skin and serge and two hundred and fifty years.

I have now brought the Mic-Mac from his Stone or pre-historic age, his French age, and his English age, to our own times, and it remains to give his present condition. Estimated in early French times at about between three and four thousand souls, and that including Prince Edward's, we find them at the next authentic record (Judge Monk's return, 1808) as from three hundred and fifty to four hundred fighting men. This would make about two thousand souls, making a decrease of something more than fifteen hundred in two hundred years. In 1842, Mr. Howe returns them at fourteen hundred and twenty-five. The last census makes them:

Halifax	158	Annapolis	68
Lunenburg	50	Kings	61
Queen's	110	Hants	168
Shelburne	28	Cumberland	44
Yarmouth	37	Colchester	31
Digby	224	Pictou	125
Antigonish	81	Guysborough	48

1233 N. S.

Cape Breton—

Inverness	138	Victoria	69
C. Breton	188	Richmond......	78
	473 C. B.	——1706 Total.	

Thus we find from census returns they are rather increasing. This is owing in part, perhaps, to the census being more correct; but there are other causes that may contribute. Within the last fifty years a greater change in their dress and habits has come over them than when they passed from skins to serge. With regard to the men, the blue hunting frock and gaiter with its scarlet seams have entirely disappeared. The men dress in ordinary clothes, but usually affect a grey tunic and pantaloons, with shoes or high boots. The high pointed cap and short petticoat lingers a little amongst the old women; but hats and feathers, veils, flounces and high laced boots are rapidly taking their place. Though the artist must mourn, the wild graceful figure lost in the modern navvy, yet no doubt the change is beneficial. Anything that lessens the separation between them and the dominant race into which they must sink, hastens the hour. Another change in their habits is telling greatly upon them, they all now have permanent winter houses. If they do not sleep in beds, they at least sleep on floors of wood during the cold winter, instead of on the hard ground covered by spruce bushes.

Their summer camps are still as of old. Clothed like ourselves, with a boot keeping the feet dry, and sleeping warm and dry, they cannot retain the old instinctive adhesiveness of race, or the ancient consumptions and palsies that formerly decimated them. Ever minding all these changes and these ceaseless influences on their moral and physical condition, we will describe the Mic-Mac Indian of the present hour. His stature is below the medium; slight, carrying his shoulders overhanging forward and high; his limbs light, and extremities small; the tibia or shin bone well curved, but this curve is high in the bone and forward as well as outward, and springing as it does from the high boney arch of a very clean instep, has the grace of fitness and beauty which is not found when the curve is near the ankle and the instep flat. This beauty which was formerly brought out by the tight gaiter and moccasin, the fisherman's heavy boots is fast destroying; and the loose trouser with its baggy knees hiding from sight. He is beginning to turn his toes outwards. Even the Indian squaw who once stole so softly on you with her parrot-toed foot, fringed to the ground like her native grouse, now flaunts with outward toe, a crimson topped high laced boot. He wears his hair cropped now, which brings still more in relief the small and narrowed skull, high and broad cheek bone, high frontal ridges, and square heavy jaw bone of the red man, or Mongolian type.

If we look in the children and women we find the oblique eye of the same race; but in the adult the continual exposure has caused the muscles of the orbit drawing and puckering around the eye for its defence, to draw down the corners. The nose sometimes approaches to the Roman, but always has wide nostrils; the mouth large with the upper lip convex, and the chin retreating.

In the women and children the mouth is the worst feature, being large, unmeaning, and often open,—the greater force in man giving it stronger expression. The eye is dark, oblique and small, and rather intelligent than bright. The French called their colour olive. This now could scarcely be true. We miss the richness of the olive. The men were almost a clay yellow, and it is only in the women and young we find a reddish tint or coloured lip or cheek. The beard is scanty, a small moustache and a few hairs on the point of chin. Such is the description at present of the Stone man of two hundred and fifty years ago,—how little changed in habit or feature. The ceaseless influences of civilization, of different food and altered habits, have worn down and softened his contour. The high cheek bone is lessened, the strong jaw is less square, and the wild aspect of savage life softened. He has ceased to tear his meat like a dog, therefore the square jaw is more pointed, and the cheek bone, which is only a bridge for the jaw and its muscles to play beneath, has fallen; nor has he the wild utterance or startled look of one always fearing his enemy.

Recollecting that these changes are as ceaselessly working upon ourselves, we cannot but marvel at the strong cohesiveness of race that has kept him so little unaltered. Give him back his well stored forest and stream and one generation would obliterate his whole civilization.

It is generally said our Indians are changing from mixed blood. No doubt there is some truth in this, as the white names continually occurring amongst them prove; but as far as my own researches, principally amongst the western families, have reached, I think this is only by illicit intercourse,—the child taking the name of its father. I never saw but one Indian with a white wife, and I have only known two white men living amongst them. One of them was married. I saw one negro, whose half-breed child showed so many signs of unconformability of races; and as I have never met her afterwards, or but a single trace of her descendants since, I think the cast has died out. The Indians themselves remarked it. "Me tink," said old Molly to me, "Indian squaws with wool, nasty, nasty."

The Biologist would have been equally disgusted, but would not have failed to note the Mongolian and Caucasian were more nearly allied than the negro.

These remarks are based upon the Nova Scotia Indian, as we know from the statement of the late Colonel Chearnley, Indian Commissioner, that a race of half-breeds between the French and Indians of Cape Breton, were rivalling both parents in stature and habits. Yet it must be confessed that a lighter colour, a tendency to fatness, especially in the women, and a smoothness of contour as regards form, and a loss of that so pleasant scanty tongue (the words dropping out so unwillingly), is stealing amongst them.*

* These observations are made principally from the idle groups of men, women and children hanging around our country villages, or their own summer camp. Yet, it is but fair to the Indian to say that, seen in the forest or in the hunting grounds, all the old instincts of his race start out, clothed though he may have been in skins, blue hunting frock or grey trowsers,—his exact knowledge of localities, day or night, his keen observations of all animal signs, and his power of forming rapid and true conclusions from them. Unlike white men, he never works lazily, although off work none can excel him in it. He tracks his game with all his might,—eye, ear, foot, touch, is strained to their utmost intensity. His pose, shooting porpoise from his frail canoe, is a study for an artist. Such seemingly careless repose, such nice balancing,

Whether from cross-breeding or the ceaseless efforts of new circumstances, the grey loose trowsers, heavy boots, cook-stove and dry bed, will rapidly accelerate all these changes. It seems now by the census returns, they have a slight increase; yet the fewness of children amongst them too surely proves a doomed race. From the many returns of now nearly one hundred years, and my own observations, to allow three children to one family is a very high estimate. In some counties two, or two and one-half, was nearer the truth. The very early marriages of thirteen or fourteen years may conduce to this, as though many die in infancy, fewer are born than amongst the whites.

The race between change of habit and existence, will end in existence, marking the score. They will die out as Mic-Macs. They have ceased to be forest hunters. No Indian lives by the chase, and although they are now generally spread over the Province, the shores of the great Bay of Fundy will be their last haunt. The attractions of porpoise-hunting, the only chase left them, and the St. Francis Xavier reserve, the one settlement of Nova Scotia still in existence, will keep them lingering around the Digby Gut. Here they will lazily plant their barren fields, hunt porpoise, shoot gulls, and make woodenware and baskets, fading away, the victims of altered circumstances, as their congeners, the cariboo and the moose, have done before them.

It is evident that the time has long passed to consider them as a nation, in approaching them for their good. The sooner all national feeling, language and traditions are gone the better. They must be approached as individual men and women, taught English, to write, and to speak it. The English boot and trowsers have done much for them. A few years ago many most sincere persons gave large sums of money to civilize them. Their money and work were all wasted, if not injuring the race they sincerely sought to benefit.

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followed by such rapid actions, like the recoil of a steel spring, is what no white man may learn,—is hereditary. These powers remain in some individuals still, but the individuals are fewer. But few hunt, and of the Indians collectively, it may now be said they do not live by the chase. Basket making and woodenware, a little planting of potatoes, selling porpoise oil, sometimes moose-meat, and a few furs, with occasional hiring at stream driving, afford a miserable living to those who need only food and lothing, paying neither rent nor taxes.

By a most fatal mistake in natural laws, and by teaching them their own language, by printing what were called (but really were not) Mic-Mac books and gospels, they meddled with their faith, and sought to carry them back to their old worn-out life and language, now sadly disjointed from the present times. Their only language should be English. They have no written character dating beyond their conversion to Christianity; but amongst them are devotional books in manuscript, hieroglyphics where a figure like a beaver stands for a sentence, and others, also manuscript, where the sounds appear to have been reduced to English letters somewhat modified, but all derived from the French clergy. We can only lament so much money, and so much hard work sincerely wasted, in harrassing their untutored minds with another language and another faith, before they had taught them to wear shoes and stockings, or to eat from tables.

In making a list of names and families, I have had recourse to ancient treaties, old vouchers and Government lists, and my own knowledge. I have found that many, and those the most permanent ones, are derived from Scripture, and were no doubt given them by the French clergy in baptism, others seem territorial, and others seem to have sprung from illicit intercourse with the whites, the son taking the white father's name. Many found in old records have died out. The Cape Breton names are peculiarly French, as it was held by the French fifty years after Nova Scotia. The families whose names are derived from original baptism by the French clergy, are:—

Peter,	Thaughmough,	Nicola,
Paul,	Bernard,	Juhairie,
Noel,	Glode,	Phillip,
Thomas,	Meuse,	Bettis,
Slome,	Leuxy,	Martin,
Toni,	Charles,	Joseph,
Jeremy,	Francois,	Cobadeel,
Scire,	John,	Simon,
Sosop,	Elixe,	Louis,
Malti,	Pattus,	Mick.
Toma,	Tonsux.	

Thus Noel means Xtmas; Toma and Thaughmough comes from Thomas; Slome from Siloom; Toni from Anthony; Sosop from Joseph; Malti from Matthias; Glode from Claude, by the following steps:—Clod, (1744) Cloud, Cloat, Gloat, Gleude, Glode, so spelt in old records to the present day. Meuse from Michael; thus Moesel alias Michael is found in an old treaty, (1744), then Mosel, then Mioce, who held a brevet and medal from Duquesnol, French Governor of Cape Breton, though a British subject, living at La Have, (ob circa 1754), then Francis Mius, son of the same, dying at Clare, (1811), but holding brevet and medal, and according to the good Father Segoigne, not transmitting their high reputation in faith and morals. James Meuse, lineal descendant of the same, now holds the medal and still retains the Indian Governorship at St. Francis Xavier Settlement, Bear River. Thus in almost every instance we can refer the names in this list to their original baptism.

In the next list we find the white names indicating their various crossings; but as the descendants of these half-breeds intermarry with whole breeds, the tendency is to return to the old race. The families whose names are derived from the whites, are:—

Williams,	Stevens,	Bartlet,
Knockwood,	Barron,	Bradford,
Nocot,	Mitchell,	M'Grode,
Nogood,	Wilmot,	Ball,
Nuffcoat,	Hadley,	Guy,
Morrice,	Wisdom,	Davis,
Knowland,	Duncan,	Alley,
Cope,	Walton,	Wise,
Coop,	Nugent,	Butmere.
Brooks,		

This list sufficiently shows its origin. Perhaps Nocot, Nogood, Nuffcoat, may all come from Knockwood, whilst Bradford now has a negro strain.

In the next, which finishes the list, are many we can scarcely class, and have become extinct.

Pictou,	Oakum,	Porpus,
Labrador,	Pulpis,	Brinaugh,
Mabou,	Petition,	Leguire,
Kalecl,	Bonta,	Savio,
Lapier,	Paspish,	Bardo,
Genesh,	Muscataway,	Snasin,
Penaul,	Amquasset,	Snake,
Letone,	Algomartin,	Mercatowan,
Morier,	Agamone,	Pearless,
Prospea,	Beatle,	Polalance,
Brospea,	Bobbii,	Sesough,
Brashea,	Marble,	Hogamaw,
Sheponie,	Quarrel,	Dinney,
Lurlan,	Docomorno,	Gogos.
Legou,		

In this list we find several that may be called territorial, as Mabou, Pictou, Labrador, Genish to be represented by one, Jackish, who surrendered to Governor Mascarene, (ob circa 1740); some with a French origin and many evidently, as Algomartink, Muscatawry, and others of remote Indian origin. These last all appear, some of them many times in old manuscripts, but are now, with a few exceptions, extinct.

The spelling has been made by the various writers of these old papers, seemingly each one by his own idea of sound, and thus families may have been confounded. In saying that at present there may be about forty to fifty-five families in the Province is an approximation.

To show the uncertainty of any deductions from these words of an unwritten dialect, we have a tradition of a great chief named Hogomaw, who fought against Wolf at Louisbourg and Quebec, and was there saved from being shot by having spared an officer at Louisbourg, and his grave is still shown in Cape Breton. Now Malti Pictou, an Indian of Digby County, upon hearing the word Hogomaw, said directly, "that means where big tree lies fallen." Thus memory and tradition having died out, even among his descendants, now named Dinneys, the beautiful epithet for a Red warrior's grave has passed into a name for himself.

To further illustrate the Indians, I will give a sketch of a visit to St. Francis Xavier settlement, Beaver River, the most successful of all the experiments to attach them to the soil, made in July, 1877. It was formed by the late Mr. Justice Wiswell, acting under government, who called to his assistance the Abbe Segoigne, a French clergyman of great devotion and simplicity of habit, in 1828. A reserve of one thousand acres was divided into thirty-acre lots, and one lot given to each head of family, upon certain conditions, and not on fee simple. At present about twenty-five families reside upon it, each in its own house. A road about a mile and a half long and fairly enclosed by stone dyke or rail fence runs through it. A few potato patches, pot herbs and garden bits about each house are the only signs of cultivation. All the fields were in hay lands or in pasturage. The houses were small frame ones, with glazed windows, shingled, and each with a porch. Inside they had good floors, chimney, cook-stove, table, but few chairs, and walls not plaistered, though some were papered with *Illustrated London News.* A porch and single room formed the lower floor, but there was an upper loft, approached by a ladder, which formed sleeping apartments.

In the whole settlement there was but one barn. Other fields were grown up by alders and birches, with Indian paths leading by devious routes to other houses,—to the chapel, or to the square lodge-like house, where had dwelt the Chief and his family for these fifty years. The chapel, a plain, square building, with porch and square windows, stands in an enclosure, guarded by many a rude grave with ruder head-stone, and quaintly carved wooden cross sticking through the coarse matted grass. These two buildings are by the charity of a descendant of Selina the famous Countess of Huntington, who was moved thereby by James Meuse, the Chief, visiting England about eighteen hundred and twenty-five. A print portrait of the lady still hangs upon the dingy walls. Though as an agricultural settlement, this is a failure, though each house stands bald, no barn or out-house standing by, with pig or chick or cow, as have the whites, and devious Indian paths lose themselves in open porches of houses passed in and out, rather than dwelt in. Yet it may be called a success. Here have twenty-six families been weaned from wigwams and bed on the ground, to permanent dwellings, dry floors, to separation of sleeping rooms, to cook-stoves, and to a sense of the necessity of all these wants.

At the time of our visit,—Summer,—the men were all away shooting porpoise on the Bay of Fundy, and nothing but women and children were left behind. A scanty crop of potatoes, and letting their fields for pasturage, with here and there a cow, is all that they gain, save fire-wood and a home from the land. The sale of baskets and woodenware, with that of porpoise oil, berries, some deer meat and wages gained in log cutting, make up the scanty hoard which clothes and feeds them. Begging is carried on everywhere and every place. As are the habits of the citizens of this the most permanent and populous settlement, such are those of their fellows, scattered in smaller parties in every county of the Province,—of those who dwell at Cape Breton, in larger settlements, and who linger in Dartmouth, from its neighborhood to the metropolis. Much has been done. Dry feet and a cook-stove fits man for moral reform far more than any but the thoughtful will allow; but in all that is to be done, they must be considered as individuals,—the past forgotten, the future aimed at. They must be taught in English,—to write, to read, and to forget their own language, with all its traditions; but which is only and never was but a dialect of a roving tribe, with an ever varying pronunciation of years and individuals.

Instead of distributing the conventional blankets and pipes,—things of the past,—the Dominion Government should use the same means, in improving their very rude way of trying out fish oil and of selling their oils well in the American market. They mentally oppose farm labour, but are ready and skilful mechanics. Basket work, woodenware, especially mast hoops, buckets and barrels, they naturally take to. Surely it is better, and greater results will follow in running with their inclinations, and giving greater facilities to them in these directions. But the question, who is to do this?

The government can give means, but not the man. Unfortunately, we have not their confidence, and the unhappy attempt of converting them from their ancient faith a few years since, ended in widening the breach. This mission belongs to the church that won them from paganism. The late Abbe Segoigne is an instance of what good may be done, and how honored he was by the highest authorities and gentlemen of his time; and no doubt should there now arise a gentleman of his profession, who made these two thousand poor souls his special mission, teaching them the language, the habits and manners of our own life, and do it as we unhappily cannot, not disturbing their faith; and if in this he devoted himself, his life, his talents and labour, the government would soon put every means in his power, and men of all parties would honour him,—the government ridding itself of a troublesome thing, and all willing patiently to wait till the Indian stood side by side us as equal man, before he was burdened with the discussion of civil and religious liberties.

ART. V.—NOTES ON THE CARIBOO. BY ROBERT MORROW, ESQ.

(Read before the Institute, April 9th, 1877.)

THIS paper is the consequence of the following quotation from the " Fauna Boreali-Americana " of Sir John Richardson, pages 250 and 251:—Mr. Hutchins " mentions that the buck (Cariboo) has a peculiar bag or cist in the lower part of the neck, about the bigness of a crown-piece, and filled with fine flaxen hair, neatly coiled round to the thickness of an inch. There is an opening through the skin, near the head, leading to the cist, but Mr. Hutchins does not offer a conjecture as to its uses in the economy of the animal. Camper found a membranous cist in the Reindeer, above the thyroid cartilage, and opening into the larynx, but I have met with no account of a cist with a duct opening externally like that described by Mr. Hutchins, and unfortunately, I was not aware of his remarks until the means of ascertaining whether such a sac exists in the Barren Ground Cariboo were beyond my reach."

This account of cist and sac for the last four or five years has occasioned me much thought; having several times looked for the cist without success, but always forgetting the sac, and not being able to obtain any information on these points, it occurred to me last Fall that the only way left was to look for a Cariboo, and examine it myself, and the result of this examination, and dissections of others, male and female, made since, I will now place before you. But first, it is necessary that Camper's description and drawing of the "membranous sac" from a Reindeer "four years old" should be placed before you.

Camper says* :—"As I did not yet know the Reindeer, and as the inaccurate dissection which Stenon had made of it in 1672, and of which Valentyn gives an account, did not furnish me with much information, I was obliged to proceed to the examination (date, June, 1771) with great caution. I had often observed with astonishment, in the bucks, that when these animals swallowed, all the larynx rose and fell in a peculiar manner, and seemed to indicate something singular in this part. I then removed with much care the skin of the neck, uncertain of what I might find there.

"The muscles having been raised in the same way upon the sides, as I have represented them, I found a membranous sac, of which the origin was placed between the os hyoides and the 'thyroid cartilage.'

"Then I discovered two muscles which take their origin from the lower part of the 'os hyoides' exactly where the base of the 'os graniform' and the cornua meet. These muscles were flat and thin at their beginning, but they widened in descending towards their junction with the sac, and certainly serve to raise and support it, as well as to expel the air at the will of the animal.

"After I had opened the æsophagus from behind, I found under the base of the epiglottis a large orifice which admitted my finger very easily. This orifice spread and formed a membranons canal

* Vol. I, Chapter VI, page 338, Paris 1803, where reference is made by letters to a plate.

which, passing between the two muscles, terminated in a species of membranous sac. Consequently, the air driven from the lungs through the cleft of the larynx fell by this aperture into the sac, and necessarily caused a considerable swelling."

On the 4th December, I succeeded in killing a large and old buck Cariboo, some measurements of which were as follows :—

Length from muzzle to back of horns	1 ft. 6 in.
Back of horns to insertion of the tail	5 ft. 4 in.
Length of tail, including hair	9 in.
Height at shoulder	4 ft. 6 in.
Length from lower lip to hair sac, and opening into the larynx	1 ft. 8 in.
Length of liver	1 ft. 2 in.
Depth of liver at widest part	7 in.
Length of heart	9 in.
Diameter of do	6 in.

Lungs very large } I had no means in the woods of weighing
Trachea do., do., } either heart or lungs.

At this time I had not seen the account quoted from Camper, and groping somewhat in the dark, my specimen is not so perfect as it might otherwise have been. Examining the throat of the animal, the cist of Mr. Hutchins, "with an opening through the skin," does not exist, but immediately under the skin there was a roundish sub-triangular cyst or valve of cellular membrane "of the bigness of a crown-piece," and on cutting through the cellular membrane this valve is found to be a closed sac, with a peculiar lining membrane, and closely packed with what may be called loose hairs of a flaxen colour in a considerable quantity of sebaceous matter; at the same time, however, the lining membrane is covered with hair of the same quality, apparently growing from, and rather lightly attached to the lining membrane. Camper, in the account of his dissection, just read, has described the valve, as if it were the sac, and his drawing, a copy of which is before you, gives only the valve, as may be seen by examining the larynx of the animal obtained by me, or more conveniently the drawing of it, kindly made for this occasion by Dr. Gilpin. The muscles which Camper describes as connecting the sac with the "os hyoides," and which he considers peculiar to this organ, in my specimen do not exist, but their representatives are probably the muscles found in the larynx of the young buck by Dr. Sommers, as will later appear. The valve is connected with the omo-hyoid muscles as they pass towards their insertion in the hyoid bone. The valve which Camper has evidently taken to be the sac, lies outside of the mucous sac, but is incorporated with its anterior walls; the inner wall of the true sac surrounds and is attached to the larnyx, extending longitudinally from the hyoid bone to the base of the thyroid cartilage, but from the imperfect state of the specimen already referred to, I cannot say how much further it extended; and until a more perfect one is obtained, can only call the whole an organ of voice. The slit or "orifice," as Camper calls it, exists as he has described, but it opens into the laryngeal sac which lies above the valve, that is next the larynx, as already shown.

The dimensions of the larynx, after having been some time in spirits, are as follows:—

Length of larynx from base of epiglottis to base of thyroid cartilage	5 in.
Circumference of do	11 in.
Inside diameter of larynx	2 in.

The age of the reindeer, which Camper dissected, he says was "four years," but "it had not attained all its growth;" again he says, "if we admit that this reindeer had not attained its full growth," and still further, "I cannot determine anything respecting the length of the life of the reindeer, save that it ought to reach the age of sixteen years, because it takes four years to attain all its growth, although, however, the epiphyses continue even some time after." He seems by this to have been in doubt as to the age of the animal, or whether it was fully grown, and it is therefore possible that the sac was not perfectly developed. The muscles described by him, taken in connection with those found in the young buck, make this very probable. For further comparison we therefore require a buck somewhat younger than that from which the larynx shown to you was obtained.

Wishing to obtain a more perfect specimen of the larynx of an adult buck,—during the past winter I have made every exertion to obtain one but without success,—a small buck was sent to me from Cumberland, which was dissected on the 27th January by Dr. Sommers, Dr. Gilpin, and myself, some of its dimensions were, say of Buck Calf 8 months old;—

Length from tip of nose to tail	4 ft. 5 in.
do. of tail	5 in.
Tip of nose to centre of ears	1 ft. 1 in.
Height	about 3 ft.
Liver	11 x 5½ in.
Weight of liver	2 lb. 6 oz.
Heart, 6 x 6, somewhat flattened, weight	1 lb. 1 oz.
Weight of lungs only	1 lb. 6 oz.
Total weight of animal, including heart, liver, lungs and kidneys, skin, and all except entrails	83 lbs.

A female calf, and an adult doe certainly not less than 6 years old, were put at my disposal by Mr. T. J. Egan, and dissected February 19th. Of this calf the measurements were not made, but those of the doe were as follows:—

Length from end of nose to base of horns	1 ft. 1 in.
Length base of horns to line of rump	4 ft. 11 in.
Height at the shoulder	3 ft. 10 in.
Girth behind the shoulder	3 ft. 10 in.
Length of trachea to bifurcation	1 ft. 8 in.
Length of larynx	3½ in.
Diameter of larynx	2¼ in.
do. trachea	2 in.
do. at bifurcation	2 in.
Weight of lungs, including trachea	4¼ lbs.
Length of right lung	1 ft. 2 in.
Greatest breadth of right lung	8 in.
Length of left lung	1 ft, 1 in.

Greatest breadth of left lung.................. 7 in.

RIGHT LUNG.—3 lobes. Upper lobe deeply cleft, with a small lappet between it and the middle lobe. The upper and middle lobes were quite distinct. The lower lobe had a large lappet nearly as large as the middle lobe.

LEFT LUNG.—2 lobes. Upper lobe deeply cleft, giving it the appearance of two lobes. The lower lobe was quite distinct from the upper.

Weight of the heart........................ $2\frac{1}{2}$ lbs.
Length of the heart........................ 8 in.
Circumference of the heart....................1 ft. $2\frac{1}{2}$ in.

Of these three Caribou, Dr. Sommers has given me his notes as follows:—

"The dissection of the young Caribou provided by you, for the purpose of determining the anatomical structure and relations of the laryngeal sac, described by Camper, as existing in the Reindeer, together with subsequent examinations of the same parts in a female calf and an adult doe are recorded below for your information.

"1st. *Larynx, &c.* Body of the hyoid bone, horse shoe shaped, flattened laterally having an equal width from middle to the cornua, which have a narrow termination, the representatives of the corniculi in man being greatly developed; they pass upwards and backwards, measuring each over four inches in length, articulating by cartilage with the upper border of the body near its median line, separated, however, by an interval of about one-fourth of an inch, each consists of three pieces with cartilaginous connections, the united whole having the shape of a diminished human clavicle, its acromial end being more curved and attached forward. The larynx measured in front $2\frac{1}{4}$ inches; behind, from upper border of arytenoid to lower border of cricoid cartilages, $2\frac{1}{2}$ inches in length—circumference external $6\frac{1}{4}$ inches; internal diameter nearly 2 inches; the inferior or true vocal cords and ventriculi laryngi appeared faintly marked, for though visible when the larynx was entire, they disappeared when the organ was laid open, its inner face presenting an even surface from thyroid cartilage to sacculi above.

"At the notch formed in the upper border of the thyroid cartilage, by the junction of its Alæ, is found a pit or depression forward of the mucous membrane which lines it. Viewed in position, it would be taken for an opening leading into the thyro-hyoid space, and seems large enough to admit an ordinary lead pencil; a probe introduced here found a very shallow depression scarcely one-fourth of an inch in depth; this appearance was obliterated when the walls of the organ were stretched apart after section, but returned when the parts were allowed to resume their usual relations to each other. It is therefore a slight hernia or depression forward of the respiratory mucous membrane into the thyro-hyoid space; the thyro-hyoid membrane which forms here, the outer wall of the respiratory passage, is thin and lax; when the point of the little finger is forced into the depression it produces a sacculus, the walls of which will consist of mucous membrane internally, and the thyro-hyoid membrane externally, it finds here also, opposite the depression and partly filling the space, a flattened rounded oblong body about the size of a small horse bean; dissecting the areolar tissue, covering it in front, this body is seen external to and resting upon the thyro-hyoid membrane, its upper border connected with the base of the epiglottis is provided with a thin fibrous coat, and when cut into, presents to the eye a coarse granular structure.

"Arising apparently from the base of the epiglottis on either side 'possibly continuous with the thyro-epiglottidean and aryteno-epiglottidean muscles,' are two bands of muscular fibres, they pass over this body on either side, being connected with it by fibrous adhesions; extending forwards, they unite at its upper border, forming a single muscular band, which becomes inserted into the upper and inner edge of the hyoid bone; these fibres have no analogues in man.

"A microscopic examination of the structure forming this body, shows it to consist mostly of fatty tissue, with a moderate proportion of granular cells, apparently epithelial.

"The examination of the organ in an adult female, and female fawn, presents essentially the same anatomical peculiarities as given above; but the pit at the laryngeal notch is deeper in the doe than in either of the young animals, it not being obliterated when the parts are stretched. The vocal cords and ventricles are also much more developed; but the body described above is absent from the doe, and very rudimentary in the female fawn.

"On a consideration of the facts recorded, we must conclude that the organ described in part by Camper is peculiar to the adult male caribou, the specimen in your possession standing in proof. My dissections given above show that the organ exists in the immature male in a rudimentary form; but having all the parts necessary to its full development, present, we must conclude, that such development will advance with its growth. In both adult and immature females it is still more rudimentary, as the body which forms the valve in the adult male was not present in the doe, and was evidently atrophying in the fawn (female)."

From the above description of the larynx of the young male, together with that which I have pointed out in the adult, it would appear that by some unaccountable oversight, Camper in his account has only described the valve, passing over without observation, the true sac; but he points out that the female reindeer is without the organ above described; and also that it is not present in the male fallow deer; and from the specimen now exhibited, you will also perceive that it is absent in the Virginia deer. In this specimen you will notice the almost bony hardness of the thyroid cartilage.

I need hardly point out to you that the measurements of the two adult animals show that they were very fine specimens; but I may draw your attention to the size of the hearts and lungs, as well as mention that the windpipe in all four was very large, and that Camper has noticed this to be the case in his reindeer.

Inside of the hock of the Caribou, you will observe that there is a patch of hair of a lighter color and somewhat longer than that which covers the skin in its immediate neighborhood, and that the skin under this patch is slightly thicker than that immediately round it. This spot is usually called a "gland," whether it is strictly so, I cannot say; but at all events it is caused by an enlargement of the hair follicles, has a very strong smell, which you will immediately notice, and in the Caribou is a scent "gland." The matter producing this scent is of an entirely different character from that contained in the tubes. It appears to be a highly volatile oil, and resists salt for a long time after the surrounding skin has been thoroughly saturated, and when dry collects on the outside of the skin in the form of very small yellow waxy scales, such as would be left by minute portions of varnish. Although I did not see the animal use this so called "gland," yet my Indian who hunted with me in December saw a doe Caribou use it in this way; when she had finished urinating (she squats in the act almost exactly like a sheep), she rubbed these "glands" together, leaving true scent behind her for a short distance. When "creeping" moose or Caribou, it has been often a subject of enquiry with me why it was that beside the smell of the fresh urine, there floated above it as it were, and for some distance in advance, the true scent of the animal; and for myself, I have very little doubt but that this is one way at least in which these "glands" are used, and in confirmation, it may be mentioned that the dogs at one time openly used for hunting moose, did not often take the scent of that animal from the snow over which it had just passed, but stood upon their hind legs and took it, as if it had been rubbed from the "glands," as described. This point is merely mentioned in the hope that some gentleman present may be able to throw some light upon it, or keep it in mind when an opportunity offers for observations confirmatory or otherwise.

If you will look a little further down, that is, nearer the hoof, on the skins now before you, you will perceive on each leg just on the outside of the hinder part of the skin at the hair parting, a second "gland;" it is, perhaps, more "typical," than developed. You will notice that it has no smell, nor had it while the animal was warm. Professor Baird (Mammals of North America, page 633, U. S., P. R. R. Exp. and Surveys General Report), in his diagnosis taken from Gray's "*Knowsley Menagerie*," says: "The external metatarsal gland is above the middle of the leg." For this gland our President, Mr. T. J. Egan, and I had vainly sought for some years, in answer to enquiries made by an American naturalist, the Honorable Judge Caton, of Ottawa, Ill.; and this is the first one we have ever seen, and my Indian, to whom I pointed it out, immediately after the buck was shot, told me that he had never before seen it. It may be taken as a mark of adult age, and will not probably be found on any Caribou under the age, perhaps, of six years. This gland was 4 inches above the insertion of the dew claws, and 10¾ inches below the centre of the hock "gland." You will also see it on the leg of the old doe, but not so perfectly marked, perhaps owing to the lighter colour of the hair which surrounds it,—the doe having been killed in February, the buck in December.

It may not be out of place to mention that the buck Caribou, as well as the moose, often voids its urine while on the march, as the ox may be seen to do.

The tubes in the feet of the Caribou are another point to which your attention is directed, and which first attracted the notice of Dr. Gilpin, from inquiries made respecting them by the American naturalist already named. Dr. Gilpin and others, including myself, thought that they were only to be found in the hind feet of this animal, and the discovery of them in the fore feet is due entirely to Dr. Sommers.

In Camper's description of the reindeer, made in 1771, (vol. I. page 347, Paris, 1803) he says, speaking of these tubes: "In addition to the peculiarities of the reindeer, of which I have just spoken, I have discovered besides something very singular in the hind feet of this animal; that is to say, a deep sheath between the skin at the place where the dew claws are united together, of the size of the barrel of a quill, running deeply as far as the point where these dew claws are articulated with the bone of the metatarsus. These tubes were filled internally with long hairs, and a yellow oleagenous matter proceeded from them, the odour of which was not very agreeable.

"I have not found these tubes in the forefeet. It was not possible for me to discover the use of them, inasmuch as the heat of the summer obliged me to remove the flesh quickly from the skeleton;" and a little further on he says that in the feet of a reindeer, sent him in 1777, he did not find the tube in the hind foot, but one very apparent in the fore foot; and in another, sent him in 1778, the tubes were in the hind feet, but none in the fore feet, "so that I am not able to determine anything very exactly on this subject."

In the skin of one of the hind legs of the old buck, just above the coronet, you will see the tube, the bones having been removed for the purpose. The tube of the other foot has been sacrificed to experiment; and among the other specimens in spirits, are the hind and fore foot of a young buck, and the hind foot of a Virginia deer; and of the latter, a separate tube, and also dried, the hind and fore foot of the old doe caribou, and fore foot of the young one, and skins from the fore feet of the old buck. In the skin of the fore feet of the old buck there is and was no appearance of the tubes, they have been absorbed. By many, it appears to me erroneously, these tubes are considered to be scent "glands." Camper evidently did not think so; but he says (page 348): "The skin of the fore feet, as well as that of the hind, which unite the dew claws, were sprinkled with thousands of glandules, which probably give out an oleagenous matter, intended to protect the hoofs against the snow." This, it appears to me, may be said as to the "glandules" of any part of the skin with equal correctness. Prior to December last, having paid very little attention to these tubes, and having superficially examined only a few specimens some days killed, had the question been asked me, were they scent glands, the answer might have been affirmative; but after a careful examination of the animal while warm, my original note made in the woods reads, "The passage or so-called 'gland,' opening in the front of the hind foot, terminates close to the skin of its under surface. It is hair lined to its extremity. The separation or unity of this tube with the lower part of the sole skin is by 'fascia' attached to the apex of the passage; it is not a gland properly so called." From further examination of a number of fresh tubes, and from the observations made by Dr. Sommers, my first view that they were for the purpose of strengthening the bones of the foot of this animal in its spring or jump, does not now appear to me to be tenable, and for my own part, I adopt Camper's statement, and cannot say what their use may be; but they are not scent glands, if they were, it appears scarcely probable that as the buck comes to maturity he would be deprived of the means of leaving scent from his fore feet at the time when he most requires it, without taking into consideration the fact that the tube only exists in the fore feet of the male (up to an unknown age), or in the female in a rudimentary state.

The tubes in the hind feet of the Caribou are filled with a waxy matter (those in the fore feet being only rudimentary, contain but very little), and so are the tubes, one in each foot, of the Virginia deer; but this is retained in them, owing to the shape. That of the Caribou is rather wider in its mouth and of more equal diameter to its lower end than that of the Virginia deer, which, at its opening, is somewhat constricted and widens towards its centre; and the tubes of these two animals retain this waxy matter or scales, while the moose which, contrary to preconceived ideas (and this shows how little we study our animals), also has the tubes in its feet, fully developed in the hind, rudimentary in the fore feet, and if you will look at the hind foot, kindly sent me by A. Chipman Smith, Esq., Mayor of St. John, you will see that the tube is of a very different shape from that of the other two animals, being in the hind feet, very wide at the mouth, and gradually narrowing towards its lower extremity; from its shape it can retain but little, if any, of this "waxy" matter, it being washed out by any swamp or by the grass or plants through which it would pass. The disagreeable smell ascribed to this matter is owing in a great measure to the quantity of it which is contained in a narrow space. In general terms it may be summed up that the Caribou buck when young has the tubes in the fore feet in a rudimentary form, which instead of passing upward and backward to the skin close to the dew claws, as in the developed tubes of the hind feet, lie between the hollow of, and nearly parallel with the bones of the feet, and that they are gradually absorbed until certainly in the adult male they entirely disappear. The doe has them also rudimentary in the fore feet;

perfectly developed in the hind, and it is a question which is yet to be decided whether the tubes ever entirely fade out of the feet of the doe. In the old doe, the age of which cannot be less than six years, although small, the tubes are still plainly to be seen.

A young moose, in possession of Mr. J. W. Stairs, has these tubes in all its feet. Those in the hind feet are fully developed, and pass in the same way as those of the Caribou,—between the phalanges; in the fore feet they are as in the Caribou of the same age, not passing upward and backward between the bones, but lying between and nearly parallel with them, and being, as in the Caribou, only rudimentary; but at what time of life they disappear in this animal, or whether in male or female, or both, cannot, owing to our prohibitory law, at present be decided.

The bones of the fore feet of the Caribou have the same general appearance as those of the moose. The "splint" bone is, however, very much shorter in proportion. In the hind feet the bones are the same; in the Caribou they are, however, rounder than in the moose.

Permit me to tax your patience a little longer, it has been shown that the Caribou and Moose have the tubes fully developed in the hind feet, and rudimentary in the fore. An examination of a Wapiti or Elk (Cervus Canadensis) skin with feet attached, in Mr. Egan's collection, presented the fact, confirmed by Judge Caton, that this animal has no tube in any foot, and that its feet are of a different shape from those of the Caribou, Moose, and Virginia Deer, being * broader and shorter, and that the length of the phalanges is very much less in proportion to the size of the animal in

* Professor Baird, U. S. P. R. R. Exp. and Surveys, page 638, Sp. ch.: "Hoofs short, broad and rounded;" 639: "The hoofs of the elk, fig. 10, are very different from those of the smaller deer; instead of being narrow and pointed, they are short, broad, and with the outer edge of the under surface much rounded; in fact, they bear a very close resemblance beneath, to those of a buffalo. . . . In the hind foot of the elk, the hoof is rather longer. . . . The length but little greater than the width of both hoofs together. The anterior hoofs are rather the largest.

"There is a patch of whitish hairs on the outer edge of the hind leg, about one-third the length of the metatarsus, from its upper edge. This is narrow and about two inches long. There is no naked space between these hairs, as in the Virginia deer. I have not observed the bushy bunch or patch of long hairs seen on the inside of the tarsal region in the Virginia deer, though it may possibly exist." (Judge Caton says it does not.)

the specimen referred to, than in the Caribou and Virginia Deer; from the metecarpo-phalangeal articulation, to the point of the hoof, they measure 7 inches; while those of the young buck Caribou, measured 7¼ inches, of the old doe 7½ inches, and of the old buck 9 inches. The gentleman already referred to, informs me that the Wapiti is a natural trotter, * "he, however, can, and does run much faster than he can trot, but it is a laboured effort, and soon tires him out." "His run is an awkward, lumbering, rolling gallop. A few hundred yards of this gait tells. It is said that an Elk will trot at an equal speed without stopping, or even flagging for twenty miles." The Virginia Deer has a tube scantily furnished interiorly with short hairs, fully developed in each foot, which led me to inquire respecting the gait of this animal, my impression being that it would prove to be a galloping or running deer, and this has been confirmed. "The natural gait of the Virginia Deer is a gallop or run. He never trots except when he wants to move a short distance voluntarily, and then it is a slow lazy gait."

The inference which you will allow me to draw from this is, that the number of tubes in the feet of the different species of deer will point out the gait of the animal, that is, those which have a fully developed tube in each foot, should be bounders and runners, while those wanting the tubes, or having them partially developed in the fore and fully in the hind feet should be trotters. The point is one which has not, to my knowledge, been touched upon by any naturalist; and as it cannot be further inquired into among us where we have only the Moose and Caribou, it is mentioned in the hope that it may be examined into by those who have access to a number of different species of Deer.

It remains for me to present to you the notes of the scientific examinations of the tubes, kindly furnished by Dr. Sommers, as follows:—

In the observations here annexed, I have endeavoured to furnish an accurate description of the so-called "interdigital glands" which exist in the feet of the Cariboo, by subjecting them to very careful anatomical and microscopical inspection. The conclusion at which

* "Plains of the Great West," by Col. Dodge, pages 164 and 166.

I arrive, relative to their structure and functions is, that they are not glandular, in the correct meaning of that term, an opinion which coincides with that which you previously expressed.

Caribou Buck, 8 Months Old—Hind Foot.

"The cleft in the hoof is very deep, and the phalanges are loose and movable, the only connection of any consequence existing between them being formed by the skin covering the hoof. It forms a broad web between the phalangeal bones, thus affording a broad surface with which the animal may rest upon the ground; the cleft in the hind foot measures from metecarpo-phalangeal articulation, to the tip of hoof, 7¼ inches. In the fore foot, it measured 7½ inches, the free border of the web in both feet is found at the insertion of the nails or hoofs into the skin, the length of web being about 5 inches, greatest width at free border 1½ inches, diminishing gradually upwards, the anterior and posterior walls of the web are separated by an interval filled with areolar tissue, and a small proportion of fat.

"About one and a-half inches above the edge of the web in its anterior wall, at a point midway and opposite to the articulation of the first and second sets of toe bones is found a circular opening or foramen, large enough to admit the barrel of a goose quill, it gives passage to a tuft of hairs lighter coloured than the surrounding ones, which are slightly smeared or stiffened with smegma, a probe introduced here discloses a passage or "cul de sac" continuous with this opening, having a depth of one and a quarter inches. On dissecting the skin from the under side or sole, and removing the surrounding tissue, the "cul de sac" was exposed, extending upwards and backwards between the proximal phalanges, approaching, but contracting no adhesion to the skin of the sole, and terminating at a point corresponding to the articulation of the dew claws with the splint.

"This organ presents the appearance of a fleshy tube with thick walls, and a rounded blind extremity like that of a small test tube, flattened on its posterior or under side, convex on its upper or anterior side, about one and a-half inches in length below, somewhat shorter above, its circumference being about three quarters of an inch: it tapers slightly towards its termination. When viewed in position, it bears a striking resemblance to the human uvula.

"The surface exposed by dissection exhibits a structure consisting of rounded or slightly polygonal spaces, resembling very large cells, these are convex of a deep red colour, and united by paler interspaces. The whole organ has the appearance of a body constituted of immense cells united by their thin cell walls. This, however is deceptive; these spaces are the rounded terminations or bases of the bulbs or follicles from which the hairs inside of the sac grow: the resemblance to cellular interspaces arises from the pressure of a very delicate layer of true skin upon which they rest, and which has been pushed into these interspaces by the growth of the hair follicles. The same structure can be observed in other parts of the skin by dissecting off the true skin which is underneath from the epithelial layer which covers it, and gives origin to the hairs, but here the spaces observed are much smaller, since the hairs and their bulbs are more crowded, the space occupied by each bulb being less than in the cul de sac, or organ under notice.

"On examining the web of the fore foot, the opening was found similar in character and co-relative position, to that of the hind foot; previous to making these dissections, I was informed that this structure did not exist in the fore feet of the Caribou, nevertheless certain preconceived opinions relative to its structure and function, led me to seek for it here. The organ in the fore feet differs from that in the hind, by being very shallow, measuring not over one-quarter of an inch in depth; this is due to the drawing up and partial obliteration of its anterior wall; when dissected from the surrounding tissue, it presents all the characteristics of the organ in the hind foot, yet it differs in its position relative to the phalangeal bones, for instead of passing obliquely between them as in the hind foot, it lies in the same plane as that of the anterior wall of the web, its own anterior wall being incorporated with the under surface of the skin, being thereby shortened to about one-quarter of an inch in length; the posterior wall, however, remains distinct and measures from the blind extremity to its termination in the skin, somewhat over an inch.

"The microscopic examination of this organ proved it to be of Epidermic origin. Sections through the thickness of its walls showed an external layer of flattened prismoidal cells with small nuclei, a deeper or internal layer in which the cells were more rounded and filled with granular protoplasm, (this difference in the uppermost and lowermost layer was brought out by the staining process, and it is in these only that we find the line of demarcation, the intervening layers merging gradually one into the other). Other structures observed were the hairs and hair follicles with their accompanying tissues, and some fibres representing, no doubt, the true skin, which is not developed in these organs to any considerable extent. The two layers of cells correspond to the same parts in man, viz., a horny layer external, but of course internal in the 'cul-de-scac;' a mucous layer external when the sac is dissected from its surroundings, the changed position of these layers is owing to the circumstance of the sac's being an invagination of the epidermic layer into the true skin.

"Regarding the function of this structure, various and contradictory opinions are expressed, that of its being glandular being most prevalent; again it is said to have no existence in the Wapiti and Moose, and fore feet of the adult Caribou. The fact of its existence in fore and hind feet of the Virginia Deer being well understood, its presence in this animal is said to be for the purpose of leaving a trace or scent on the ground, and in this way serving the union of the sexes at certain seasons, but if this is the case, we may ask why should it not exist in the Wapiti and be fully developed in the Caribou and Moose, since it must be obvious to us that the fulfilment of the conditions which obtain in the Virginia Deer are required also in the Wapiti; more than this, we know that a true scent organ in the Caribou is situated on the inside of the heels or gambrils.

"I may say here that on the occasion of my first dissection of the organ in the Caribou buck fawn, I expressed the opinion, that this organ or structure would be found also in the fore feet of the adult animal, though perhaps more rudimentary; a subsequent examination of the fore feet in an adult doe confirmed this opinion in the fullest degree, since I there found the structure as well developed as in the young animal. I now feel more than ever convinced that it exists in all our deer tribe, not excluding the Wapiti, although it may be larger in some than in others; an immature living moose in possession of Mr. J. W. Stairs, being provided with it.

"The following summary of its Histological relations will aid in arriving at correct conclusions relative to its importance :—

"1st. It is a growth or offset from the epidermic layer of the skin, invaginated between the phalangeal bones, containing the Malpighian and horny layers of the epidermis, and carrying with it a very thin layer of the true skin.

"2nd. Hair follicles and hairs growing from its internal walls and emerging through its opening, these being also epidermic or of epithelial origin.

"3rd. The absence of glandular tissue, excepting the sebaceous follicles which accompany the hair follicles or bulbs over the whole integument of the animal, 'this exception is made for obvious anatomical reasons,' nevertheless the sebaceous follicles were not observed in the specimens examined with the microscope.

"4th. The examination of the matter filling the tubes in the Virginia Deer, and present in much smaller proportion in the Caribou, showed it to consist in principal part of desquamated epidermic scales and oil globules; microscopically it resembled smegma from the skin of man, or perhaps closer still the 'vernix caseosa,' from that of the recently delivered infant, remembering that the epidermis in man and in all animals is a non-vascular tissue, that unlike our other tissues it is shelled off from the surface; we can readily account for these desquamated scales being retained here in a narrow pocket, from which they could not be readily discharged. Retrograde changes in these cells, secretions from sebaceous and sweat glands in adjacent parts will account, not only for the oily matter seen, the viscidity of the substance, but also for the odour which it possesses, the latter being no greater than that of the general integument, and arises from the same cause, viz.: the perspiration, but in this respect they are not in any degree comparable with the glandular collection at the hocks before mentioned, which will retain the peculiar odour of the animal for a long period after the removal of the skin.

"In the presence of these facts we must conclude that this organ is only rudimentary, having no function which is obvious to us, it is not a secreting organ since it lacks glandular tissue; the opening in the dorsum instead of the sole of the foot would point also in this way; it does not serve to give strength or firmness to the foot, having none of the toughness and elasticity of skin in other parts, without comparison with the tendons, etc., which are provided for this purpose. Organs without uses are found from man downwards, we sometimes call them fœtal structures because some are well developed and are in use before birth, wither and remain useless after birth; for example, the woolfian bodies, said to be represented by the suprarenal capsules; others have no obvious use at any period, but are better developed in the fœtus than in the adult; example, Appendix vermiformis in man, others may point to structural affinities inherited from a distant period, of which natural history furnishes many examples.

"From an individual point of view, taking in all the circumstances referred to, there appear to be only two ways of accounting for this structure, it is either an aborted ungual follicle or otherwise it is a 'cul-du-sac' representing the suture formed by coalescence of the skin from side to side in the fœtus. Its structure would convince one of the first conclusion, if the animal had rudimentary toe bones in the same position, indicative of a three toed ancestor, but all observations relative to the morphology of the foot, are opposed to this view, since the outer bones and their appendages are aborted in all animals of this kind. We are therefore compelled to adopt the other view which can be only settled saisfactorily by examination of the part in the fœtus. Nevertheless from knowing the difficulty of substantiating any theory connected with its supposed origin and use; still more of ridding one's mind of a theory once entertained, my faith in either of these is held very loosely."

In conclusion, it may be that what I have written has been better told by some one more competent to the task, but I have not met with anything upon the subject of the sac and tubes except in Camper's works. The notes of Dr. Sommers, which he kindly handed to me to be used as I saw fit, are given in full, as those which might have been made by me would only be the notes of a hunter, and therefore of but little value in comparison. I regret that I have been unable to explain more fully the use of the sac, but what additional light has been added may possibly encourage some other, naturalist or hunter, to continue the enquiry.

Art. VI.—Nova Scotian Meteorology. By F. Allison, Esq., M. A., *Chief Meteorological Agent.*

(*Read before the Institute*, 14*th May*, 1877.)

The facts, deductions, and opinions, brought before this Institute in this little paper, are the results of over fourteen years of personal observation at Halifax, of all elements entering into the constitution of climate; to which are added several previous years of observation of Temperature and Rain by the Medical Officers at the Citadel, which were taken under excellent supervision, and considered to be trustworthy enough for scientific calculation. I have also been much assisted by many careful observers through this Province, and in Prince Edward Island, and Newfoundland, to whom I would thus publicly tender my thanks; and some of whom are now performing good service in the Dominion Meteorological organization. Most of the following remarks, though taken directly at and for Halifax, are applicable to all Nova Scotia. The deviations from this general rule will be noted as we proceed.

Heat—its degree and alternations—must of course lie at the bottom of all considerations of climate; but for several reasons of convenience, the first instrument we record is the Barometer.

Let me again mention, that beside almost all Barometers having a considerable error in themselves, they are commonly observed by the public without regard to the marking of the attached Thermometers, or their height above the level of the sea. Obviously, their readings are constantly wrong, generally too low. It may be argued, that if the readings be always made from the same instrument, merely to test the condition of the atmosphere at the one point, and not for comparative or scientific purposes, they serve the end sought. But this is not correct, even with this small object alone in view, for the temperature will always affect the mercurial column; and as it cannot be kept regular to a degree, these simple readings must prove erroneous. Thus, let the observed height of the column be 29.750, and the attached Thermometer 70°, and again, let the same observed height remain, but with temperature reduced to 40°—which may easily happen in any room—and the ordinary observer says that the pressure is the same; whereas, if the first instance be only 29.750 in reality, the latter observation is .080 higher, or 29.830, else the Barometer could not retain its apparent height with 30° reduction of temperature. Therefore, when I speak of Barometrical Height, or Pressure of Atmosphere, I mean with all corrections included, viz., instrumental error corrected, temperature calculated at 32°, Fahrenheit freezing point, and addition made for height above sea. Aneroid Barometers are not used in Meteorology, as though very useful in measuring elevation, they are very apt to get out of order without the observer's knowledge, and their rate of error is uncertain, beside the metal scale being unduly affected by heat, and they cannot be set to a point to obviate the expansion and contraction. The mean Pressure for the whole year at Halifax is 29.779, and this is near enough to that of other parts of the Province for application to any climatological purpose. The Barometer here has risen to 30.992, and fallen to 28.455, but from 29.000 to 30.500 inches is the general range, and readings outside of these limits are very rare. Our Barometrical altitude is comparatively low for our Latitude, but the weight of atmosphere is affected, like the other Meteorological constituents, by our Peninsular position, and proximity to the great ocean. Thus the mean Barometer in 1875, at Halifax, in Latitude 44°.39′ N., was 0.151 inches lower than that at the inland station of Brockville in Ontario, in almost the very same Latitude—44°.34′, while at Esquimault, in British Columbia, as we again approach the ocean on the West, the Barometer comes down again nearer the Nova Scotia means, although that station is 2 degrees farther North than any point in Nova Scotia where the observations are recorded. This comparatively small Pressure helps our climate to produce agricultural results, belonging to a more southern latitude inland, shewing that the atmosphere is lighter, because warmer. The equability of this Pressure is also our safeguard against the violent storms, which to the South, the West, the North, and East of us, rage frequently, but seldom touch this Province, its extreme limits being the most exposed to their ravages. This again, is partly due to the level surface of Nova Scotia; and when we complain of the monotony of our low sea coast, and the want of abrupt hills through the country, we should remember the compensation gained by our comparative immunity from high winds and heavy rains. The warmer (and lighter) air over the Gulf Stream to the Southward, and the mild waters of the Bay of Fundy to the North and West, assist in keeping level our Barometers, and thus preserving the general regularity of our climate.

Before leaving this topic of whole pressure, I will allude briefly to a much neglected item in calculating the weight of the atmosphere. The pressure, or elastic force of vapour, must be eliminated from the total, before we can get what we really want,—the dry air to be weighed by itself. This vapour, with relative humidity, is calculated from tables carefully prepared from the reading of the wet bulb Thermometer, and the difference between it and the day or true temperature of air. There is but a very slight discrepancy between Glaisher's tables for this purpose and Guyot's, but the latter is preferred, and is computed from the third edition of Regnault's tensions, in which he has "modified the numerical values of some of the coefficients" of the formula adopted. The barometric height is supposed to be 29.700 inches. "Enter the tables with the difference of the two thermometers, and the temperature of the wet-bulb given by observation. In the column headed by the observed difference of the thermometers, and on the horizontal line headed by the observed temperature of the wet thermometer, are found the force of vapour and the relative humidity corresponding to these temperatures." Let the apparent height of the column, reduced to 32° and to sea-level, be 29.800 inches, the temperature of air 43°, and of the wet-bulb 40°,—the difference thus being 3°; then you will use the psychrometrical table as above, and subtract 0.208 as force of vapour, giving the result—

	29.800	inches.
—	0.208	"
	29.592	"

as pressure of dry air, and the relative humidity will be 75.0. But suppose the barometer, and the difference between dry and wet bulbs, to be still the same, but the wet to be fallen to 33°, then you will subtract only 0.149, giving—

	29.800	inches.
—	0.149	"
	29.651	"

as dry pressure, and a relative humidity of 70.5. This will readily explain how necessary it is to take into account the temperature and difference of the bulbs, when calculating climatological results from barometric observations. The difference is increased or diminished simply by evaporation, depending again upon the capability of the atmosphere to hold moisture. Even in the heaviest rains there is generally a degree or more of difference between the thermometers; but a fog is complete saturation, or 100 per cent. of relative humidity.

As Nova Scotia has a less pressure than corresponds to its latitude, so should it have a greater heat than its proper due; but the immense stretches of snow and ice prevent that during the longer portion of the year; and as these frozen regions of land and water lie from the north-west to the north-east of us, and exert their influence over us from November to June, we have less heat during that period than might otherwise be expected. The mean yearly temperature of Halifax is 42°.81; of Digby, 43°.50; of

Truro, 41°; of Sydney, 41°.50; and of Baddeck, 39°.90. The series are not quite long enough to strike so accurate a normal at these country stations as in this city; but I have selected some of the best, at widely distant localities, and the errors will, I think, prove in time to be not very important. At St. John, N.B., in 1875, (the latest finished year that I have) the mean temperature was 38°.3, against 40°.2 at Halifax; 38°.2 and 38°.3 at Charlottetown and Georgetown, P. E. I., respectively; and 39°.1, 38°.1 and 37°.5 at the stations of Harbor Grace, St. John's, and Channel, in Newfoundland, in order. It is interesting to watch how the mean temperatures of each month vary at some of the Nova Scotia stations. In January, Digby is the warmest and Truro coldest. In February again, Digby is highest, but Sydney falls as low as Truro. In March, Digby still remains highest and Sydney lowest. In April, Digby is passed by Wolfville, while Sydney is far behind. In May, Windsor is warmest and Baddeck coldest. In June, the inland station of Windsor is still hottest, and the sea-side Baddeck much the coldest; and in July the extremes are observed at the same stations. But in August, Halifax increases much in proportion, while Baddeck is still the lowest, remaining so in September, when Wolfville marks the highest. In October, the interior becomes much colder, and Halifax is the warmest, and Truro slightly colder than any. Sydney takes first place in November, with Truro still coldest, where the latter remains through December, in which month Digby is a little higher than any. Digby gives the highest mean and Baddeck the lowest of five Nova Scotia stations for the year; but Wolfville, in May, June and August, and Windsor, in the five months following July, are too defective for fair comparisons, otherwise, as warm inland stations, they might contest first place with Digby.

The winds, their direction and force, are very important in deciding climate and calculating its effects. First—As to direction, westwardly winds are much more prevalent in Nova Scotia than those from any other quarter, giving a resultant,—whether we estimate force in connection with direction, or merely count the years' average of daily means,—of a very few degrees N. of W. During

January, February, March and April, the average wind keeps well N. of W. In May, we get it nearly W. In June, still farther S., and again nearly W. S. W., in July. In August and September, we have prevalent W. S. W. winds, going up to near the Winter average in October and November, till in December the N. W. wind prevails. In the Eastern part of Nova Scotia, the wind is more frequently from the East than in these central and Western counties, and there is a comparatively greater tendency to draw from S. E., so that the average wind which is N. of W., taking the Province as a whole, is a little S. of W. in Cape Breton. Rather than a cause, this direction is an effect due to geographical position, and a less humid atmosphere than Europe in the same latitude; so we will pass on to wind force.

The faulty construction, bad exposure, and deficient readings, make many of the Auemometers at out-stations untrustworthy for series sufficiently long to calculate means with accuracy; but from what I have been able to learn so far, the velocities for the Province, when all can be satisfactorily reduced, will not differ to any very great extent from those observed at this Chief Station.

In Halifax the result of 14 years observation places the average velocity about 9 miles per hour, (strictly 9.36), varying from a dead calm up to 63 miles per hour. This latter wonderful velocity I noted in the great gale of Sunday morning, the 3rd of August, 1867, which blew down many fences and trees on the Peninsula, also unroofing several buildings and destroying chimnies, etc. Fortunately the wind which had been S.E. for two days previous, and returned to that point that same evening, had veered S. during the greatest height of the gale, so that the wharves and shipping were partially protected and the destruction there was not so great as in some lesser S.E. gales. But a fearful sea broke on Meagher's Beach. The nearest approach to this wind was on August 24th and 25th, 1873. This will be remembered as the disastrous Cape Breton storm. In Halifax and westward it did not reach the violence exhibited in the Eastern Counties, but it blew up to 60 miles midnight of 24th, and continued very heavy the morning of the 25th. Here the direction was N. and N.NE. with thunder, lightning, and over 2.5 inches of rain in 22 hours.

Taking up the wind average forces of the months we find January a trifle above the year's normal. February still a little higher. March getting up to the maximum of **11.35**. April falls off very much, and May remains much the same as its predecessor. But June shews a mean still less. July and August are far the most quiet months, the former giving an average of only 4.86, the latter the minimum of 4.69. September returns to near the mean of June. October increases a little more, while November approaches very near to March. In these two months the general force of wind is much the greatest. December has an average about equal to January.

Our Peninsular position, equal Barometric distribution, and level surface of country, divert many violent gales from this Province, and we cannot be too thankful that, as one of the most quiet spots of North America, we thus enjoy the most favourable facilities for the production of the land crops peculiar to the Latitude, and safety on our sea coast, compared with other shores of the Atlantic. Even in a station so far inland as Toronto the mean velocity is very much the same as our own. 30 miles an hour is the minimum of a gale, and in 1876 there were 20 gales; in 1875, 19; in 1874, 18; in 1873, 17; in 1872, 26, and in 1871, 26; of these 126 gales, 103 took place between October and March, inclusive. It is very rare to reach 30 miles per hour in May, June, July, or August, though the two heaviest gales, as recorded above, occurred in this latter month. In total precipitation both the rain and the water obtained from snow when melted, are included. The dry snow is first measured on a platform, and has been found to give on an average one-tenth of its depth in water. Thus one inch of level dry snow gives .100 of water over the same superficial area. Occasional the equivalent of 1 inch of snow varies from .090 to .110 of water, but one-tenth is quite near enough for an average. In Great Britain 1 inch of snow rarely measures over .090 of water, as the flakes generally lie much more loosely, and occupy more space than here.

In looking at total precipitation by the month, although the same months in different years vary very much, a tolerably long series—say of 11 years—gives a fair idea of the most wet and dry periods of the year; and in the fourteen complete years from which I now can calculate, the Precipitation of Nova Scotia can be distributed with sufficient accuracy. January, October, and November give very nearly the same results—about 5.5 inches—and are closely followed by February with an average of 5.4. April, December, March and May give 4.8, 4.6, 4.5, and 4.2, respectively. The normal fall of September is 3.9, of August 3.5, of June 3.4, and July is decidedly the driest month, with 2.9. It will be at once noticed how comparatively dry our Summer is; and that, dividing the year into two equal periods, the six months from 30th September to 31st March, yield 30 inches out of the normal annual 53, leaving 23 only for the warmer months. Or, going farther, and taking the four Winter months of December, January, February, and March, we find twenty inches in them; twenty inches also in the four Spring and Autumn months of April, May, October, and November, and only about thirteen during the remaining third, June, July, August, and September. Of the whole yearly precipitation, about 44.5 inches fall as rain, and the melted snow measures about 8.5 inches more, being the product of seven feet fallen frozen. The above figures are most applicable to Halifax and the Atlantic coast, but the yearly amount does not differ materially from this on the Gulf or Bay Shores, or Inland. The differences by season in the interior are a slightly heavier rain fall in Summer, and a little greater snow depth in winter, balanced by not quite so much rain water in Spring and Autumn. I find that the years of most snow and rain make the soil of Nova Scotia most productive, and are most satisfactory to our farmers, provided that the hay-making and harvest seasons are not wet. There are good reasons for both of these conclusions. A thick layer of snow from the beginning of December to the end of March, prevents the frost from striking very deeply into the ground; the ammonia of the rain and melting snow, combining with the salts of the soil, enables it to nourish the coming roots and grass; and the continuance of good sledding facilitates, the hauling out of all kinds of wood. April is better dry till the Spring ploughing and planting are over, but then we can stand a large quantity of rain till the middle of June, for proverbially, "a wet May makes good hay." From that date, till August is half gone, much rain is not needed, but the after crop needs moisture then ; and through September frequent and copious showers do the pastures more good than they can do harm in other ways. On all accounts, we are better off for a large rain fall in October and November, and we usually are blessed by it. Thus the swamps are filled, and freeze earlier and harder for the Winter's work ; and the brooks and rivers running high suit another great branch of the country's industry—lumbering. Indeed the labours of the woodsman, and of the mills are benefitted by rain at all times in this Province where evaporation is so great from March to October.

Of the four oldest provinces of Canada, the total precipitation of Nova Scotia is decidedly the greatest, as is the rain fall. As yet, the observations in British Columbia, Manitoba, and Prince Edward Island, are not numerous enough to place their averages in proper order; but, for the sake of comparison, calling Nova Scotia 40, New Brunswick would be 35, Quebec 26, and Ontario 23. In the latter Province so little rain falls (except in the W. and S. W. district) that frequently the draughts are injurious ; and in Toronto, the facts prove that their already limited supply is decreasing, which causes much apprehension. Our large precipitation would be troublesome, did it come in smaller quantities on many days ; but this is not so, and we enjoy the farther advantage of having a great number of fair days. Thus Toronto, with an average fall of only 35.5 inches, scores but 186 fair days, while Halifax, with 53 inches rain and melted snow, has still an average of 204 days completely dry. Again, to show how free this Province is is from the light drizzling rains common in many other parts of the north temperate zone: the average rain fall of the London district for 60 years is about 24.5 inches,—less than half of our total precipitation, while the number of wholly dry days is very much the same in any year.

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Sea-level 122.5 feet.

ALLISON.

	September.	October.	November.	December.	YEAR–1876.
Mean Tempe29	54.12	45.49	38.67	22.84	42.06
Difference frc89	–2.90	–2.56	+1.61	–2.68	–0.56
Maximum T2	72.2	70.0	62.8	43.0	90.2
Minimum Te4	37.2	27.0	18.1	–1.0	–16.9
Monthly and 8	35.0	43.0	44.7	44.0	107.1
Mean Maxin52	64.54	54.36	44.33	30.28	51.66
Mean Minim45	45.34	37.77	33.51	14.25	33.40
Highest Dail14	62.71	58.00	57.25	35.61	75.14
Lowest Daily34	50.10	34.38	23.29	3.12	–6.78
Mean Daily 107	19.20	16.59	10.82	16.03	18.26
Greatest Dail8	30.2	30.9	26.8	33.2	44.6
Mean Pressu53	29.941	29.825	29.883	29.743	29.900
Difference frc43	+.076	—.005	+.125	—.013	+.112
Maximum P87	30.494	30.199	30.520	30.519	30.992
Minimum Pr91	29.308	29.145	29.288	28.921	28.774
Monthly and 96	1.186	1.054	1.232	1.598	2.218
Highest Dail43	30.423	30.100	30.439	30.290	30.698
Lowest Dail87	29.491	29.385	29.344	29.182	29.165
Mean Pressu0	.341	.256	.219	.114	.262
Mean Relativ7	81.4	80.1	87.5	85.8	82.79
Mean Amou6	5.05	5.47	7.84	5.34	6.09
Difference frc6	—.52	.00	+1.21	—1.11	+.13

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GENERAL METEOROLOGICAL REGISTER FOR 1876.

HALIFAX, NOVA SCOTIA.

Latitude 44° 39′ 20″ North. Longitude 63° 36′ 40″ West. Height above Sea-level 122.5 feet.

OBSERVED BY FREDERICK ALLISON.

1876.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	YEAR–1876.
Mean Temperature	21.74	22.81	28.87	36.30	45.36	60.40	63.80	64.29	54.12	45.49	38.67	22.84	42.06
Difference from Normal (14 years)	-0 88	+0.17	+0.47	+1.11	-2.02	+1.62	+0.57	+0.89	-2.90	-2.56	+1.61	-2.68	-0.56
Maximum Temperature	48.6	48.0	51.0	56.6	70.0	84.8	86.7	90.2	72.2	70.0	62.8	43.0	90.2
Minimum Temperature	-8.8	-16.9	7.1	19.6	29.9	36.2	49.2	46.4	37.2	27.0	18.1	-1.0	-16.9
Monthly and Annual Ranges	57.4	64.9	43.9	37.0	41.1	48.6	37.5	43.8	35.0	43.0	44.7	44.0	107.1
Mean Maximum Temperature	31.10	33.15	36.93	45.06	55.76	71.92	74.99	77.52	64.54	54.36	44.33	30.28	51.66
Mean Minimum Temperature	10.33	11.53	20.85	29.08	36.42	51.64	55.64	54 45	45.34	37.77	33.51	14.25	33.40
Highest Daily Mean Temperature	40.21	38.48	40.52	42.20	56.52	72.51	71.72	75.14	62.71	58.00	57.25	35.61	75.14
Lowest Daily Mean Temperature	7.51	-6.78	13.30	28.36	35.38	50.05	56.70	53.34	50.10	34.38	23.29	3.12	-6.78
Mean Daily Range of Temperature	20.77	21.62	16.08	15.98	19.34	20.28	19.35	23.07	19.20	16.59	10.82	16.03	18.26
Greatest Daily Range of Temperature	38.6	44.6	26.8	26.5	35.0	37.2	33.8	30.8	30.2	30.9	26.8	33.2	44.6
Mean Pressure Corrected	29.940	29.921	29.898	29.850	29.940	29.995	29.913	29.953	29.941	29.825	29.883	29.743	29.900
Difference from Normal (14 years)	+.160	+.145	+.095	+.107	+.200	+.208	+.123	+.143	+.076	—.005	+.125	—.013	+.112
Maximum Pressure	30.614	30.992	30.484	30.337	30.434	30.343	30.164	30.287	30.494	30.199	30.520	30.519	30.992
Minimum Pressure	29.063	28.774	28.981	29.342	29.219	29.484	29.433	29.591	29.308	29.145	29.288	28.921	28.774
Monthly and Annual Ranges	1.551	2.218	1.503	0.995	1.215	0.859	0.731	0.696	1.186	1.054	1.232	1.598	2.218
Highest Daily Mean Pressure	30.513	30.698	30.404	30.305	30.362	30.315	30.136	30.243	30.423	30.100	30.439	30.290	30.698
Lowest Daily Mean Pressure	29.304	29.165	29.242	29.434	29.346	29.527	29.649	29.687	29.491	29.385	29.344	29.182	29.165
Mean Pressure of Vapour	.112	.112	.138	.176	.243	.462	.488	.480	.341	.256	.219	.114	.262
Mean Relative Humidity	82.9	80.8	83.2	82.0	80.5	87.3	83.3	78.7	81.4	80.1	87.5	85.8	82.79
Mean Amount of Cloud	5.91	5.69	6.83	6.85	6.52	7.42	6.48	3.66	5.05	5.47	7.84	5.34	6.09
Difference from Normal (10 years)	—.32	+.24	+1.01	+.54	—.69	+1.33	+.73	—1.86	—.52	.00	+1.21	—1.11	+.13
Prevalent Direction of Wind	N.W.	N.W.	W.	W.	W.S.W.	S.S.W.	W.S.W.	W.S.W.	W.S.W.	W.N.W.	W.N.W.	N.W.	W.
Mean Velocity of Wind	9.97	11.47	11.35	9.39	8.66	6.07	6.17	6.79	8.47	8.49	10.85	12.75	9.20
Difference from Normal (14 years)	+1.04	+2.21	+1.10	+1.33	+.04	+.45	+1.22	+1.95	+2 35	+1.55	+.45	+4.24	+1.26
Amount of Rain	1.341	3.133	5.774	2.130	4.574	3.384	3.914	1.909	6.094	4.067	7.397	0.618	44.335
Difference from Normal (14 years)	+1.030	+0.077	+2.600	—0.719	+0.475	—0.097	+0.956	—1.618	+2.201	—1.393	+2.386	—2.431	+0.899
Number of Days Rain	7	7	9	15	19	21	17	8	10	13	12	5	143
Difference from Normal (14 years)	0	+1	+4	+5	+4	+6	+6	+3	0	0	0	—4	+17
Amount of Snow	21.10	33.23	5.60	9.95	0.90	0	0	0	0	0.01	inap.	25.58	96.37
Difference from Normal (14 years)	+2.05	+14.47	—10.63	+1.05	+0.28	0	0	0	0	—0.45	—3.88	+8.91	+13.10
Number of Days Snow	13	16	9	6	1	0	0	0	0	1	0	12	58
Difference from Normal (14 years)	+3	+7	—2	0	0	0	0	0	0	—1	—4	+1	+9
Total Precipitation	3.576	6 401	6.329	3.208	4.662	3.384	3.914	1.909	6.094	4.076	7.397	3.164	54.114
Difference from Normal (14 years)	—1.798	+0.984	+1.843	—1.354	+0.556	—0.097	+0.956	—1.618	+2.201	+1.385	+1.956	—1.385	+1.803
Number of Dry Days	13	13	13	10	12	9	14	23	20	17	18	17	179
Difference from Normal (14 years)	+4	—3	—5	—6	—4	—6	—6	+3	0	—2	+3	+3	—22
Number of Auroras	0	2	0	3	0	0	1	1	1	0	1	0	9
" Gales	3	4	4	1	0	0	0	0	0	1	2	6	21
" Fogs	4	0	7	3	10	18	14	2	2	4	1	1	66
" Dews	0	0	0	0	4	10	10	13	11	9	1	0	58
" Hoar Frosts	9	5	6	7	4	0	0	0	0	7	3	9	50
" Thunders	0	0	0	0	1	4	3	3	0	1	1	0	13
" Lightnings	0	0	1	2	2	5	1	6	0	1	1	1	20
" Hails	0	0	0	0	0	0	0	0	0	0	0	0	0
" Rainbows	0	0	0	0	0	4	0	2	1	1	0	0	8
" Lunar Halos	3	2	1	3	1	0	0	1	1	0	3	0	15
" Lunar Coronæ	0	0	0	1	0	0	1	0	0	0	3	1	6
" Solar Halos	0	0	5	2	1	3	0	0	0	1	0	0	12
" Days Sleighing	16	27	9	2	0	0	0	0	0	0	0	23	77

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With this comparison I must conclude this paper, already extended beyond my first intention; but, with permission of the Institute, I hope on some future evening to complete these climatic remarks, by noticing the occasional phenomena and periodic events, which, with their causes and effects, contribute largely to our meteorological knowledge, and the probable and possible productions of our country.

Art. VII.—Geology of the Site of the Belleveau Mining Operations.—By Rev. John Burwash, M. A., Communicated by John T. Mellish, M. A.

(*Read May*, 1877.)

I.—Character of the Rocks.

The following paper is compiled from notes of observations made during a visit to the property of the Belleveau Albertite and Oil Company, in July, 1876. I may be allowed to state that my stay was short, and that my opportunity for personal observation was limited; but through the kind attention of Mr. Patrick, the Manager of the Mine, who conducted me to the principal exposures, and gave me the benefit of his knowledge of the locality which he has thoroughly studied, I was able to make a much better use of my time, and to obtain a much better knowledge of these rocks than would otherwise have been possible. I found Mr. Patrick practically well acquainted with the stratigraphy of the Carboniferous series in Nova Scotia, and his opinion of the position and relations of these beds, is well worthy of attention.

The place where the Company have sunk their shaft is situated in the Parish of Dorchester, between Memramcook and Peticodiac Rivers, about a mile from the latter, and about five and one-half miles in a direct line from the Albert Mine. It is, Mr. Patrick informed me, on the same line of upheaval as the latter; that is, taking the general direction of the strike at the Albert Mine, you would come to the Belleveau property.

There are two principal kinds of rock—shales and conglomerates. The shales are very characteristic of all places where veins of Albertite occur, and are described in Dr. Dawson's account of the geology of Albert Mine, under the name of Albert Shales. They can be traced all the way from Albert Mine to Belleveau. They, nearly all, contain Carbonate of Lime; some beds having crystals of calcite disseminated through them. They are bituminous, and it is a matter worthy of investigation, whether some of the beds could not be advantageously used for the production of oil or gas. As these shales are supposed to be the origin of the mineral, Albertite, the amount of their development and their bituminous character are matters of great importance to the miner in prospecting for this mineral.

The conglomerates are in massive beds, forming on account of their weathering more slowly than the softer shales, the summits of the ridges between which the shales form the depressions. They are grey, greenish grey and reddish grey rocks; some quite coarse, others passing into a gritty grey sandstone. One of the lowest beds of this rock deserves special mention. It has been named by Mr. Patrick "oil rock." It is a grey, micaceous sandstone, thoroughly saturated with, and having the characteristic odor of petroleum. It occurs, as Mr. Patrick informed me at the Albert Mine, and crops out in several places between that and Belleveau. On digging through this rock considerable quantities of petroleum flowed into the pit; and Mr. Patrick thinks that this is the source of nearly all the oil which has been found in this region. It is his opinion that oil might be obtained in paying quantities by boring where a considerable thickness of this rock is found near the surface; a condition which exists in the northern part of the Company's claims.

2.—Order of Strata.

The relative position of these shales and conglomerates is a somewhat difficult matter to determine. The spot selected for mining at Belleveau has the appearance of a centre of disturbance. The character of the beds would suggest the idea that some explosive force, confined within the earth, had there found vent. This disturbance and contortion of the Strata is especially seen on the Southern half of the claim. Here, Mr. Patrick thinks there is a great fault, the direction of which is 73° E. Along the line of this fault the shales are thrown up against the conglomerates, dipping from them at a high angle. This being the case, his opinion that the conglomerates overlie the shales, is probably correct, and goes with the description of their relations elsewhere, as given by Dr. Dawson. The strata of the conglomerates are nearly horizontal, while those of the shales dip southward at a high angle.

At a short distance north of the line of fault, there is a noteworthy outcrop, which seems to be the summit of an arch; the beds on the north being similar, in inverted order to those on the south. At this point, the shales are very much contorted, being corrugated as if by a combination of upward and lateral pressure. As an example, illustrating the forces at work in producing this formation, I obtained a piece of shale 15 inches in length, bent into the form of a double hook, or letter S., and having that peculiar "slickensided" appearance indicative of great pressure. This arch has its parallel in the arched strata near the Albert Mine, which are similarly contorted, and contain, like these, remains of fish of the general Palæoniscus. In fact, the general resemblance between the arrangement and conformation of the strata at Belleveau and Albert Mine is somewhat remarkable, especially when we take into account their disturbed condition. This resemblance is such as to justify the remark of Mr. Patrick that a section might be made of one, which would, with very little alteration, represent the other. North of this arch, in the bank of a small brook, there is exposed a considerable thickness of shale. Reckoning from this point to the arch, it would appear that these shales which are generally regarded as the source of the Albertite, are as fully developed here as at Albert Mine.

With respect to the question of the probable occurrence of any considerable quantity of Albertite in this locality, as the matter will shortly be practically tested, speculation is out of place.

Should the mining operations now in progress be successful, an impetus will be given to those researches which alone can develope the mineral wealth of our country; and in the case of Albertite prospecting, with largely increased chances of success.

Art. VIII.—Additions to the List of Nova Scotian Plants. By Henry How, *D. C. L., Professor of Chemistry and Natural History, King's College, Windsor, N. S.*

The following notes are intended to supplement the "Catalogue of the Flora of Nova Scotia" in the Proceedings and Transactions of the Nova Scotia Institute, 1875–76, by Dr. A. W. H. Lindsay, to whom botanists are much indebted for the first labour of its kind. The names of plants and stations below are either not given in the "Catalogue," or not on the responsibility now advanced. Some of the plants have been known to me as Nova Scotian as long as others in the Herbarium of my formation referred to by Dr. Lindsay, but not being represented in that collection, nor named in some short notes of mine published in the Transactions of the Nova Scotia Institute, 1871–72, of course are not placed in the "Catalogue" on my authority. The majority have been, however, I think, found since that Herbarium left my hands, (1876), either by myself or others, to whom credit is given, and some have been met with quite recently. In a few cases I have added a word or two, relating to local or Indian names, and other points, which may be found acceptable. I have also corrected a few errors.

For some particulars, I am indebted to Mr. G. A. Thompson, of Massachusetts. This gentleman came here chiefly for minerals, in 1873, having been directed to me. He was kind enough to give me a few botanical notes in return for showing him specimens, and advising him as to localities of minerals. The following observations of his will be found interesting.

"I was quite surprised to see the *Liriodendron tulipifera* successfully cultivated so far North. I had only seen one or two specimens in Massachusetts. The *Monotropa uniflora*, found at Scot's Bay, is somewhat rare near Boston, I think; at least, I have not seen it. Among other Heaths (Gray) I noticed that there seemed to be a total absence of *Gaultheria procumbens*, so common with us in Woburn, at Scot's Bay; it seems to be supplanted by the *Chiogenes*. I did not notice the *Kalmia latifolia, Azalea viscosa, A. nudiflora*, and *Rhodora Canadensis*, all of which are very common Heathworts with us in Woburn or Amherst, Mass. *Mitchella repens* was far less abundant than *Cornus Canadensis*, just as the reverse is true with us in Woburn. *Juglans Carya*, *Quercus*, and *Castenea*, sparingly represented. *Fagus* very common; *Abies* also, and *Larix*. *Juniperus Virginiana* not found at all. *J. communis* by no means abundant. Of course, the above notes are very imperfect, and are confined mainly to Scot's Bay, where I was obliged to pass through more or less woodland, etc., on my way to the shores of the Bay of Fundy."

The list of plants is made out to correspond with Dr. Lindsay's "catalogue":—

RANUNCULACEÆ.	
Clematis Virginiana, L.	n. N. Glasgow, Pictou.
Hepatica triloba, Chaix.	Nesbit's Island, Windsor, Hants.
Thalictrum Cornuti, L.	Digby Gut, Digby. (7 ft. high; 8 ft. at Windsor Falls.)
Ranunculus cymbalaria, Pursh.	Falmouth, Hants.
R. repens, L.	Windsor, "
R. acris, L.	Windsor, "
MAGNOLIACEÆ.	
Liriodendron tulipifera, L.	Waverley House, Canning, King's, ("a small tree, cultivated,") E. A. Thompson.
BERBERIDACEÆ.	
Berberis Vulgaris, L.	Windsor, Hants, (cultivated.)
NYMPHÆACEÆ.	
Nuphar advena, Ait.	Windsor, Hants.
PAPAVERACEÆ.	
Papaver somniferum, L.	Windsor, Hants, (introduced.)
FUMARIACEÆ.	
Corydalis glauca, Willd.	St. Croix, Hants.
CRUCIFERÆ.	
Cakile Americana, Nutt.	Halifax Harbour.
DROSERACEÆ.	
Drosera rotundifolia, L.	Scots' Bay, Kings; E. A. Thompson.
CARYOPHYLLACEÆ.	
Saponaria officinalis, L.	Windsor, Hants, (escaped.)
Lychnis githago, Lam.	New Glasgow, Pictou, (introd.)

Honkenya peploides, D. C.	Halifax Harbour.
Cerastium viscosum, L.	Windsor, Hants.
Sagina procumbens, L.	Windsor, Hants.
Spergularia rubra, Pers. Var. Marina.	Windsor, Hants; Halifax Harbour.
TILIACEÆ.	
Tilia Europæa.	Windsor, Hants, (planted.)
GERANIACEÆ.	
Oxalis acetosella, L.	Windsor, Hants; H.; Scots' Bay, Kings; E. A. Thompson.
Geranium Carolinianum, L.	Windsor, Hants; Rev. J. B. Uniacke.
G. Robertianum, L.	Spencer's Isl., Cum.; Marble Mt., C.B.
Impatiens fulva, L.	n. Digby, Moose River, Digby,
VITACEÆ.	
Ampelopsis quinquefolia.	Windsor, Hants, (cultivated.)
CELASTRACEÆ.	
Enonymus Americanus, L.	Windsor, Hants, (cultivated.)
STAPHYLEACEÆ.	
Staphylea primata.	Windsor, Hants, (cultivated.)
SAPINDACEÆ.	
A. Esculus Hippocastanum, L.	Windsor, Hants, (planted.)
Acer. pseudo-platanus, L.	Canning, King's; E. A. Thompson; (cultivated—"fine tree.")
LEGUMINOSEÆ.	
Vicia tetraspermum, L.	*not* Windsor, Hants, *as in "Catalogue."*
V. cracca, L.	Granville, Annap.; E. A. Thompson.
Lathyrus maritimus, Bigelow.	Parrsboro', Cumb.; Long Isl., C. B.; Halifax Harbour.
Apios tuberosa.	Windsor, Hants, (brought from Little Harbour, Pictou; Indian name is Sagaban.)
ROSACEÆ.	
Cratægus oxyacantha, L.	Windsor, Hants.
Amelanchier Canadensis, Var. Botryapium, Gray.	Windsor, Hants. (Indian Pear, Mulberry.)
Dalibarda repens, L.	Bloomfield, Digby.
Rosa lucida, Ehrhart.	Windsor, Hants.
R. Carolina.	*not* Windsor, Hants, *as in "Cat."*
ONAGRACEÆ.	
Epilobium angustifolium, L.	Pictou; Colchester.

CRASSULACEÆ.	
Sedum rhodiola, D. C.	n. Margaretville, Annap. ? (intr.)
HAMAMELACEÆ.	
Hamamelis Virginica, L.	n. Windsor; Chester Road; Windsor Falls; Windsor, Hants.
UMBELLIFERÆ.	
Heracleum lanatum, Michx.	Marble Mt., C. B.
Conium maculatum, L.	Chester, Lunenburg. ?
CORNACEÆ.	
Cornus Canadensis, L.	Scots' Bay, Kings; E. A. Thompson.
C. alternifolia, L.	Mt. Uniacke, Hants, (Herb. J. B. U.)
CAPRIFOLIACEÆ.	
Symphoricarpus racemosus, Michx.	Windsor, (cultivated.)
Sambucus pubens, Michx.	N. Mt., Annapolis. "White Elder," "Poison Elder."
Viburnum nudum, L.	Kentville, King's.
Lonicera periclymenum.	Granville, Annapolis; E. A. T.
RUBIACEÆ.	
Galium trifidum, L. Var. Tinctorium.	Marble Mt., C. B.
Mitchella ripens, L.	Scots' Bay, King's; E. A. T.
Houstonia cærulea, L.	Windsor, Hants; Horton Bluff, King's, Halifax Common.
COMPOSITÆ.	
Eupatorium perfoliatum, L.	Mt. Uniacke, Hants; Gates' Mt'n., Annapolis.
Tussilago farfara, L.	Horton Bluff, King's.
Tanacetum vulgare, L.	Windsor.
Graphalium polycephalum, Michx.	Coldbrook, King's.
Ambrosia artemisiæfolia, L.	Kentville, King's.
Achillea millefolium, L.	Wilmot, Annapolis (rose-colour.)
Lappa major, Gærtn.	Windsor.
Taraxacum Dens-leonis, Derf.	Windsor.
Sonchus arvensis.	Halifax Harbour.
CAMPANULACEÆ.	
Campanula rotundifolia, L.	D. Gut, Gulliver's Hole, Digby.
ERICACEÆ.	
Gaylussacia resinosa, Torr. & Gr.	Gold R., Chester, Lunenburg; General's Bridge, Annapolis.
Vaccinium macrocarpon, Ait.	Falmouth, Hants; Dr. Harding.

Chiogenes hispidula, Torr. & Gr.	Digby Neck, H.; Hantsport, Hants; Scots' Bay, King's; E. A. T.
Arctostaphylos Uva-ursi, Spreng.	Wilmot, Annapolis; G. Robertson.
Cassandra calyculata, Don.	Mt. Uniacke; Rev. J. B. Uniacke.
Andromeda polifolia, L.	do. do.
Moneses uniflora.	Scots' Bay, Kings; E. A. T.
Chimaphila umbellata.	Pembroke, Hants.
Monotropa uniflora, L.	n. Digby.
M. Hypopitys, L.	College Woods, Windsor, Hants, (under *spruce*, *not pine.*)
Ilex glabra, Gray.	N. W. Arm, Halifax; Capt. Hardy.
PLANTAGINACEÆ.	
Plantago major, L.	Windsor.
P. lanceolata, L.	Windsor.
PLUMBAGINACEÆ:	
Staticé Limonium, L.	Racket, Digby; Hantsport, Hants.
PRIMULACEÆ.	
Anagallis arvensis, L.	Granville, Annapolis; E. A. T.
SCROPHULARIACEÆ.	
Veronica scutellata, L.	Wilmot, Annapolis, (*not* Windsor, *as in* " *Cat.*")
Gerardia purpurea, L.	Gulliver's Hole, Sea Wall, etc., Digby.
Euphrasia officinalis, L.	Scots' Bay, King's; E. A. T.
Rhinanthus crista-galli, L.	Windsor, Falmouth, Hants; H. Granville, Annapolis; E. A. T.
VERBENACEÆ.	
Verbena hastata, L.	Nictaux Mines, Annapolis.
LABIATEÆ.	
Monarda didyma, L.	Windsor, (cultivated.)
Nepeta Cataria, L.	Windsor, (cultivated.)
N. Glechoma, Benth.	Windsor, (escaped.)
Galeopsis Tetrahit, L.	Scots' Bay, Kings; E. A. T.
Leonurus cardiaca, L.	Windsor.
Calamintha clinopodium, Benth.	St. Croix, Hants. ?
BORRAGINACEÆ.	
Mertensia maritima, Don.	Beach, Gulliver's Hole, Digby.
CONVOLVULACEÆ.	
Convolvulus arvensis, L.	Windsor.
Calystegia sepurm, R. Bronn.	Windsor, (H.); Canning, King's; E. A. T.

SOLANACEAÆ.	
Nicandra physaloides, Gœrtn.	Windsor, (escaped.)
Datura Stramonium, L.	Windsor, (escaped.)
GENTIANACEÆ.	
Limnanthemum lacunosum, Griseb.	Lakes between Windsor and Halifax ; Rev. J. B. Uniacke.
OLEACEÆ.	
Ligustrum Vulgare, L.	Windsor, (planted.)
CHENOPODIACEÆ.	
Chenopodium album, L.	Windsor.
Suæda maritima, Dumortier.	Windsor.
POLYGONACEÆ.	
Polygonum arifolium, L.	Windsor Road, 15 miles from Halifax.
P. cilinode, Michx.	N. Mt., Granville, Annap. ; E. A. T.
Rumex crispus, L.	Windsor.
EUPHORBIACEÆ.	
Euphorbia nelioscopia, L.	Windsor.
E. cyparissias.	Windsor, (escaped.)
CUPULIFERÆ.	
Fagus ferruginea, Ait.	Marble Mt., C. B.
Corylus Americana, Walt.	Ponhook Lake, Windsor ; E. Mt'n., Onslow, Col.
Ostrya Virginica.	Hantsport, Hants ; E. A. T.
CONIFERÆ.	
Pinus strobus, L.	Windsor.
Abies balsamea, Marshall.	Windsor.
A. nigra, Poir.	Windsor, ("back in the woods.")
A. alba, Michx.	Windsor, ("the common spruce.")
A. Canadensis, Michx.	Windsor.
Larix Americana, Michx.	Windsor, H. ; Scots' Bay ; E. A. T.
Thuja occidentalis, L.	Windsor, (planted, does not flourish.)
Juniperus communis, L.	Mt. Uniacke, Hants ; Part. Isl., Cum. ; H. ; Scots' Bay, King's ; E. A. T.
TYPHACEÆ.	
Typha lalifolia, L.	Windsor.
NAIADACEÆ.	
Potamogeton lucens, L. Var. rufescens, Schreber.	Windsor Junction. ?
P heterophyllus, Schreber.	Welsford, Halifax. ?

ORCHIDACEÆ.	
Habenaria obtusata, Richardson.	Pine Tree, Merigomish. ?
Spiranthes cernua, Richard.	Wilmot, Annap.; Stillwater, Hants. ?
Arethusa bulbosa, L.	Mt. Uniacke, Hants; Rev. J. B. U.
Calopogon pulchellus, R. Brown.	3 miles from Springville, Cumb.; H. H. Jan.
Microstylis ophioglossoides, Nutt.	Ponhook Road, Windsor. ?
Cypripedium arietinum, R.Brown.	Newport; Rev. J. B. Uniacke.
IRIDACEÆ.	
Iris versicolor, L.	Windsor.
SMILACEÆ.	
Trillium cernuum, L.	Windsor; Rev. A. F. Hiltz.
LILIACEÆ.	
Smilacina Racemosa, Desf.	Uniacke, Hants; Rev. J. B. U.
Clintonia borealis, Raf.	Pembroke, Hants.
JUNCACEÆ.	
Juncus bulbosus, L.	Windsor.

In conclusion, I may direct attention to a list of "83 varieties of various woods grown in the Province," published in the catalogue of the N. S. department, International Exhibition, 1862, by Amos Fales, Jr., Wilmot.

List of the rarer plants collected at Glace Bay, C. B., by Henry Poole, Esq.:—

Ranunculus Cymbalaria, Pursh.
Actæa spicata, L.
Viola pubescens, Ait.
Lotus corniculatus, L. Eur.
Lathyrus maratimus, Bigelow.
Comarum palustre, R.
(Potentilla palustris, Ait.)
Potentilla anserina, L.
P. tridentata, Ait.
Mitella nuda, L.
Cotyledon umbilicus? L.
Nardosomia palmata, Hook.
Lobelia Kalmii, L.
Campanula rotundifolia, L.
Moneses uniflora, Salisb.
Statice limonium, L.
Chelone glabra, L.
Veronica scutellata, L.
V. Americana, Schweinitz.
V. officinalis, L.
Euphrasia officinalis, L.
Echium vulgare, L.
Mertensia maritima, Don.
Cypripedium spectabile, Swartz.
Calopogon pulchellus, R. Brown.
Equisetum pratense, Ehrh.
Aspidium (Lastrea,) Thelypteris, Swartz.

Pyrola rotundifolia, L.
P. elliptica, Nutt.
P, secunda, L.
Aspidium Filix-mas, Swartz.
Marchantia polymorpha, L.

In the notes appended to the list, I omitted to mention Lobelia, Kalmii, as an addition to the flora, not being observed by any other Provincial collector.

The object of the foregoing list is no doubt that of presenting an additional location for species already described, since all contained therein, with the exception of seventeen, will be found in the catalogue appended to vol. IV., p. II., of our Transactions, 1875 and 1876. The major part of them have not been before credited to Hants County, although the species in the present list from other places appear in the catalogue under their respective localities. Of the seventeen additional species denoted by italics, five are cultivated exotics, and two are garden escapes, leaving twelve to be accounted indigenous additions to the Provincial Flora.

I may be excused for remarking here upon the concluding notes of Prof. How's preface, viz., those furnished him by Mr. Thompson, affording as they do, an example of error, to which all are liable by generalizing from a narrow field of observation. In one place, he remarks upon what seemed to him a total absence of Gaultheria, procumbens, and of its substitution by chiogenes. Such a circumstance may be true of Scot's Bay, but it would be wrong to imply that the same held good for the whole Province. A reference to the published catalogue gives as localities, Hants, Halifax, Guysborough. It is very plentiful in Halifax county, and can be found within convenient distance from the city. It is moreover more abundant than chiogenes, although yver often they accompany each other. Likewise, he notices the absence of Rhodora Canadensis, scarcely excepting the Vacciniæ, the most abundant and wide-spread of our Heathworts. The failure was, no doubt, owing to the season at which the locality was under observation. The Rhodora, it must be remembered, is an early bloom, putting forth, previous to leafing. It is usually out of blossom by the time that its leaves are fully expanded. It is rare to find a specimen for the Herbarium with perfect flowers and leaves together. Those, who in early Spring observe the purpling of our road-sides and field borders by its masses of bloom can never separate it from our landscapes. In the catalogue it is denoted in all localities observed. *Mitchella repens*, also referred to, is by no means scarce, as the catalogue shows, though truly less abundant than Cornus Canadensis, an observation which obtains for those parts of the New England States which I have visited. As for Juniperus communis, the botanist who struggles through uncultivated pastures or pine openings, etc., in quest of plants, is in this locality, (Halifax), at least, unpleasantly reminded of its abundance.

The interest attaching to Mr. Poole's list arises from the presence there of two foreign species, both occurring in the British Flora, but not before described as American, at least we fail to find them in the books on American Botany. These are Lotus corniculata Ord. Leguminosæ, and Cotyledon umbilicus, Ord. Crassulaceæ. We may conclude with safety that both are importations, derived from Britain, like a host of others, which to all appearance are indigenous; both orders supply us with many introduced plants which have spread themselves either widely or in very few localities. We have in this locality (Halifax) Medicago, Vicia, etc., of the Leguminous order, now spontaneous. Sedum, acre, and S. rhodiola of the Crassulaceæ in like circumstances. I noticed recently, also, the occurrence Linaria vulgaris, in two places near Halifax, viz., the termination of the Coburg Road, and a fallow field on the Chebucto Road.

We cannot attach too much importance to the separation of our indigenous species from those which have been introduced, the latter are annually encroaching upon the former, and are in many instances supplanting them, being aided by the increase of our agricultural area, and the destruction of the forests. Our efforts should be at the present time directed towards collecting and recording the existence of native plants, leaving the others for future effort. To me it seems as unscientific to include introduced plants in our list of aboriginal species, as it would be to enumerate our domestic animals as being members of our native fauna. I am therefore, compelled to confess that the published catalogue to which

I have so often referred, contains many such species presented without explanation as to their origin. The list which formed the basis of this catalogue was prepared by myself, and contained very few species, not indigenous, but in its subsequent compilation the numerous additions from other sources caused the introduction of many species not of native origin, many of which are presented without comment, a circumstance, which was owing to the short time afforded for preparation for the press, along with other exigencies which prevented me from giving it that amount of attention and care which it deserved.

The foregoing explanation is deemed to be requisite for those who cannot avoid observing the errors referred to.

J. SOMMERS,
For Editing Com.

ART. IX.—MOLLUSCA OF NOVA SCOTIA, (CORRECTED TO DATE, 1877.)
BY J. MATTHEW JONES, F. L. S.

CLASS CONCHIFERA.

Fam. PHOLADIDÆ. Leach.

Teredo navalis, L. This species is inserted in Mr. Willis's privately printed list with a query. It was taken from a log in a spar-yard at Dartmouth. Marine Slip timbers at Pictou. (*Whiteaves.*)

T. dilatata, St. Very large specimens have been received from Sable Island, taken from wreck timber. (*Willis.*)

T. Norvagica, Speng. Marine Slip timbers at Pictou. (*Whiteaves.*)

Zirphæa crispata, Morch. Large specimens have been received from Sable Island. (*Willis.*)

Fam. SOLENIDÆ.

Ensatella Americana, Verrill. Sandy shores; whole coast.

Siliqua squama, St. Fishing banks; rare. (*Willis.*)

S. costata, Ad. Fishing banks. (*Willis.*)

Solenomya velum, Say. Fishing banks; very rare. (*Willis.*)

S. borealis, Tott. Fishing banks; very rare. (*Willis.*) Halifax harbour; rare. (*Verrill.*)

Panopæa arctica, Gould. Halifax harbour.

Glycymeris siliqua, Lam. Halifax harbour. Sable Island beach; dead specimens. (*Willis.*)

Fam. MYADÆ.

Mya arenaria, L. Halifax harbour, etc.; very common.

M. truncata, L. Halifax harbour; not uncommon.

Fam. CORBULIDÆ.

Corbula contracta, Say.

Neæra arctica. La Have banks.

Fam. PANDORIDÆ.

Clidiophora trilineata, Carp. Halifax harbour; rare. I have only dredged stray valves.

Northumberland Strait, north of Pictou Island. (*Whiteaves.*)

Fam. ANATINIDÆ.

Lyonsia arenosa, Morch. Halifax harbour.

Periploma papyracea, Verrill. Sable Island. (*Willis.*)

Cochlodesma leanum, St. Fishing banks. (*Willis.*)

Thracia Conradi, Couth. Fishing banks. (*Willis.*)

T. myopsis, Beck. Halifax harbour. (*Smith* and *Harger.*) Fishing banks. (*Willis.*)

T. truncata, Migh and Ad. Fishing banks. (*Willis.*)

Fam. MACTRADÆ.

Mactra solidissima, Chemn. Sandy beaches; whole coast. I have a specimen in my collection, presented to me by the late Mr. Willis, measuring in length 7¼ inches, and 6½ inches in extreme breadth. It came from Sable Island.

M. ovalis, Gould. Sable Island. (*Willis.*)

Mulinia lateralis, Gray.

Ceronia arctata, Ad. Sable Island. (*Willis.*)
C. deaurata, Gould. Sable Island. (*Willis.*)

Fam. KELLIADÆ.

Kellia planulata, St. Sable Island. (*Willis.*)
K. suborbicularis, Turt. Sable Island. (*Willis.*)
Turtonia minuta, Ald. Sable Island. (*Willis.*)

Fam. GASTROCHÆNIDÆ.

Saxicava arctica, Desh. Whole coast; common.
Petricola pholadiformis, Lam. Sable Island. (*Willis.*) Northumberland Strait, off North Shore. (*Whiteaves.*)

Fam. TELLINIDÆ.

Macoma fusca, Gould. Halifax harbour. Fishing banks. (*Willis.*)
M. sabulosa, Morch. Halifax harbour. (*Smith* and *Harger.*) Fishing banks. (*Willis.*)
Tellina tenera, Say. Fishing banks. (*Willis.*)

Fam. LUCINIDÆ.

Cryptodon Gouldii, St.

Fam. CYCLADIDÆ.

Sphærium simile, Gould. Truro, N. S. (*McCulloch.*)
S. partumeium, Prime. Fresh-water lakes; common.
Pisidium dubium, Gould. Fresh-water lakes.

Fam. CYPRINIDÆ.

Astarte castanea, Say. Halifax harbour. Sable Island. (*Willis.*) Off Cape Sable. (*Verrill.*)
A. crebricostata, Forbes and Hanley. Halifax harbour.
A. sulcata, Flem. Halifax harbour.
A. semisulcata, Gray.
A. elliptica, McGilliv. LaHave Bank. (*Smith* and *Harger.*)
A. Banksii, Leach. LaHave Bank. (*Smith* and *Harger.*)
A. undata, Gould. Northumberland Strait, off North Shore. (*Whiteaves.*)

Cyprina Islandica, Lam. Halifax harbour; common. Northumberland Straits, off North Shore. (*Whiteaves.*)

Fam. VENERIDÆ.

Callista convexa, Ad. Halifax harbour. Sable Island. (*Willis.*)
Venus mercenaria, L. Whole coast; common.
Tapes fluctuosa, Desh. Fishing banks. (*Willis.*)
Tottenia gemma, Perkins.

Fam. CARDIADÆ.

Cardium Islandicum, L. Halifax harbour.
Cardium pinnulatum, Conr. Halifax harbour. Northumberland Strait, off North Shore. (*Whiteaves.*)
Lævicardium Mortoni, Verrill. Halifax harbour.
Serripes Grönlandicus, Beck. Halifax harbour. St. Margaret's Bay. (*Willis.*)
Cyclocardia borealis. Fishing banks. (*Willis.*)

Fam. ARCADÆ.

Arca pectunculoides. Off Halifax harbour.
Nucula tenuis, Turt. Sambro Banks. (*Willis.*)
N. proxima, Say. Fishing banks. (*Willis.*)
N. delphinodonta, Migh. Northumberland Strait, off North Shore. (*Whiteaves.*)
Yoldia limatula, St. Fishing banks. (*Willis.*) Northumberland Strait, off North Shore. (*Whiteaves.*)
Y. obesa, St. Halifax harbour.
Y. thraciæformis, St. Halifax harbour.
Y. sapotilla, St. Halifax harbour. Northumberland Strait, off North Shore. (*Whiteaves.*)
Y. myalis, Gould. St. Mary's Bay, Digby Co. (*Verkruzen.*)
Leda tenuisulcata, Couth. Halifax harbour.
L. minuta, Mol.
L. caudata, Loven.

Fam. UNIONIDÆ.

Unio complanatus, Lea. Fresh water lakes and streams.
U. radiatus, Barnes. Grand Lake. (*Willis.*)

Margaritana arcuata, St. Fresh water lakes and streams.

Anodon implicata, Gould. Inland lakes; rare. *(Willis.)*

Fam. Mytilidæ.

Mytilus, edulis, L.

var, *pellucida*. All rocky shores.

Modiola modiolus, Turt. All rocky shores.

M. plicatula, Lam. Northern coast. *(Willis)*.

Modiolaria nigra, Loven. Halifax harbour.

M. discors, Beck. Halifax harbour.

M. corrugata, Morch. Halifax harbour.

Crenella glandula, Ad. Halifax harbour. *(Willis)*.

C. nigra. Northumberland Strait, off Pictou Island. *(Whiteaves)*.

Fam.. Pectenidæ.

Pecten tenuicostatus, Migh and Ad. Whole coast. One in my collection, presented by the late Mr. Willis, measures over 6¼ in.

P. islandicus, Chemn. Whole coast.

P. irradians, Lam. Sable Island. *(Willis)*.

P. pustulatus. LaHave bank. *(Willis)*.

Fam. Ostræidæ.

Ostrœa virginiana, List. Northern coast.

Anomia glabra, Verrill. Halifax harbour Off Cape Sable, 8 fath. *(Verrill)*.

A. aculeata, Gmel.

A. electrica, L.

A. squamula, L.

CLASS BRACHIOPODA.

Fam. Terebratulidæ.

Terebratulina septentrionalis, Couth. I have found this species very abundant in one particular part of the harbour; adult and young, in all stages of growth together, generally much covered by a sponge; 10 fath.

Fam. RHYNCONELLIDÆ.

Rhynconella pisttacea, Owen. St. Margaret's Bay, LaHave Bank, *(Smith* and *Harger)*, Halifax harbour, *(Smith* and *Harger)*

Waldheimia cranium, Gd. One single specimen only has yet been obtained on our coast, at St. Margaret's Bay.

CLASS GASTEROPODA.

Fam. BULLIDÆ.

Philine quadrata, Searles Wood. Fishing banks. *(Willis).*

P. lineolata, St. Fishing banks. *(Willis).*

Scaphander puncto-striatus, St. Fishing banks. *(Willis)*

Diaphana debilis, St. Fishing banks. *(Willis).*

Utriculus pertenuis, St. Fishing banks. *(Willis).*

Cylichna alba, St. Fishing banks. *(Willis).*

ORDER NUDIBRANCHIATA.

Fam. TRITONIDÆ.

Dendronotus arborescens, Ald. and Han. Halifax harbour.

D. robustus, Verrill. Thirty miles S. E. from Chebucto Head; 110 fathoms.

Eolis nana? Ald. and Han. Piles, Halifax harbour. Verrill.

Fam. CHITONIDÆ.

Trachydermon ruber, Carp. Halifax harbour.

T. marmoreus, Fabr. Halifax harbour.

T. albus, Lowe. Halifax harbour.

Amicula Emersonii, St. Halifax harbour.

Fam. DENTALIDÆ.

Siphonodentalium ——? La Have Bank.

Fam. PATELLIDÆ.

Acmæa testudinalis, Forbes and Hanley. All rocky shores.

Lepeta cæca, Gd. Fishing banks; very rare. *(Willis.)*

Fam. CALYPTRÆIDÆ.

Crepidula fornicata, Lam. Whole coast.

C. plana, Say. Sable Island; Northern shores; Bay of Fundy. *(Willis.)* La Have Bank. *(Smith* and *Harger.)*

C. convexa, Say. Sable Island. *(Willis.)*

Fam. FISSURELLIDÆ.

Cemoria Noachina, Gd. Fishing banks. *(Willis.)*

Fam. JANTHINIDÆ.

Janthina fragilis, Desh. Sable Island; occasionally as a drift shell.

Fam. TROCHIDÆ.

Margarita cinerea, Gd. Fishing banks. *(Willis.)*

M. undulata, Sow. Fishing banks. *(Willis.)*

M. helicina, St. Halifax harbour.

M. argentata, Gd.

M. obscura, Gd.

M. varicosa, Migh. and Ad. Halifax harbour. *(Smith* and *Harger.)*

Fam. PALUDINIDÆ.

Valvata tricarinata, Say. Lakes in the interior.

Melantho decisa, W. G. Binney. Dartmouth lakes, &c.

Amnicola limosa, Hald. Ponds and stagnant waters.

Fam. LITTORINIDÆ.

Skænea planorbis, Forbes and Hanley.

Lacuna vincta. Gd. Whole coast.

Littorina rudis, Gd. All rocky shores.

L. tenebrosa, Gd. All rocky shores.

L. littorea, Johnston. All rocky shores.

L. palliata, Gd. All rocky shores.

Fam. SCALARIDÆ.

Scalaria Graoenlandica, Sow. Halifax harbour, LaHave Bank, (*Smith* and *Harger*).

Fam. TURRITELLIDÆ.

Turritella erosa, Couth. Fishing banks. *(Willis).*

T. reticulata, Migh and Ad. Halifax harbour.

T. acicula, St. Halifax harbour.

Fam. CERITHIIDÆ.

Aporrhais occidentalis. Sow. Halifax harbour, LaHave Bank, *(Smith* and *Harger),* Annapolis Basin, *(Verkruzen).*

Bittium nigrum, St. Whole coast.

Fam. PYRAMIDELLIDÆ.

Turbonilla interrupta, Tott. Northumberland Strait; north shore, *(Whiteaves).*

Menestho albula, Möll. Fishing banks; rare. *(Willis).*

Fam. VELUTINIDÆ.

Velutina haliotoidea, Gd. Fishing banks. *(Willis).*

V. zonata, Gd. Halifax harbour.

Fam. NATICIDÆ.

Lunatia heros, St. All sand beaches.

L. Groenlandica, Gd.

Natica clausa, Brod. and Sow. Halifax harbour.

Lunatia immaculata, Ad. Fishing banks. *(Willis).* Northumberland Strait, off Pictou Island, *(Whiteaves).*

Bulbus flavus, St. Fishing banks. *(Willis).*

Amauropsis helicoides, St. Fishing banks. *(Willis).*

Fam. TURRITIDÆ.

Pleurotoma plicata, Ad. Fishing banks. *(Willis).*

Bela turricula, St. Fishing banks. (*Willis*).

B. harpularia, St. Halifax harbour.

Bela violacea, St. Fishing banks. *(Willis.)*

B. decussata, St. Fishing banks. *(Willis.)*

B. pleurotomaria, St. Halifax harbour.

B. cancellata, St. Northumberland Strait. *(Whiteaves.)*

Fam. COLUMBELLIDÆ.

Astyris rosacea, H. & A. Ad. Fishing banks. *(Willis.)*

Fam. PURPURIDÆ.

Purpura lapillus, Lam. All rocky shores.

Ilyanassa obsoleta, St. Halifax harbour; Pictou; Annapolis Basin.

Tritia trivittata, Ad. Halifax harbour; Northumberland Strait, off Pictou. *(Whiteaves.)*

Buccinum undatum, L. Whole coast.

B. ciliatum, Gd. Fishing banks. *(Willis.)*

Fam. MURICIDÆ.

Neptunea curta, Verrill. Halifax harbour.

Neptunella pygmæa, Verrill. Halifax harbour.

Neptunea ventricosus, Gray. Sable Island.

N. decemcostatus, Halifax harbour; LaHave bank. *(Verrill.)*

Trophon clathratus, St. Halifax harbour.

T. scalariformis, Gd. Halifax harbour.

T. Gunneri, LaHave bank. *(Smith* and *Harger.)*

Ptychatractus ligatus, St. Halifax. *(Willis.)*

Fam. CANCELLARIDÆ.

Trichotropis borealis, Sow. Halifax harbour.

Admete viridula, St. Fishing banks. *(Willis.)*

SUB-CLASS PULMONIFERA.

Fam. HELICIDÆ.

Hyalina cellaria, Morse. Halifax; scarce. *(Willis.)*

H. arborea, Morse. Neighbourhood of Halifax; scarce. *(Willis.)*

H. electrina, Morse, do. do.

H. chersina, Binney, do. do.

H. lineata, Binney, do. do.

Helix alternata, Say. Only found in the interior of the country and not on the Atlantic Coast.

H. striatella, Anth. Neighbourhood of Halifax; scarce. (*Willis.*)
H. hirsuta, Say. do. common.
H. pulchella, Müll. do. not uncommon.
H. hortensis, Müll. Whole country; common. The yellow variety is far more abundant than the striped.
Succinea obliqua, Say. Stagnant waters; Halifax, &c.
S. avara, Say. do. do.

Fam. AURICULIDÆ.

Alexia myosotis, Pf.

Fam. LIMNÆIDÆ.

Limnæa columella, Say. In most lakes and ponds; common.
L. elodes, Say. Truro marshes: common.
L. catascopium, Say. Dartmouth Lakes; rare. (*Willis.*)
L. humilis, Say. Pond at Fort Needham, Halifax.
Physa heterostropha, Say. Truro marshes; common.
P. ancillaria, Say. Dartmouth Lakes. (*Willis.*)
Bulinus elongatus, Binney. Truro marshes; not common.
Planorbis trivolvis, Say. Dartmouth Lakes; common.
P. bicarinatus, Say. do.
P. deflectus, Say. do.
P. dilatatus, Gould. do.
Ancylus parallelus, Hald. Fresh water lakes and streams; common.

PROCEEDINGS

OF THE

Nova Scotian Institute of Natural Science.

VOL. IV. PART IV.

Provincial Museum, Oct. 10, 1877.

ANNIVERSARY MEETING.

WILLIAM GOSSIP, ESQ., *Vice-President, in the Chair.*

Inter alia.

The following gentlemen were elected office-bearers for the ensuing year :—

President—J. B. GILPIN, B. A., M. D., M. R. C. S.
Vice-Presidents—WILLIAM GOSSIP, ESQ., F. ALLISON, M. A.
Treasurer—W. C. SILVER, ESQ.
Joint Secretaries—REV. D. HONEYMAN, D. C. L., JOHN T. MELLISH, M. A.
Council—A. P. REID, M. D., J. R. DEWOLFE, M. D., ROBERT MORROW, J. SOMMERS, M. D , HON. L. G. POWER, PROF. LAWSON, AUGUSTUS ALLISON, J. M. JONES.

ORDINARY MEETING, November 12, 1877.

DR. J. B. GILPIN, *President, in the Chair.*

MAJOR KING, Royal Artillery, who had been absent from the Province for some years, was re-admitted as a member of the Institute.

The REV. DR. HONEYMAN read a paper entitled—1. Geology of Halifax, 2. Geology of Nictaux,—which was replete with information of interest to Geologists.

MR. H. S. POOLE and MR. GOSSIP made some remarks on the subject.

DR. SOMMERS exhibited some feet of sheep with holes similar to those found in the feet of the moose.

ORDINARY MEETING, December 10, 1877.

The PRESIDENT *in the Chair.*

The SECRETARY announced that the Council had elected, as members of the Institute, DR. H. A. BAYNE, of the Halifax High School, and DR. J. MCKENZIE, of Dalhousie College.

The PRESIDENT exhibited a specimen of abnormal growth of considerable size on the hind leg of a moose, and explained the probable cause of it.

MR MELLISH stated that he had seen a similar growth on the fore leg of a living moose, caused by injury sustained when the animal was snared.

MR. ROBERT MORROW exhibited a peculiarly shaped oyster shell, which had been attached to a vessel—adhering in the angle formed by the keel and the bottom of the ship.

DR. SOMMERS read a paper "On the Mosses of Nova Scotia," illustrating his subject by diagrams and specimens. *(See Transactions.)*.

ORDINARY MEETING, January 14, 1878.

The PRESIDENT *in the Chair.*

PROF. LAWSON read a paper by PROF. HOW, of King's College, Windsor, "On the East India Herbarium of King's College." The subject was regarded as of considerable interest to Botanists. *(See Transactions.)*

MR. H. S. POOLE, Inspector of Mines, delivered a lecture on "Bell's Telephone." The illustrations were interesting, and the operating of the Telephone very satisfactory.

ORDINARY MEETING, February 11, 1878.

The PRESIDENT *in the Chair.*

It was announced that Messrs. JOHN BRUNTON, J. M. GELDERT, JOSEPH OUTRAM, SEYMOUR SCOTT and W. HARRINGTON had been elected members of the Institute; and MR. HENRY LOUIS, of Londonderry Mines, an Associate Member.

MR. EDWIN GILPIN, M. A., read an instructive paper, "On the necessity for preliminary scientific training for Civil and Mining Engineers." Drs. REID and SOMMERS, and Messrs. GOSSIP and FAIRBANKS made some remarks on the subject of MR. GILPIN's paper. *(See Transactions.)*

MR. J. T. MELLISH, M.A., read a paper on "Acadian History—L'Isle de St. Jean." DR. GILPIN referred to the importance of treasuring such historical facts as Mr. Mellish had collected.

ORDINARY MEETING, March 11, 1878.

The PRESIDENT *in the Chair.*

The SECRETARY stated that DR. BROOKFIELD, of England, had been elected an Associate Member of the Institute.

Geological Reports from British Columbia and Ontario were laid on the table.

MAJOR KING, R. A., presented the Institute with the Journal of the Royal United Service Institution, Whitehall Yard.

The PRESIDENT exhibited a tooth taken from the skull of a beaver, which had grown round inwards until the point had met against the roof of the mouth and caused death. The immediate cause of this abnormal growth was explained to be the previous loss of a lower tooth directly opposite.

W. GOSSIP, ESQ., Vice-President, having been called to the Chair, the PRESIDENT delivered an interesting lecture, "On the Wild Ducks of Nova Scotia." A number of beautiful specimens were exhibited, and their peculiarities and differences minutely described. *(See Transactions.)*

After remarks by DR. SOMMERS, Messrs. SILVER, MORROW and GOSSIP, the meeting adjourned.

ORDINARY MEETING, April 8, 1878.

The PRESIDENT *in the Chair.*

DR. REID read a paper "On the relations between Labour and Science," which elicited considerable discussion.

MR. ROBERT MORROW then read an instructive paper (being a translation from Camper by MR. MORROW himself), "On the Bones of Birds." Drs. GILPIN, SOMMERS, Messrs. GOSSIP, J. M. JONES and JOHN FORBES, each made observations on the subject. *(See Transactions.)*

The SECRETARY laid on the table :—

1. A volume containing Reports of the Palaeontology of the Fortieth Parallel, presented by CLARENCE KING, U. S. Geologist.

2. Memoir by DR. SCUDDER, "On Fossil Myriopoda of Nova Scotia, &c.," presented by the Boston Natural History Society.

ORDINARY MEETING, May 13, 1878.

The PRESIDENT *in the Chair.*

Reports were laid on the table—(1) Of the Geological Survey of the United States, and (2) Of the Institutes of Natural Science in Iowa and Minnesota.

MR. THOMAS FYSHE was elected a member of the Institute.

MR. FREDERICK ALLISON, M. A., read his report of the Meteorology of Nova Scotia for 1877. Mr. Allison's paper embodied conclusions drawn from a long series of observations respecting our climate, of a most valuable character. *(See Transactions.)*

MR. GOSSIP and MR. MELLISH followed with some observations.

MR. H. S. POOLE then read a paper by MR. H. LOUIS, of Londonderry Mines, "On Nova Scotia Mineralogy," and exhibited several specimens of minerals recently found. *(See Transactions.)*

LIST OF MEMBERS.

Date of Admission.			
1873.	Jan.	11.	Akin, T. B., D. C. L., Halifax.
69.	Feb.	15.	Allison, Augustus, Halifax.
69.	Feb.	15.	Allison, Frederick, *Chief Meteorological Agent*, Halifax.
77.	Dec.	10.	Bayne, J., Ph. D., High School, Halifax.
64.	April	3.	Bell, Joseph, High Sheriff, Halifax.
63.	Jan.	8.	Belt, Thomas, F. G. S., Newcastle-on-Tyne, England.
73.	Jan.	11.	Binney, Edward, Halifax.
64.	Nov.	7.	Brown, C. E., Halifax.
78.	Feb.	10.	Brunton, Robert, Halifax.
75.	Feb.	11.	Brunton, John, Halifax.
67.	Sep.	20.	Cogswell, A. C., D. D. S., Halifax.
72.	Apr.	12.	Costley, John, Halifax.
63.	May.	13.	Cramp, Rev. Dr., Wolfville.
70.	Mar.	30.	Day, Forshaw, Artist, Halifax.
75.	Jan.	11.	Dewar, Andrew, Halifax.
63.	Oct.	26.	DeWolf, James R., M. D., Edin., L. R. C. S. E., Dartmouth.
63.	Dec.	7.	Downs, Andrew, *Corr. Memb. Z. S.*, London, Halifax.
71.	Nov.	29.	Egan, T. J., Taxidermist, Halifax.
75.	Dec.	13.	Fairbanks, Lewis P., Dartmouth.
74.	Apr.	13.	Forbes, John, Manager of Starr Works, Dartmouth.
72.	Feb.	12.	Foster, James, Barrister-at-Law, Dartmouth.
76.	Mar.	13.	Fraser, J. F., Richmond, Halifax.
78.	May	13.	Fyshe, Thos., Cashier, Bank N. S., Halifax.
78.	Feb.	11.	Geldert, J. M., Halifax.
63.	Jan.	5.	Gilpin, J. Bernard, M. D., M. R. C. S., *President*, Halifax.
63.	Feb.	2.	Gossip, William, *Vice-President*, Granville Street, Halifax.
76.	July	20.	Greville, Hon. Mr., 60th Rifles, Halifax.
63.	Jan.	26.	Haliburton, R. G., F. S. A., Halifax.
63.	June	27.	Hill, Hon. P. C., D. C. L., Provincial Secretary, Halifax.
66.	Dec.	3.	Honeyman, Rev. David, D. C. L., F. G. S., &c., *Secretary Prov. Museum*, Halifax.
68.	Nov.	2.	Hudson, James, M. E., *Superintendent of Albion Mines*, Pictou.
78.	Feb.	11.	Harrington, W. M., Halifax.
74.	Dec.	10.	Jack, Peter, Halifax.
73.	Jan.	11.	James, Alexander, Mr. Justice, Dartmouth.

63. Jan. 5. Jones, J. M., F. L. S., Halifax.
66. Feb. 1. Kelly, John, *Dep. Chief Commissioner of Mines*, Halifax.
77. Nov. 12. King, Major, R. A.
64. Mar. 7. Lawson, George, Ph. D., L. L. D., *Professor of Chemistry and Natural History*, Dalhousie College, Halifax.
75. Jan. 11. Mellish, John T., M. A., SECRETARY, Halifax.
72. Feb. 5. McKay, Alexander, *Principal of Schools*, Dartmouth.
75. Feb. 12. McKay, Adam, Engineer, Dartmouth.
77. Dec. 10. McKenzie, J. J., Ph. D., *Lecturer on Physics*, Dalhousie Col.
66. Feb. 3. Morrow, James B., Halifax.
72. Feb. 13. Morrow, Robert, Halifax.
73. Mar. 10. Moseley, E., Dartmouth.
70. Jan. 10. Murphy, Martin, C. E., *Provincial Engineer*, Halifax.
65. Aug. 29. Nova Scotia, the Rt. Rev. Hibbert Binney, D.D., *Lord Bishop of*
78. Feb. 11. Outram, Jos., Halifax.
74. Mar. 9. Pitts, D. H., Halifax.
63. Jan. 16. Poole, Henry, M. E., Derbyshire, Eng.
72. Nov. 11. Poole, H. S., F. G. S., *Inspector of Mines*, Halifax.
70. Jan. 20. Power, L. G., Senator, Halifax.
66. July 28. Reeks, Henry, Manor Hall, Truxton, Hamp., England.
71. Nov. 29. Reid, A. P., M. D., Halifax.
74. Nov. 9. Robertson, Thomas, Halifax.
66. Jan. 8. Rutherford, John M. E., Halifax.
78. Feb. 11. Scott, Seymour, Halifax.
64. Mar. 7. Silver, W. C., TREASURER, Halifax.
68. Nov. 25. Sinclair, John A., Halifax.
76. Mar. 13. Skimmings, Robert, Halifax.
75. Jan. 11. Sommers, J., M. D., Halifax.
74. Apr. 11. Stirling, W. Sawers, Halifax.
73. Jan. 13. Waddell, W. Henry, High School, Halifax.
66. Mar. 18. Young, Sir William, Knt., *Chief Justice of Nova Scotia, Halifax.*
77. Jan. 13. McGregor, J. G., M. A., D. Sc., Bristol, Eng.
77. Jan. 13. Haggarty, J. R., Halifax.
77. Jan. 13. Morrow, G., Halifax.

ASSOCIATE MEMBERS.

1863. Oct. 6. Ambrose, Rev. John, A. M., Digby.
78. Mar. 11. Brookfield, Dr. Derbyshire, Eng.
73. Apr. 11. Gilpin, Edwin, M. E., F. G. S., Springville, Pictou.
75. Nov. 9. Kennedy, Professor, Acadia College, Wolfville.
78. Feb. 11. Louis, Henry, Assoc. R. Sch. M., Londonderry Mines.
75. Jan. 11. McKay, A. H., A. M , *Principal of Academy*, Pictou.
75. Nov. 9. McKinnon, Rev. John, Hopewell, Pictou.
65. Dec. 28. Morton, Rev. John, Trinidad.
76. Mar. 13. Patterson, Rev. George, D. D., Greenhill, Pictou.
77. May 14. Burwash, Rev. J., Prof .Nat. Hist., Wes. Coll., Sackville, N.B.

CORRESPONDING MEMBERS.

1871.	Nov.	29.	Ball, Rev. E., Springhill.
68.	Nov.	25.	Bethune, Rev. J. S., Ontario.
66.	Sep.	29.	Chevalier, Edgcumbe, H. M., Naval Yard, Pembroke, Eng.
76.	Dec.	11.	Dr. DeWolf, Tintern, England.
77.	May	14.	Thomas Weston, Geol. Survey of Canada.
71.	Nov.	1.	Cope, Rev. J. C., Pres. N. Orleans, Acad. of Science.
70.	Oct.	27.	Harvey, Rev. Moses, St. John's Nfld.
66.	Feb.	6.	Hurdis, J. L., Southampton, England.
71.	Jan.	10.	Matthew, G. M., St. John, N. B.
72.	Feb.	5.	Tennant, Prof. J., F. G. S., F. Z. S., &c., Mineralogist to H. M. the Queen, and the Baroness Burdett Coutts.

LIFE MEMBER.

Hon. Dr. Parker, M. L. C., Nova Scotia.

TRANSACTIONS

OF THE

Nova Scotian Institute of Natural Science.

ART. I.—PRECARBONIFEROUS FORMATIONS OF ANNAPOLIS AND KING'S COUNTIES.—REV. DR HONEYMAN, D. C. L., F. R. H. S., &c., *Curator of the Provincial Museum, and Lecturer on Geology and Palæontology in the Technological Institute, &c.*

(Read November 12, 1877.*)*

NICTAUX.

THIS is one of the great Iron Districts of the Province. It is situate in the eastern part of the ancient, beautiful and fertile County of Annapolis. For the past forty years it has been known to Geology. Latterly, while the Devonian has gradually lost ground in Nova Scotia so as not to be *certainly* recognized as one of the Formations of the Province, this has generally been regarded as, at least, a sure resting place. Dawson's Acadian Geology, with map, *second Edition,* 1868. The strata containing its iron deposits have been considered to be of Devonian age,—and the associated Granites have also been considered to belong to the *latter part of the same age.* The Devonian age of the other granites associated with the great metamorphic—auriferous—Band of the Province, has been inferred from the same premises. I must confess that I have always entertained doubts of the validity of these conclusions, and I have taken the first opportunity that presented itself of examining the district in order to test their validity. As this was my first visit to Nictaux, and as I expected to find everything Geologically different from the other parts of the Province which I had examined, I proposed to make myself a little familiar with the general aspect of things before investigating details.

I accordingly took a glance at the Rocks of the Falls of Nictaux River, and at the numerous outcrops of rocks appearing on the Old Road between the Falls and the Cleveland Mountain Iron Deposits. I inspected the excavations in the *magnetite beds* below the residence of Messrs. Stearns and Page. I followed the strike of the strata toward the Nictaux River, and found cuttings on the Nictaux and Atlantic Railway which might be useful in the prosecution of my investigations. I accepted of the generous offer of hospitality and assistance of Messrs. Stearns and Page, and thus secured an admirable centre of operations and valuable aid. A plain copy of Church's excellent map of the County was also placed at my disposal, as well as Mr. Page with his horse and carriage ; so that my equipments for work were all that could be desired.

On the second day Mr. Page took me to the *Old Mines* on the east side of Nictaux River, and left me to make the best of my opportunity.

The aspect of matters here did not look very encouraging. The mines were filled with water, the banks of rubbish were obscured with age and vegetation. Only a few little patches of fossiliferous iron ore were seen lying here and there, having a few specimens of *Spirifer nictavensis*, Dawson. There was therefore nothing to excite special interest. Taking the course of the trench, I followed it easterly, seeking for other openings mentioned by Mr. Page. Not observing them, as I had not advanced far enough, I deviated from my course and proceeded to the high ground lying to the north. I then observed strata outcropping on the farm of Benjamin Wheelock, (Church's Map). Examining these I found them to be sandstones, altered more or less with abundance of fossils in casts. I at once recognized the Mayhill sandstone or Medina sandstone of my "Upper Arisaig Series." I was at home, and now proceeded to a systematic examination of

Locality 1, B. Wheelock's.

The fossils collected in this locality are :—

Athyris.
Spirifera.
Orthis, var. species.
Strophomena.
Strophodonta.

The genus *athyris* is eminently characteristic of the Mayhill or Medina sandstone of Nova Scotia, a member of the "Upper Arisaig Series." In this horizon it is very abundant. At Arisaig, Lochaber, Marshy Hope and Sutherland's River, it occurs generally in casts, sometimes however, it is found in the same rock specimens, in groups, whole and in casts, so that there is no room for mistaking its character. The peculiar shape of the cast of the ventral valves is easily recognized. It has not been recognized in any other division of the Arisaig series, except in the Ironstone bed of Arisaig Brook, and in the Ironstone bed of Blanchard, East River of Pictou. In the chief localities where this form prevails it has also an eminently characteristic associate, the coral *Petraia*, e. g. *Petraia Forresteri*, Salter. Although I have not yet found a similar association in this locality, we may confidently anticipate that this defect will be remedied.

The only other genus of the above list to which I would at present direct attention, is *Strophodonta*,—Hall.

This is readily distinguished from the *Orthis* and *Strophomena*, by the crenulated hinge line, from which the genus derives its name. The typical form being *Strophodonta prisca*,—Hall, of the Clinton, New York. The species of our locality is about twice the width of *Str. prisca*, and the width is to length as 7 to 5. We have casts of ventral and dorsal valves.

Hall's note on his species is interesting. "This shell occurs in shaly laminated sandstone highly charged with oxide of iron, associated in the iron ore beds in the town of Kirkland, Oneida county." The *Strophodonta*, under examination, occurs also in shaly sandstone in like association. I only give this as a coincidence. Our Stropohdonta seems to be older than the *Str. prisca*.

The sandstones here are included in siliceous argillaceous slates as at Arisaig.—*Transactions.* So that the strata are lithologically as well as palaeontologically, identical. Observing that the strata had a high southerly dip, I proceeded northerly in order to ascertain the cause of their alteration and elevation. I had not far to go to find the cause. I found the last outcrop of strata on Wheelock's Farm, passing under the line fence to Parker's Farm, which lies on the east side of Wheelock's. This was overlying *Diorite,* having an imposing outcrop. This was just what might have been expected, a precise coincidence with the order of things at Lochaber, Merigomish, Sutherland's River and McLellan's Mountain, in the Eastern Counties of Antigonish and Pictou.

Here the Mayhill sandstone strata, as generally in like connection, are vertical. The strike is N. 80° E., S. 80° W. To the north of this Diorite the ground makes a rapid descent, bringing us to the valley where all seems to be obscure. Re-crossing the Diorite, Slate and Fossiliferous Sandstones, and still advancing south the ground is obscure, no strata appearing. About 20 rods short of the road we come to a trench filled with water—this is a part of the Old Mines of which I was in quest. Mr. B. Wheelock, the owner of the Farm, who had come to my assistance somewhat opportunely, succeeded in getting for me two interesting specimens of the Iron ore. Adhering to the casts of some large and imperfect *Lamellibranchs* were found *Serpulini* and *Escharoid* forms *in groups.* Still farther south on the north side of the road, strata were seen. These were dark coloured slates—metamorphosed—having abundance of minute crystals—cubes of pyrite and occasional fossils.

Crinoid joints.
Spirifer crispus.

These seem to belong to the C. member of my "Upper Arisaig Series,"—Aymestry or Niagara Limestone.

The strike of these strata is N. 55° E., S. 55° W. and their dip. 70° S., 35° E. Beyond this no higher strata appear. According to the measurement on Church's map, the distance of these strata from the Diorite is about half a mile. This accords with the distance given by Mr. Wheelock. This would make the vertical thickness of this series of strata about 2480 feet. This is about the thickness of the same members of the series at Arisaig, and the horizon of the Iron ore is approximately the same as that of Arisaig, and also of East River, Pictou, Clinton age. Returning to Cleveland Mountain we find Diorite outcropping at I. Allen's, and at a new house between Parker's and Allen's, occupying the same position relative to the bed of iron ore, as the Diorite already observed. Still farther we find the same Diorite outcropping on the W. side of Nictaux River, in the Railway section; and then we find it outcropping in Mr. Page's garden; then largely exposed in Banks' Field between Stearns' and Page's and the road, and then on the road. The three last occupy the same position relative to the beds of Magnetic Iron ore of Cleveland Mountain already referred to. Shewing the *Clinton Age* of these deposits.

Under Mr. Page's valuable guidance, I proceeded to examine other exposures of the Iron beds and their associated strata. Another trench at Parker's Farm, already referred to, was pointed out. This was on a line with B. Wheelock's locality 1. Like the other it was filled with water—specimens of the iron ore were collected from those scattered around. At a short distance to the north of this bed, or under it, another *Trench* was pointed out—the ore of this bed is *Red Hematite.* Still farther north we came upon a great exposure of slates and white quartzites. This is a continuation of the Medina sandstone strata of Loc. 1. Here they are more highly metamorphic and are apparently nonfossiliferous. Succeeding these is the great *Diorite* already referred to. Mr. Page shewed me specimens of *Fibrous Gypsum,* which he said were brought up when a well was being sunk near the roadside. This is somewhat singular and apparently incomprehensible.

Thence we proceeded in a north-easterly direction, and passing out of the Mountains into the Valley. At a distance of $2\frac{3}{4}$ miles—air-line—we reached an outcrop of Red Hematite. On the east side of the road that runs at right angles to Valley Road, that passes below the mountains, a short distance north of the Cross-roads, we found a potato field with the soil like red ochre, with abundance of ore of Red Hematite scattered over the surface. Underlying this outcrop I found grey slates *in situ*—Mayhill sandstone age—with specimens of the *desiderated Petraia* in casts. Proceeding to Meadowvale—to a distance of one mile from the Windsor & Annapolis Railway,—we took a road running easterly and at a distance of $\frac{3}{4}$ of a mile we turned off into a field road, and after going south about $\frac{3}{4}$ of a mile we approached Torbrook locality, and found large pieces of white quartzose rock—sandstone—identical with that of Locality 1, B. Wheelock's, having,

Athyris, sp.
Spirifera, sp.
Strophodonta, sp.

The sandstones and fossils in my collection cannot be distinguished from those of Loc. 1, except by the labels.

Coming to the excavations we found large heaps of ore,—red hematite. These excavations are on the north side of Torbrook, part of the red ferruginous strata in which the ore is imbedded is beautifully exposed in the bed of the brook. The strata are metamorphosed and tilted, seeming to indicate the presence and influence of *Diorite,* as at B. Wheelock's, Parker's, the Railway and Stearns and Page's. So that there can be no question that this is a continuation of the *Iron ore beds* mentioned in the other localities.

A day or two before, when I was on the New Canaan Road in the mountain south of this locality, Mr. Page pointed it out as the position of an iron ore bed. I could not suppose that it had any connection with the other beds. Lying in the valley, at a distance from the foot of the mountain, at the side of a brook, where every exposure visible seemed brick-red. I concluded that the formation there must be *New Red Sandstone,* and that the ore must be of a character altogether different.

Preceding observers have gone *wide astray* in defining the course of the Nictaux Iron beds, as the direction given in Geological Maps, e. g. the *Maps of Acadian Geology.* The course there defined, would make them traverse the mountain strata on which we were standing when the works of Torbrook were pointed out to me in the dim distance.

The fossils of the Red Hematite and Red Slates collected are:

Ptylodictyum problematicum.
Stenopora fibrosa.
Cornulites flexuosus.
Trilobite, pleura.
Spirifera, sp.
Modiolopsis orthonota.
Tentaculites, sp.
Bellerophon expansus.

The course of the iron ore beds may be defined thus on Church's Map:

1st. Magnetite beds. Stearns and Page's, distant from the Annapolis Railway due south, $5\frac{1}{4}$ miles.

2nd. Beds at Wheelock's and Parker's, distance from the Railway, S. $3\frac{1}{8}$ miles.

3rd. Beds at Torbrook, S. $2\frac{5}{8}$ miles, or *2 miles S. of the Annapolis River, and nearly a mile from the County line.*

The same line is defined with the *utmost accuracy* in the Map of Acadian Geology, Ed. 1868. The course begins in the Devonian West of Nictaux River, traverses this formation, passes into and traverses the *Upper Silurian*, even to the *New Red Sandstone.*

This is certainly range enough for the Bed, Devonian and Upper Silurian; the position might be called a dilemma for the author, believing as he does in the Devonian age of the iron deposits. I was led to infer the probable existence of middle silurian fossils in connection with the ores of Cleveland Mountain. A search in the direction supposed, led to the discovery of fossils on the side of the public road. The fossils were not *in situ*, but they were evidently not far from their original position. This position was apparently on the *wrong* side of the *Diorite* already referred to.

LOCALITY 3, CLEVELAND MOUNTAIN.

The rock containing the fossils is *slaty*, *siliceous*, and *pyritous*. The fossils are :

Petraia, sp.
Crinoid joints.
Athyris, sp.
Spirifer, sp.
Strophomena, sp.
Corallines, sp.?

Mr. Page took me to another locality already alluded to, on the New Canaan Road, S. W. from the Mines of Torbrook.

Loc. 4. W. Wheelock's (*Church Map.*) In a hollow beginning at the road and passing along the house, and onward to the height, strata were observed which we thought might be fossiliferous. On examination we found strata outcropping at the top of the hollow, which seemed to correspond with those of No. 1, B. Wheelock's. They were white siliceous rocks (sandstones) with slates. In these we found abundance of fossils identical with those at No. 1, with additions.

Stenopora fibrosa.
Trilobite pleura.
Orthis, various.
Strophodonta, sp.
Spirifera, sp.
Ambonychia, sp.
Tentaculites.

The dip of the strata seemed to be nearly vertical with a tendency northerly.

I went over the ground some distance to the south of the fossiliferous strata looking for *Diorite* as at Loc. 1, but all was obscure. Returning by the Hollow we found dark coloured strata having a dip 76° N. 30 W.

In the digging of a well in the front of the house, fawn coloured slates have been cut. These seem to be the *Dictyonema Websteri* of Beech Hill, Kentville, Kings County. At the road where the hollow meets there was a considerable outcrop of fawn coloured slates.

To the east of this locality and about $\frac{3}{4}$ of a mile from the county line we found the strata of the mountain side beautifully exposed in a branch of Torbrook. These strata resemble those of Kentville and Beech Hill. They are grey, reddish and varying coloured.

Near the foot of the mountain before the brook reaches the valley, the strata are solid and penetrated with quartz veins. A short distance above the road the brook takes its rise and the strata disappear. The strata are metamorphosed and apparently non-fossiliferous. Their strike is N. 60 E., S. 60 W. Their dip is 82, S. 30 E. At the road they are vertical. This seems to be an upper silurian series, *intervening* between the middle silurian of locality 4, and that of the iron ore series of locality 2, Torbrook.

Still farther beyond the county line, in King's Co., at Gordon's Farm—*Church Map.*

LOCALITY 5, GORDON'S.

In this farm, on the south side of the New Canaan Road, strata were observed outcropping in several places, associated with *Diorite.* In a stone heap I found a piece of sandstone with casts of fossils. The size of the specimen is about 10x6 inches, thickness $1\frac{3}{4}$. It is coarse, shaly, ferruginous. The fossils are:

Athyris.
Orthis.
Spirifer.
Strophodonto, grandis ?

This *Strophodonta* differs from those found in localities 1, 2, 4. It is larger, its width is 2 inches, its length 1 8-20 inches, its width is to that of the other 10:7; its length 14:10. The smooth part of the hinge at the beak measures four twentieths of an inch, the crenulation on either side of the beak area measures seven twentieths, on either end of the crenulation the smooth part of the hinge line measures eleven twentieths. It is the cast of the dorsal valve.

The specimen doubtless, represents *sandstone* beds in the strata.

Parallel lines drawn on the Maps of Annapolis and King's (Church's), show that an extension of these strata westward would pass in the *rear* of locality 4, at a distance of about ¼ of a mile, so this locality seems to belong to a *repetition* of the series of strata represented in locality 4, *farther south.*

A rocky eminence, about half a mile south-east of Gordon's, near the side of road branching off New Canaan Road, attracted attention, and had to be examined. On our way we passed from the Middle Silurian strata into others of a widely different lithological aspect, indicating *greater age.* The present strata are gneissoid—micaceous. The eminence when reached presented a very striking appearance. It was entirely formed of gneissoid strata, marvellously contorted, surfaces presenting the ornamental lines of oak or pine panelling, and other lines of beauty. The aid of the photographer was desiderated to picture the rocks. The pressure contortions of Point Pleasant rocks, Halifax, are plain in comparison.

I shall have occasion to notice these rocks in the sequel.

A farther examination of Cleveland Mountain, showed that the Magnetite containing strata outcropping on the road had the regular strike and dip until we reach Hatley's, i. e., about a quarter of a mile south of the Diorite, at Stearns and Page's. They are then seen assuming a synclinal arrangement, having a dip 70 S., 50 W., and 52 N., 45 E.

This syncline appears on the road below the house, and in the pasture. This gives direction to the drainage. In general, however, the strata here are broken and confused. A broad *Magnetite* bed in the valley thus formed seems to shew the effect of this disturbance. We proceed onwards, and, after a few paces, we come to the *cause* of the disturbance. A considerable band of gneissoid strata, succeeded by granite. These having been *thrust up,* have caused the disturbance. These gneissoid rocks are quite distinct from the Magnetite strata, and nothing but hasty observation could confound them. They are not seen here in contact. Passing over granite, about a mile in width, on the road, we come to slates containing fossils, which, *apparently*, separates this granite from the broader granite, filling a gap between the two. The granite over which we have passed is seen exposed on the left, east, but it does not extend to any great distance in this direction. Here it bounds the valley. Standing on the granite on the road we have an uninterrupted view as far as Locality 1, B. Wheelock's, and along the New Canaan Road as far as W. Wheelock's, Locality 4. On the right the Granite rises into a mountain, passing on it rises behind Hatley's and advances to Banks' Mountain, where we shall meet it again.

The last westerly exposures are seen on a new road (?) which Mr. Page and I traversed when returning from the examination of a locality west of the Mountains. This shews its length to be 1½ miles. The band of Middle Silurian strata that fills the apparent gap between them extending to Dunn's and Hogan's on the road, seems to be less than half a mile in width. East of the road it becomes obscure at no great distance, so that I was unable to trace its course in this direction. Westerly it is found extending about a mile, making its last appearance on a road that leads to Lawrencetown. Here it appears near a mill seat; it then passes into the forest and is obscured.

This Band is peculiarly interesting:—

1st, on account of its *Fossils*.
2nd, " " *Magnetite*.
3rd, " " *Granite association*.

LOCALITY 6, FOSSILS.

The first outcrop on the road contains lenticular patches of impure limestone. This is whitish, pyritous and fossiliferous. The fossils collected are:—

Stenopora fibrosa,
Spirifer sp.

LOCALITY 7.

About half a mile farther west, I picked up one hand specimen containing:—

Ptilodictyum problematicum?
Spirifer sp.

LOCALITY 8.

At the Lawrencetown Road, near the Sawmill, strata was observed. A piece which I broke off contained fossils. The rock is calcareous. The strike of the strata is N. 55 E., S. 55 W. The fossils are:—

Stenopora fibrosa,
Crinoid, joints,
Spirifer?
Avicula?
Incertae sedis.

The last are leaf-like forms, ribbed, bifurcating, first into coarse, and these in turn into finer ribs or striae. It is possibly *Bryozoan.*

MAGNETITE.

About half a mile west from the road, Mr. Page pointed out to me beds of Magnetite. The position of these is on the south side of the Band, not far from its junction with the granite. This is a matter of some interest, geologically as well as economically, as it tends to shew the intimate relation that exists between this and Stearn's and Page's Magnetite Band. Mr. Page conducted me to the locality for the purpose of shewing me the course and extent of these deposits. There can be no doubt that the *apparently* different series of iron-bearing rocks under examination all belonged to one series of strata and Iron beds. I refer to this, also, for another purpose, i. e. to establish the age and relation of another apparent series, where we may not have the aid of Palæontology for direct correlation.

GRANITE CONNECTION.

At no great distance west of the road at a point before we reach the fossiliferous outcrop, I observed outcrops of slate and granite, apparently at close quarters. I found, however, that these were distant about 70 paces. As it had been affirmed that the lithological character of the supposed Devonian strata was materially affected by proximity or connection, I examined the exposed strata very carefully, and found that there was no such lithological change as a metamorphosis into Gneissoid rocks. They were of about the same character as the Silurian strata at

Stearn's and Page's, Wheelock's or elsewhere, where *Granite* could only be found in boulders. I do not mean, however, to affirm that the granite was not a secondary agent in affecting their *position* as elsewhere observed—e. g., Hatley's.

Farther west, nearer the magnetite beds referred to, I observed outcrops of slates and granites at the distance of *one pace*, without the alleged lithological change. Not far from this last, I found the slate and granite in contact, and no appearance of the alleged change. In contact the slate was so friable that I could not get two inches to hold together. I had to try about 6 inches distance before I could succeed in getting the specimen on my table, which is only 3 x 1½ inches in size. It is certainly not gneissoid rock with *garnets, mica or such like.* The specimen of granite associated with it now, as originally, is a reddish granite somewhat weathered. This shews, *beyond question,* except to any one who *will not* be convinced, that the granite had its present character, *minus,* the weathering, before the associate middle silurian was formed on it. It is therefore of *pre-middle silurian age.*

This granite and the associated middle silurian band of strata are not defined on the Map of Acadian Geology, Second Ed., so that the author may be disposed to question their existence. They are there, *notwithstanding* the scale of the map be set up as a defence.

At Dunn's and Hogans', the south side of this middle silurian band, the strata have a strike, N. 75 E., S. 75 W., and a dip of 90 degrees. Here the band is not seen in contact with the granite. The road passes over a boar's back, probably of drift, beyond this the granite reappears and continues without interruption beyond New Albany to a place not yet ascertained.

Supposing that this band of strata, in its course eastward, assumes the normal strike after parting with the granite in the same manner as it does to the west at the Lawrencetown Road, and passes onward, N. 55 E., and supposing also that the strata of localities 4 and 5, W. Wheelock's and Gordon's, in like manner, were to proceed westward to meet them. The road to Bloomington, on the east side of Nictaux River, might be considered a place of meeting. Expecting to find outcrops of these strata, I traversed, so far, the road referred to. In passing along this road, southward, we found Allen's *Diorite*, and then passed over the ground *overlying the* course of the fossiliferous iron ore beds already noticed ; we then descended into the valley viewed from the granite on the New Albany road, and then ascended. Within a few feet of the position indicated by hypothetical lines on Church's Map, a prominent outcrop of strata was observed. The first piece of rock which I collected from the strata contained two specimens of petraia. The collections of localities 4 and 5, on the south side were thus supplemented, in the same way as that of locality 1 was supplemented by locality 2, on the north side. This specimen of rock in common with the other specimens collected in the same locality 9, shows that the strata are siliceous, hardened and very pyritous, fossils are numerous and various on account of the hardness of the rock, they are principally available where the rock is weathered.

The strike of these strata is N. 55 E., S. 55 W. At no great distance to the south of the fossiliferous strata, at a barn, are lower strata with *Diorite.* The strata in contact with the diorite is very hard, having beautiful crystals of *tin white pyrites*, Arseno-pyrite ; the strike of these strata is N. 75 E., S. 75 W., the dip is 85 N. 35 W. The existence of this *Diorite* seems to indicate its existence at locality 4, south of the New Canaan Road.

The strataon this side of the valley seem to be synclinal to these of the north side, having the Iron Mines. This geological arrangement seems to have formed the valley.

I would here observe, that the Diorites seem to have had an influence over the strata in altering and hardening them, which the granite did not possess, and that the prevalence of these is the cause of the general metamorphism which seems more or less to have affected all the Middle and Upper Silurian strata of this region and their contents. They also seem to have been the primary agents in elevating them, and giving direction to their strike and dip, the *granites* having been *made* to assist in the work of *elevation* and *disturbance.* I shall have occasion to refer to and illustrate these phenomena in the sequel.

The fossils of this locality (9):

Petraia, sp.
Stenopora fibrosa.
Crinoidea.
Cornulites flexuosus.
Spirorbis.
Beyrichia, sp.
Dalmanites, sp.
Trilobite, incert gen.
Orthis, sp.
Strophomena, sp.
Spirifer, sp.
Avicula, sp.
Incertae sedis.

Petraia here is not *P. Forresteri*, but it is a species of very common occurrence at Arisaig, and other localities having May-hill sandstone strata. *Crinoidea*, are casts of column joints. One is more ornamental than any that I have yet seen, it resembles *Pentacrinus*, it may possibly belong to *Glyptocrinus*.

Beyrichia, not distinguishable from *Beyrichia Kloedeni*. There are two specimens of this fossil, being external and internal casts. This is the lowest position of *Beyrichia* in Nova Scotia. The *genus* culminates in D, "Upper Arisaig Series." It also occurs in the lower carboniferous limestones. *Dalmanites*, sp. This is a large trilobite. Its first appearance suggested *Dalmanites limulurus*. The cephalic shield has the same form, spines, eyes, front, glabella. The pleura are spinous. The pygidium is unknown. It differs, however, considerably on closer examination, the eye is much larger, and so is the whole head. The thorax is about the same as *Dalmanites limulurus*, Fig. Hall's Pal., N. Y., but its proportion to the head is different. It seems to be nearer to *Dalmanites Hausmanni*. It is possibly a *new species*.

Trilobite, *incerti generis*. Of this I have only casts of two *pygidia* (internal and external). At first I supposed that it was a species of Proetus. The tail has the smooth margin of this genus, but on closer examination, I found that the margin was *spinous.* I then compared it with a small species of the genus, *Lichas*, in Hall's Pal., N. Y., but I found, that while the margin has some resemblance, our specimens are *much unlike.* It may, therefore, be a *spinous Proetus*, or it may belong to a different *genus.* In either case, this will make the fifth genus that I have discovered in the Middle Silurian formation of Nova Scotia, viz —*Calymene, Homalonotus, Phacops, Dalmanites* and *incertum genus.*

Incertae sedis. There are several forms that come under this class, especially some leaf-like forms which may be fucoids, one is *veined* like a leaf.

Advancing still further on the road, southward, we find strata out-cropping, and when we have ascended to the cross roads where the road to Bloomington turns to the left, we see on the right side a fine out-crop of strata on which the school-house stands. This locality (10), has its fossils. The strata, judging from the specimens, are very siliceous and much hardened. The strike is N. 55 E., S. 55 W., and the dip northerly. This bears the same relation to the preceding locality as Gordon's to W. Wheelock's. The strata here are succeeded—underlaid by Diorite, showing a large outcrop. It crosses the road to the right and has a width of 93 paces extending to Jefferson's barn.

To this igneous rock the strata are evidently indebted largely for their metamorphism and also for their present position. The fossils collected here are :

Stenopora fibrosa
Cornulites flexuosus.
Spirifer, sp. ?
Orthis, sp. ?
Tentaculites.

Proceeding farther on the road on which we have now entered we find succeeding the Diorite gneissoid strata. These are seen outcropping in front of Viditoe's house. We have thus the same sequence as at locality 5, (Gordon's). We have evidently reached the strata of a different formation. The lithological character of the strata on either side of this Diorite is very dissimilar. Their original characteristics, existing at the time of the intervention of the Diorite must also have been very different.

At a farther distance of about a quarter of a mile, we reach another and very interesting outcrop of the same series of strata. These are neither so solid nor dark and ferruginous as the strata at Viditoe's. The latter resemble the strata associated with the granite at Hatley's, being what is commonly called *Ironstone* at Halifax. The strata of the present position correspond with the contorted Gneissoid strata of the height beyond Gordon's, only they are not so much contorted. An interesting fact in the present case is that the strata are in *contact with granite*, and not merely in contact, but fragments of the strata are actually *imbedded* in it, showing that the strata were *consolidated* before their present *apparent* connection, and that the granite was in a sort of plastic condition when brought into this connection. It shews that the granite assumed its present relations and condition after the formation if not metamorphism of the (now) Gneissoid Strata. The Gneissoid character, their mineralogy, contortion, &c., may be accidents connected with the production of the *Granite phenomena.*

Some of the strata here abound in small *garnets*, dark-colored and red. The rock itself is composed of orthoclase and black mica. These phenomena and associations are quite common in Halifax Geology, where *andalusite* and *chiastolite* represent the garnets of the present case.

Passing over these *garnetiferous* strata and associated granites along the road to E. Viditoe's, *a straight distance* of *three-fourths of a mile*, I unexpectedly came upon an outcrop of clay slate. This is black, ferruginous and quite soft, so as to be easily cut with a knife. It is seen in occasional outcrops to a distance of ¼ of a mile. The strike of the strata is E. & W., the dip is 80 S. They are evidently isolated, nothing but granite is observed all around. I did not find any fossils in them, their precise age may therefore be regarded as uncertain. They seem to be an *outlier* crowning the granite. There are no Diorites connected with them; they are not hardened, and are far from being gneissoid. If the granites had been in a molten state like a seething cauldron as *graphically depicted*, after their formation, why were they not metamorphosed or engulphed? *Mirabile dictu!* they have only been lifted up. In all probability they are of middle or upper silurian age.

The end of this series is six and a quarter miles from the forks of the Annapolis and Nictaux Rivers. By applying the compasses to the Map of Acadian Geology, it will be found that this series lies in the Devonian colouring, extending to its southern border. South of this the same Map indicates a width of 11 miles of upper silurian before coming to the granite. These strata must be *concealed* by the granite, I did not see them. In justice to the author of Acadian Geology, I would observe that the colouring of the map in the edition of 1855, is, in this case, preferable as well as in a multitude of cases, to the last and improved map, the former being more in accordance with *facts*; the latter with fanciful *theories*. I would now give prominence to the following *inferences*.

1st. The Fossiliferous formation is *principally* of middle silurian May-hill sandstone age, of England, and *Clinton* of the United States.

2nd. The age of the Iron deposits of Nictaux is approximately, *Clinton*, being the same age as the *fossiliferous* Iron bed of Arisaig, and the *fossiliferous* Iron bed of Blanchard at East River, Pictou.

3rd. The granites of this region are of pre-middle silurian age, and therefore of lower silurian age.

4th. The Gneissoid formation is *apparently pre-granitic*, and therefore pre-*lower silurian?* i. e., of the age of lower members of the Lower Silurian or probably Cambrian.

Resuming our examination we return to Cleveland Mountain, examining more closely the outcrop of *Diorite* on the road at Banks', i. e., the Diorite under-lying the *Magnetite* beds and strata of Stearn's and Page's, we find associated with it on the west side of the road, a considerable outcrop of Gneissoid strata with red felspathic and micaceous rock (granite?) These do not *re-appear* with the Diorite east of the road. Following the outcrops of rocks on the road, *northerly*, we come to fossiliferous locality 3. Beyond this we have several considerable outcrops of strata, slates and quartzites. These extend beyond the *road to Banks' mountain* and school house, until we reach *Diorite* outcropping. This Diorite is of considerable width. Beyond this we have a broad band of black ferrugineous strata, and then a band of red siliceous (Cryptocrystalline) rock pervaded by quartz, veins. This is followed by a prominent *black volcanic rock*, with small cavities containing slender crystals of epidote? we have then slates and quartzites, and *Diorite* at the brow of the mountain. Descending, we reach a cross road. Here we have an outcrop of slates with *Diorite*. A prominent outcrop of rock is seen to the west of the road, a wide field intervening. Examining this, I found the rocks to be granite with gneissoid strata (micaceous schist).

No other strata appeared until we reached the beginning of the *Upper Silurian strata* of "Acadia Geology," the strata of the Falls of Nictaux river. There are gneissoid strata, where polished by the running water having a beautifully banded appearance, they are slightly crumpled and jointed, they are micaceous and highly metamorphic. I found in them a lenticular deposit of pyrite. The strike of the strata is N. 60 E., S. 60 W., and their dip 70 S., 30 E. They extend wholly across the river, the water runs nearly in the direction of their strike. To all appearance they are an easterly continuation of the gneissoid strata, last examined in association with the Granite. Immediately below the Falls we make a great lithological transition, passing into grey homogeneous and soft shales. These outcrop on the west of the river, and form walls on either side. This band terminates with a *Diorite* at the site of an old saw mill. In close connection with the *Diorite* the strata have a greater solidity and hardness. It is not like any Upper Silurian series that I have observed elsewhere in Nova Scotia. It has some resemblance to the Middle Silurian series, which occur on the south side of the East Branch, East River, and also at Sutherland's River. *Vide*—my papers on the Pre-carboniferous Formations of the Pictou Coal Field. *Transactions.*

The *Diorite* besides hardening the contiguous strata has given them a dip 70 S.. 35 E., and a strike N. 55 E., S. 55 W. I did not find any fossils in the strata. Lithological considerations would lead me to regard them as of Middle Silurian age. Beyond these comes the valley.

EXTENSION EASTWARD.

All the strata, noticed below the Falls, disappear at no great distance in the valley, so that those geological maps which make them border the mountains are *decidedly in error*. All the others of Cleveland Mountain, after appearing in the railway cuttings and outcropping on the east side of the Nictaux river, and underlying and giving contour to the ground beyond, disappear in the valley before coming abreast of Locality 1, B. Wheelock's and Parker's. B. Wheelock mentions some exposures of rocks in a small brook in the valley north of the *Diorites* on Parker's which may possibly represent some of these. Since I received this information in Halifax I have not had an opportunity of examining the said appearance.

EXTENSION WESTWARD.

Under Mr. Page's guidance I was enabled to make a very satisfactory examination of their westward extension.

Taking the road to Banks' Mountain, we passed over outcrops of the strata between Stearn's and Page's *Diorite*, and the *Diorite* north of the school house, or rather the part of them between the road the school house and the *Diorite*.

We also passed over part of the strata between the latter *Diorite* and that of the *Epidotic Rocks* and following Diorite. These strata appeared to keep the normal S. 55 W. course, until we approached the summit of Banks' Mountain. Here the strata were *thrown into confusion, neither strike nor dip being observable.*

Beyond this, in Parker's farm, strata were observed outcropping. We proceeded to examine these and found that the strata were gneissoid, having a strike east and west. Enquiring at Mr. Parker if the Granite was to be found solid at no great distance, he led us along a wood road, and after crossing a great band of compact black gneissoid strata, we came to the solid granite.

This is a continuation of the gneissoid strata and granite already observed on the road at Hatley's. The confusion of the strata on the summit of the mountain is evidently caused by the *thrusting up* of the granite and associated gneissoid rocks, as has already been observed at Hatley's. On the east side of the mountain Mr. Page and I observed the *Diorite of this series outcropping.*

Another object which we had in view was the examination of Banks' Iron mine. Mr. Page led me to the mine. This is situate on the north side of Banks' Mountain. The ore of this mine is *Magnetite,* the rocks are much hardened by metamorphism. I had not much time to examine this locality. I intended to re-examine it but did not get an opportunity. This is one of the *old mines.* It is evidently in the extension of the strata whose outcrop we have noticed at the Cross Roads, associated with the *Granite and Gneissoid Rocks* which are regarded as connected with the gneissoid strata of the Falls. I have not yet examined any extension westward of the strata below the Falls.

West of Banks' Mountain.

I examined the outcrops in this direction along with Mr. Page, when observing an Iron deposit. I shall reverse the order of examination in giving an account of it. Beginning at the summit of Banks' Mountain, we take a road on the north side leading to a new road in course of construction on the west side of the mountain—in this way we traverse in a manner the rocks occurring. We passed over granites, the last outcrops of the boss of granite which enters into the constitution of the mountain. Looking back we see the mountains rising in our rear, in grand proportions. Our road is admirable, geologically, but awful for a horse and waggon. The difficulties and obstructions impeding progress were regarded as of rather a desirable character by the geological observer.

We observed strata outcropping the probable extension of Banks' *Magnetite* strata. *Diorites* were also observed. So that the mountain thus beset, before and behind, east and west, must, at the *Diorite producing period,* have had a shaking, troublous and also an elevating time. A broad outcrop of *Diorite* was also observed on the road, *to the north* of the fossiliferous and *Magnetite* strata of the *Gap*, at Locality 8, on the road to Lawrencetown—and also another outcrop of crystalline rocks of a very mixed character. At C. Beals', in the heights south of Lawrencetown, strata were observed outcropping—the probable extension of Banks' Magnetite strata. On the north side of these Diorite was exposed in outcrops. This band also seemed to underlie the swampy, meadow at Beals', in which were taken *in situ* beautiful specimens of *Bog Iron ore*. This is the *deposit* of which we were in *quest*.

While Mr. Page was extracting specimens of Bog Iron Ore, I went to examine the heights to the south, which seemed to be a range of outcrops of rocks. Expecting to find granite, I saw nothing but height after height of *Diorite rocks* extending south, east and west, as far as could be observed by the naked eye. We returned home by the new and old mountain roads which have been described.

Observations.

After having established the age, and course of the Iron-bearing strata from Meadowvale to Cleveland Mountain, I was for some time at a loss to determine the age and relations of the strata outcropping from Stearns and Page's to the old saw mill below the Nictaux Falls.

1st. The rocks dipping in one direction seemed a regularly ascending series, extending upwards of four miles.

2nd. This breadth, with the high dip. 70 degrees, gave an enormous thickness.

3rd. The lithological variety, crystalline, uncrystalline metamorphic and gneissoid rocks.

4th. All underlying a Middle Silurian series.

These phenomena seemed to indicate a Lower Silurian formation of great thickness.

At length I seemed to find a satisfactory solution of the problem, furnished by certain *Palæontological*, *Mineralogical* and *Lithological* data.

THE POSITION OF THE FOSSILS OF LOCALITY 3.

1st. This seemed to underlie the *Diorite* of Stearns and Page, instead of overlying it, being situate on the north side rather than the south, and therefore did not belong to the Magnetite series of strata.

2nd. It seemed too far above the Diorite north of the school-house, and consequently did not seem to occupy a proper position in this series of strata.

These considerations seemed to indicate some structural peculiarity.

3rd. The existence of Banks' *Magnetite* (old mine) evidently shews that the containing band of strata is a repetition of Stearns and Page's Magnetite strata or of the fossiliferous and Magnetite strata of the gap, in other words it shewed that all the three series of beds *were originally one series.*

4th. The peculiar character and position of the Granite gneissoid rocks of the Falls strata continuation, as well as the Gneissoid and Granitic ? rocks associated with Stearns and Page's *Diorite* seemed to indicate that these were insertions from underlying formations brought up by the respective Diorites.

The Mineralogical *datum* seemed to indicate *repetition*, the Lithological *addition*, and the Palaeontological *plication*. Thus, then the enormous thickness is apparently the result of the repetition and plication of strata of the same age, with the addition of rocks of an older period. This much for the strata, &c., on the north with the southerly dip.

The strata on the south with the northerly dip have also their structural peculiarity to be explained.

The apparent succession on this side is peculiar. There is a *Diorite* with an overlying series of strata having fossils indicating a certain age, dipping northerly, and then there is another Diorite with an overlying series of strata having fossils of the same age as the other series, in the same position, in the series, and also dipping northerly. This arrangement seems to include the strata of Localities 4 and 5, Wheelock and Gordon's. We have therefore, here also, *repetition* if not *plication*.

The Northern and Southern thus have a synclinal arrangement, of which the Valley lying between, holds the axis. The series of Torbrook branch, near the county line of Annapolis and King's, comes in between the two to continue the mountain outline.

DIORITES.

These have evidently been the chief agencies in the Metamorphosis of the Middle Silurian formation, and in the induction of the structural phenomena which have been observed.

As elsewhere in Nova Scotia, viz.: At East River, Irish Mountain, McLellan's Mountain, Sutherland's River, these phenomena have evidently been induced between the Upper Silurian and Lower Carboniferous periods, i. e., Devonian.

So that these may be regarded as the only *representation of the Devonian age at Nictaux.*

ECONOMICS.

In my work at Nictaux my attention was chiefly directed to the solution of problems in our Geology.

Yet my attention in the course of my investigation was necessarily in some measure directed to the Economics of the district examined. Mr. Page's valuable assistance — without which I would have been unable to make the satisfactory examination that I did—insured a certain amount of attention to Economical Geology.

IRON ORES.

1st. Magnetite.

The principal areas of *non-fossilliferous Magnetite* that came under my observation are:

1st. Stearns and Page's.
2nd. Banks'.
3rd. Of the Granite Gap.

All these are situate in the mountainous region, west of Nictaux River, in the region of *maximum* metamorphism and disturbance. No. 3 did not seem to be of so much economic as geological importance. My examination of No. 2 was merely assuring of the existence of *Magnetite*, which was made known by ancient mining, and described fully by Gesner and others. *Vide Gesner's Nova Scotian Geology and Mineralogy*, 1836.

The first, Stearns and Page's, which seems to be by far the most extensive and important, being situate near my centre of operations, necessarily received more of my attention. The excavations on the Magnetite beds, below the house and toward the river, were the first objects to which I directed attention, as well as almost the last. Other excavations were pointed out to me by Mr. Page—which appeared sufficiently numerous and distinct—extending from the middle to the top of the band of strata as far as the line between Stearns and Page's property and Hatley's. Much time and labour had evidently been spent in exposing the iron deposits of the locality. The dipping compass has been well applied in ascertaining the positions of the deposits; but the work of the miner is required to reveal their true extent and the relative positions of the several beds. These beds were unknown until Messrs. Stearns and Page commenced their explorations. The ore besides being abundant, is reputed to be of superior quality.

Fossiliferous Ores.

Brown and Black.

These are the ores which have been chiefly worked at Nictaux. The old trenches to which I have had occasion to refer in the course of my investigations, were the old mines from which the greater part of the ore was extracted which was smelted at the old furnace at the Falls of the Nictaux River. Specimens of this fossiliferous ore, with *Spirifer nictavensis*, Dawson, are to be found in Museums.

Hematitic.

This ore seen and excavated at Parker's and also at *Torbrook, Meadowvale*, is a beautiful ore. It is often arenaceous and fossiliferous. It has the appearance of a good ore and *seems* to be abundant.

Granites.

These are sufficiently abundant and accessible. They are not much different from the Halifax granites, but the variety is greater, some of the reddish varieties are very beautiful, and adapted for ornamental purposes. At the back of Banks' Mountain, masses of very beautiful varieties, were examined.

Garnets were found in some of the Granite boulders as well as in the gneissoid strata.

GNEISSOID.

Rocks similar to the Gneissoid rock, *Ironstone*, of N. W. Arm, Halifax, may be applicable to building purposes.

The rocks of the Nictaux Falls are quarried for building stones.

ART. II.—A CONTRIBUTION TOWARDS THE STUDY OF NOVA SCOTIAN MOSSES.—By JOHN SOMMERS, M. D., *Prof. Physiology and Microscopy, &c., in the Halifax Medical College. Examiner in Physiology of University of Halifax, Lecturer on Zoology, &c., to the Institute of Technology, Halifax.*

(Read before the Institute, Dec. 1877.)

THIS paper is presented as one of a series, which, time and opportunity permitting, will be continued until a complete collection of our Moss Flora will be described.

I stated on a previous occasion, as a result of a then superficial observation of the subject, that the study of this class of the Provincial Flora would repay well for any labour expended upon it, inasmuch as it afforded an unexplored field for research. I had at that time but little idea of its extent, or of the profit and pleasure which subsequent experience has proved to be derived from its cultivation.

The study and detection of the minute distinctions which enable us to separate the species and genera of mosses, demands from the observer very careful and laborious microscopic work, without which it is impossible to attain to success.

To one who can snatch but few leisure hours from his more engrossing labours, the task of collecting and arranging the material presented by this class of vegetable growth is an exacting one, many species being so fugaceous that constant alertness is required to enable him to seize them at the proper time for diagnosis. Some amongst them are winter blooms and consequently more difficult to collect and describe. Besides the mosses, we have yet other orders, such as Hepaticæ, Lichens, Fungi and Algæ, yet awaiting our study, material enough, indeed, to occupy the pages of our Transactions, should they be carefully worked out.

Mosses, though of little apparent interest from an economical standpoint, so far as their direct usefulness to man may be concerned, have, notwithstanding their uses in the economy of nature: they, with others of the lower forms of vegetables, afford a foundation for the higher classes; their nutrition takes but little from the soil, their decay adds much to it. Our morasses and bogs derive a very large proportion of their solid matter from the growth and subsequent decay of successive generations of Sphagni, which serves as a nidus for the growth of conifers, exogens, &c., whose foliage, making additions annually to the vegetable mould, have in time rendered many of them available for the operations of the husbandman.

The granite and gneissoid rocks of our Atlantic coast furnish asylums in every fissure and cranny favorable to the growth of these plants; they serve here to hide the baldness and sterility of those formations, and also combine with the atmospheric influences engaged in pulverizing them, the combined detritus of rock and vegetable affording sufficient soil for the nutrition of shrubs and trees.

By their habit, or mode of growth, mosses also give protection during severe winter frosts, to seeds of plants and the eggs and larvæ of insects.

To the scientific mind they possess a higher and more extended interest, whether regarded from the problem of their structure, growth and reproduction, the beauty and variety of form and color which they present, or that of their origin and position in time among the successive generations of vegetable life that have clothed the earth.

As nature in her proceedings moves from the simple to the more complex, we may be warranted in regarding the mosses as primary formations in the vegetable order, whatever may be the opinion relative to the seniority of granite or gneiss. We observe that mosses and lichens find thereon a situation favorable to their existence: on the supposition therefore, that there existed a period when our Province presented exclusively such surfaces, we are justified, other things being equal, in concluding that our flora was such as would result from the conditions then existing.

The most striking fact presented in this connection is that of the very close correspondence of our Moss Flora with that of Northern Europe, which is very suggestive of the idea that both continents were at one time connected. Their floras having common origin, though since changed by variation, which has not however extended to these lower forms, they being less affected by it, have a strong tendency to adhere to primordial forms, being influenced by temperature less than by the humidity of their surroundings. Hence it is found that our species are for the most part identical with those of Britain and Northern Europe. It may not be out of place to remark here upon the tendency which many American Naturalists exhibit in trying to separate American from European species, to all appearances identical, applying to the former designations new and strange.

The separation is for the most part an unnatural one, it multiplies genera and species unnecessarily, and increases by a process of artificial refinement the perplexity of a subject already sufficiently perplexing.

It is not at all likely that we have had separate acts of creation for the species of two continents, or that the forces of nature acting upon organic matter had produced national distinctions of this kind: these forces are cosmopolitan, blind and rigid in their action, producing always similar results under similar conditions; light, heat, moisture, are the same everywhere in their action. A granite or slate rock, an iron or copper ore are pretty much the same on both sides of the Atlantic. A herring is still a herring, whether netted in European or American waters, why it should be called Clupea Harenga on the one side and C. Americana or Bostoniensis on the other, is a something which would puzzle one to explain by any process of scientific reasoning.

Our native mosses verify the above; any text book on British mosses will afford the botanist here sufficient means for diagnosticating almost all our species. Allowing some elasticity to the forces influencing the growth and reproduction of plants, we might safely narrow or converge our genera and species with benefit, be more in accordance with nature, and avoid separations from characteristics which are often suspiciously artificial.

As specific descriptions of native species are not attainable, and systematic works on American Bryology rare, or like Sullivant's Icones, unattainable by many, I have prepared a description of each species, deeming such to be more useful to workers in the field than a mere enumeration of them. The arrangement of the species, &c., is that which is followed by Berkeley in his work on the British Mosses.

FAMILY PLEUROCARPI, Bridel, ORDER, HYPNEI. BR. & SCHIMP, MONT.

HYPNUM. radicale.—P. BAUR.

Sporangium, arcuate, oblong, cernuous; lid conical, beak short and sharp, setæ long, leaves spreading more or less cordate, ovate acuminate, nerve not reaching the apex, in moist ground amongst grass; fruiting late in spring, common in this vicinity, (Hx.,) mentioned by Berkeley, (Brit. Mosses) as rare in England, being confined to Anglesea and South Wales.

H. CHRYSOPHYLLUM, Bridel.

Sporangium, cylindrical, curved; lid conical, leaves crowded squarrose, secund, ovate, acuminate, entire, nerve half way, stem prostrate, forming golden green patches in vicinity of bogs, and in wet land fruiting in summer—common here.

H. POLYMORPHUM, Hedw.

Sporangium curved, oblong, cernuous, lid conical, leaves crowded, spreading, somewhat secund, ovate, lanceolate, acuminate entire and nerveless, forming yellow patches on granite, very common in this locality, fruiting in spring, more delicate than the above.

H. STELLATUM, Schreb.

Sporangium, oblong, curved, cernuous; varying in size, lid conical acute, stems tufted loosely, branched, leaves entire squarrose, nerveless; cordato ovate, acuminate,—cells at the base loose. Forming tufts, more or less dense, stems sub-erect, larger than the last, of a yellowish green colour, fruiting in summer,—common in marshy localities.

H. PALUSTRE, L.

Sporangium, ovate, cernuous, lid conical; leaves crowded, somewhat secund, spreading, elliptic; concave entire, nerve short; varies in characters of leaves, stem creeping, somewhat branching; branches sub-erect, forming dense tufts of a blackish green, on stones in brooks; fruit in summer,—common in this locality.

H. PULCHELLUM. Dicks.

Sporangium, oblong, sub-cernuous, lid conical, apiculate; leaves crowded, flattened, secund upwards; ovate, lanceolate; entire nerveless; minute forming dense glossy dark green tufts or masses on stumps of trees and decaying timber, in shady woods, branches fastigiate, sub-erect, immersed in a mass of rootlets at the base; fruitstalk arising from the base, fruiting in summer and early autumn. Woods on Peninsula and Dutch Village.

H. SYLVATICUM, L.

Sporangium, subcylindrical, cernuous, lid rostlelate; leaves somewhat complanate; ovate, lanceolate, acuminate; entire, two nerved. Stem decumbent, branches few, forms soft deep green patches on roots and boles of trees in damp shady woods; fruiting in autumn. Woods near Bowery Road, Hx.

THUIDIUM. tamarascinum. Br. & Schimp.

Sporangium, oblong, curved, lid rostrate; stem leaves cordate, sulcate acute, branch leaves ovate, lanceolate; all serrate above; papillose, nerved to near the apex, paraphylla numerous; growing in large loose patches in damp woods and by streams and margins of swamps, of a dark deep green colour, stem arched irregularly, tripinnate, fruitstalk red, elongated, a very beautiful moss; abundant everywhere in this locality. In Europe used in manufacture of artificial moss roses and other flowers.

FAM. II.—ACROCARPI.

ORDER.—Splachnei. Br. & Schimp.

SPLACHNUM. ampullaceum, L.

Sporangium, oblong, apophysis; large globose or pitcher-shaped, lid conical, leaves oblong, lanceolate; stem short; forming dense matted tufts, rootlets brown; recognised by its pear-shaped, flesh-colored apophysis and lemon-colored sporangium; fruitstalk long. The fructification presents a very beautiful appearance in the recent state.

Woods near Rockhead, the only locality where I have found it, growing on decayed wood that had broken down into a pulverulent mass, fruiting in June.

ORDER.—Disceliei. Br. & Schimp.

DISCELIUM. nudum. Brid.

Sporangium, globose, cernuous, lid conical, somewhat acute, veil split on one side, leaves few, imbricated lanceolate entire reddish, small, leaves few, insignificant, growing on clayey soil, fruiting in early spring, woods on the peninsula common.

ORDER.—Funariei. Br. & Schimp.

FUNARIA. hygrometrica. Hedw.

Common in soil fertilized by decomposed wood, &c.

ORDER. Meesiei. Br. & Schimp.

AMBLYODON. dealbatus. P. Beauv.

Sporangium subpyriform incurved suberect, mouth small oblique, peristone double, apophysis swollen, leaves spathulate, minutely toothed, pale green, sporangium and fruitstalk, golden brown; forms loose clusters not matted like other mosses, found in one locality only, viz., recent cutting on the Sambro road, near Marling's Hill, made for the purpose of levelling or grading, the plant was growing upon the recently exposed boulder clay on the margins of little pools of water. Fruit in August.

ORDER.—Bryei. Br. & Schimp.

MNIUM. affine. Bland.

Sporangium ovate oblong, lid convex apiculate, fruitstalks aggregated, upper leaves rosulate bristled, border toothed, swampy woods under hardwood trees. The Gore near Shubenacadie, August.

ORDER.—Buxbaumiei. Webb & Mohr.

DIPHYSCIUM. foliosum. W. & M.

Sporangium slipper shaped, buried in the leaves, nearly sessile veil, mitriform, lid conical, acuminate, leaves spreading acute, nerve reaching the apex, perichætial leaves divided into jointed cilia nerves excurrent. Plant about one-fourth of an inch in height, in broad patches more or less scattered, on shady banks, fruiting in summer. Young Beech Grove, George Deal's farm, Dutch Village.

ORD.—ORTHOTRICHIEI. Br. & Schimp.

ULOTA.—Drummondii. Brid.

Sporangium oblong, exserted striate, lid acicular, leaves linear lanceolate, ovate at the base; forming little tufts of a yellowish green colour on the trunks and branches of trees. Common.

ORD.—Dicranei, Mont.

DICRANUM. majus. Turn.

Sporangium cernuous, olive brown, beak long, fruitstalks, pale agregated, leaves long, falcato secund, subulate from a lanceolate base, tips of leaves and nerves toothed, forming deep green tufted and tall patches in woods; fruiting in summer. Common everywhere.

D. PALUSTRE. Lapyl.

Sporangium cernuous, turgid neck, strumous leaves, undulated, transversly linear, tips of leaves toothed, fruiting in summer, habit like the above, but a smaller and more delicate, fruitstalk, solitary. Common.

D. SCOPARIUM. Hedw.

Very common in woods and on exposed banks. Fruiting through the summer.

DICRANELLA. crispa. Schimp.

Sporangium erect, striate lid, long beaked leaves, subulate, toothed at the tip, stems very short. Common in moist places. Fruit in autumn.

D. HETEROMALLA. Schimp.

Sporangium elongated, obovate, gibbous, fruitstalk yellow, leaves entire, channelled, forms deep green silky patches on banks. Common. Fruit in summer and autumn.

D. SUBULATA. Schimp.

Sporangium gibbous, ovate, cernuous lid, long beaked, leaves lanceolate at the base, secund falcate, stems short forming loose tufts on the soil. Fruit in autumn. Common in all localities.

ORDER.—SPHAGNEI. Mont.

SPHAGNUM. Squarrosum. Pal.

Leaves ovate, acuminate, squarrose, grass green above, branchlets horizontal and deflexed, pores large, growing in bogs, forming dense and extensive patches, in some places solitary, oftener mixed with other species; fruiting in summer. (Pennant, Halifax Co.)

ART. III.—THE EAST INDIAN HERBARIUM OF KING'S COLLEGE, WINDSOR. BY PROF. HOW, D. C. L., WITH INTRODUCTION BY GEORGE LAWSON, Ph. D., LL. D., *Dalhousie College, Halifax.*

(Read January 14, 1878.)

Prof. Lawson's Introduction.

BEFORE reading Professor How's paper, I desire to ask permission of the Institute to offer a few prefatory observations. The collection of Indian Plants in King's College consists of 168 specimens. It is not a large one by any means, when we reflect upon the richness of the Indian Flora, and the immense territory which it occupies. But it is a collection of very great interest to botanists. Its chief source of value has to be pointed out to those not already intimate with Indian Botany. This collection, formed about the close of the eighteenth century, leads us back to the early history of Botany in India, but its interest is not merely of the dusty antiquarian kind. Nomenclature has always been regarded by systematic botanists as practically the most important department of their science, of which classification is the framework, and in no other department of knowledge, has so much careful attention been paid to it. The modern system of botanical nomenclature originated with Linnæus, the Swedish naturalist, who was in the zenith of his glory, as botanical classification itself was, in the middle of the eighteenth century. The plants studied then were chiefly those of western Europe, but those of distant lands, of America and the Indies, were greedily sought for, and carefully named and described. The names originally applied by Linnæus under the binominal system which he invented, and by his followers, are to this day held sacred by virtue of the law of priority which the common consent of botanists has established. A country or state may lose its name by conquest, or by fusion with another; a lady may lose her name by entering into a matrimonial partnership; a man may lose his name by Act of Parliament: but a plant's name, once given, goes on unchanged in the stream of time forever. The identification of plants with the first or original binominal names given to them by the early botanists, becomes then a matter of great importance, and it is in this respect that the King's College Collection is valuable.

For two hundred years the Botany of India has been more or less known to Europeans. The first knowledge of Indian plants long preceded the Linnæan era. The first work on the subject was the Hortus Malabaricus of Henry Van Rheede, a Dutch Governor of Malabar; the specimens were collected in 1674 and 1675 by the Brahmins, and sent to Cochin, where drawings of them were executed by Mathæus, a Carmelite and missionary; descriptions were made in the Malabar language, which were afterwards translated into Portuguese, and from that into Latin, and the work was at length published at Amsterdam, between 1686 and 1703, in 12 volumes folio, with 794 plates. Dennstædt published at Weimar, in 1818, an identification of Van Rheede's plants with Linnæan names;—the same Dennstædt whose memory is kept green on every wayside bank in Nova Scotia by the fragrant fern Dennstædtia punctilobula.

In London, between 1696 and 1705, Plukenet published quarto plates with figures of nearly 3000 plants, many of them Indian

John Burmann of Amsterdam, published the Thesaurus Zeylanicus in 1737, with figures of 155 Ceylon plants.

George Everhard Rumphius, a Hanover physician and merchant, was consul of Amboina. He collected specimens, afterwards became blind, but, by assistance from some young men, completed his "Herbarium Amboinense" in 1690. He died in 1706. His manuscript lay in the Dutch East India Company's office for upwards of 30 years. Between 1741 and 1757 it was published by John Burmann of Amsterdam, with a Latin translation (that of Rumphius' having been lost). The work consisted of 7 volumes, representing drawings of 1300 plants.

Dr. Paul Hermann was sent out in 1670, at the expense of the East India Company, to describe the plants and spices of Ceylon, and his Museum Zeylanicum was published in 1717. Hermann's Herbarium lay unknown for half a century, after which it passed into the hands of Linnæus, and afforded material for his Flora Zeylanica, published at Stockholm, in 1747, and is now, as a part of Sir Joseph Banks' Herbarium, in the British Museum.

In 1768, Prof. Nicholas Laur. Burmann, of Amsterdam, son of the author of Flora Zeylanica, published his Flora India, describing some 1500 species, and the mistakes of that work are corrected in DeCandolle's Prodromus.

A very large collection of Indian Plants existed in the Oxford Herbarium at an early period, but it is only of late years that it has been subjected to scientific examination.

In the same year as the publication of Burmann's Flora Zeylanica, viz., 1768, John Gerard Kœnig, a Danish pupil of Linnæus, landed in India as Physician to the Tranquebar Missions, and, by imparting some of his own enthusiasm to his companions, originated the Society of "United Brothers," who lightened their labour of instructing the natives by botanical recreations. This was the commencement of the study of Botany *in* India, under the Linnæan method. Such men as Jones, Fleming, Hunter, Anderson, Berry, John, Roxburgh, Klein, Buchanan Hamilton, and "the venerable Rottler," the last survivor of the group, formed themselves into a Society for promoting Botany; plants were collected, and were named, at first by the Society in common—to such was usually added the word "*nobis*;" but, as opportunities for meeting became less frequent, and their confidence in themselves greater, Roxburgh, Klein and Rottler commenced attaching names without consulting with their friends. Confusion was an unavoidable result, and much of the labour of recent Indian botanists has been devoted to unravelling the tangled skeins of these early workers in the science. The specimens forming the King's College Herbarium are from Dr. Rottler and Dr. Klein, and it will be seen from what I have said that their historical interest is only exceeded by their scientific value. Kœnig's collections are in the British Museum. Many of Rottler's plants were described by himself in the Nova Acta Acad. Nat. Curiosorum of Berlin; but Willdenow, Vahl and Smith gave new names to many of the others which they described, without reference to his, so that, among Rottler's plants, names may be found that have never been published. Klein's plants were principally described by Willdenow.

I hope next summer to be able to go over the Windsor Herbarium with Dr. How, and, by comparing the specimens with those in my own Indian Herbarium, to identify them with modern names. In the meantime I have thought that the members of the Institute might like to know what was the real point of interest in this collection, which I have endeavoured to indicate by bringing together a few facts in the early history of Indian Botany, chiefly derived from the "Prodromus Floræ Peninsulæ Indiæ Orientalis" of Wight and Arnott.

The East Indian Herbarium in the Museum of King's College, Windsor, N. S.

By Henry How, *D. C. L., Professor of Chemistry and Natural History, University of King's College, Windsor, N. S.*

It will perhaps be of interest to the members of the Institute, and to some of those belonging to Scientific Bodies which have found it advantageous to exchange their periodicals for our "Transactions and Proceedings," to have a list of certain East Indian Plants which have been for close upon three-quarters of a century in the Museum of King's College, such plants being by no means easily accessible on this continent. The plants in question were sent in 1802, to the Honorable Sir Thomas Strange, Madras, from Dr. Rottler and Dr. Klein, and were presented by the first named, who had been Chief Justice of Nova Scotia, to King's College, Windsor, in 1804. I think it not improbable they were examined, when they arrived, by a former Vice President of this College, Rev. Dr. Cochran, who, I believe was an enthusiastic botanist, and doubtless secured for the College Library the greater part of the valuable works on Botany of an early date which it contains; he made, I may state, a large collection of N. S. plants, which, I have heard, failed for want of agreement in negociations, of which I do not know the particulars, to become the property of the College, and was diverted to other keeping in an Upper Province. The plants from the East Indies were in all probability untouched for many years after Dr. Cochran's death, and, excepting for a partial examination which I gave them about 1855, or soon after I arrived here from England, they have only been handled in removal from the old to the new Museum, until last summer, when I went over the whole of them and made the list which I now submit to the Institute. The plants are not mounted, but are enclosed in separate sheets of coarse paper, each, with a few exceptions as noted, having a label attached or lying with it. They are almost all in a very good state of preservation. I have copied the labels as accurately as I could, omitting some characters unknown to me, which I would not venture to reproduce. Of the sheets numbered 168 seriatim, nine contain no plants or are wanting, and in five the labels are missing, while there are three plants loose and unlabelled, and in two cases, instead of a name, Linnæan class-marks are given. The station is never mentioned, except apparently once, it being Madras. The collection is known to us as "The Strange" or "East Indian" Herbarium. The following is the list of plants, etc.:—

1. Justicia repens.
2. Sida, sp. nov.
3. Hedysarum.
4. Asclepias.
5. Grewia.

6. Urtica.
7. Polygonum, sp.
8. Conyza.
9. Phlomis, sp.
10. do. do.
11. Strychnos potatorum, (ab amiciss. Heyne.)
12. Glycine filiformis.
13. Hibisc ficulneus.
14. Santalum album.
15. Arum spirale.
16. Ophio glossum scandens.
17. Hydrolea, (Zylanica ?)
18. Poa interrupta
19. Polypodium dichotomum.
20. Bubroma Gŭazŭma.
21. Ipomœa pestygridis.
22. Acrostichum digitatum.
23. Apocynum frutescens.
24. Ocymum album.
25. Panioi miliæi, Str. Menerj, Cinghal. Lamej, Tam.
26. Illecebrum lanas, Kilei-Siru-Pulei, T.
27. Melochia odorifera, Punnak Kulek Kiri, T.
28. Nyctanthes arbor tristis.
29. Barleria Prionitis.
30. Cyperus Haspan.
31. Amama debilis, (under some characters unknown to writer.)
32. Atriplex.
33. Mattom Kaj pillu. Cynosur. Ægypticus.
34. Indigofera.
35. Acrostichum heterophyllum.
36. Polygonum glabrum.
37. Gratiola lucida, Willden.
38. Phyllanth. debilis, nob. Niruri ? affinis.
39. Carissa spinarum.
40. Trigonella (indica ?)
41. Phasæolus trilobs.

42. Psoralea tetragonoloba
43. Indigofera hirsuta.
44. Buchnera Asiatica.
45. Cassia occidentalis.
46. Nyctanthes angustifol.
47. Cleome viscosa.
48. Memecylon capitellat.
49. Cressa Indica.
50. Amania sanguinolenta.
51. Æschinomene aspera.
52. Hedysarum biflorum, Willden.
53 Bassia longifolia.
54. Agrostis linearis.
55. Hibiscus obtusifol. Willd.
56. Sida cordifolia.
57. Scirpus capitat.? Lin., S. caribæus, Rottl.
58. Ficus Benghalensis.
59. Arachis hypogæa.
60. Furriena scirpioides, Koenig. Scirpus ciliaris, Lin.
61. Cyperus aristatus, Rottl., Scirp. intricat, Lin.
62. Saccharum cylindricum, Willd., S. Kœnigii, Retz.
63. No plant.
64. Scirpus lateralis.
65. No plant.
66. Xyris pauciflora, Willd.
67. Saccharum spontaneum.
68. Scirpus tortuosus, nob., Katshij pillu, Tam.
69. Cyperus arenarius.
70. Calyptranthis, Schwarz. Myrtus communis, Lin.
71. Solanum nigrum. Baccis rubris.
72. Carissa Carandas.
73. Cyperus monostachyos.
74. Poa viscosa.
75. Cyperus triflorus.
76. Ixora parviflora, Vahl. Kadluma, Tam. d. 20 Mart., 1794.
77. No plant.
78. Jasminum auriculatum.

79. Justicia paniculata, Vahl.
80. Jasminum grandiflorum.
81. Acrostichum an Calomelanos ?
82. Cacalia coccinea.
83. No plant.
84. Polygonum aviculare. Florib. octandris, trigynis axillaribus. Fol. indivisis, linearibus, alternis, acutis. Caule herbaceo, ad radicem diviso.
85. No plant.
86. do.
87. Hedysarum giganteum.
88–90. No plants.
91. Hedysarum nummularifoli.
92. No label (one unattached in next paper gives Ferreola buxifolia Roxb ?)
93. Antidesma acida.
94. Cissampelos (Pareira).
95. Mimosa catechu.
96. Hydrocotyle Asiatica.
97. Rhamnus Nagera.
98. Achyranth, corymbosa.
99. Nauclea orientalis.
100. Ipomœa Quamoclit.
101. Achyranthes polygonoides.
102. Combretum laxum.
103. Gentiana verticillata.
104. Illecebrum lanatum.
105. Gentiana diffusa
106. Impatiens Sinensis.
107. Conyza bracteata.
108. Artemisia vulgaris.
109. Sigesbeckia orientalis.
110. Verbesina biflora.
111. No plant.
112. Hedysarum pulchellum.
113. Echites, sp.
114. Coniam, [(sic) um. ?]

115. Germinalia, T. ?
116. Convolvulus nervosa.
117. Ornithogalum tuberosum.
118. Hexandria monogyn.
119. Rubus.
120. Achyranthes dioica
121. Inula Indica.
122. Scirpus squamosos'
123. Scirpus articulatus.
124. Andropogon pilosum.
125. Cenchrus granularis.
126. Commelina spirata
127. Cyperus exaltatus.
128–129. No labels.
130. Poa glabra.
131. Peganum Harmala
132. No label
133. Cotyledon paniculata.
134. Limonia.
135. Bauhinia, sp.
136. Sinaba.
137. Verbena Boswalli
138. Syngenesia polygam.
139. Onopordum lanatum.
140. Echinops spinosus.
141. Verbesina dichotom.
142. Polygonum lapathifolium.
143. Indigofera.
144. Tagetes minima.
145. No label.
146. Rhus.
147. Solanum quadrangulum.
148. Indigofera dendroides.
149. Scirpus.
150. Hedysarum diphyllus.
151. Crotalaria.
152. Mimosa dulcis, Roxb. Pl. Car. 1,99.

153. Ægilops ciliaris, Koenig.
An Ischæmum ?
Auf der Reise von Madras nach. Wanda-wasi, 1799.
154. Lichen fuciformis.
155. Fucus sp. n. ? Siliculoso proximus.
156. Tradescantia axillaris.
157. Lycopodium plumosum.
158. Fucus cartilaginus. Exper.
150. Psoralea corylifolia, (under characters unknown to writer.)
160. Excœcaria Agallocha.
161. Panicum tripoides ? (Under unknown characters.)
162. Andropogon prostratum, " " "
163. Andropogon gryllus.
164. Justicia (Achatodes ?)
165, Carthamus cæruleus.
166. Flacourtia sepiaria, Roxb. Wuddla (?), Tam.
167. Eriocaulon sexangulare.
168. Galedupa scandens.

Three plants loose and wanting lables.

Note on some of the Works on Botany in the Library of King's College.

It will probably be interesting to local botanists to have the titles of some of the most important books on Botany in the Library of King's College. The following is a list of them :—

1. English Botany, or coloured figures of British Plants, etc., by James Sowerby. 36 vols., 1790—1814.
2. Hull's British Flora. 1799.
3. " Elements of Botany. 2 vols., 1800.
4. Flora Anglica, Gulielmi Hudsoni. 1798.
5. Flora Scotica, Rev. John Lightfoot. 1777.
6. British and Garden Botany. Geo. H. Grindon. 1864.
7. Flora Diatetica or History of Esculent Plants. C. Bryant. 1783.
8. Flora Boreali-Americana. Andreas Michaux. 2 vols. 1803.

9. Flora Americæ Septentrionalis, or Descriptions of the Plants of North America, by Frederick Pursh. 2 vols. 1814.
10. North American Botany. Eaton and Wright, 1840.
11. Icones Plantarum sponte nascentium in regnis Daniæ et Norvegiæ ad illustrandum opus Floræ Danicæ. 7 vols., folio, 1754. Colored Plates.
12. Flora of Colorado. Porter and Coulton. 1874.
13. Linnæi Bibliotheca Botanica.
14. " Systema Naturæ, translated into English. 7 vols. (2 " Vegetables.")
15. G. Hudsoni Philosophia Botanica. 1770.
16. Botanical Extracts or Philosophy of Botany. Robert J. Thornton. 2 vols., folio, (the second consisting of fine plates), 1810.
17. Evelyn's Sylva or Discourse of Forest Trees and Propagation of Timber in His Majesty's Dominions. Fifth Edition, 1729.
18. A General System of Gardening and Botany by George Don. 4to. Vols. III. and IV. only.

Art. IV.—On the Necessity for Preliminary Scientific Training for Civil and Mining Engineers.—By Edwin Gilpin, M. A., F. G. S., Mining Engineer.

(Read. Feb. 11, 1878.)

In view of the attempt now being made to establish a Nova Scotia School of Science and Technology in this town, it may not be out of place to attempt to anticipate the objections that will be raised against it by those who have not considered clearly its aims; and to endeavour to show the advantages that its training would confer on those who, in a few years, by the irresistible march of time, must become rulers and leaders of our country.

I would be glad indeed to explain and show how wide-spread and directly felt, would be the advantages of having among us men more skilled to apply practically, physics, mechanics, agriculture, natural history; and even to investigate that most important, yet least understood field, the world beneath the waters, whence we draw our harvest of the deep; such an important item to a people whose land borders on two oceans, and is intersected by the largest lakes and rivers of the world. But I must leave that to abler hands than mine, and touch only on what I am best acquainted with—the professions of the Civil and Mining Engineer. These two professions are of great antiquity, although the records of their achievements are too frequently obscured in the annals of conquest and intrigue. The ancient aqueducts and harbours of Europe and Asia form striking monuments of the value attached to the services of the Civil Engineer engaged in those two most important duties, the supplying of towns with fresh water, and the formation of commodious harbours at points of commercial and strategical importance.

The enterprise of an English traveller has recently re-opened the historical mining district of Midian, and certainly from his account of the richness of its mineral resources the "old men" deserve credit for their selection of a good mining ground.

Still the progress of these twin professions was very slow, and it appeared at one time as if the art of the continental Coal Miner was doomed to extinction, for it became very evident that with the appliances of the day it would soon be impossible to raise the water of the coal mines from a depth materially exceeding that already reached by the workman.

The discovery of steam however has changed all this, and opened to the Civil and Mining Engineer a vast and unlimited field. To the one it gave the Railway and its accessories of bridges, tunnels, and the improvement and deepening of rivers and harbours at points hitherto undreamt of. To the other it furnished a powerful agent for deepening and extending the subterranean galleries, and by its economical application afforded scope for a vehement and yet well regulated extraction of minerals, so that it is not unusual to see an English Colliery raising over one thousand tons of coal daily. And by its aid, more or less directly applied, minerals are smelted which were before considered valueless; all the labours of the metallurgist are facilitated, and his products correspondingly cheapened.

We thus find that these professions have widely extended their aims, and now call to their assistance and use practically every item of knowledge that has been gathered about the composition and laws of the earth, the waters and the atmosphere —electricity—chemistry—geology—the laws of fluids—the yet almost unknown currents of the air,—all are pressed into the service of the Civil and Mining Engineer, and we are irresistibly led to the thought that their preliminary training must correspond in liberality and breadth to the importance of the subject they are to deal with.

Few, perhaps, except a professional man, can detect and account for the imperfections in the practice of the subject he is interested in, and I can hardly hope to take you all behind the scenes this evening; but the leading facts to be noticed are quite familiar to you all.

When the scant production of Canada is considered, and the preponderating importance of agriculture and the fisheries, the first and most natural question is, whether these professions are important enough to require any special training for those intending to engage in them; in short, would it pay to give our engineers a better training than that at present in their reach.

When a practical question is to be dealt with in a practical manner, figures may perhaps convey a clearer impression than any mere assertion.

The value of the minerals raised in Canada for export and home consumption for the year ending June 30, 1876, was, on a rough estimate, $4,038,000.

The readiest way of estimating the value of the Civil Engineering profession is from a consideration of the number of miles of railway annually built in the Dominion. From figures furnished to me I believe the amount under construction in 1877 to be about 1000 miles, which would involve an expenditure of over $5,000,000. The amounts paid for private and preliminary surveys must also be very large. The value of the railway iron imported during the years 1875-76 was $3,951,000.

If then we have two items amounting to an annual value of $8,000,000, no one can justly say that he would advise any negligence in the education of those who are to expend and control such large sums of money.

Many easy going people say that the Engineers that we have now are quite good enough for all the work required, and that their education is properly regulated.

Usually when a young man is destined for the profession of a Civil Engineer, he is sent out on a surveying party, and after serving an indefinite time as axeman and chainman, which is quite unnecessary, and moreover frequently injurious from unavoidable association with men of indifferent character,—is gradually advanced to leveller and transit man as he acquires the necessary manipulative skill and quickness in the practical part of his profession, and not from his knowledge of the principles on which the Engineering art is founded.

And this is unavoidable, for the young Engineer is generally away from books and lecture rooms, and after a hard day's work is little disposed to sit down to severe study; and his chiefs have seldom the time or inclination to give him the necessary assistance. The consequence of this is a blind adherence to the formulæ of a text book, and a certainty of failure when obstacles of an unusual nature are encountered.

How many Engineers, for instance, are able to calculate the dimensions and strains of an iron bridge, or to investigate its working strength when erected by a contractor.

The study of Geology (excepting palæontology beyond the outlines) is an useful aid to the Engineer. Under this heading he would acquire a knowledge of the properties of various limestones, concretes, mortars, etc., and of the rules guiding their selection and action. The choice of localities likely to contain stones, etc., suitable for building purposes is one of no small practical value, and the field geologist can give many valuable hints on this point. The careful railway projector or contractor would gladly gather any information that would enable him to form an idea of the hardness and state of aggregation of the rocks and soils likely to be met in tunnels, cuttings, etc.

In one or two instances a slight acquaintance with Geology would have effected a large saving of expense in bridge-building on the Intercolonial Railway, as for instance the Miramichi and Restigouche Bridges, and an instance of the neglect of the physical effects of sloping rock surfaces was shown on the Eastern Counties Railway. As the Engineer is forced in the pursuit of his profession to spend much of his time in the forests and mountains, an acquaintance with mineralogy will always prove an interesting occupation for his leisure moments; his collections, especially when made in untrodden lands, will always prove valuable; and by a fortunate discovery he may secure an independence for himself.

The systematic study of the effects of river currents and tides on the deposition and removal of diluvium, is one of great value and almost indispensable to a permanent and economical opening and improvement of harbours. An interesting instance of this is furnished by the almost complete destruction of Port Hood harbour by the winds and tides of the Gulf of St. Lawrence.

Take again the case of a very respectable body of men who are extensively engaged in the laying off and division of property—the land surveyors. Who has watched an ordinary land surveyor, with an antiquated compass gravely running out a set of farm lines, and not noticed with admiration how bravely he conceals his fear of local or daily variations of the compass. The care with which the chaining is carried up hill and down, and the gravity with which ten per cent. is added to the distance measured, irrespective of the nature of the ground passed over, would be amusing if it were not for the thought of the trouble entailed on the future tenants of the properties. In many cases extensive blocks of farms have been surveyed, and no date given, nor any reference made to the astronomical North. The consequence of this is that endless troubles arise when attempts are made to find the boundaries of old properties; which as a rule are either imperfectly or not at all marked on the ground. And the remark made to me by an eminent barrister that the "land surveyors were his best friends," is fully justified.

The surveying compass is liable to several errors, which in ordinary practice cannot be sufficiently guarded against to allow of accurate work. The magnetic variation can be readily provided for if the surveyor confine his work to a limited district, otherwise frequent observations are requisite. Daily variation and local attraction are almost beyond regulation, and it is not uncommon to find that the brass work of the compass contains such a quantity of iron as to make the indications of the needle valueless on certain courses. The variation of the seasons is also another source of annoyance. This variation amounted in a compass survey made during the summer under my superintendance to a difference of 32 ft. at the end of a two mile course, between the same line as run on a fixed course in May and October, starting from the same point and using the same compass. There are other sources of inaccuracy to which I will refer further on, but those above mentioned are quite sufficient to condemn the compass as an instrument of precision.

Surely it would be worth while establishing a Chair of Civil Engineering, were it only to provide competent men for surveying and valuing our public and private lands. This is a point that should be taken hold of by the various Provincial Governments, and no surveyor should receive a commission unless he is able to make his surveys with the transit theodolite from the true meridian, and to chain his lines properly within a variation of two feet in every mile.

I believe that the importance of accuracy in land surveying has been understood by the Manitoba and Ontario Governments, and that there the public and private lands are required by law to be surveyed by men of higher standing than those filling corresponding situations in the other Provinces. I would even go further, and would advocate that no man should be allowed to practice as a civil engineer except he hold a certificate of competency. And without in any way wishing to detract from the necessity for field work which is indispensable in this case, it appears to me that the certificate should include a course of collegiate instruction, extending over at least two years, the subjects taught being the same as those found in the calendars of the various foreign schools of science where civil engineering is taught.

I think I am safe in saying, that were a school of civil engineering founded by the various governments, that in a single year after its graduates had passed into the field, in charge of work, its cost would be more than repaid by the money saved by the avoidance of such blunders as had been previously committed, through ignorance of principles which the proposing engineer can learn only before he is occupied in the practice of his profession.

I have already noticed the value of the mineral exports of the Dominion,—when we consider more particularly the mining profession it may not be amiss to add a few other items directly referring to it.

The value of the iron, raw, partly and completely manufactured, entered for duty or free, in the Dominion for the year ending June 30th, 1876, was....................$12,111,838
Of the coal.................................. 3,230,060
Of the lead, copper and other minerals............ 1,707,802

$17,049,700

or over one-fifth of the total imports—and this it must be remembered in a year of unusual business depression.

I do not wish in any way this evening to touch on political matters, as a school of science can have no connection with any party divisions, for its graduates are educated solely for the advancement of the material prosperity of the country; but I think I may say that we should all hope for the hour when our mineral resources shall become so developed that we will not be under the necessity of importing these articles.

The value of the raw minerals annually raised in the Dominion will itself naturally lead to the contemplation of the training of those who are to discover fresh ores, open new mines, and manage those now in operation. And the question arises, will their duties be more satisfactorily and economically performed if the standard of their education is raised.

It is generally said that people prefer buying their own experience to getting it second hand for nothing. It will, however, not interfere with this feeling to cite the case of England. Here the cry was raised that the coal supply was not going to last much longer, but it was found that the alarm was groundless. However, there was evidence to show that coal was being mined in a slovenly and wasteful manner, and now a manager of a coal mine must hold a certificate of competency.

If in England such a precaution is necessary, where the mining profession is adorned by some of the brightest intellects of the day, how much more requisite must it be in Colonies, where carelessness and want of economy almost become proverbial.

Large as our Coal and other resources are, they have a limit, in some cases very clearly defined; and we are drawing on deposits which can never be renewed.

As our minerals are in many cases a source of direct revenue to the Provincial and Dominion Governments, the agents of the companies working them should be regarded in the light of stewards, who should not be permitted to waste the treasures of the earth which are held for the common good of all.

The limits of this paper would be unduly extended were I to enter fully into the various points which show that the mining interest of the Dominion demands a better standard of education for those who are to enter its ranks. But I think that the consideration of a few leading points is all that is required to lead the public to entertain those views on the subject which have already forced England to take a practical precaution.

The proper planing of the levels and galleries of coal mines, in order to maintain a steady out-put for a number of years, and to extract as much as possible of the coal, is a problem requiring, in an unusual degree, a combination of practical knowledge and mathematical calculation. This includes a proper proportioning of the size of the pillars of coal left to support the roof according to the thickness and nature of the overlying strata, a judicious arrangement of the ventilating galleries, and the proper preservation of the roads left for drawing out the coal. The consideration of all these points on a scale at once permanent and economical, demands much laborious calculation. As a consequence of a neglect of these points it is common to see expensive shafts, etc., abandoned, and a heavy outlay incurred in sinking new ones, when proper forethought would have made one answer all purposes.

Under this heading may be classed a custom which has recently crept into our gold mining. Within the last few years numerous gold areas, and partly worked mines have been let on short leases to men paying a percentage rent. The effect of this is a superficial working of the richer parts of the auriferous veins, which on being abandoned fill with water, and become a burden to future operators, who are forced to mine at a greater distance from the surface. Gold mining in Nova Scotia will, I am afraid, never pay until it is conducted systematically and on a large scale, as is the case in Australia and California. Mr. Selwyn, the Director of the Canadian Geological Survey, who has had a large experience in Australian gold mining, in a conversation with me last summer on this subject, expressed similar views founded on a careful examination of the veins, and the conditions under which they occur.

Take again the case of underground surveying. In the Dominion this is nearly always done with the magnetic compass. In addition to the errors already referred to in connection with this instrument, it is liable to the attraction of iron rails, etc., under ground, and to a serious source of error arising, I believe, from the presence of various ores of iron in a decomposing state. It may be considered indispensable that, in order to ensure accuracy in mining plans, the theodolite must be used, and the inclined measure properly reduced to the horizontal. Unless these points are carefully attended to now, in the future old plans will prove practically useless, and all miners will be liable to serious dangers when approaching abandoned workings.

The systems of ventilation are another point to which every attention should be directed, and constantly as the workings of coal mines are extended, we hear of increased trouble from this source.

I would only weary you if I went further, and merely leave those among my hearers who are interested in coal and other properties, to recall the cases they have noticed themselves of neglect of the above fundamental principles of mining. I am myself acquainted with a mining engineer in this Province who has ruined three collieries by his want of skill.

It is at this point that collegiate learning steps in and extends the engineer's knowledge of each special branch of his profession. I do not wish in any way to underrate practical training, for in mining no man can rise even to mediocrity unless he has been through the mill himself. No mining school can supply this want, and he leaves it provided only with a general knowledge of his profession which may divert into any particular channel, to be perfected by practice and accumulation of experience.

At present there are more specialists in mining than in almost any other profession. And it is frequently the case that an expert manager of a mine is unable to survey, or arrange his workings, or on moving to a new district is at a loss to meet the change of conditions under which his work is usually to be carried on.

The mining school meets this difficulty as well as it can be met in the closet. It gathers and presents to the student all the methods of mining adopted in the principal districts, the various engines, pumps, etc., used in every country, and so on, through all the branches of his education. Finally the pupil should leave with his education directed chiefly to the systems employed in his own country, and yet carry with him the most valuable points connected with foreign mining.

It is almost too soon yet to judge of the practical working of the system of certificated managers adopted in England. The intending pupil spends five years, I believe I am correct, in a coal mine, and then passes an examination to entitle him to his certificate as a competent engineer. This system is open to the great objection that the education is comparatively limited, being confined generally to one district, and the pupil is ignorant of all but coal.

An instance of what the adoption of this system among ourselves would lead to, occurred to Mr. Selwyn and myself last summer. We were standing at the mouth of a coal mine in this Province, and noticed that in the excavated debris of a gallery there were specimens of clay ironstone, similar in appearance and quality to the famous blackband of Scotland. On enquiry we found that no one connected with the practical working of the mine was aware that a bed of iron ore was being passed through.

Were it possible to establish, as would be most desirable, a system of certificated mine managers throughout the Dominion, I would suggest a modification of the English plan, and would require the attendance of the pupil for a fixed time at a school of mining. Here the points more particularly studied would be mathematics, including trigonometry, algebra, etc. A general system of geology, more particularly of the Dominion, a general knowledge of palæontology, to enable him to judge of the age of the strata he may find minerals in—which has frequently an important bearing on the probable permanency of the deposits. Mineralogy, and the use of the usual re-agents and tests for detecting the presence of metals, etc. Metallurgy, the composition, etc., of the most important ores, their concentration and reduction. Wet and dry assaying. Surveying and drawing of plans, and finally the most comprehensive course of mining that can be presented to him.

After passing a satisfactory examination in these subjects he should be compelled to spend a certain time as a mining pupil, and then be entitled to a certificate, after undergoing a second examination of a more practical nature than the first.

I have not ventured to suggest any details for the more effective carrying out of this scheme, as they could be decided on only after careful and lengthy consideration of the necessities of the various mining districts.

If as is the general case throughout the country, the minerals are held by the Government as a source of revenue, the public are not wrong in requiring that their exploration be managed by men directly under its control, and as well educated as possible. By this means there will be increased confidence in mining enterprises, when it is known that they are conducted by men liable to lose their certificates if guilty of carelessness ; and the fact of their proper education will equally lessen the liability to error.

ART. V.—ON THE GOLDEN EYES, OR GARROTS IN NOVA SCOTIA.

BY J. BERNARD GILPIN, A. B., M. D., M. R. C. S.

(Read March 11, 1878.)

SUB-GENUS BUCEPHALA, BAIRD.

Bucephala	clangula,	*Coues.*
Bucephala	americana,	*Baird.*
Anas	clangula,	*Linn.*
Fuligula	clangula,	*Bon.*
Clangula	vulgaris,	*Richardson.*

The Common Golden Eye.

Bucephala	islandicus,	*Baird.*
Anas	islandicus,	*Gmelin.*
Clangula	barovii,	*Richardson.*

Barrow's Golden Eye.

Bucephala	albeola,	*Baird.*
Anas	albeola,	*Linn.*
Fuligula	albeola,	*Richardson.*

Spirit Duck.

Thus we find that the genus Anas, formed by Linnæus to include these species, has been since sub-divided into Fuligula, Clangula, and Bucephala, and that the specific Clangula, also given to the common Golden Eye by Linnæus, has been justly restored to it by Coues, though disallowed by Richardson and Baird. In the Barrow's Golden Eye, Baird has justly restored Gmelin's first specific Islandicus, though Richardson had named it after his friend, the Secretary of the Admiralty.

There are many circumstances making Digby Basin a chosen resort during fall and winter, for many species of migratory sea birds. Its easy access from the rough tides of the Bay of Fundy, its sheltered basins and broad wide flats, with their shallows teeming with life, and scantily covered by a warm brackish tide of mixed river and ocean water. Flying before the heavy south-westers, numerous sea birds find themselves swept up the Bay of Fundy, and then almost imperceptibly swept through the narrow Digby Gut into warm, peaceful and teeming waters. The numerous and discordant family of gulls are the first to arrive, which they do in September, they and their new fledged young. The passenger in the passing steamer hearing their wild cries, looks towards Bear Island or Goat Island, and seeing the sand whitened for many a yard, scarce knows whether it be surf or birds. Towards the middle of November, the sea coots, as they are locally and collectively called, come flying in, in parties between four or five to ten or fifteen. These are the scoters (Oidemia americana. Swaim). The velvet duck or white wing (Melanetta, velvetina. Cassim), and the surf duck (Pelionetta, perspocillata. Linn). These usually in small separate flocks, spread themselves along the shore diligently diving, though, when pressed by heavy weather, they seek a lee shore in large flocks of all species. In these birds, as well as in all which frequent our coasts, the number of adult plumaged males are as about one to four or five of female and immature ones. Coming sea-ward, also arrives about the same time the old wife, or old squaw (Harelda glacialis, Linn), and remains the winter. Whilst the sea is thus furnishing its peculiarly oceanic birds, our inland lakes, still waters and runs or rapids, as their waters are swelled by the autumnal rains and over-flow, their feeding grounds, or are coated in ice, are contributing also to this mutual feeding ground. In November, the garrots appear in the basin, two species, (Bucephala, Americana and B. islandica. Bon and Gmélin). These, though loving the fresh water best, resemble, in their short neck, robust shape, and leg placed far backward, the oceanic families, and seem much at home on their new fishing grounds. With them comes another species of this sub-genus, the buffle-head or spirit duck, (Bucephala albeola, Linn), and the scaups, two species, identical except in size, (Fulix affinis, Foster and F. marila, Linn), the latter less pelagic in figure, yet still alert divers. The wood duck, (Aix sponsa, Linn), never leaves his inland waters, but lingers around the open runs the whole winter. Not so the black duck (Anas obscura, Linn). This type of the fresh water ducks, with its slender bill, long neck, and legs placed well forward, fitted for the land, and to feed floating on shallow waters with its long neck and head at bottom, a vegetarian, loving succulent winter grasses, and even berries, to feed upon which it must land upon the barrens—is the last to arrive. Reluctantly he quits his solitary lakes, retreating from the ice to the estuaries or tide mouths of the streams, driven from them by the frost, he seeks the basin and even the wild Bay. Not being an adroit diver like his congeners, mid-winter finds him creeping over the slippery rock at ebb-tide, perchance to feed upon the soft sea weeds, oftener to pick off the small mollusks adhering in such quantities upon our sea rocks. At flood tide, waiting for the ebb to bare his hunting ground, we even find him burrowing in the snow for warmth. The crop, a few months ago swelled with blue-berries, is now filled with shell fish. The luxurious floater and dreamer in the summer lakes, bivouacs with the furred hare and feathered grouse in the snow. His strong, non-migratory instincts do thus alter his food and habits to a degree that is almost incredible save to an eye witness; one would suppose too he should be made the peculiar study by those who support the views of natural selection origin of species, as in the contest of life, few birds are exposed to such repeated and violent changes of habit and food. The practical naturalist, however, finds no difference, saving a more robust form in those who pluck frozen mollusks from snow-covered rocks, and the busy fruit eaters in the soft September sun, on the blue-berry barren.*

From this pack of migratory sea birds meeting here on mutual ground, those from the cold north finding in the shallow sun warmed waters of the basin a genial retreat, others equally adapted to fresh or salt, finding comfortable quarters, and others again pure fresh water fowls a chilly tarrying-place, I have selected, a very restricted sub-genus of three species for this paper. These three species, the two species of Golden eyes or Garrots,

* On submitting two hundred and twenty-seven specimens of Mollusks taken from the crops of Blue Wings, Garrots and Scaups, shot during the winter 1876, Digby, N. S., to my friend, J. Matthew Jones, he gave me the following list:

Littorina	palliata, Gd.	221 adult & young.
L.	tenebrosa, Gd.	2 young.
Purpura	capillus, Linn.	3 young.
Lucuna	vincta, Gd.	1

known locally as Whistlers, and the Spirit duck or Buffle-head, locally Dippers, have been formed into the sub-genus Bucephala, by Dr. Baird, in his catalogue of the Birds in the Smithsonian Institute. In this sub-genus the males have all tumid head crests, and parti-colored plumage. The females ashy-brown—tails of sixteen feathers, robust necks, round bodies, legs far behind, seek their food by diving, escape from enemies by diving rather than flying—can, from backward position of leg scarce walk, but with wings and tail stretched, and webbed feet, obliquely striking the sand with awkward splash, and in a semi-erect position drag themselves a short distance along. They are frequently seen sleeping upon the rocks, and oftener perhaps upon the water. They arrive from the fresh-water lakes during November, probably the rise in the waters of the lakes as well as the early ice driving them out, and are seen spreading themselves about sixty yards apart along the shore and diligently diving for food. In February or the last of it, other thoughts than food steal over them. The warm February sun often finds the male with tumid head dress, drooping neck and tail erect swimming in short circles, about two or three females seemingly avoiding his advances. In March this powerful instinct begins to send them to the far north for reproduction. The last of April or beginning of May finds a few loiterers about the deserted shores. Such are the habits of this sub-genus about the Digby Basin, and no doubt in many bays and coves of Nova Scotia. In studying the Golden-eyes, I soon found there were two varieties if not two species amongst them, and that though they frequently kept together, yet very often each kind kept by itself, that the males were easily distinguished, but the females and young birds were very hard to separate, and that some of the immature males and females of each variety had parti-coloured (yellow and black) bills, whilst all the adult males and many females had dark-blue bills, the number of yellow bills being very few comparatively. I found that the Rocky mountain Golden eye, though described by Gmelin, according to Dr. Baird, but usually known by Dr. Richardson's description as an inhabitant of the arctic regions, and by Nuttal, said to be found in the Rocky mountains only, was by no means rare amongst us. In this paper I shall make as minute a comparison as I am able between the males and females of each species, and hope by showing some anatomical differences heretofore not observed by naturalists, to prove that they are two distinct species, for though Richardson distinctly asserts it, yet the last writer upon American birds, Dr. Elliott Coues, leaves the question an open one.

THE COMMON GOLDEN EYE.

This description is taken from a mounted specimen in the Provincial Museum, Halifax. The whole head and about ten inches of the neck is black with duck green reflections, the green being more seen upon the cheeks. The rest of the neck to the shoulders, the breast, belly and beneath is white. There is an irregular round white spot at the corner of bill, reaching upward towards the eye. The back, shoulders and rump are jet black, the tail more brownish black. On looking at the bird from the back, two white axillary stripes commencing from the white collar, back of the neck, run down the back for about five inches, being very narrow and ending in a point. A second white patch joining the first narrow stripe on its upper position, runs down over the wing coverts about two inches broad and five inches long, ending in the white speculum on the wing. Thus the back may be said to be black with four distinct stripes or patches of white upon it. The long flank feathers covering the wings, and the spaces about the thighs are brownish with long black spots. The bill is black, a slight horn blue wash over it, nostril large, nearer the tip a round nail upon the tip, and decided hook. The irides are golden yellow. The feet and legs are orange, the webs black, nails black. There are on the inside black pencillings, running up to joint of tibia. and the hind toe is orange upon the outside, the inside black with orange edges. In form the head is large, forehead moderately high, figure round, neck robust, wing shortish, and tail long for a duck, plumage of head rather tumid than long. Those dimensions I take from Richardson:

Total length 22 inchs., 6 lines. Length of tarsus 1.6½.
of tail 4 " 6 "
of wing 9 "
of bill above 1 " 6½ "

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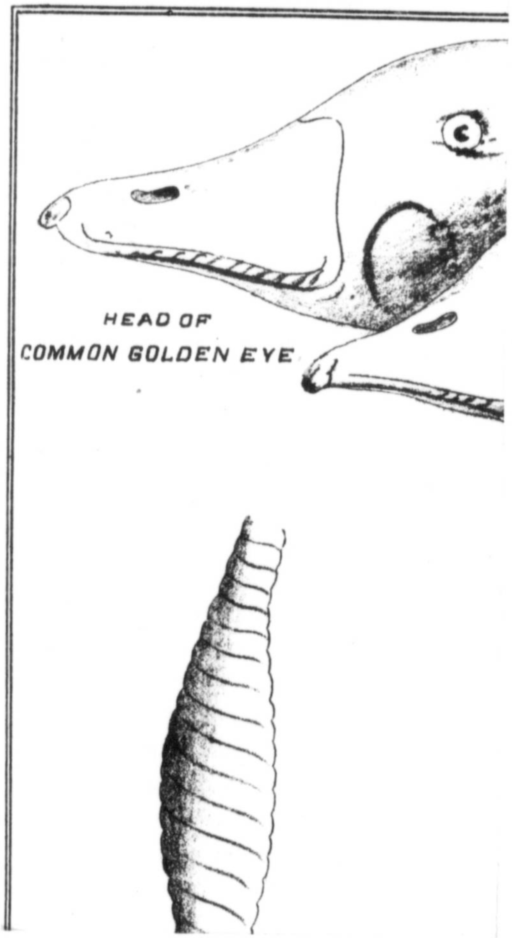

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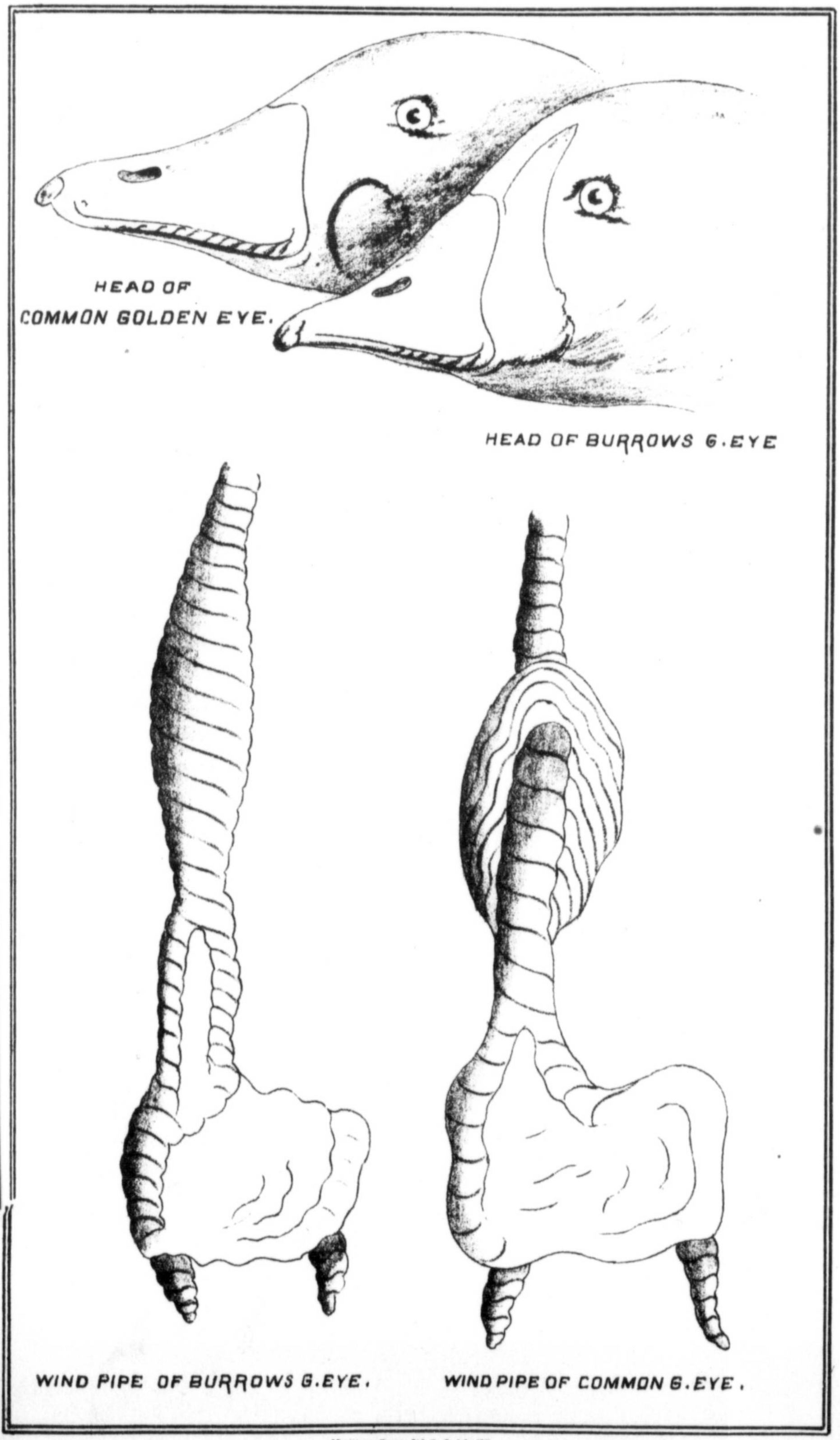

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A female common Golden Eye, shot at Digby, March, 1876, measured:

Total length....	1 ft. 4 inch.
Length of bill....	1 ft. 8-10 "
Height of bill....	9-10 "

I considered this to be a female of the common species, because its bill was longer and forehead lower actually than other females of larger dimensions. Colour of head, cheeks and nape, dark, umber brown, with a yellowish wash on forehead, a narrow greyish white ring about the neck, followed by a French grey collar, with whitish pencillings two inches broad. Below the breast, belly, and beneath tail, pure white; the sides of belly however, marked with black and grey pencillings, and an interrupted line of black through the vent. On the back this obscure French grey collar spread itself down the shoulders and back, insensibly joining with the sooty black of back and tail. As each feather was lighter on its edge than middle, it gave the idea of scales. Primaries black, secondaries white, two or three posterior ones with a black spot on inner veins. In the folded wing, a few of the greater coverts being white, and uniting with the speculum, make a good sized white patch upon the wing. In this specimen there was no interrupted line of white and grey upon the shoulders, as there is in many. On the inside of the wing the primaries, secondaries and tertiaries were slate blue, the other parts were darker, nearly black. The bill was longer and lower than in other specimens; it was blue-black with the slightest brownish yellow upon culmen and tip of lower mandible. The legs and feet pale orange; the webs black, a black line running up the back of the leg to tibia; hind toe, outside yellow, inside black with yellow edge. The irides were golden yellow. In figure this specimen was tumid head, short neck and very round body, short wings and long tail. I have given the exact colour of this specimen, which being shot in March may be considered a good type, but in looking carefully over a series, I found they varied only in intensity of colour; the most having an irregular patch of black and whitish grey upon shoulders. The dark umber of the head sometimes approaches black and again black with green reflections. Of the colour of the bills, some being black and others having yellow patches upon them, as I have found the same in the next species also, I will refer to it more fully after I have described them.

THE ROCKY MOUNTAIN, OR BARROW'S GOLDEN EYE.

This description is taken from a male in full plumage, shot January, 1876, Digby Basin:

Total length 1 ft. 8 in.,—length of bill 1 8-10 in. } dried
height, 1 inch, } specimen.

colour head and neck for about two inches, dark with purple reflections on the crest and forehead, duck green upon cheeks; a triangular spot beginning a little below the corner of the mouth rises above the culmen of the bill $\frac{3}{4}$ of an inch, the outside edge for two-thirds lining the bill. This triangle is white. The neck, upper shoulder, breast and belly white. The long flank feathers with long black spots, and a black band crossing the belly at vent. The back and tail black. The axillaries on their upper part have a few white feathers that make an interrupted line. The greater wing coverts have a patch two inches long and half inch wide white, and the secondaries forming the speculum with a few of the greater wing coverts make another white stripe. The inside of the tail slate, inside wings slatish, other parts black. The irides golden yellow, bill black, nostril large nearer the tip, a decided nail and hook, the bill narrowing at point, where the feathers meet the culmen subcircular. The feet and legs yellow orange, webs and nails black, hind toe orange outside, inside black with yellow edging. Black pencilling running inside of leg to joint. The form of this specimen was robust, head tumid with occipital crest, neck short and body very round. Female Rocky Mountain Golden-eye. This description is taken from one shot with a drake of the same species, on the 15th February, and therefore in good plumage. It may be considered the type of a female in nuptial plumage—

Total length 1 ft. 6 inches; breadth 2 ft. 2 in.; length of bill $1\frac{1}{2}$ inch.

The folded wing reached to sixth feather of tail, and the feet to nearly the end of tail. Colour dark umber brown with a slightly yellowish wash on head and cheeks, a small ashy white ring about neck, then a French grey collar with white pencilling about two inches broad. Below this the breast, belly, and beneath tail pure white, with the sides of the belly having black and grey pencilling, and an interrupted line of black crossing the vent. These pencillings were darker about and behind the thighs. On the back, the French grey collar spread itself over the shoulders and back, insensibly joining with the sooty black of back, rump, and tail. Each feather having a lighter edge than middle, it gave one the idea of scales. The primaries were black, but the secondaries and speculum white, a few black spots on the last of them making the white bar obscure, a little above the speculum, an interrupted bar of white, black and grey upon wing coverts one-half inch wide and two and one-half ins. long. Indsie of wing primaries, secondaries and tertiaries plumbous, other parts dark, irides golden yellow, bill yellow, with black nail, margins and tips of lower mandible black, upper mandible with a few black markings on front and sides. Feet as bright orange as in the male, and marked the same—toes and webs black, hind toe black inside with yellow edging, outside yellow, black line inside leg. This is an exact description, but in looking over a series I find they differ in darker or lighter plumage; the umber brown of the head running in some into black, and black with green reflections.

In studying the specimens of both species, both male and female, I found that whilst the males of both species had black bills, the females and immature birds had many specimens with yellow and black bills. In these cases the nail and the margins of both bills were invariably black, whilst in some cases the yellow covered nearly the whole of the bill, at other times only below the nostrils, and again with scarce a trace upon the culmen. There were females of both species with all black bills and some young males of the common golden eye with yellow bills. I have no doubt that the Rocky mountain young males would also be found with yellow bills, but I have no specimens. From the very few yellow bills in comparison with the dark ones found, we are led to conclude that the yellow is only as it were a transient mark of the young, and that the adults of both species have dark bills: that the young should have gaudier bills than the adults, or the female than the male, is almost unknown in natural science. Here then we have two species, in the male easily distinguished by colour, but in the female by colour impossible, and our only guide is that the Rocky Mountain bird, though larger, has a shorter and higher bill, and in consequence of this height a difference in the shape of the forehead, where the feathers meet the culmen, tolerably well enough shown in the male adults, but more obscurely in the female and young—all being in the recent state, and in the dried or mounted specimens scarcely discernible. Dr. Coues, the last American writer upon the subject, says: "Female doubtfully distinguished from that of clangula (common golden eye) with certainty, unless by the dark bar in wing," and again, "doubtfully distinct from the last, from which I am not prepared to unite it," Coues, 290 Key, N. A. birds. In searching further for some typical mark of distinction, I was led to the anatomy of the birds, but whilst finding little or nothing in the parts of reproduction, the ovaries and testes, I unexpectedly found in the male birds so great a difference in the shape of the windpipes as at once to mark a different species. This difference is much more easily seen than described, as is readily shown in the plate. In the male common golden eye, the wind-pipe soon after leaving the throat and before it enters the breast, has a very sudden enlargement, almost as it were a broad hoop thrown obliquely around its stem, on the inside this leaves large circular pouches on the posterior surface before the restriction of the pipe takes place again. In the Rocky Mountain species, the wind-pipe simply and gradually enlarges itself, becoming restricted again before it enters the breast. In one the enlargement is suddenly from 2-8 of an inch to an inch and an 1-8, while in the other from 2-8 to 5-8 inch, and that with no protuberances. In the males alone of both species there is, after the wind-pipe has entered the breast, that very complicated subquadrangular knob, from which the bifurcation of the pipe proceeds. This form is common in a modified degree to other species. According to our present ideas of species, this great divergency in form of wind-pipe, existing in the males though lost in the female, must mark them as two different species, although in the males a little more or less white on head and back, a little purple reflection in one, and a higher base of bill and forehead marks the only difference, and in the females as regards colour no difference can be found. The tails, wings and feet of both, in the most minute examination, affording no differential types.

The Spirit, or Buffle-Head Duck.

Description of male in Provincial Museum, Halifax,—colour, head and part of neck, duck-green with purple reflections; a broad white bar beginning behind the eye, spreads out to the back of the head. The breast, belly, the rest of the neck and under parts white. The back velvet black, the primaries black with brownish wash; the tail and tail coverts brown with a slate wash. The under tail coverts white, with some slaty pencilling about the anus and legs. On the shoulders, the outside axillaries, the shoulder and the wing coverts make one continuous white patch. In the female, also in the museum, the head, neck, back are dark brown, the primaries and tail rather lighter. There is an obscure white patch upon the cheeks. The throat, the sides of the breast and flanks shaded brownish white. Beneath white, but brownish beneath tail. The greater wing coverts with part of secondaries, make a small interrupted white bar. The tail in both sexes is long and graduated, the male much the longer, the bills bluish-black and legs yellowish. So far from a mounted specimen; but from Sir John Richardson we find, that the length of the male is about sixteen inches, and of the wing 6 inches and 8 lines, and the length of the female 14½ inches, and that in the male, of the secondaries, five or six have their outer edges white, things that we could not get from the mounted specimens. This bright and active little duck, with its tumid and brilliant head in the male, and very plump form, leaves our inland lakes to which it has arrived during the fall from its Arctic breeding grounds, in November for the sea coves and sheltered bays. He remains with us all winter —leaving us in April. He is a diligent diver, and in hard cold days may be seen spread along the shore in pairs, or threes, or single. If the weather is warm he keeps further off shore, but a storm will drive him far away to windward seeking a lee, where huddled together with Garrots, sometimes even with Heralds, whole flocks may be seen nestling almost in contact with the coarse beach grasses which line the salt lagoons of the coast, or again bravely keeping the open sea, head to windward, and couched into his back and tail turned up—the living model of a fishing pink.

I have chosen these two species for a paper, because in the first place they differ from all other annatide that I know, in having the bills in the female decorated with brighter colours than those of the male. The females, and in one instance at least the young males of the common Golden eye having lemon yellow upon the bills, whilst the males of both species have black bills. This yellow sometimes extends to the nostrils, but usually shows as a ring about the tips of both mandibles, the tips themselves being black; at the same time the far greater number of females and immature birds have black bills. Thus from the many specimens I have studied, I can only conclude that the yellow is common to the females of both species, that three specimens at least of young common Golden eye had it, and that it is transient, and in the old females passes into black. The fact that those markings are not very pronounced, and that in a series of bills the yellow will pass from bright edge to a tranfused yellow wash, sometimes pervading the nostrils, sometimes not, and that sometimes it fades out after a few days, on the dead bird, are sufficient to form this conclusion. But the fact of the female being higher ornamented than the male as regards bills is almost a solitary fact. As in other species this coloured bill may be brighter during the nuptial season, and fade darker at other times, and altogether in old age.

Another reason for choosing these species for a paper is the addition of Barrow's Golden eye for the first time to the fauna of Nova Scotia. There is one specimen in the Museum of Halifax of a male Barrow, mounted some twenty-five years ago, and with no history or date attached, but with that exception it is only within a few years that they have been found in some numbers wintering in Digby Basin. Mr. Boardman records them as occurring at St. Stephen's, New Brunswick. Coues, (Birds of the North-west, 1874), acknowledging it a true species, notes its occurring at New York, and Merriman (Birds of Connecticut, 1877), at Long Island Sound and Cape Cod, 1867 and 1871. Thus a bird first described one hundred years ago, then lost sight of till Richardson described and figured it as a new species, ignored by Audubon and subsequent writers, is at last restored to its original name and discoverer, Gmelin. It must be that for some reason unacountable to us, it is extending its migrations, and appearing where it never was before, into regions from which the Labrador duck (C. Labradorius) is disappearing in our own times, for like unaccountable reasons.

Amongst writers of the present day, the term "mimicry" is often used, that is, that in some cases certain bright colours, are given in nature to attract the different sexes or repel them, or neutral ones to avoid the notice of enemies, and by the word used it is insinuated that the possessors of these colours have an instinctive knowledge of them, even though the principle is pushed so far as insects and plants. Now in studying these two species we find two co-ordinate species, each carrying out its individual life and condition, without any assistance of colour. Though naturalists have scarce yet acknowledged the differences in the males, the females are still without a distinguishing mark in science, and which can only be discovered by a still further, long and exact study; yet we find both species living together, and under exactly the same circumstances, and yet preserving their separate conditions. To enumerate opposite facts is perhaps the best argument to oppose the laying down of such general principles, which owe their existence to the brilliancy of their authors rather than objective reasons. Similar cases can be brought from our small plover and stints and sand-peeps, where the smallest web perhaps ½ inch wide, is all that distinguishes species. It has boldly been said that there is no man of science at the present, but believes in evolution or development. A theory whose practical proofs, when you ask for them, its authors tell you are lost in the immense lapse of time, that it has taken by the gradual, slow and all but imperceptible changes, from vegetable life to animal life of the present day. Years by the tens of thousands or hundreds of thousands having swallowed all links in the great chain. But when you look at their proofs, we find them all drawn from modern life and variations of so short a period as ten or fifteen years. The many variations of pigeons developed by breeders from one species, the blue rock or common pigeon; the infinite variety of dogs of most opposite forms from one species, bull-dogs, hounds, collies with no tails, or grey hounds with long ones, thus developing in one a bony variation of numerous vertebræ, the bones being always considered more typical than colour, or the soft parts; the wonderful variations in cattle and horses produced by man, are also cited. But there can be no analogies between variations of three or four generations watched over most carefully, continually sliding back if not prevented into old forms, (as witness the long horn either of the African ox or Texas heifer, in opposition to the modern short horn), and one great principle drowning all other principles, never going back, always advancing into new forms, resistless, unceasing, yet counting thousands of centuries in its work. There may be such a grand necessity in creation, but the pigeon fancier or the stock-breeder may not prove it. Yet if we can advance forms that externally are so much alike, that it is impossible to distinguish them, but which, by some fixed inherent power, are still keeping up as it were an internal anatomical difference, we may at least say that here is one form that does not obey the grand principle of evolution, but that commencing as two species, still run in courses parallel, so close indeed as almost to evade connection. In this sense, these two species that I have presented to you this evening, I hope are of greater interest. The immense number of facts that are supposed to bear favorably on evolution, which have been massed together by those brilliant compilers, is perhaps the most splendid record of the age. Would they turn their attention to gather all facts that oppose it, they would not only be adding equally to our stores of science, but only doing what, from their fairness and candour, the world is expecting from them.

During the preparation of this paper, I have been examining many more specimens of Golden eyes, especially females, which I now can immediately separate from young males by their different wind-pipes. I find that females vary in having, or not having a narrow black bar across the white on the wings. This narrow black bar is formed by the white greater coverts having black tips, where they cover the white secondaries or speculum. In all the specimens studied, I have found this bar only in those I had already considered Barrow's females, whilst the common female had none. But as this bar differs in specimens, and also in the wings of the same bird, as respect to size and interruption, and as I never have had the opportunity to study it in the young males, I think it requires more observation before it is pronounced a typical mark. The pansy purple of the head dress of the male Barrow, in distinction to the duck-green of the common species, noted as typical by Richardson, does not hold, as I had before me this winter, a common Golden Eye drake with head dress of the finest pansy purple. It is now in the collection of Mr. A. Downs, Halifax, N. S.

ART. VI.—OF THE STRUCTURE OF THE BONES IN BIRDS, AND OF THEIR DIFFERENCES IN THE VARIOUS SPECIES. BY PIERRE CAMPER, 1771. TRANSLATED BY R. MORROW, FROM VOL. 3, PAGE 449, ET SEQ, PARIS EDITION OF CAMPER'S WORKS PUBLISHED IN 1803.

(Read April 8th, 1878.)

WHENEVER I have examined the internal structure of animals, I have admired the observation of the great Galileo, that one there always meets with new wonders! I have already given many proofs of it in the exhibition of the generation of the toads of Surinam; in that of the organ of hearing in ordinary and cartilaginous fishes and of the cachalot, which I have presented in part to the Royal Academy of Sciences, in part to the Society of Haarlem. Among the descriptions which I have not yet had time to complete, none appears to me more worthy of attention than that of the cavities, which are present in the bones of birds, chiefly in those which surround the trunk.

The bones of the wings, the clavicles, the bones of the chest, the vertebræ of the back, the bones of the haunches, and in many, the bones of the thighs, are quite hollow, without marrow, and receive into their cavities, by respiration, the air, by means of which the birds are made lighter and more capable of rising in the air.

This is quite a new discovery, which will be so much the more agreeable to the Academy, that it is purely physical. I made it in the month of February last year, when I was occupied in making investigations upon birds, in order to develop the mechanism of respiration, which in them is very peculiar.

I knew from the studies of Galileo[1] and of Borelli,[2] that the bones of birds were hollow and slight, in order that they may fly more easily: these two great men have been alone studious of the substance of the bones. Galileo especially, who has very evidently proved, in comparing them with tubes of wood or of metal, that a bone of the same length and weight being hollow has more strength than a bone of the same weight and length, but solid;[3] he has even added this remarkable rule: That the strength of hollow bones is to that of solid bones, in this case, as their diameters.[4] This reflection can not only be applied to the structure of bones in general, but also to that of plants, in which we see similar cavities without pith, but full of air.

Borelli[5] has displayed, in the explanation of the flight of birds and of the mechanism of their wings, the perfect knowledge which he had of the composition of their bones,[6] of the cavity of their chest and of their abdomen, as well as of the air which fills these two cavities.

1. "De Mechan." Dial. II, page 132.
2. "De Motu anim." Proposit 194, page 156.
3. Ibid.
4. "De Mechan." Dial. II, page 132.
5. Proposit 182, page 146.
6. Proposit 194.

The respiration of birds is at the present time too well known to need particular explanation; but the respiration into the bones of the trunk, of the wings and of the thighs, deserves a particular account. It is to this consideration only that I will limit myself in this paper.

I have called it a discovery, because I know of no author who has pointed out the least thing about it. It is very true that M. le Comte de Marsigli[1] knew that the bones of the wings in the pelican were hollow and without marrow, and very light; but he had no idea of the air, nor of the manner in which the air might enter into this cavity.

M. leComte de Buffon, the greatest naturalist which we have had since Aristotle, was not ignorant of that which Galileo and Borelli have communicated on this subject: he makes use of it in his excellent discourse upon the nature of birds;[2] but he did not know that the cavities of these bones received air instead of marrow, and that this fluid entered there by respiration.

They brought to me on the 10th Feb., 1771, a great sea eagle[3] like those of which they annually shoot a large number in the neighbourhood of this city during the frost. I dissected the ribs, above all the claws and their muscles, &c. I prepared a bone of the thigh principally to show its cavity and the fibres which support it within the bony laminæ in the animal. I expected to find marrow there, but only found periosteum, a large vein i. k. l., which covered it, and traces of the air vent as I have represented pl. xxxiv., fig. 6.

Astonished with this singularity I went immediately to examine the skeletons of an eagle, a toucan and an owl. I found a very large orifice under the great trochanter from the skeleton of the eagle; I did not perceive any trace of it in the others; but I noticed very large holes under the heads of the bones of the wings in all my skeletons of birds. I then examined the wings of the eagle with much attention; I opened this bone lengthwise and did not find marrow in it, but periosteum as in the bone of the thigh, and a very large opening in the inside

1. Danub. Fran. Mysic. tom, vi, tab 8, page 10 et seq.
2. Pages 16, 33, 34.
3. The sea-eagle of Buffon "Hist. Nat. des oiseaux," tom. I, page 112.

part of the head of the humerus, pl. xxxiv, fig. 1, a. b. c. Here is an analogy. The air can enter by these holes into the cavities of the bones; but I do not yet know how it could penetrate as far as these openings. I had by accident a dead owl. I made a small hole at the extremity of the bone of the wing, fig. 3, idem; I applied a copper tube, and blowing I saw with much pleasure that all the chest and abdomen swelled out; the air went out by the wind-pipe in proportion as I blew. I then tied, in order to have an opposite proof, the wind-pipe around my tube; and blowing I had the satisfaction to see the air go out by the small hole made in the bone of the wing, when I there applied the flame of a candle, or some light body, or a small feather.

The bone of the thigh of the owl, although perforated, did not convey the air; therefore it had no opening under the trochanter.

The chest and the abdomen of the eagle, were too offensive to repeat these experiments; I then removed the intestines, I blew through the bone of the thigh, and I saw that the pleura which goes as far as into the abdomen, forms a membranous conduit, which, going along the crural vessels, comes out at the opening of the thigh, d. e. f., fig. 6, and which gave passage to the air to enter freely into the cavity of this bone. This redoubled my ardour to push my discoveries further.

I took from my larder, a turkey, some pullets; I perforated in the same way the extremities of the bones of the wings; I applied to them my tube, and blowing, I saw, with surprise, the chest and the abdomen swell out as in the owl; the femurs did not admit the air, not being empty, but full of marrow as in the owls. In the grouse the experiment succeeded as in the eagle, for they have the holes under the trochanter, fig. 8, d. e. f.

The stork, of which they showed me the skeleton, has the bones of the wings void of marrow and filled with air, and a considerable hole, a. b. c., fig. 2. It has also the thigh bones empty, and a manifest hole under the trochanter, fig. 7, d. e. f.

I consequently imagined that I would find the bones of the wings in the greater number of birds empty; but that I would find the thigh bones perforated and permeable to the air only in those which fly very high, as the eagles, the storks, and all those which have the body heavy and a great many muscles, &c.

This conjecture was verified by the dissection of a sparrow: its thigh bones as well as its wings were full of marrow, as its flight is not high, nor of long continuance. The lark, for example, which fills the air with its melodious song, sustains itself a long time upon the wing; its wings are hollow, filled with air, and they have a very considerable opening.

I then earnestly desired to have the skeletons of the ostrich, the cassowary and the penguin, in order to know if the bones of their wings were full of air. I had already formed a negative conclusion; I requested M. Professor Allamand, of Leyden, to examine the skeleton of the ostrich; he had the kindness to answer me that he could find no opening under the head of the humerus of this bird. I could find no part of the skeleton of a cassowary nor of a penguin; I have since secured two penguins from the Cape of Good Hope, in spirits of wine; I have not yet had time to dissect the parts which are in question.

Borelli[1] has already made a very beautiful remark, that the wings are greater in proportion as birds fly higher; but ours pronounces their mechanism more curious and more interesting.

I return from this digression to the eagle, of which I examined very attentively the clavicles and the supports of the scapulæ, the scapulæ themselves, the sternum, the ribs and the vertebræ of the back: I have found all these bones hollow, vacant, full of air; also the sacrum and the coccyx.

On the 24th February, 1771, I made the following experiments upon a strangled owl.

1st. Having removed the great pectoral muscle, and perforated the bone of the wing near its extremity, I blew into this hole and I immediately perceived a large membranous pouch between the two pectorals, which goes along the vessels and the brachial nerves, giving a membranous duct towards the opening which lies near the head of this bone; this pouch also swelled when I blew through the trachea.

2nd. I removed the bony support of the scapula which was articulated with the sternum; I then made a very small hole, and blowing into it the same pouch swelled several times.

1 Proposit. 182.

3rd. I perforated the exterior plate of the sternum, near its union with the supports before described; the air also passed immediately into the chest and into the abdomen; almost all birds have orifices in the interior of this bone, and the pleura is the continuation of the internal periosteum of the cells of this bone.

4th. I made the same experiments upon the clavicles, and noticed in the same manner their communication with the cavity of the chest.

5th. I removed the posterior part of the coxa; perforated the exterior bony plate, and the air passed by its cells into the chest as if I had blown through the trachea.

6th. The air passed also through the body of the vertebræ of the back after having removed the flesh, perforated the bony plate and applied a tube.

7th. The ribs are also empty and receive the air by many holes which are visible in the cavity of the chest; by the same operation can one also blow the air through the ribs into the chest, as by the other bones before named.

I repeated the first, second, third, fourth and sixth experiments upon an eagle, March 13, 1771, before my auditors, in the anatomical theatre, with the same success.

8th. I perforated the bone of the thigh of this sea-eagle; I applied there my tube, and the air passed easily into the chest of this animal. Having blown by the trachea, the air went out by the same hole with so much violence, that it was easy, by this means, to extinguish a candle very quickly.

I could not say whether the same structure exists in the other birds; this requires a more particular examination; it is sufficient that the eagle, of which the velocity and height of flight are the greatest, and of which the strength as much to fly as to seize and tear its prey, ought to be necessarily greatest; that the eagle, I say, becomes lighter, not only by the air which distends its lungs, its chest and its abdomen, but further with the air which fills the cavities of its bones.

It is very probable from the experiments made upon the owl, that nature makes use of the same mechanism in all birds of prey.

It is likewise very probable that in the ostrich, the cassowary and the penguin, one will not find any hollow bones; that in the swan, the goose and the duck, the bones of the wings only will be empty and full of air; and only in part in the turkey, the fowl and the partridge; for these last have the bones of the wing partly full of marrow and partly full of air, or else, to speak more generally, it is apparent that the bones are void of marrow and full of air, in proportion as the birds carry the flight more or less high.

Galileo and Borelli have proved that the substance of the bones in birds is concave, as in the flute; but they supposed that they were full of an oily marrow much lighter than the bone. M. de Marsigli has observed that the bone of the wing of the pelican was void (of marrow) and full of air. I flatter myself to have discovered that in many birds, and in the birds of prey, all the bones which can have communication with the chest or the abdomen are filled with air, and I have verified the openings by which the air regularly enters, and is thus renewed by respiration.

The air which enters, and which thus fills the cavities of the bones, must necessarily become lighter by the heat of the body, by means of which the animal, becoming specifically lighter than the air itself, flies with more ease.

This discovery makes us see besides that the marrow is not necessary for the nutrition nor for the growth of the bones, nor for the anointing of the articulations, nor for the forming of the callus. I have found very often the bones of the wing, in fowls, broken and perfectly healed. I add, in order that the demonstration should be more complete, the drawing of such a bone, fig. 10, pl. xxxiv. Ossification receives from this much elucidation, and appears to claim to be examined according to this new plan.

It is not, however, without example, even in our bodies, to see the cellular substance of the bones filled with air; the mastoid apophyses receive air by the Eustachian tubes.

The head of the owl furnishes also another curious example—the air enters into the diploe of the whole skull by the auditory holes, for birds have no Eustachian tubes, like quadrupeds and amphibians.

Having dissected, December 13th, 1773, one of the penguins which I had received from the Cape of Good Hope, of the second species of "diomeda," of Linnæus, edit x., page 214, I found the bones full, as they should be according to the explanation which I have given.

Some time after, one brought me a diver of the species which Linnæus, ibid., page 222, calls "Colymbus immer," of which the wings are too small for it to fly. In this bird the bones of the wings are also filled with marrow and without air holes; therefore the bones of these two species of birds do not admit the air.

The thigh bones of the diver merit the attention of naturalists, in that they have no trochanter, of which the structure with that of its muscles is so admirable. The periosteum is black in this bird, and its colour comes off like that of the uvea of the eyes in the greater part of animals.

The head of the elephant[1] furnishes yet a more striking proof; but it is time to finish this memoir, after having given a short explanation of the figures, without which the description would have been less instructive and clear.

EXPLANATION OF THE PLATES.

PLATE XXXIV.

Figure 1—Represents the upper part of the bone of left wing of the sea-eagle; a, b, c, the hole by which the air enters.

Figure 2—The upper part of the bone of the left wing of the stork; a, b, c, the air hole.

Figure 3—The bone of the left wing of the owl; a, b, the air hole; p, the hole made at the lower part to apply the tube.

Figure 4—The bone of the right wing of the turkey; a, b, c, the air hole.

1. Camper, vol. 2, page 175, Paris, 1803.—"Account of the dissection of a young Elephant."—In order to confine the brain within proper bounds not to overburden the head with a useless weight of bony matter, and to give, moreover, the greatest spread which the muscles require, the plates of the skull are removed one from the other by a great number of bony partitions prolonged to the distance of many inches. The spaces, filled with an infinite number of cells, more or less spacious, communicate with the gullet by means of the Eustachian tubes, are filled with air in place of blood or of marrow, which is usually found in the diploe of mammalia. Perrault, Blair and Daubenton have noticed this structure in the elephant, in the boar, and in other quadrupeds: but Camper first discovered its analogy with the structure of the skull of birds.

Figure 5—The bone of the right wing of a hen; a, b, c, the air hole.

Figure 6—The bone of the left thigh of the sea-eagle; d, e, f, the air hole under the trochanter, h; g, the head of this bone; i, k, l, m, the supports which give strength to the bone, without which it would be too slight; i, l, m, n, the vein which covers the internal periosteum.

Figure 7—The bone of the left thigh of the stork; d, e, f, the air hole; h, the trochanter; g, the head of the bone.

Figure 8—The bone of the left thigh of the grouse; d, e, f, the air hole.

Figure 9—The bone of the right thigh of the hen, without air hole.

Figure 10—The bone of the right wing of a pullet; a, b, the air hole; g, r, the fracture perfectly united by callus.

[The translator regrets that he is unable to present copies of the plates referred to above, and in the supplement.]

Structure of the Bones in Birds.

Letter upon the same subject addressed to the Editors of a Literary Journal entitled "Hedendaagsche Vaderlandsche Letteroeffeningen."

Gentlemen,—It is with pleasure that I have seen in the third volume of your weekly Journal, [1] the Dissertation of Mr. John Hunter, "upon the interstices between the muscles and the cavities in the bones of birds, by which the air communicates with their lungs, which you have translated from the LXIVth volume of the Philosophical Transactions of London; a volume which only reached Holland in the autumn of 1774; whereas this dissertation had been read to the Royal Society, the 27th February, 1774. I have been at the same time pleased that you have done me the justice to remark: "That I had already, March 2nd, 1771, communicated to the Batavian Society of Rotterdam, this discovery, and consequently *three* years before M. Hunter had spoken of it."

This concurrence of ideas ought in the meanwhile to fix the

1. No. 10, 1774, page 421.

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attention of the learned of our country and incite them to compare my dissertation with that of M. Hunter; and that so much the more as the first volume of the Batavian Society of Rotterdam appeared later than volume LXIV of the "Philosophical Transactions." One might then easily pass over the date of my dissertation, or even as it often happens, neglect it voluntarily; which might be prejudicial to the priority of my discovery.

In order to remove all doubt upon this subject, I proceed to furnish the most peremptory proof to show that I have in effect discovered and communicated, three years before M. Hunter, this singular property of birds; and I will produce at the same time, the new observations which I have made since that time, by the dissection of the cassowary, the ostrich, the hooded-crow, the owl and other birds.

Delighted, and not without reason, I think, to have made this beautiful discovery in birds, February 11, 1771, I communicated it at once to many of my friends, and, among others, to M. Allamand, of Leyden. I have preserved for particular reasons, the answer which this *savant* made to me upon this subject. I had promised to him my observations upon the reindeer (which appeared in 1771, in the form of a supplement to the Amsterdam edition of Buffon's Natural History); and I communicated to him, in the same letter my discovery of the cavity in the bones of birds. This is the reply which he made me: "I thank you "before hand for your observations on the reindeer which you "have the kindness to cause me to expect, &c.—I have not yet "had the opportunity of making the experiments which prove "the communication between the abdomen and the large bones "of birds; but after what you have said of it, I believe the fact "as if I had seen it.—I am going to Guelders, where I shall have "birds of divers kinds in abundance, in order to verify your "beautiful discovery." This letter is without date, but has however been written at the beginning of the year 1771, as appears by the publication of my observations upon the reindeer.

I, at the same time, requested M. Allamand to examine the skeleton of the ostrich; upon which he answered me in another letter of June 23, 1771: "Your discovery of the passage of the

"air in the bones of birds, appears to me more and more interest-
"ing, and you will not be sorry to learn that your conjecture as "to the bones of the ostrich is true, at least in a skeleton which "I have of this bird; and I have not been able to discover any "vestige of the least opening either in the humerus or in the "bone of the thigh. It will be without doubt the same with the "cassowary; which seems to show that you have found out the "real use of this air passage in the bones; since neither of these "two birds nor the penguin can fly." [1]

However eighteen months passed without my having any hope that they would soon grant the insertion of my discovery in the Transactions of the Batavian Society of Rotterdam to which I had sent it.

This determined me to send my memoir to M. Portal, at Paris, which I did the 21st November, 1772, with some additions in French requesting him to insert it in the Memoirs of the Royal Academy of Sciences, with some observations upon the ant-eater of the Cape of Good Hope, upon the peccary (Sus. sp., 3 dorso cystifero, cauda nulla. Linn., gen. 35), and upon the organ of hearing and the blow holes of the cachalot, etc. M. Portal did me the honor to reply to me the 16th March, 1773, that the observations which I had sent to him had been deemed of so great importance by the members of the Academy, that they had commissioned M. M. Daubenton, Tenon and Portal to make observations on the birds which I had named; and M. Portal afterwards informed me, under date of the 26th April, 1774, that they had made these observations with which they had been much satisfied, and which were found perfectly conformable with that which I had said; so that the Royal Academy of Sciences, to which they had reported the 23rd April, in the same year, had judged them worthy to be inserted in its Transactions; certain proof that at this time no person had yet had the least knowledge of this peculiar structure of birds.

As a new proof, useless without doubt, that I had made much sooner than M. Hunter this discovery, I send you from this place

1 One sees by these two letters that already in 1771, M. Allamand knew not only my discovery, but that he had even verified it by his own experiments.

a latin dissertation which M. Ladislaus Charnack, a Hungarian, read the 25th August, 1773, at a public meeting of the University of Groningen, upon the respiration of birds. [1] M. Charnack, admits that I was the first who made the discovery of this singular property, since he says: "It was the celebrated Camper "who first discovered that birds breathe also through the cavities "of the bones of the wings, the thighs and even of the trunk, "&c." [2] If we compare this dissertation with that which I have sent to the Society of Rotterdam, we shall see that it agrees with it exactly. This is not astonishing: M. Charnack has been one of my most assiduous hearers, to whom I have often repeated my observations upon this subject; even as he also expressly mentions it: "The celebrated Camper, has often made in presence of his hearers, experiments of this kind upon the owl, the eagle, etc." [3]

These convincing proofs show incontestibly that I had already, at this time, a perfect knowledge of the intromission of air into the cavities of the bones of birds, which M. John Hunter spoke of to the Royal Society of London only upon the 27th February, 1774. I pass now to the corrections which I have made since that time to my dissertation.

In the dissertation which I sent the 2nd March, 1771, to the Batavian Society, I say expressly: "Nevertheless, birds have "not as the quadrupeds, ducts, which terminate in the mouth "or in the gullet; but there is probably an opening in the length "of the auditory conduit to introduce and refresh the air between "the bony plates of the head." I am so much the more certain in this respect as already in 1745, when I was still studying, I knew, and exactly drew, the organ of hearing of birds; but it was only the 12th November, 1774, that I discovered, for the first time, the outlet of the auditory conduits in the mouth of an ostrich, which was used in my investigations on this subject; and when I found myself once upon the track, it was not difficult to make the same discovery in the cock, the sparrow, the owl, the

1 Dissert. medica de inspiratione volucrum.

2 Respirationem, avium etiam, per ossa cava humeri, femorum et ipsius, trunci exerceri, mortalium primus cel. Camperus detexit, &c.

3 Varia hujus generis, experimenta in noctua et aquila coram auditoribus suis instituit cel. Camperus, etc.

hooded-crow, and in other birds. I then perceived the cause of my error. They have only one common opening for the two Eustachian tubes; and the opening lies placed very much hidden between the two digitiform apophyses above the œsophagus.

DuVerney, Casserius, Blasius, Valentin and Collins even, though the last was well aware of these apophyses, which he called "processus cristati," make no mention of this opening.

The multiplied duties of the place of professor which I then occupied, left me little leisure to read, or even look over all the dissertations which came to us from England. Now as I am disengaged, I find that Dr. Allen Monten had already described in 1681 these conduits, as well as their union with the cavities between the bony walls of the head in birds. One has only to consult Badham or Lowthorp, who say: "There is but one aquaeductus (hollow conduit) in the head of all the fowls, exactly in the middle of the palate, below the insertion of the nostrils into it,—It is a membranous tube, which reaches backward as far as the communication from ear to ear." As it was in 1771 that I fell into this error, it appears that it was the following trial which led me into it. Having made a hole in the lamina of the head of a common brown owl, I found that the air went out with such violence by the openings of the ears, that I extinguished the flame of a candle with it; as has been confirmed by M. Charnack.[1] The violence with which I blew had broken the tympanum, because the Eustachian tubes were too small? to permit all this air to pass with sufficient rapidity.

In the sparrow owl (strix passerina, Linn.) which I dissected the 25th December, 1774, I made a small opening over above the orbits of the eyes in the exterior bony plate. I blew then by the Eustachian tube, and the flame of a candle held opposite the opening which I had made, confirmed the communication and the statement of M. Hunter,[2] as well as the discovery which Dr. Monten had made nearly a century before. I have renewed since these same experiments upon the hooded-crow, the cock and other birds, always with the same success. In the cock we must make the opening behind the ear.

1. Ibid, page 13.
2. Ibid, page 210.

Respecting the very conspicuous apophyses of which I have spoken in the supplement of my dissertation, I ought to remark here in passing, that Willoughby has indeed published a very rude drawing of these apophyses in his ornithology [1] but without giving a description of it, although he has elsewhere pointed out the situation of the bone of the thigh. Meyer [2] has them also perfectly well drawn in the diver, without speaking of them in his text.

M. Hoffman, a celebrated Doctor of Batavia, formerly one of my most zealous pupils, and to whom I owe many precious morsels in my collection, has sent me from the East a cassowary preserved in arrack, after having removed the intestines. The bones of the wings are proportionately to the size of its body, unusually small, and absolutely receive no air, nor do the bones of the thighs or the ribs; but there is air in the cavities between the haunch bones and the sacrum. This bird does not run quickly, and its wings are even much smaller than those of the penguin from the Cape of Good Hope. In this bird the middle claw of the feet was not the largest, as Linnæus [3] contends; but it was the inside claw, which was as long again as all the others.

A short time after, M. Pennant, arrived at the end of September, 1774, from Holland, at Leeuwarden, with an elephant, an ostrich and other animals; the ostrich died from having swallowed too much copper coin. I bought this dead bird in October, but divers occupations compelled me to put off dissecting it until the 6th November, 1774.

The ostrich is a bird too well known, and has been too well described by Perrault, Valisneri, Brown, Ranby, Warren and Buffon, for it to be necessary that I should stop here to speak of its exterior form. I will merely remark that it is with astonishment I have seen, that Valisneri, Brown, Perrault, Klein, Brisson and Linnæus, have not observed the claw of the little toe, whereas it is visibly half an inch and often even three quarters of an inch in length. It certainly sometimes happens that the scaly skin covers this claw, but one can, however, always per-

1. Figure 62.
2. Kur Vorstell, allerh. thiere. Nar. 1748, B. I., fig. 99, 100.
3. Dixieme edition, page 265.

ceive it. Johnston, Cheseldon and Meyer, have, on the contrary, represented this toe very large; perhaps from want of attention, or because they have imagined that it ought to be so.

I have found (and this is the question here) in the ostrich that which M. John Hunter had remarked in it, namely, that no air enters into the bones of the wings, but certainly in all the other bones as in all other birds; that is to say, in the vertebræ, the sternum, the ribs, &c.; and, that which is here the principal subject in the bones of the thighs. On the 11th December, 1774, whilst preparing the skeleton of this bird, I noticed on the front of the thigh bone quite a large air hole, divided into many small holes between the condyles; so that the bone of the thigh is not only full of air, but it appears even probable that the air goes out again between the membranous interstices of the muscles. However, this requires further investigation.

The air penetrates to the end of the coccyx along the spinous apophyses. It fills the large interstice of the sacrum, and of the bones of the haunches, with the peculiar membranes which communicate with the stomach and with the chest. M. J. Hunter was then right and I am not the only one who has deceived himself. The cause of this error appears to consist in this, that these holes are not found as in the eagle, the stork, the grouse, etc., on the front, but entirely on the posterior side of the thigh; so that it is only with difficulty that one discovers them, particularly when one does not suppose them to be there.

Mr. Hunter also says that the air penetrates into the "medulla oblongata": I have found this to be true in a hooded-crow; after having made an incision in the middle of the neck, and introduced a blow pipe between the spinal marrow and its membranes, I caused the air to enter quite easily until I had distended the stomach; and the air then went out through a hole which I had made in the bone of the wing. I cut off the head of another hooded-crow between the occiput and the atlas; but it was impossible for me to introduce the air into the spinal marrow. It appears to me by the experiments which I have made as much upon the hooded-crows as upon fowls, that the air can permeate within the vertebræ of the neck.

I had already seen but not so distinctly as I could desire, that the lower jaw of the ostrich, the heron, the bittern and the crow; was filled with air. It appears that M. Hunter has noticed the same thing in the pelican, he says: "The lower jaw of the pelican is also furnished with air; but by what means I do not know."[1.]

I have sought to know this means and have discovered it evidently in the ostrich, the heron and in the bittern. It is easy to perceive it in the hooded-crow. On the upper side of the apophyses placed behind the lower jaw which are curved inside there is a round hole, large enough in the ostrich for one to introduce a quill into it; in the heron and the other birds this hole was smaller, but however, conspicuous and spacious. From this hole proceeded a membranous conduit which went round it showing behind the tympanum, and is attached to a similar hole a little below the upper edge of the drum. It is by this conduit that the air penetrates from the cavities between the bony laminae of the head into the lower jaw; so that the lower jaw receives the air through the Eustachian tubes.

It is with the hooded-crow that one can best make this experiment, making a hole in the horny part of the lower jaw, and another hole behind the ear after having raised the skin. Let one then blow through a blow-pipe alternately into the one and the other hole. When we hold the head with one of these holes beneath water we shall see the air go out with force; and if we raise the muscle behind the lower jaw, we will very distinctly see the membranous conduit.

The discovery of this part belongs then to me. My account, as if the holes in the bones of birds were peculiar to those which fly a long time and very high, appears certainly, to lose its weight, from what I have just now said with regard to the ostrich, but it is not nevertheless entirely destroyed, since we know that the ostrich runs with extreme velocity and flies even along the earth; which it could not do, if the Creator had not considerably diminished its weight by giving to it this admirable structure. This will become still more clear, if we call to mind

1. Ibid, page 211.

what the Count de Buffon says, according to M. Martine, [1] that the natural heat of birds is very much greater than that of man, and that it consequently should render the air in all the cavities of the bones sensibly lighter than that of our atmosphere. The cassowary, whose running is not swift, has not the bones of the thighs and of the wings, etc., empty, as I have already noticed.

The snipe, the sea-swallow and sparrows, do not have the bones of the thighs and of the wings empty. The feathers of the tail of these birds appear to make up this defect; besides, these birds do not fly very high nor remain a long time upon the wing.

For these reasons I cannot determine to abandon my conjectures, to adopt those of M. John Hunter, "That all these cavities "are only appendages of the lungs, and that we should only re- "gard them as reservoirs of air."

Franeker, January 15, 1775.

SUPPLEMENT

TO THE MEMOIR UPON THE STRUCTURE OF THE BONES OF BIRDS.

Sec. I. In my letter to the editors of the "Hedendaagsche Vaderlandsche Letteroeffeningen," I have already observed [2] that there is a large air hole in the posterior side of the thigh bone of the ostrich. I think that the reader will be pleased to find here the drawing of a similar bone, taken from a young ostrich and represented with great accuracy, though reduced a little.

Fig. 11 of plate xxxiv, represents the bone of the right leg seen in front: A, is the head; B, the great trochanter; D and C, are the condyles which are united with the tibia by the articulations, to which E also belongs. There is something which is visible only in part, this is the epiphysis of the upper part, a. b.; in the same manner as c, d, e, f, g, is the epiphysis of the lower part of the bone of the leg.

One sees clearly that from this side there is no hole visible; but on the back side where A, B, C, D and E, point out this same part in fig. 12, plate xxxiv., we see very distinctly the large air holes, h, i, k, l, m, on the upper part, and n, p, q, on the lower

1. Suppl. tom I, page 84, note C.
2. See page 417.

part above the cartilage, C and E. These holes were covered with periosteum; in such a manner however, as to leave sufficiently large openings so that the air could pass in requisite quantity into the bones.

I ought here to return many thanks to the learned Dr. Bloch, of Berlin, for the friendly reception which he has given to me during my stay in this city, and for so obligingly sending me a male bustard, (otis, gen. 95, sp. edit. x. Linn.) In the hollow bone of the leg of this bird there is a remarkable air hole, but exactly upon the great trochanter; it appears then that the situation of this hole varies much in many birds, though it is found to be, in truth almost always on the front side of the bone.

In the crowned Indian pheasant (columba, Linn., gen. 104, sp. 17). I have found the same bone of the leg filled with air, and the air hole placed upon the front of the bone, as in the eagle, the stork, the grouse, etc.

In a spoonbill (platalea, gen. 80, sp. 1, Linn.,) which had been dissected the preceding winter, the bones of the legs were entirely filled with marrow. It was remarkable that between the muscles of the coccyx (glutei) it had two large air pouches, which resembled those which are between the pectoral muscles, which were also very considerable. The air penetrates even into all the bones of the chest and of the stomach in the same way as into the bones of the thighs and of the sacrum.

Sec. II. Although the holes by means of which the air penetrates into the lower jaw of the terrestrial birds, have been sufficiently described in the before mentioned letter,[1] I think that it is necessary, to make me better understood in this respect, to give drawings of these parts: I have then in fig. 13 of plate xxxiv. represented the lower jaw of an ostrich, and in fig. 14 that of the third species of hornbill (buceros, gen. 74, Linn.,) as well as that of the fourth species of hornbill, in fig. 15. Figure 16 represents the entire lower jaw of a hooded-crow (cornix, gen. 50, sp. 5, Linn.) In fig. 17 we see the lower jaw of a heron (ardea, gen. 84, sp. 12.) All these jaws are of natural size and seen from above.

1 See page 418.

A and B, in figs. 13 and 17, but A, D, in the figs. 14, 15 and 16, are the inside epiphyses of the extremities of the lower jaw. C, is the point of it; but as in the figs. 14 and 15, the jaws of the hornbill have been mutilated, C, C, show the place where this amputation has been made. R, points out in all these jaws the air hole, to which is attached the tube which goes from the interior of the ear and which receives the air by the Eustachian tubes. The lower jaw of aquatic birds, such as the swan, the duck, the goose, the penguin and others similar, receives positively no air, no more than the other bones of the head. It appears that nature has by this means intended to make their heads better fitted for diving.

Sec. III. Though nothing may be more easy to demonstrate than the manner by which the air finds its way into all the bones which surround the cavity of the chest, it appeared to me however, difficult to divine how the air could fill all the vertebræ of the neck so far as the head.

In dissecting, November 24th of last year, 1780, the spoonbill, I discovered very evidently an air duct, which from the anterior cavity of the chest passed the whole length of the vertebræ of the neck as far as the head. The bird was too fat, so that it was impossible for me to follow its other air tubes.

The 27th November I killed a heron, in which I discovered three air tubes, which proceeded from the anterior side of the pleura. One of these tubes passed in front along the vertebræ of the neck as in the spoonbill, and two laterally between the intertransversary muscles, that is to say, which are found placed between the tranverse apophyses of the vertebræ. Each vertebra takes a branch from these tubes, and by this means is filled with air. But I have not yet been able to discover how the air can find its way even into the tough membrane which envelopes the spinal marrow (medulla oblongata).

It is probable that for this it will be necessary to make injections with mercury, as well upon the sides of the chest as the length of the neck, etc. But it would require the investigations, not of one person only, but of many. Until this is done, I proceed by way of recapitulation to sum up with a species of conviction that which I have said before.

1st.—That the air penetrates, in birds, through the nose, between the bony plates of the skull and the vomer, as in the ostrich, the hooded-crow, the heron, and other similar birds.

2nd.—That the skull and all the lower jaw receive the air by the Eustachian tubes.

3rd.—That the vertebræ of the neck receive the air through the three ducts from the anterior cavity of the chest, of which I have before spoken.

4th.—All the bones around the chest and the body have large holes which come out internally into the pleura, and which easily admit the air inhaled through the trachea.

5th.—The bones of the wings and the air pouches which are found between the pectoral muscles receive the air immediately from the cavity of the chest by the brachial vessels.

6th.—The thigh bones receive the air, by the membranous conduits of the pleura, or from the air holes which are above the intestines as far as the haunch bones: these are also accompanied by the crural vessels. They have sometimes the form of large bladders between the coccygeal muscles, as I have observed in the spoonbill. It may be possible that the same thing occurs in the ostrich and other birds. Perhaps there are behind, air pouches which go downwards beneath the crural muscle. But I had so much to observe in the dissection of this large and rare bird, in regard to the eyes, the feet, the intestines, &c., that it was impossible for me to examine the whole of it with the proper care.

7th.—Aquatic[1] birds do not appear to have air in the bony frame of the head, nor even in their other bones.

8th.—Some birds, such as the woodcock (rusticula or kolopax, gen. 86, sp. 6) and others of similar character, have positively no air in their bony frame, and fly nevertheless far and a very long time. But in all these birds the pectoral muscles are strong enough for such a flight, and the apophysis of the sternum is very large.

1. The Wild Goose (B. Canadensis) and Black Duck (A obscura) have the humerus hollow with large air holes, and other aquatic birds are most probably similarly furnished.—Note by the Translator—see also page 409.

We see also in the bat that nature compensates for the great weight which results from the marrow of the bones, in opposition to air, by the strength of the muscles which move the wings, and by the magnitude of the wings themselves.

Sec. IV. However it may be, I was much gratified when I perceived that the primary feathers of the eagle are hollow up to the end. I have noticed the same thing in the primary feathers of the heron and of the spoonbill ; and there is room to believe that this is also the case in many other birds.

An observation which seems to me worthy of naturalists, would be to know how the air finds its way into the feathers and penetrates into the stalks of the feathers of all birds ? How then does it come into the quills of the porcupine, etc. ? It is certain that there are no air-ducts which go there from the chest. In what way can this then be brought about ? It is probable that it is the blood-vessels which take the air there ; the same as we see that the plants carry the air into their air-ducts. Let this be as it may, it appears that nature has intended to make a mystery of this admirable peculiarity ; and notwithstanding that the celebrated Poupart [1] has made some attempts in order to discover the mechanism of it, and that Perrault speaks [2] of it in his description of the ostrich, all the other naturalists have kept silence upon this important and obscure point.

ART. VII.—NOTES ON NOVA SCOTIAN MINERALOGY. BY HENRY LOUIS, ESQ., ASSOC. R. S. M., LONDONDERRY MINES, N. S.

(Read May 13.)

THE extensive development in Nova Scotia of the palæozoic formations, the metamorphism which they have undergone, their frequent and excessive dislocations and contortions, together with the physical features of the country, all combine to render this Province peculiarly attractive as a field for mineralogical research. For, whilst violent volcanic and metamorphic agencies

1. Hist. de l'Acad. royale des sciences, année 1699, p. 56 in 8vo.
2. Mém. pour servir á l'hist. nat. des anim, part II., page 272.

have promoted the development, in the various strata, of many rare and beautiful minerals, the numerous valleys, the result of long continued glacial action, intersecting the country in all directions, render even the lowest strata readily accessible, and permit us to examine their rich and varied mineral deposits with facility.

For my own part, I find an especial source of interest in the wide differences that exist between Nova Scotian and English minerals, both as to character and modes of occurrence, and have thus been led to devote some little time to their study; having during the past year met with a few minerals which appeared, either on account of their variety or of some peculiar characteristic, to merit a careful examination, I now venture to lay before the Institute a short account of some of the results obtained.

1.—Having lately had the opportunity of visiting the well known copper mines at New Annan, I noticed several nodules of covelline while examining the heaps of material that have been extracted from the workings on the left bank of French River, where the nodule bed has been driven upon for some little distance. These nodules are for the most part very small, and some of them, but not all, differ from the nodules of vitreous copper ore (the principal ore in the nodule bed), in not being coated with carbonate of copper. The mineral exhibits all the usual physical characteristics of covelline; the fracture is crypto-crystalline or earthy, the lustre sub-metallic or dull, the colour dark indigo blue, and the streak black; the hardness is about 2, some of the specimens being somewhat friable, the specific gravity is 4.388. The following is an analysis of one of the most characteristic specimens:

Copper	64.11
Sulphur	25.64
Ferric Oxide and Alumina	3.89
Insoluble matter	5.78
Manganese, Lime, Magn., &c,.	traces
	99.42

The empirical formula deduced from this analysis is Cu_5, S_4;

this formula requires that the copper shall bear to the sulphur the ratio of 100 : 40.38 ; the ratio actually found is 100 : 39.99. The constitutional formula equivalent to Cu_5, S_4; is most probably $3 CuS + Cu_2S$. Coveline is always the product of the alteration of other copper ores, in this case evidently of vitreous copper ore, part of the copper having probably been removed by oxidation and solution in the water which carried the nodules; in this connection it is important to note that the sandstone in which the nodules occur is more or less impregnated with copper. In order to convert vitreous copper ore into Coveline, it is necessary that one-half of the copper contained in the former shall be removed; but in the case of the specimen now under consideration three-fourths of this amount has been abstracted, and some of the nodules appear, from their greater hardness and the absence of crystalline structure, to retain an even larger proportion of copper, so that all stages of decomposition, from nearly pure vitreous copper ore to nearly pure Covelline, are probably represented among these nodules.

I have lately seen a nodule consisting of alternate irregular layers of covelline and vitreous copper ore; I am informed that it was not obtained at New Annan, but I was unable to ascertain its precise locality.

The examination of another of the nodules from the same bed yielded results which do not agree with the description of any known mineral, as far as I know. The fracture is uneven, lustre dull metallic, color bronze-brown, streak greyish or greenish-black, hardness about 5, specific gravity 4.13. The following is the average of two closely concordant analyses:

Insoluble matter	19.66
Iron	25.95
Copper	20.52
Sulphur	31.35
Organic matter, Lime, Magnesia, Manganese, present, but not determined; Cobalt, Nickel, traces.	
	97.48

Disregarding the insoluble matter, which appears to be due to an admixture of sand or shale, and is evidently an accidental constituent, the empirical formula given by the analysis, is Fe_3, Cu_2, S_6. This formula demands the following per-centage composition:

Iron	33.34
Copper	26.08
Sulphur	39.43
	100.00

The per-centage composition, as deduced from the determinations of the three principal elements is:

Iron	33.34
Copper	26.37
Sulphur	40.29
	100.00

The correspondence between these two per-centages is, I think, sufficiently close to justify the empirical formula which I have assigned to the mineral. The constitutional formula corresponding to it is probably $Fe\,S_2 + Fe_2\,Cu_2\,S_4$ (iron and copper pyrites). This mineral approaches more nearly to Cubanite than to any other that I am acquainted with, both as regards its physical characters and its chemical composition. Dana gives the specific gravity of Cubanite as varying from 4026 to 418, its hardness as 4, and its formula as $Fe_4\,Cu_2\,S_8$, or $_2\,Fe\,S_2 + Fe_2\,Cu_2\,S_4$ so that the New Annan mineral differs from Cubanite in containing one equivalent less of iron pyrites. Although the New Annan mineral is thus not quite identical with Cubanite, and certainly appears to have a well defined composition, yet it would be extremely hazardous to attempt to found a new mineral species upon a specimen which shews no crystalline structure and contains as much as 20 p. c. of extraneous matter. It is of course possible that the mineral may merely be a mixture of sand, iron pyrites and copper pyrites, but it is hardly probable that in a purely accidental mixture the iron and copper pyrites should occur in such exact molecular equivalents. It is to be hoped that further explorations may bring to light purer specimens of this mineral.

3.—Mr. Henry S. Poole, in his Mining Report for 1876, mentions that he found in the Martin's Brook Mines, at Londonderry, a delicate fibrous mineral encrusting some of the Iron ores, which mineral was determined by Prof. How to be manganite. These incrustations occur principally in the upper levels of the mine, in bunches of very dark ore, some of which yielded on analysis as much as 14 p. c. of manganese; a great deal of this ore is of a vescicular structure, containing in some of its cavities little masses of a manganiferous mineral, varying from the size of a small pea up to that of a hazel nut; * this mineral is probably identical, in composition and origin, with the encrusting films before mentioned. It is of a light spongy texture, sometimes obscurely fibrous, has a black or iron-grey colour, semi-metallic lustre and black streak; it is friable and very soft; its hardness being less than 2; some of the masses contain a minute kernel of brown iron ore. The following is an analysis of this mineral:

Insoluble matter	4.08
Water of hydration	9.63
Manganic dioxide	67.10
Manganous oxide	10.67
Cupric oxide	0.88
Ferrous oxide	4.09
Nickelous and Cobaltous oxide.	0.65
Lime	2.49
Magnesia	trace.
Alumina (with a trace of soluble silica)	0.67
	100.26

The simplest formula that can be deduced from this composition is $3\ Mn\ O_2\ RO + 2\ H_2O$. where R O represents all the protoxides, namely, Mn O, Cu O, Fe O, Co O, NO, Ca O. Judging from its physical characteristics, this mineral must

* Since this paper was read, a magnificent bunch of this mineral has been found, showing a fibrous structure four inches in depth, somewhat resembling one of the forms of limonite or the familiar tree fungus.

evidently be classed as a Wad, although the formula which I have obtained for it does not correspond with that given by Dana for Wad; however in so indefinite a mineral species much variation in chemical composition is naturally to be expected. This mineral is probably produced by the decomposition of the Iron ore, for it has exactly the composition that would be obtained by removing all the hydrated peroxide of Iron from a very large body of ore, so that the residue would contain all the impurities originally present in the whole mass, and in something like the same relative proportions; for while the Londonderry Iron ores always contain a decided percentage of Manganese, they only contain minute and quite inestimable traces of Copper, Nickel and Cobalt. The physical characters, both of the mineral and of the surrounding ore, undoubtedly give considerable support to this view, for their open and spongy texture readily permits the percolation of water, by means of which the iron might be removed.

4.—The last mineral on my list, to which I wish to call your attention, is Native Sulphur. This mineral occurs in a gypsum quarry, situated about two miles to the west of Johnston's road station on the Intercolonial Railway. The gypsum, as usual, overlies a bed of limestone; the lower layers of it are white, moderately hard, and contain some anhydrite; the upper layers are softer, of a blackish or grey colour in places, and contain numerous loosely embedded, much shattered crystals of native sulphur, the largest of which does not exceed ¼ inch in length. The mode of occurrence of this mineral gives considerable support to the theory that these deposits of gypsum are due to the action of sulphuric acid upon the limestones, the sulphuric acid being of volcanic origin; under such circumstances, it is highly probable that the same stream that conveyed the sulphuric acid, would also carry down with it shattered crystals of sulphur, which would then be deposited amongst the gypsum, which the acid water was producing.

The percentage of sulphur in the rock appears to be small, but as I was unable to make more than a very hasty and imperfect examination of the deposit, I can form no opinion as to the probable economic importance or extent of the sulphur bearing rocks.

ART. VIII.—METEOROLOGICAL PHENOMENA OCCASIONAL AND PERIODICAL. BY FRED. ALLISON, M. A., CHIEF METEOROLOGICAL AGENT, HALIFAX.

(Read May 13, 1878.)

LAST year I had the honour of reading before this Institute a paper in which were noted many of the facts deduced from a long experience, and statistics of instrumental observations. These sheets contain a continuation of that series, embracing the chief recurring events of the seasons in animal and vegetable life ; and those appearances in the clouds and disturbances in the atmosphere which from time to time are visible ; and, though familiar and of frequent occurrence, are irregular, and governed by laws unknown to us at present. Of these, as well as of periodic events, I propose to give a summary of means, terms, and peculiarities, as observed by me in Nova Scotia.

To begin with occasional phenomena. The principal which we will discuss this evening are Gales—Lunar and Solar Halos and Coronæ—Fogs—Dews and Hoar Frosts—Thunders and Lightnings—Hails—Rainbows—and days of Sleighing ; adding a few words to the remarks made here by me in 1869 concerning the Aurora Borealis (vide Transactions of N. S. I. of N. S. Vol. II. Part III.)

The Gales of Nova Scotia were noticed in my preceding paper, among instrumental observations of wind force (vide Transactions of this Institute, Vol. IV. Part III.) so little more need be said now. But, apart from the excessive velocity of the wind, a Gale must be considered as a Phenomenon due to widely extended atmospheric disturbance. It is commonly agreed that 30 miles per hour is the least Gale rate ; 80 miles per hour has been reported from different out stations of this Province ; but in Halifax (as before said) I have never recorded above 63. Last year was wonderfully quiet, scoring but 12 Gales, whereas 20 is the annual average. For farther details I again refer to my communication of last May.

All Halos and Coronæ round the Sun and Moon are interesting in their formation and connections, but care must be taken to distinguish between these very different "rings." As is well known to most here, Halos are the large circles, generally 45°, frequently 90° in diameter. They proceed from the prismatic particles of ice in the higher strata of atmosphere, and the colours which often tint them are the effects of refracted rays of light; Red naturally appearing on the inside of the circle; because a very low temperature of the upper air is betokened by the Halo, and because this heavier cold air descending compresses the moisture hitherto held in the warmer lower strata. Wet weather is commonly looked for after this Phenomenon. But it does not necessarily follow. The temperature of the mingled currents may become so gradually assimilated as to avoid Precipitation. Or a wind draught induced by other causes may carry off the colder air, or give space for a still warmer rush of heat; in either of which cases the power of precipitating moisture would be annihilated.—The smaller rings, or Coronæ, are merely the effects of light passing over the Sun's or Moon's face, and are 8 or 10° in diameter. When coloured the Red is on the *outside*, being reflected. The same effect may be seen in dust round any luminous object. In the more intense light of the sun, solar circles are much less visible. Winter is the general season for Lunar Halos. From April to October they are very rare, while here they average 10 appearances during the remaining months.

Fog—or complete saturation of the atmosphere, when the wet and dry bulbs of the thermometer stand together, and no evaporation takes place—is common enough on all the coasts of our Peninsula, though almost unknown beyond the sea slopes. Owing to the frequent great difference in temperature between land and water, most fogs visit us between April and September; winter being comparatively clear, except from occasional land-fogs brought on by the induction of tropic currents upon our colder climate. Of the average 50 fogs annually in the City of Halifax, 9 come in July; 8 in June; 5 each in May and August; 4 in October; 3 each in January, March, April, September and December, and 2 in February and November respectively.

Dews and hoar frosts are one and the same; though, strange to say, those who pretend to wisdom in such subjects will tell you that dew is followed by dry and hoar frost by wet weather. There is obviously no reason in this. The fact seems to be that when the atmosphere is near saturation, and the sky clear enough to keep the earth's surface cooler, by radiation, than the lowest atmospheric layer, and the night calm enough to prevent the removal of this incumbent atmosphere rapidly, or the mixing of different portions thereof of unequal temperature by wind, Dew is formed in the milder months. Exactly the same process is gone through when Hoar Frost is deposited from the same causes, but if the temperature on the ground be below the freezing point the deposit congeals. Should the lower air become cooler from any cause, then Precipitation is apt to follow both Dew and Hoar Frost as Rain or Snow; but a warmer air may absorb this moisture and keep the weather dry. About 25 per cent. of our Dews are recorded in September, when the earth and air differ most greatly in Heat. Annually an average of 75 nights witnesses this Phenomenon, as Dew; and 53—as Hoar Frost, December shewing the greater number of the latter; then February, January, March, November, April, October, May, in order.—September generally has one such deposit, but June very rarely; as during the last 10 years, I once noticed 2—viz: in 1875, and once 1 Hoar Frost in June, in 1874. In July and August I have never seen Hoar Frost in Nova Scotia, nor have authentic record thereof.

It will not be necessary to say much regarding Thunder and Lightning, which being of so startling and attractive a nature, are very familiar to all. The former is the report as the latter is the flash of an electrical discharge. These discharges may take place between clouds and the earth, or between two layers of cloud. The former case is most common and its effect most to be feared. The Thunder may be heard without any visible Lightning, but this is only owing to other masses of wind obstructing a view of the latter. Again, that which is commonly known as "Heat Lightning" had better be called "Reflected Lightning" as it is merely the reflection of some Lightning, itself beyond our vision, upon the low lying strata just above the horizon; and has nothing more to do with *Heat* than has any other Lightning—which however is a good deal. Many meteorologists argue that the sudden heavy Rain showers accompanying this Phenomenon are the *cause* of the condition of the atmosphere which creates Thunder and Lightning, and not the *effect*, as was for so long believed. And this appears more reasonable, as the descent of large quantities of water must certainly disarrange the electrical state and change the relative position of the cloud strata; while it is hard to say why the display of Lightning should cause immediate rain. But as so many different agencies are at work on the Temperature, causing numerous ascending and descending currents, and divers excitements of electricity, the question becomes excessively intricate, and even yet is probably not thoroughly understood. It is a mistake to suppose that "Thunder clears the air" as is so often said. After such a storm fair weather may ensue, from outside and totally independent causes; but my experience has been that fog, or cold drizzling rain, much more frequently follows; as, upon consideration, is the condition most natural to expect with a suddenly lowered Temperature. The great heats of the tropics are more productive of Thunder and Lightning than the temperate air of this Latitude. In Nova Scotia the normal number yearly is 12—five-sixths of which occur in Summer, or between May and September.

Hail is another consequence of a disturbed electric state of the atmosphere, and is again more common in the hotter seasons. Indeed we never see it in Nova Scotia in winter, and very seldom at any time of the year. The combination of conditions necessary to produce Hail is very similar to that from which Thunder and Lightning originate. An upper stratum of air of very different Temperature from that below; and in this case the warmer being uppermost, and the lower very cold and a long distance above the Earth, the precipitation from the former freezes on its descent, and reaches us in fragments of ice, frequently of sharp-angled crystallized form. *Sleet* is often spoken of as *Hail*, but the two are very distinct and should not be confounded ; for while the one is as I have attempted to describe it just now, Sleet is merely snow thawing or Rain freezing as it approaches the earth's surface.

The Phenomenon of the Rainbow, although comparatively speaking not very frequent, is so striking and impressive, and at the same time so easily understood, that no particular description of its appearance, cause, and effect, is called for in these notes. Two, and even three, bows are sometimes observed : growing fainter by repeated reflection as they recede from the centre, till the colours of the outside arch of the three become very pale and indistinctly merged in the hues of the surrounding sky. The Rainbow is seen in showery weather, when there is much disturbance or mingling of air currents, so that a rather long term of unsettled cloud and electric conditions generally accompanies its appearance. This, and the well-known fact that the sun must not be very far from the horizon, so that its oblique rays may strike through the falling Rain-drops, are the only two points of practical importance in connection with this Phenomenon. The differences in effect ascribed to the Rainbow in the morning and in the evening are evidently not founded upon reason. An average of only five Rainbows annually takes place, and by far the larger number between May and October. Indeed during the past 10 years in Halifax, I have observed but three in winter, and those late in February, in March and April.

In Halifax the normal number of days of Sleighing is 70 ; almost always comprised between the beginning of December and the end of March. In 1872 I entered the largest number of days when runners were preferable to wheels in the city, viz: 98; and in 1870 the least, 45. Unless we have much snow in November and December of this year, however, 1878 is likely to show the most bare ground of any year of the last 20, as so far we have had only 28 days on which sleighs could be used—11 in January and 17 in February—none since the 26th of the latter month. The farther you go from the sea-water, as is natural, the longer the snow roads remain good, and in the interior of the Province of the five months between middle of November and middle of April, three are generally good for sleighing. In November and April, however, the ground is rarely covered with snow for more than a few hours together. The earliest sleighing I have ever recorded was on the 1st day of December, 1857, and again on the same day of the year 1870—but I believe there has been an occasional day's sleighing in November in one or two earlier years. The latest of which I have any knowledge was on the 27th April, 1876—being thirteen later than the occurrence formerly, the last of which was in 1874. This audience will excuse me from dwelling so long and particularly on details which are not very important to us, and at the same time familiar; but I hope, through the medium of this Institute, that I am speaking over a much wider field than is now before me; and to those who instead of being well acquainted with the effects of Nova Scotian climate believe it to be Arctic in its winter frosts, and inhospitable to immigrants and agriculture during every season; a misapprehension which cannot be too soon rectified, and which I sincerely trust these papers may have a tendency to correct, bringing forward as they do the indisputable testimony of observed facts.

I have been accustomed to believe that the Aurora Borealis was "not a purely magnetic Phenomenon," and on several occasions have publicly expressed such an opinion. But I confess to now thinking that I have been mistaken; and the wonderful and intimate relation of Electric force to all Atmospheric convulsions has chiefly led to this change; while the evident disturbance of the magnetic needle during these displays quite overthrows the objection made to this theory, that the Auroral streamers were not only North and South, but often sprang from every quarter towards the zenith as the sustaining ribs of a mighty canopy arching the heavens. I have frequently noticed the sudden fall in Temperature accompanying the Auroral Phenomenon, and have brought before this Institute some remarkable instances of this fact, especially in a series of observations taken in 1869, when an average loss of Heat 2.2° per hour occurred during the period of visible Aurora. As high a loss as of nearly 3° degrees per hour for 9½ hours has been recorded at the time of display. The idea that the Aurora is a constant forerunner of storms, or even of any quantity of Precipitation is erroneous. Of course it is an index of atmospheric disturbance to a greater or less extent, and the record is in accordance with the reasonable supposition that storms do occur within the wide area of observance of the Phenomenon ; but, as said, it by no means follows that because we see the Aurora Borealis at any one given point, a change of weather for the worse may be expected at the same point. In Halifax by my observations 44 per cent. of Aurora are succeeded by a continuance of fair weather. After the remaining 56 per cent. Rain or Snow has been measured the next day, but in only 36 instances out of the hundred has a Gale visited this locality. By thus expanding the ground of observation we can alone upset the narrow conclusions of isolated and casual notices. The seasons of the year when the most rapid and frequent variations take place are the most favorable to the appearance of this display. Consequently we count the greatest number of them in Spring and Autumn. In the year the average number to be seen is 26.—In the following months respectively : January 1, February 2, March 2, April 3, May 3, June 3, July 2, August 2, September 2, October 3, November 2, December 1. But there appears to be a rotation in the visibility of the appearance of the Aurora, as yet not sufficiently accounted for, and at present we must be at the farthest extremity of the term, and may soon look for its return. In all the last year 1877, I saw but five displays, and in the first four months of 1878—including April, the month of highest average of Aurora, only one visit of this Phenomenon have been observed.

In a paper brief as this I have necessarily omitted several of the minor appearances and optical illusions, such as the Paraselene, mock sun, Saint Elmo's fire, &c. ; and now pass on from the principal celestial and atmospheric Phenomena, to those periodic animal and vegetable recurrences which mark the progress of the seasons in this Province.

I have been favoured by Mr. Fitzgerald Cochran with " the " summary of the weather and seasons kept at Windsor, Nova " Scotia—being the average for 18 years, viz: 1794–1811—both " inclusive, by Rev. Dr. Cochran, Vice President, King's College."

This "Summary" (although the *instrumental* observations must be taken with caution, as the Barometers, Thermometers and Guages could hardly have attained the perfection of manufacture and position of the present day) is most interesting from the careful character of the observer, and its great age of 84 years. Another very interesting feature of the summary is its close agreement with the periodic events of the seasons of the last 18 years; disproving to a large extent the popular fallacy that the winters were longer and the springs later in bygone years than recently. Without recording all the events noted in Dr. Cochran's table, I refer to some of the leading occurrences. Thus between 1794 and 1811, the average date of the beginning of ploughing at Windsor was the 11th of April. Frogs began to croak 12th, and Gooseberry in leaf 23rd of same month. Swallows appeared 1st May (rather late.) The Plum, Cherry and Apple in flower 15th, 20th and 27th of May (all a little early.) The Lilac bloomed 1st (decidedly early), and the English Thorn or May 10th June. Mowing Grass began in Windsor 8th July—an early average for that locality, though close to the usual period of the more moist Atlantic coast. It is a pity this valuable table did not include the fruit bearing season of this Province, that farther comparisons might be made of the products, as well as of the blossoms of our country.

To come down to our own time, I find the averages of spring to be, as taken from a list compiled from my observations last year.

Daffodil, May 4th.
Cherry, May 21st, (a day later than above summary).
Lily of the Valley, May 28th.
Pear, May 28th.
Wild Cherry, May 31st.
Apple, June 3rd (a week later than above.)
Horse Chestnut, June 6th.
Lilac, June 9th (8 days behind the older record.)

The summer ripeness was of the

Strawberry, June 30th.
Pea, July 1st.

Cherry, July 7th.
Potato, July 8th.
Raspberry, July 21st.
Blueberry, July 30th.
Blackberry, August 14th.
Harvest Apple, August 20th.
Madeleine Pear, August 25th, and
Nectarine Plum, August 26th.

The Autumnal fruits averaged—

The Maria Pear, September 9th.
The Washington Plum, September 10th.
The Bonleritica Pear, September 28th.
The Green Gage Plum, September 13th.
The Capianman Pear, September 28th.
The Cycle Pear, the same date.
The Marie Louise Pear, September 29th.
The Flemish Beauty Pear, September 30th.
The Gravenstein Apple, October 1st.

Thus it will be readily noticed that at any rate the end of the eighteenth century and the middle of the nineteenth, do not vary materially from one another ; and it is fair to infer that the progress of vegetation, and therefore the temperature and other natural features of climate were much the same, at least, in the last century as in this.

I shall probably have to leave to others the more extended labor of deducing results from the facts which I have accumulated ; but this is evident, as I think that I have proved both by the paper read before this Institute last May, and by this its successor,—that the climate of Nova Scotia inland and seaboard, is more salubrious, more agreeable, and more capable of producing the fruits of a similar latitude in Europe, than is generally believed outside of the Province, or even by the inhabitants of this country themselves.

This proof, however, is only from a partial comparison of a portion of the middle term of this century, and the closing years of its immediate predecessor. More lengthened comparisons with accurate instruments are needed to bring out full results

The successive Governments of Canada have already done some good work in partly equipping a few stations, and enabling observers to some extent to tabulate their statistics. But the present neglect by Government of a Vital Registry has thrown back, and is losing many valuable periods of the discussion of Canadian longevity. The partial returns collected point to facts favourable especially to Nova Scotian length of human life. About 16 lbs. of ammonia per acre are annually deposited over the surface of this Province, generally from the great snow and rain precipitation on comparatively few days. In Great Britain from 6 to 9 lbs. is the annual allowance—and this on many days comparatively. Thus Halifax has 161 wet days and London 152—or nearly as many ; but in those days we receive about double of the life-giving salt, that falls over the latter city. Therefore, supposing the soil of this peninsula to be as highly cultivated as that around Kew (which, by the way, it is *not)*, it should be more productive, from atmospheric influence, and, cæteris paribus, human life here should be safer from functional disorder ; and consequently we should live longer.

Our wettest months—October, January, February, and November—(loosely speaking, the winter), are the most healthy. Except of course, among very old people, where the vital force is already so feeble that it cannot await the reaction from the lowered circulation. The same phenomenon becomes still more clear in Great Britain—that immense storehouse of our learning—where, if the world learns best how to destroy life, it also finds the most knowledge of its preservation, and alleviation of its miseries while lasting on this earth.

ART. IX.—NOVA SCOTIA GEOLOGY, PRECARBONIFEROUS, LOWER CARBONIFEROUS, &c., RETROSPECT, TO 1859. BY THE REV. D. HONEYMAN, D. C. L., *Hon. Member of the Geologists' Association, London. &c. Curator of the Provincial Museum, Fellow of the University of Halifax, Prof. of Geology, Palæontology & Mineralogy in the Science Department of Dalhousie College and University, and Lecturer on Geology, Palæntology and Mineralogy in the Technological Institute of Halifax.*

"*Suum Cuique tribuito.*"

1859, April 4.—On the "Fossiliferous Rocks of Arisaig." By the author. Trans. N. S. Literary and Scientific Society of Halifax.

This was my *debut* in writing on Nova Scotian Geology. The paper was illustrated by a large collection of fossils from rocks of *supposed Devonian Age.* "Acadian Geology, Ed. 1855, by J. W. Dawson, Esq., F. G. S.

In my paper, I gave the results of the study of these fossils and their comparison with the Upper Ludlow fossils of Wales, so beautifully figured in the plates of Murchison's "Siluria." I was thereby convinced that not only was the *facies* of the *fauna* of the strata near McAra's Brook, Moydart, Arisaig, an Upper Ludlow *facies*, but that many of the forms were identical, and that therefore the containing strata were of Upper Silurian Age.

This was the first-step *onward* to our present position. The last step taken by the author of "Acadian Geology," had been in a different direction, as the Arisaig formation had previously been regarded as Upper Silurian. This was also the first recognition of an "English aspect" of the Silurian *Fauna* of Arisaig. 1860; "On the Silurian and Devonian Rocks of Nova Scotia," communicated to the Natural History Society of Montreal, by J. W. Dawson, LL.D., F. G. S. In this paper the Upper Strata of Arisaig are correlated with the "Lower Helderberg" of the United States. Another part of the strata is correlated with the "Clinton." In this work of correlation, Dr. Dawson was aided by Prof. Hall, the distinguished Palæontologist of the New York Geological Survey. The latter did also good service in identifying certain forms and in describing and figuring others which were new. The Devonian is here also, specially pointed out as occurring at Nictaux. This paper may be regarded as first indicating an "American aspect" of the "Arisaig Series."

They are farther divided, in this paper, into Upper Silurian and Middle Silurian, according to Hall.

1860. On new localities of fossiliferous rocks in Eastern Nova Scotia, communicated to the Nat. Historical Society of Montreal, by the author.

The first locality or rather district is in the County of Pictou. It is traversed by the New Glasgow and Antigonish Road, and has Barney's River as its East boundary and Sutherland's River as its West. The places where the fossils were found are where the road is crossed by two small brooks that run into French River, and another brook that runs into Sutherland's River. In the two first, the fossils were found *in situ*, in the last in boulders, the fossils of the one are identical with Clinton forms of Arisaig as identified and described by Hall, of the other, Upper Ludlow or Lower Helderberg. The Arisaig Clinton forms are, Graptolithus clintonensis—Hall. Strophomena corrugata, &c., the Ludlow forms, Homalonotus, sp., Dalmania, sp., Beyrichia, sp., Chonetes nova scotica—Hall. Crania acadiensis—Hall, &c. Here then we had evidence of the existence of the two recognized members of the Arisaig Series. We shall have occasion to refer to this locality in the sequel.

The second locality is on the N. West side of Lochaber Lake, Antigonish Co. Here we have also two distinct groups of rocks and fossils—one group, which is the upper, has familiar Upper Ludlow forms of Arisaig, e g. Dalmania, sp., Calymene Blumenbachii, Bellerophon trilobatus, Chonetes nova scotica—Hall, and Crania acadiensis—Hall; the lower is altogether strange. The fossils are: Athyris, sp., Orthis, sp., Cornulites, sp., Stenopora fibrosa, and a Cyathophylloid Coral. (Petraia Forresteri, Salter.) The strata containing these are highly altered; they are siliceous, the fossils generally in casts. Some of these, especially

Petraia, are singularly beautiful. Dr. Dawson, in a note to my paper, considered a specimen of this coral as a zaphrentis, not unlike imperfect specimens from the Devonian at Nictaux, and therefore he supposed the Lochaber *Petraia Strata,* to be of *Devonian Age.* A difficulty in the way of this correlation was the evident *stratigraphical* relations of the two series, which showed that the supposed Devonian Strata underlie the Upper Ludlow.

The first locality or district upon re-examination also received a very interesting addition. A section of very unpromising strata, *almost* a clay-bed, on the side of the road near Barney's River, was examined. A considerable number of spherical and oval concretions rolled at my feet. These, when tapped with the hammer, were found to contain beautiful lingulæ, with their phosphatic-calcareous valves, perfect, black, and beautifully iridescent. This was the discovery of my favourite lingula nodule bed, which has since been much extended and elsewhere repeated. This seemed to be the equivalent of the Doctor's Brook lingula shales. The bed at Barney's River is lower than the graptolithus clintonensis strata at the tributary of French River. The construction of a new bridge at this brook led to a recutting of the section already referred to, which enabled me to enlarge my collection of its fauna by the addition of a number of trilobites, Dalmanites, a small *lingula oblonga*, discina; a small orthoceras and a compressed conularia. Other exposures added a large and perfect discina, cornulites and crinoidea. The boulders near Sutherland's River also made additions to the Upper Ludlow fauna of the locality, and I made acquaintance with a "Boulder" to which I shall again refer. Lochaber was also re-examined and important additions were made to its fauna. The series did not receive any addition to its members. The Petraia strata were found to be backed by the Diorite of the Mountain. Several visits were afterwards made to the same locality, which invariably brought additions to the several collections. An old and well known locality, Springville, East River, Pictou Co., was also visited annually, but not much examined until 1860. In this year, and at the memorable time of the Prince of Wales' visit to

Nova Scotia, I spent a month in making a thorough examination; my loyalty could not even induce me to intermit my interesting work. This was the first systematic examination of the district. I examined and made interesting and extensive collections from the higher strata. The fauna here are generally identical with the Upper Ludlow fauna of Arisaig, the coincidence in position and association is very striking. Many new species were also collected. In a mountain, a mile above Springville, I found Clinton strata on the day the Prince of Wales was in Pictou. This was their first recognition here. They were distinguished by the difference of the strata as well as by the fossils.

The fauna which they contained, were two large species of lingula, a discina, a conularia and a new species of homalonotus. Of the last I found two pygidiums, one of them was much distorted. Another specimen had pygidium and thorax, the head being wanting—a most important defect. An intermediate sett of strata is strongly defined especially in its palæontology. The largest orthoceras yet found in Nova Scotia was taken from these strata. Rhynchonella Wilsoni is abundant, so is the genus Strophomena—Atrypa reticularis, and Spirifer crispus, Cornulites is unusually large. It has also its own Homalonotus, different from any of the *four* species that are found in the upper Ludlow of Arisaig and from those occurring in the Clinton. At Moydart, Arisaig, is a set of strata intermediate between the *Clinton* of Hall & Dawson and the upper Ludlow near M'Cara's Brook, having a fauna of like marked character with large cephalopoda. Rhynchonella Wilsoni is abundant, Strophomena in great variety and abundance, Atrypa reticularis abundant, large Cornulites and the peculiar Homalonotus. East River and Arisaig are the only two Districts where this set of strata has been found. The localities and districts thus examined have revealed the thoroughly typical character of the Arisaig Silurian Series extending from Doctor's Brook to McAra's Brook, and at the same time have enabled us to divide the series into distinct members. The Arisaig series in turn has revealed the defects of each, and their comparative importance. At Doctor's Brook we have two members, at Arisaig one, at Moydart two, in all five members, i. e., one between the Upper Ludlow and Clinton, and two below the Clinton.

The third locality is Doctor's Brook, about 1½ miles east of Arisaig. Here there is a section of dark coloured shales without any apparent stratification. These were heretofore considered non-fossiliferous. The only thing remarkable in the shales is the presence of concretions. On closer examination, a few *lingulae* were discovered; a large species of *trematis;* a species of strophomena; a cast of a crinoid joint. The lithology of the locality was strikingly different from the Clinton of Arisaig, as well as its few *fauna.* It was regarded as lower than the Clinton.

Having made a subsequent examination of this locality, I happened to examine the stones of a sluice and was astonished to see in them a Lochaber Petraia, and to observe that the stones themselves were like Lochaber slates. I immediately searched for the rocks and found them out-cropping in all directions to the north of the fossiliferous shales, i. e., between them and the igneous rocks which had been referred to in my paper as having elevated and confused the former. These igneous rocks were known as extending to Arisaig Pier, and as having given a southerly dip to the Clinton and Upper Ludlow of Arisaig and Moydart, so that there could be no reasonable doubt that the strata in question were to be regarded as a lower member of the Arisaig series, and that the Lochaber series was an apparently incomplete "Arisaig series." Its mode of occurrence at Lochaber, its lithology and palæontology seemed to give it also an *individuality.*

Not long after I recognized similar rocks in the Marshy Hope part of the Antigonish and New Glasgow road, at the Antigonish and Pictou county line. Here they contained abundance of Petraia, lingulae and cornulites—and a Cyrtoceras. Still farther at the west end of the Marshy Hope, another occurrence of similar strata was observed having abundance of Athyris in casts. This is a genus of Brachiopod eminently characteristic of the Lochaber type. No other member of the Arisaig Series accompanied them. These instances are undoubtedly confirmatory of the individuality of the Lochaber Petraia and Athyris strata.

1860–1. The Band of metamorphic rocks extending from one end of Nova Scotia to the other—from Cape Sable to Cape Canso—which had not been regarded as peculiarly interesting—had now become attractive by the accidental discovery of Gold. The first discovery at Tangier had caused a little local excitement and had ceased to be attractivea; a new discovery in another part of Tangier, renewed the excitement, which henceforth became a *mania*. Soon gold was found in other localities throughout the length and breadth of the metamorphic band. Geologists and gold hunters came to Nova Scotia from all directions. Since Dr. Dawson had gone to Montreal I had commenced below the Coal Fields, and was working downwards, having a kind of a monopoly of the pre-carboniferous formations. I was steadily working at the fossiliferous as consequently interesting, considering that there was "time enough" afterwards to attend to the supposed non-fossiliferous formations. The so-called Lower Silurian fossil—Gold—once discovered could not fail to excite interest. I began to turn attention to the Geology of the Gold Fields. The Great Exhibition of London, 1862, being in prospect, the Nova Scotian Commission engaged to make a representation of the Geology and mineral resources of the Province. Prof. How, D.C.L. of King's College, Windsor, N. S., was also engaged as my associate, with special charge of the mineral department, scientific and economic. At the same time H. Poole, Esq., M. E., was engaged by the Government to investigate the auriferous formation to the west of Halifax, and J. Campbell, Esq., the same formation to the east. I explored a great part of Cape Breton, which I had several times previously visited. Besides making an extensive collection of carboniferous fossils and economic minerals, I made a few interesting Geological observations. I ascertained that the reputed limestones of what is now known as "marble mountain" was marble of various kinds associated with granitoid rocks. I found the rocks at the mouth of Louisburg Harbour and the coast towards Gabarus to be *crystalline*, apparently *Syenites* with *Diorites*. The Baddeck mountains were found to be *Granitic*. Marble in association with Diorites was found at Whycocomah.

In Nova Scotia, I revisited Springville, East River, Pictou, and ascertained the approximate position of the Brown Hematite vein, at the same time making a collection of its varieties—fossils were not neglected. As specially directed by the commission, I examined the Geology of the Tangier Gold District. I also examined the singular "Barrel Quartz," or auriferous veins of Waverley, and the sections of the rocks of this band on the Halifax, Windsor and Truro railways.

I was also sent to London to arrange the collections, and to superintend the Nova Scotian Department.

1862. "On the Geology of the Gold Fields of Nova Scotia." By the Author. Communicated by the President, to the Geological Society of London.

(Journal of Geological Society, 1862.)

In this paper I directed special attention to the "Barrel Quartz of Waverley," and the supposed relation of its containing rocks to the sections on the lines of railway. I gave a list of the Gold Fields then discovered, and made some observations on their supposed lower silurian age—directing attention also to the magnificent illustration in the "Nova Scotia Department of the Exhibition."

GREAT EXHIBITION OF LONDON, 1862, NOVA SCOTIAN GEOLOGY.

(Illustrated by the Author.)

This illustration included a large collection of Silurian Fossils from Arisaig and the other places referred to. These were arranged in counter-cases, according to the divisions made, the fossils of each division were arranged in zoological order. Before they were exhibited, I made several visits to the Museum of Practical Geology, Jermyn Street. Examining the collections I found the Upper Ludlow all right—the next—Arisaig and East River, I correlated with the Wenlock Limestone. I found nothing to compare with the Clinton; the Lochaber and Doctor's Brook equivalent were identified with the Upper Llandovery. I afterwards requested Sir Roderick I. Murchison to examine them; he did so, and sent Mr. J. W. Salter, the distinguished Palæontologist of H. M. Geological Survey of G. B., to examine my Silurian collections and to report.

Before examining the collections, he asked me to remove any cards giving explanations or descriptions. When this was done he made first of all a general examination, and then a special examination of the respective groups. The upper he recognized without difficulty, as "Ludlow Tilestone," the next as "Aymestry Limestone," the Clinton, as Upper Ludlow, *repeated*; the upper part of Doctor's Brook was unsatisfactory on account of its poverty in forms, the only form that attracted attention was the *Trematis*, which he regarded as interesting. The Lochaber forms, e. g., Petraia, he determined as Mayhill Sandstone, (Upper Llandovery). The beauty of the Petraia specimens attracted particular attention. He said the species was new and he would give it a name. He asked me to suggest a specific name, I gave that of my most intimate friend Dr. Forrester, superintendent of education in Nova Scotia, and so it was named—Petraia Forresteri, (Salter). Mr. Salter afterwards made other examinations along with other Palæontologists, especially Dr. Anthon Fritsch, of the Imperial Museum, Prague, Bohemia; Dr. F. being familiar with Barrande's great Bohemian "Siluria" and its unparalleled riches of form, gave me valuable aid in the recognition of certain forms which had escaped Mr. Salter's notice, and which had puzzled me exceedingly, e. g., curved Cephalopoda, especially Ascoceras. Barrande, E. DeVerneuil and Dr. Bigsby and Prof. Phillips, also were interested in my collections. They were awarded a *medal* by jury of Class I. Mr. Salter, in the written report which he gave me, divided the "Arisaig Series" as above and identified a large number of forms as English species, and gave the geological structure and sequence in accordance with the supposed palæontological evidence. In consequence of the distance between Nova Scotia and England, in correlating the age of the fauna and formations of the one with the other, he suggests the use of the qualifying adverb "approximately."

It will be observed that there is some difference between Mr. Salter's correlation of the divisions and my own. I was not altogether satisfied with the difference, as I considered it hardly possible that I should mistake in recognizing anywhere, forms so familiar to me as my Arisaig forms. Not presuming to question the opinions of an authority so eminent, I revisited Jermyn Street Museum, and was assured that I was not mistaken. Mr. Etheridge, the present accomplished Palæontologist of the Survey, was at the time working among the collections near those in which I was interested. I made him acquainted with my difficulty. He very kindly opened the cases that I might take a closer look at the specimens; at the same time he informed me that the collection which I was looking at was an Aymestry limestone collection, and that the "Wenlock" had to be corrected; of course I was satisfied. Mr. Salter expressed his astonishment that the Wenlock was absent from a fauna so decidedly English as that of Arisaig. There was some difference of opinion between Mr. Salter and Prof. Hall, in regard to certain forms. I did not presume to call the views of either in question on the points of difference; accordingly, in subsequent lists published by me, I name forms according to the opinions of both, so that in these certain forms have two names, e. g. Dalmania Logani, Hall, is Phacops Downingiæ, according to Salter. Graptolithus, clintonensis, Hall, is Graptolithus ludensis, according to Salter. I would observe regarding these two examples, that the difference in the first case is of minor importance as it is merely palæontological, and does not materially affect the main view of the correlation of the group to which it belongs; it is Upper Ludlow or Lower Helderberg notwithstanding.

In the case of Graptolithus clintonensis or ludensis—the difference of opinion was of more serious consequence. It led Prof. Hall to regard the Arisaig group as of Clinton, Middle Silurian age, while it induced Mr. Salter to regard it as of Upper Ludlow, or Upper Silurian of Hall's division of the "Silurian system." There is, however, a peculiar form of the same group which has not been recognized elsewhere on this side of the Atlantic, Grammysia cingulata; Mr. Salter recognized this form which is an Upper Ludlow form in England. This also may have led him to the opinion which he formed.

After the lapse of fifteen years in which I have given no small amount of attention to such questions, I would presume to make a few observations on differences of opinion among Palæontologists on the form in question, with a view to show that any decided opinion of age formed on the occurrence of this Graptolite is altogether unwarranted. The same Graptolite has three synonyms--G. clintonensis, Hall; G. ludensis, and G. priodon, Brown. Salter recognizes the two last as the same, *vide* Appendix to Ramsay's Geology of North Wales, H. M. Geological Survey of Great Britain. It is found as G. ludensis in "Upper Ludlow;" as G. priodon in the "Woolhope Beds;" as G. clintonensis in the "Clinton," N. Y.; as G. priodon in the Mayhill Sandstone, (Upper Llandovery); as G. priodon in the Bala; so that its range in geological time is from the Bala or Lower Silurian to the Upper Ludlow, part of Upper Silurian, so that while the biological importance of this form is considerable, its geological or stratigraphical importance is *very* questionable.

Mr. Salter was led to the supposition, that the Upper Ludlow, with G. ludensis, occupied its relative position at Arisaig, by a *fault.*

1864—"GEOLOGY OF ARISAIG, NOVA SCOTIA." BY THE AUTHOR.

Journal of Geological Society of London.

In this paper, I gave the results of a lengthened and thorough examination of Arisaig, with the aid of the new light of Mr. Salter's examination and report. I directed special attention to the region of the supposed *fault*, and found that the sequence, as well seen in the section on the shore, was perfectly regular, that the supposed Upper Ludlow was certainly older than the overlying Aymestry Limestone of the District, and that therefore the Graptolithus ludensis and the Grammysia cingulata had appeared in Arisaig, N. S., before the Upper Ludlow period. On the strength of these facts, I substituted Lower Ludlow for Upper Ludlow. In the Aymestry, I found a wondrous new fauna, especially the Cephalopods, Orthoceras, Omoceras and Cyrtoceras. I also found heads of the Homalonatus of this horizon, which showed that it was not delphinocephalus, as Mr. Salter had supposed from the pygidium. I also found a new and strange organism, which I considered to be a species of Graptolite. I shall refer to this again. I made my head quarters at Doctor's Brook, as I considered that there was more work to be done between this and Arisaig, than between Arisaig and McAra's Brook. I followed the black shales with lingula up the Brook, until it met the Clinton—Lower Ludlow, with its characteristic lithology and fossils, and found it underlying the Clinton. From Doctor's Brook, I also followed the black strata along the shore and found them exposed in a cove. Here the concretions showed as at Doctor's Brook abundant, and lingulæ were found in nodules and other concretions. *Cone-in-cone* structure also occurred in masses. I followed it onward to Arisaig Cove, where it was well exposed. Its homogeneous character distinguished it strongly from the Clinton, succeeding at Arisaig Brook, as well as its *cone-in-cone* and other concretions. Fossils appeared to be rare, and I pronounced the band poor in fauna. This was an opinion which I had to modify considerably afterwards. I also found a bed of graptolites in the lower part of its section at Doctor's Brook. I made a large collection from this bed. I regarded this discovery as very interesting on account of the variety of forms and their marked difference, from G. clintonensis or ludensis. I shall have occasion to refer to these again. I also found the Mayhill sandstone division to increase in interest. From Doctor's Brook I followed it along its outcrop to the cove where the black lingula shales were found exposed. Here there was a glorious exposure of vertical strata in striking contrast with the soft coal black ferruginous shales overlying. The brown hard slates have Petraia, sp? (not Forresteri, as at Lochaber) in abundance, internal and external casts, scattered through the strata, showing that the generic name, Petraia, is singularly appropriate. Lingulæ, large black, were of frequent occurrence as at Marshy Hope. These were associated with sandstones replete with Petraia and other forms; in some cases the Petraia were preserved in the hardened rock, the carbonate of lime of the corallum surviving. Lower down the strata contained lenticular beds of Orthis and Athyris, from three to six inches in thickness in the middle. It is only when these beds become weathered that the forms can be distinguished and then they are in the form of internal and external casts. I shall have occasion to notice another locality where the same forms occur in a similar manner but in a better condition for identification. I found the igneous rocks which bounded the fossiliferous strata on the north, to be a very interesting study, from their exposure being so complete, their aspect so varied, being generally homogeneous, sometimes porphyritic, often amygdaloidal and scoraceous, and frequently ashy, their relation to the associated sedimentary rocks so peculiar, and the effects of this association so striking, especially the conversion of arenaceous strata into porcellaneous rocks, uniform and banded. Mr. Salter advised me to distinguish the respective members by local names. The mode of the distribution of those members made it difficult to act on the suggestion. I therefore adopted an alphabetical division, A, B, B′, C & D. A, Mayhill Sandstone; B, B′ Lower Ludlow; C, Aymestry Limestone; D, Ludlow Tilestone.

1865. Dublin International Exhibition. In the Nova Scotia Department, I exhibited a collection of Arisaig fossils, arranged according to Salter's division. In this were included the principal forms collected since the London Exhibition of 1862. This collection was awarded a medal by the jury of class 1.

1866. "On the Geology of Antigonish County, with a map. By the Rev. D. Honeyman, D. C. L., F. G. S., Membre de la Societé Geologique de France," Hon. Member of the Geologists' Association of London, &c.

In this paper, I correlated B, of the Arisaig Series, with the Hudson River of the United States. Since my previous examination, Prof. Hall's report on the Graptolites of the Quebec of Canada, had made its appearance. This led me to the study of the Graptolites of Doctor's Brook, which were found to be of genera not known to range above the Hudson River, Lower Silurian. Afterwards, however, I found reason to doubt this conclusion, and to refer the group to Lower Clinton? I also correlated certain strata containing copper ore, at Lochaber and Polson's Lake, as Devonian. These strata are non-fossiliferous and seem to succeed the Arisaig, A & D, of the west side of Lochaber Lake, *vide supra*, 1860. I afterwards referred these to the Lower Silurian on lithological and mineralogical considerations. Other strata, non-fossiliferous, metamorphic and associated with crystalline rocks, were also referred to the Devonian, e. g.. Antigonish Sugar Loaf (mountain), and its N. E. continuation, and also the mountains to the west. These have since been referred to Middle and Upper Silurian on account of their resemblance to certain metamorphic rocks so correlated, underlying the Pictou Coal Fields. The crystalline rocks area, was found after a subsequent and detailed examination, to be much exaggerated on the Geological maps.

1867. Exposition Universelle de Paris, 1867. In the Nova Scotia Department, I exhibited a representative collection of rocks and fossils. Among the rock specimens were auriferous, Lower Carboniferous Conglomerates, illustrating a discovery made by Prof. C. F. Hartt, with argillites representing the underlying auriferous rocks, from which the gold of the Conglomerates had been derived. This collection was awarded a *medal* by the jury of class 1.

This was my first representation of Nova Scotian rocks at International Exhibitions. Before 1867, I had devoted my attention almost exclusively to Palæontology—to the collection of fossils, their study and correlation—to the association of fauna, their distribution and the conditions under which they "lived, moved and had their being."[1] Availing myself fully of my advantages, I made a special study of the Arisaig series of fauna, in order to mark the *first appearance of new forms*, their *culmination* and *disappearance.* When it is taken into account that this field was almost wholly fallow, that its strata are so replete with organisms that they have been exposed for ages to the action of the storms and ice sheets of the Gulf of St. Lawrence, bringing into relief forms on the strata, and lining the shores with fossiliferous boulders, requiring only the application of the hammer to secure forms, new, varied and beautiful, it will be readily admitted that the work was enough to excite monomania, and to exact application. Another consideration was that I was acquiring a branch of knowledge and an intimate acquaintance with a *type* which I was assured would be of infinite importance in future works on the Geology of Nova Scotia.

Yet, other incentives were my facilities through International Exhibitions, of receiving the invaluable aid in the work, by intercourse with the great Palæontologists of England and other countries, of the examination of Museum and Exhibition collections, and the appreciation of my work by international judges. The work of the amateur had become the work of a profession. This change and removal to Halifax, a lithological centre, where fossils in the rocks are hardly recognisable, led to the association of the study of lithology with that of palæontology.

1868. "Acadian Geology," with map. 2nd Edition. By J. W. Dawson, LL.D., F.R.S., &c.

The only part of Acadian Geology which comes within the field of our retrospect is that which relates to the pre-carboniferous Geology of Nova Scotia. This part, of course, is a vast improvement upon the corresponding part of the first edition, both in matter and illustration. The map is elegant and beautifully coloured. In this respect it is a great improvement on the map of 1855. The improvement, however, is often more apparent than real, where pre-carboniferous formations are defined, eg. Between Baddeck and Cape North, I certainly prefer the white of the first map to the blue in the second. The region so coloured was a "terra incognita" in 1855—it is very much so yet, and anything that we do know of it is not in accordance with the blue colouring, as explained on the map. Another example,—on the north side of the Cobequid Mountains there is a continuous blue between the red, which represents the crystalline rocks of the centre of the mountains, and the carboniferous colouring. In the first map there is no such intervention from West Chester road (Amherst road) and westward. The colouring of the last map may be according to theory, the colouring of the first is more in accordance with fact. If required, I can multiply examples of improper colouring, doubtless, however, a great part of the colouring is *only provisional.*

Examining the volume where it treats of the Silurian and Devonian formations, there is only one point which seems to require attention at this stage of our retrospect.

This point is the new division of the "Arisaig series" into

"Lower and Upper Arisaig," a division to which the author seems to attach great importance.

In reference to this I would observe:—

1st—That it was altogether uncalled for.

2nd—It does not seem to serve any practical purpose.

3rd—The division is not topographically accurate.

4th—It disregards Mr. Salter's well established division, ignoring the Aymestry Limestone and Mayhill Sandstone divisions. It also ignores the existence of the extension of the Doctor's Brook shales, which are largely exposed in the Arisaig Cove and at the Arisaig Brook, being here better exposed and having a more numerous and varied *fauna* than at Doctor's Brook.

5th—It only recognizes the Clinton at Arisaig, and the Lower Helderberg near McAra's Brook, Moydart.

6th—In consequence, it seems preferable to consider the whole as *one series*, with five subdivisions, and to regard the whole as Upper Silurian, like Sir R. J. Murchison and Dana, or as Middle and Upper Silurian, like Prof. Hall and E. Billings.

7th—My alphabetical division, which I consider a practical one, has precedence, having been published in 1864. *Journal of Geol. Society.*

I may here state that I have found occasion to use the term Arisaig in its widest sense, "Arisaig Township," for practical purposes,and to adopt for the sake of precision the terms "Lower, Middle and Upper Arisaig," the series under consideration being called "Upper Arisaig."

1868, June—October. I re-examined professionally Arisaig in particular, and Antigonish County generally. 1st, to collect a suite of Arisaig fossils and rocks, for the museum of the Canadian Geological Survey; 2nd, to ascertain the extent and distribution of the Arisaig series. I consequently spent a considerable time among the fossiliferous rocks. It was then that I discovered the richness of the fauna of B at the Arisaig Cove, especially in corals, favosites; trilobites, phacops, stokesii, calymene tuberculosa; crinoidea, graptolites, and brachiopoda, strophomena, atrypa reticularis, &c. In collecting rock specimens, I found that the rocks lying between the Mayhill sandstone strata and igneous rocks of the shore, of which Frenchman's Barn and Arisaig Pier were a part, were singularly varied and interesting—some of them being of quartz hardness, others soft and unctuous, easily cut with a knife, and susceptible of a beautiful polish. I also examined the rocks of the Arisaig Mountains, and found a "mountain series" of very perplexing character. Two or three bands of strata led me to imagine that it was a repetition of the fossiliferous series very much affected by igneous action. It had syenites rising to the elevation of 1010 feet, mountain conglomerate—hard as jasper—rising to an elevation of 900 feet, petro-siliceous rocks at 1000 feet elevation; diorites porphyries and slates. I shall have to refer to those again.

I had to modify the supposed great area of crystalline rocks of the published maps, and to limit the exact areas to a mountain here and there, and an occasional outcrop, as I found obscurity everywhere; swamps, table land and forests. Measurements were made wherever practicable, from which maps have been constructed which are in the *Museum portfolio*—unpublished.

October—same year—Arisaig Laurentian.

In the expectation of seeing a fine section of lower carboniferous conglomerates, grits, and a continuation of the conglomerates of Malignant Cove and Cape George, I took to the shore of the Cove. I found sand banks and a shore covered with syenite and diorite boulders, then contrary to all expectation, there appeared, *in situ*, diorites, granitoid and homogeneous, on, on, on, the same, then appeared a loose mass of a mixed character, ophicalcite, then it appears in intercalary beds with diorites, homogeneous and granitoid and hornblende rock. Then succeed very coarse diorites having hornblende in crystals in albite (?) and also granitoid diorites with veins of snow white granular calcite several inches thick and quartz veins, with talc and without. Ophites, ophicalcites, crystalline limestones, petro-siliceous strata, black and hard with quartz veins containing mica. Syenites, red and white with patches of green and red orthoclase, also penetrated by dark coloured veins (diorite ?) and veins of granular calcite, three to four inches thick. A system of calcite and quartz venation thus pervades and apparently connects the whole. This seems to be the results of *re-metamorphism.* This glorious section extends nearly to the eastern line of "Arisaig Township"—having cliffs lofty and precipitous, overhanging and jutting into the deep, necessitating hard climbing and leaping for onward progress, at the same time stimulating the desire to make extensive rock collections, and restraining it.

The carboniferous band of our maps has totally disappeared and been replaced by crystalline rocks of high antiquity. These rocks extend less than two miles from the shore, so that the area of crytalline intrusive rocks of our maps situate farther south have been obliterated. Our survey has also contracted the Antigonish mountain area of the south and given an interesting carboniferous basin (8 miles wide) having conglomerates on the north and south. Limestone overlying the north conglomerates, and in the middle black and very bituminous shales with abundance of *Palæoniscus* scales, an interesting *flora* and reputed coal beds. I was of course much gratified by making the discovery of this very important series of rocks. In common with others I had taken for granted the existence of the carboniferous band, and considered that all was right with the intrusive rocks—for twelve years—and as there was no expectation of finding fossils in this direction, I did not take any special interest in examining.—"Prove all things!"

Fortunately I was in no small degree prepared for this occurrence. While I was engaged as Executive Commissioner for Nova Scotia at the Exposition Universelle de Paris, 1867, I relieved the monotony of regular attendance by occasionally studying the fine collection of Laurentian and Quebec rock specimens, exhibited in cases by the Canadian Geological Commission, only a few feet distant from the front of the Nova Scotian court, as well as by studying the magnificent specimen of polished eozoonal ophicalcite afterwards presented to M. Daubree, l' Inspecteur general des Mines, for the museum of the Ecole des Mines de Paris. I was therefore able to form an independent opinion of the character and age of the rocks discovered. I had therefore no hesitation in concluding that they were of *Laurentian age*, and I announced the discovery to gentlemen in Antigonish who had been in the habit of accompanying me to Arisaig and other localities in Antigonish county, and were consequently interested in a matter of this kind.

Not long after, I shewed specimens to Sir W. E. Logan and Mr. Hartley in New Glasgow, when on my way to Halifax. Sir W. said that he considered them to be of *Quebec age*.

1869. In the spring when I unpacked my collections, at Gabriel street, Dr. T. Sterry Hunt examined, chemically and otherwise, choice specimens, especially a beautiful polished specimen of ophicalcite which I had got polished in Halifax. When Sir W. and I were discussing the question, Dr. Hunt made his appearance in the Lapidary's Room, with the polished specimen in his hand, and said that he considered it to be Laurentian serpentine—and expressed a wish to see the rocks themselves—enquiring after the locality. I was gratified at this expression of opinion, by one so well qualified to judge in a matter of this kind. Dr. Dawson afterwards referred to Dr. Hunt's opinion, and said that he considered the rocks to be of Devonian age. Having been occupied in the following summer in investigating the pre-carboniferous formations of the Pictou Coal Field, and subsequently in establishing the Provincial museum and arranging the collections—the question of the age of the Laurentian rocks of Arisaig remained *in statu quo* until 1870.

Laurentian rocks of Nova Scotia and Cape Breton. Proceedings of Institute, January 10, 1870.

Prof. H. Y. Hind had been exploring Cape Breton, up the McKenzie River. In the heart of the "terra incognita" already referred to, he had discovered rocks which he considered to be Laurentian gneisses. He had also been examining the granites of the auriferous band in Nova Scotia, and had discovered that they, too, were gneisses, and therefore concluded that they, too, were of Laurentian age.

In communicating his views to the Montreal authorities, he was informed by letter that Eozoon Canadense had been found in my specimens of Arisaig ophicalcite, and that this was regarded as conclusive evidence of their Laurentian age. As I had long before, in the winter of 1868, noticed something of the kind and pointed it out to others, I was not at all surprised when Prof Hind gave me the information—and told him the circumstances. He published an account of the matter. This led to a spicy correspondence between Sir W. E. Logan and myself.

Prof. Hind informed me of his intention to go to London to bring his Laurentian discovery before the Geological Society.—He also suggested that I should write a paper on the Arisaig Laurentian and offered to take it with him. I accordingly acted on his suggestion, and addressed my paper to the Secretary, G. S.—Prof. Hind's paper was accordingly communicated to the Geological Society—vide Geological Journal, 1870.

At the meeting following, as announced, my paper was read by the Secretary. In this I described the rocks of the section, and gave my views regarding their age, alluding also to evidence of the supposed *Eozoon.* In the discussion which followed the reading of my paper, Sir W. E. Logan and Dr. Dawson took a part. In the report Dr. Dawson is said to have observed that the *tubulation* of the Arisaig *Eozoon* was different from that of Eozoon Canadense, and that Eozoon of other species occurred in rocks of a different age from the Laurentian, so that existence of this species.—*Eozoon Acadiense*, Dawson, was not conclusive of the Laurentian age of the Arisaig Rocks. Journal of the Geological Society, 1870. I may state that I felt somewhat annoyed at the treatment that my paper received from the Geological Society. In my unavoidable absence my paper was attacked by those who had never seen the rocks described—who had committed themselves to erroneous views which they had considered themselves bound to maintain—and my paper was subsequently printed in the Quarterly Journal of the Society in a *mutilated* form, so as to give Sir W. E. Logan and Dr. Dawson a decided advantage. Subsequently Prof. Hind had an article on the Laurentian Rocks of Nova Scotia and Cape Breton, in the American Journal of Science and Arts. In this article there was a reference to the "Arisaig Laurentian." In another article in the same Journal, Dr. T.

Sterry Hunt claims the credit of having *first* recognized the Laurentian age of the rocks in question, maintaining that it was his expression of opinion that led me to hold this view.

In an article in the same Journal I replied giving facts and references. The question of priority thus received its *quietus*. American Journal of Science and Arts, 1870.

1870–1. Reports of Geological Survey of Canada.

In the Summary Report of A. R. C. Selwyn, F. G. S., Director, page 5.—The Report of the late Mr. E. Hartley, F. G. S., of the Survey: "From the foregoing facts it appears that the Coal measures in Cape Breton are in direct contact with rocks of Laurentian age which I believe had not before been recognized in that region." I may state that their existence here had at least been suspected on the evidence of W. A. Hendry, Esq., Deputy Commissioner of Crown Lands, N. S. He had given an account to myself, before the Paris Exhibition of 1867, of a remarkable series of rocks at the head of St. Ann's Harbour—the district referred to by Mr. Hartley, and a specimen of ophicalcite from the rocks was given to me by Mr. Hendry. This was exhibited in the Nova Scotia Department of this Exhibition. It was noticed as remarkable by Prof. Lesley and Dr. Hunt. Sir C. Wyville Thomson also noticed it, finding in it what he supposed to be *eozoonal* structure. As he appeared to be particularly interested in it I gave it to him. On enquiry he was told that it came from a supposed Devonian formation at St. Ann's, Cape Breton. He afterwards produced it in London, causing considerable excitement among the *Eozoonalists.* The supposed solution of the difficulty was that the Laurentian had been brought up in Cape Breton by a *Fault.* Dr. Dawson would have suggested a difference in *tubulation*, and considered it as an evidence of the Devonian age of the St. Ann's, C. B., rocks, rather than have recourse to the *Fault* supposition.

1870. Nov. 14; Dec. 12, 1871. Feb. 13. Papers on Nova Scotia Geology, by Rev. D. Honeyman, D.C.L., &c. The first two papers are a "record of observations" made since 1855. The only point requiring notice, which has not been referred to in the retrospect, is the correlation with the supposed equivalents in the

United States, of members of the Arisaig Series, which had not been recognized and correlated by Dawson and Hall. Here the metamorphosed series in contact with the igneous rocks (Diorites) is considered to be the equivalent of the "Oneida Conglomerate" —the next—the "Mayhill Sandstone" is regarded as the "Medina Sandstone," U. S. The Doctor's Brook and Arisaig Shales, I have designated "Lower Clinton" (?) and the "Aymestry Limestone" above the Clinton of Dawson, and under the "Upper Ludlow" or "Lower Helderberg," "Niagara Limestone."

One reason that I had for making this change, was the inconvenience connected with the use of the English nomenclature on this side of the Atlantic, where the American nomenclature is in general use. I also adopted Hall's sub-division, Middle and Upper Silurian, which had been adopted by Mr. Billings in the Reports of the Geological Survey of Canada. I had also established classes of Geology and Palæontology in connection with the Provincial Museum, in which Dana's Manual and Text Book are the Text Books. I had, however, in my lectures, to adopt a middle course, as I found difficulties connected with the restricted use of the American nomenclature in consequence of the peculiarities of Nova Scotian Geology, which is decidedly "Anglo-American" in character, our Peninsula being evidently the connection of English and American Geology.

Pre-carboniferous formation of the Pictou Coal Field, Feb. 12, 1871.

In this paper are given the results of a systematic and thorough examination of the pre-carboniferous formation of the Pictou coal field made in the summer of 1869. I measured these pace by pace, collecting rocks and fossils, and defined the whole in a map made from my measurements and observations. *Museum Portfolio.* I re-examined the old "Arisaig Series" of Springville, already noticed above. (1860) I completed the series by adding to it metamorphic strata underlying the fossiliferous Clinton of the former account, I considered these to be additional Clinton, with Mayhill or Medina Sandstone. In these lie the out-crop of the Brown Hematite, long familiar on account of its detached masses scattered around. I examined and measured the great

Diorite succeeding (locally), and on the other side of this, in an elevated position, other metamorphic strata, at the point of contact, coalescing with the Diorite. Above these are slates, non-fossiliferous—Clinton—well exposed in a Brook,—they then became obscure, being covered with forest, the series re-appearing in Blanchard with fossiliferous Upper Ludlow, on McDonald's Hill. We have thus an anticlinal arrangement, having Springville, "Arisaig Series," fossiliferous and metamorphic, on the one side, the Diorite, in the centre; and another Metamorphic and fossiliferous on the other. Blanchard fossiliferous Hematite (Iron ore) was also examined. The fossils—athyris, cornulites, &c., showed it to be on the horizon of the Mayhill Sandstone and Clinton. This age was also inferred from Dalmanites sp. and other fossils in Squire Campbell's marsh. From its position relative to the intervening Diorite, I inferred that the course of the iron bed southerly, would be on the western side of the Diorite mountain. Since I examined the locality, it has been found to be on the same side as the fossiliferous Clinton Strata of Campbell's marsh and their continuation at Ross's, so that the age of the iron bed is unquestionably Clinton, the same as a fossiliferous iron bed of Arisaig. Higher strata of this series are exposed in a marsh, and then above Pleasant valley, on the East River, below the Church and on the Blue Mountain Road, the strata are on the north side of the River. The only fossils found here were *Euomphalus*, in a boulder; the strata are highly metamorphic. In the associated Diorite at Pleasant valley, there is micaceous oxide of iron. This occurs also in joints of the metamorphosed Upper Silurian, on the river side. The last of the Silurians is on the north side of the river, where they meet the Silurian of the south side of East River.

The latter appear as black shales in the bed of the river. Proceeding westward, on the south side of the river, they reappear in a brook at the dam of a saw mill. Farther on, they are again exposed in a brook at Pleasant valley. Still farther on they are well exposed in McDonald's brook.

To the west of this *Brook Section* lies one of the iron localities of this region, "McDonald's specular ore." This lies in the metamorphic Silurian rocks of the section.

In the same brook, at a bridge, I found a section of shales having fossils. These are anticlinal to the other, having a northerly dip, the iron bearing strata having a southerly dip. They contain fossils which seem to be of Clinton age.

We seem thus to have evidence of the Clinton age of the specular iron ore of McDonald's, of the Blanchard Hematite, and the Springville Brown Hematite. Writers on these and similar iron deposits in Nova Scotia generally refer them to the Upper Silurian. It may be excusable, thus to refer *veins*, but fossiliferous *beds* are certainly entitled to be treated in a scientific manner. I have to except Dana's Manual of Geology, where the Blanchard Iron bed is referred to the *Clinton age.* I succeeded in extending the Springville "Arisaig Series," north, to the extremity of Irish mountain. Beginning at the west side of this mountain and coming to the east, I found Upper Ludlow, with characteristic fossils; this extends to the end of the mountain and disappears under the Lower Carboniferous. "Aymestry Limestone" did not appear. In Cross Brook, succeeded Clinton with characteristic fossils, this extends north, in the brook, beyond the Upper Ludlow, and disappears under the Lower Carboniferous. Farther on, Mayhill Sandstones (with Petraia) and Diorite appear, the extension of these northerly appear in Cross Brook; the Mayhill Sandstone disappears under the Lower Carboniferous. I found at the side of the brook, the Diorite in the Lower Carboniferous, some distance beyond the exit of the Mayhill Sandstone. As at Springville, this Diorite is the middle of an anticlinal. On the opposite side, the strata are metamorphic, and apparently non-fossiliferous as at Springville. This band is of considerable width. It extends north and partly terminates on a mountain east of the seeming extremity of the axial Diorite in Cross Brook. A great part passes through McLellan's Brook and forms the steep western side of McLellan's mountain. The Lower Carboniferous sandstones and limestones are now seen in the brook, at the side of the mountain, at the back of the passage. As the mountain tends northerly, the back of the same strata is skirted by L. Carboniferous limestones and strata.

On my return when I descended from the mountain, east of the Coal mines—I found Diorite exposed with L. Carb. conglomerates. This is doubtless a reappearance of the axis of Irish mountain, which might readily be mistaken for a Diorite of Carboniferous age.

About three-quarters of a mile up McLellan's Brook above the junction of the Lower Carboniferous and the Irish mountain strata, Upper Ludlow strata with characteristic fossils appear. These extend up the brook about one-eighth of a mile, and assume the appearance of a syncline, so that, as at Blanchard, we may have here fossiliferous Ludlow above the Irish mountain metamorphic strata. I regard this metamorphic series as *peculiarly interesting*. *First*, because in its present connection its relation is obvious, as a middle Silurian series—the upper being fossiliferous ; *second*, apart from its present relation on the west side of McLellan's mountain it is hazardous to attempt to determine its age—*as we shall see in the sequel*. *Third*—It not merely enables us to determine the age of its extension in McLellan's mountain, which has perplexed experienced observers, but also to determine the age of similar metamorphic strata, e. g. in the Sugar Loaf and other mountains of Antigonish County, where their relations to the "Arisaig series" are not so obvious as in the case before us.

The eastern side of the fossiliferous Upper Ludlow syncline in McLellan's brook is the upper member of another fossiliferous "Upper Arisaig" series on the side of Fraser's mountain (McLellan's). Continuing our eastern course through Irish mountain, and crossing McLellan's brook, and ascending Fraser's mountain, we pass through "Clinton strata which are possibly fossiliferous, and then we come to a splendid and extensive outcrop of "Mayhill Sandstone," having a lithology so characteristic that I expected as a matter of course, to find characteristic fossils, and did find them almost as soon as expected; a fine group of *Petraia* and trumpet shaped *cornulites*, chiefly in casts, but also *entire*. These strata are vertical and have a normal thickness of 250 feet. After these came the Diorite and Porphyrite of the mountain summit. On the other side succeeded a broad band of metamorphic strata, similar to the Irish mountain metamorphic band. The extension of these Diorites and metamorphic and fossiliferous strata south, constitute the south end of McLellan's mountain (range). The extension north with the Irish mountain contingent, constitute the range northward. In the latter case the fossiliferous "Mayhill Sandstone" becomes interrupted and the Clinton becomes obscure; the Upper Ludlow with its fossils having also passed into the mountain in like manner, becomes obscure. The Mayhill Sandstone disappears a short distance beyond the place where it first appeared, and then it reappears twice or thrice in connection with the central Diorite, non-fossiliferous, but with characteristic lithology, while the Clinton and Upper Ludlow lie hid in the hollow formed by the syncline of Irish mountain strata with the Fraser mountain series.

Towards the northern end of the range—these two disappear beneath the Carboniferous, leaving the opposite metamorphic strata of Fraser's mountain, to continue the mountain by running up against the diorite of Wier's mountain, the end of the range, or passing on the east side of this mountain and on to Sutherland's river falls, and terminating on the other side of this river.

To an observer coming from the Pictou coal field, the metamorphic character of the strata, the course of the dip and the want of fossils, cannot fail in causing perplexity, while to an observer who has followed our course, all must appear sufficiently obvious.

The Carboniferous formation is now seen passing on the north of Wier's (McLellan's mountain) and coming up against the metamorphic rocks of the mountain which we have seen to pass over to Sutherland's river.

The character and age of the metamorphic strata of the lower falls of Sutherland's river seem to one coming upon them from the Carboniferous formation below, even more difficult to understand than even the metamorphic middle of McLellan's mountain.

The strata at Wier's have introduced to another very interesting and also complicated Silurian district, which I have named after the river of which it is the basin. The hard metamorphic strata at Wier's are succeeded on the east by soft Clinton strata having abundance of characteristic fossils; these are well exposed in a brook which is one of the tributaries of Sutherland's river. This *seems* to indicate the Mayhill Sandstone age of the hard strata at Wier's. At the mouth of the same brook as it enters Sutherland's river in front of the falls, strata appear. These out-crop on the east side of the brook as far south as the New Glasgow road. The section here shows them to be argillaceous strata with very irregular fracture. One cannot certainly recognize in this our old siliceo-argillaceous and arenaceous acquaintance—Mayhill Sandstone. A close search produces two distinct *Petraia*. Can it be that our Petraia is not characteristic of our Mayhill Sandstone after all. Passing along the road eastward, Diorites are observed out-cropping on the left side of the road, a little farther are argillaceous strata. On the right side of the road opposite the Diorite—we find pieces of strata brown in colour and beautifully lined—these when broken shew a bed of lovely casts of athyris and orthis; a core unweathered shows the organisms themselves. Such pieces are abundant. I have not seen anything like them except in McDonald's cove, Mayhill Sandstones between Doctor's brook and Arisaig. This shows satisfactorily that Petraia is in its right place, although the conditions of its former existence seem to have been irregular. To the south, overlying these, are seen argillaceous strata with characteristic Clinton fossils; all therefore is plain. Still farther east, Clinton strata outcrops on the road. Before we come again to Sutherland's river, Diorites are seen off the left side of the road. At McPherson's mill dam and cross roads, strata appear, having Lingulæ. These seem to be of Mayhill Sandstone age, their dip is southerly; on the north side, immediately below the dam, are Grit strata of L. Carboniferous age. These extend down the river until they approach the Falls from which they are separated by Diorite in the River bed. These Grits have the Sutherland's River "Brine Spring." Succeeding the Mayhill Sandstone of the dam and cross roads, are seen at some distance on the road side, clayey strata containing abundance of lingula nodules, the bed, its position, fauna and nodules being the exact equivalent of the lingula bed of Barney's river, and consequently of B. of the "Upper Arisaig series," these extend to the river shewing black shaly strata dropping its nodules in the water.

Farther south, we come to the outcrop of a Clinton member of another series, which has a metamorphic base on the summit of the mountains, rising on the left, and its upper member, Upper Ludlow, in the river, on the right. In the middle there seems to be an irregularity indicated by the fossiliferous Upper Ludlow strata, seeming to lie above and below the Clinton, and dipping in the same direction, as if there had been a fold with the crown denuded. The Metamorphic strata in the mountains passing on in a S. W. direction, are seen up the river at a considerable distance, crossing it, the lower part, forming the falls at McIntosh's saw mill. The strata outcropping in the river below these falls seem to be metamorphic Clinton, and are replete with quartz veins. This was a reputed Gold Field. Coming farther down the river, we reach a lofty mountain which lies on the west side of the river. The side toward the river is a bold precipice, this section of the mountain has on the south side metamorphic slates, on the north porphyrite. It has something of the appearance of Blomidon in the distance. In the river below this the Upper Ludlow of the series appears with its fossils; these continue to outcrop down the river, making formidable rapids. The exposure is magnificent. There are some minor and apparently detached sections of members of the Upper Arisaig Series, which are referred to in the paper. The last, which I would notice, lies in the mountain east of McPherson's mill. This is an exposure of Upper Ludlow strata dipping northerly at a low angle and having an east and west strike. This is the western extremity of the Upper Ludlow member of the series which is exposed at French river, Barney's river, &c., already referred to. The strata under notice are the probable source of the boulders, which have been noticed as containing Upper Ludlow fossils. We return to East River to notice one or two points of interest. At Springville, in the river, Lower Carboniferous limestone is in contact with the Aymestry limestone, the same is the case at the "Sluice" and in Holmes' Brook, where the water of the brook disappears in summer to re-appear after a subterranean course at the "Sluice."

Farther up the river, south of Blanchard, and near the mouth of McDonald's brook, already referred to in connection with the Specular Iron Ore, Crystalline Pyritous Limestone—marble—of L. Carboniferous age appears in the bed of the river; near this, a little off the road side, on the left, limestone appears in contact with the lowest beds of the Blanchard district, overlying Diorite. On the mountain side of the road to Blanchard, Limestone appears with angular fragments of Diorite set as if in mortar. At Pleasant valley, above the bridge, Limestones form walls on the right side of the River, while metamorphic Upper Ludlow occupy the left side. The Limestone then crosses the river to the left, makes a respectable appearance, and finishes above the left side of the road about a mile farther up, forming a cave. I have thus dwelt at considerable length on this very interesting, instructive and complicated district.

1871. After Feb. 13th, the date of the last paper. Report of the Geological Survey of Canada, 1860–9, received.

1871–2. Two papers, "Being strictures on Logan and Hartley's Geology of the pre-carboniferous formations of the Pictou Coal Field." In Sir W. E. Logan's Report of Survey of the Pictou Coal Field, page 7, read: "No evidence was observed by me, on McLellan's mountain, to show to what epoch these older rocks belong; but masses somewhat similar are noticed by Mr. Hartley on the west side of the East River, in a position where they have been mentioned in his *Acadian Geology*, by Dr. J. W. Dawson, who considers them to be of Devonian age, and on his authority they will be so distinguished.

My papers contained a *résumé* of the part of my paper of Feb. 13th, in which I proved that the rocks of McLellan's mountain referred to are a continuation of the metamorphic Middle Silurian of Irish mountain and Fraser's mountain. The view expressed by Sir W. Logan is antiquated, dating from the Devonian *regime* of 1855.

1872. April 8.—"On the Geology of the Iron Deposits of Pictou County." Author,—*Transactions*.

In the Appendix to Reports on the Pictou Coal Field, Canadian Survey, 1866–9, page 408. Mr. Hartley says, "Several deposits of Specular ore were examined. These all occurred in a range of metamorphic rocks lying ten or twelve miles to the south of the Pictou coal field. Of the age of their formation, I cannot speak with certainty, but it is probably Upper Silurian. The rocks consist of light and dark green, purplish, brown and black colours, and giving a white streak. The quartzites are sometimes coarsely granular, but as a rule compact and fine grained. This formation appears quite distinct in lithological character from the series which has been described by Sir Wm. Logan and myself as occurring near the Pictou coal field at McLellan's and McGregor's mountains, and at Water's hill, and which are believed, by Dr. Dawson, to be of Devonian age. I made no attempt to obtain fossils in these rocks, nor has any bed been observed likely to contain them at the few localities examined: but it seems probable that the fossiliferous beds mentioned by Dr. Dawson in his Acadian Geology, pp. 568–70, are included in these series. These beds from which a large number of fossils have been collected by Mr. D. Fraser, of Springville, are of undoubted Upper Silurian age."

The fossils referred to by Mr. Hartley, as collected by Mr. D. Fraser, were either from the Upper Ludlow or Aymestry Limestone, or possibly, both, and therefore Mr. Hartley was perfectly right in considering them to be of Upper Silurian age. The position of the Brown Hematite, as ascertained by Mr. Hartley himself, was at Fraser's, in the lower non-fossiliferous part of the series, and could only in a very loose manner be correlated with the upper members of the series.

It was shown that the fossiliferous ore of Blanchard, the only ore which could admit of precise correlation, is of Clinton age, and therefore Middle Silurian, having fossils altogether different from the Upper Silurian fossils referred to, and that the probability seemed to be that all the ores were of Clinton age.

He rather seemed to be astray in regarding the iron bearing rocks as of different ages from the rocks of McLellan's mountain, in regarding the latter as Devonian and the former as Upper Silurian, while they are evidently of the same age, and that Middle Silurian. Mr. Hartley seems to have got rather muddled in his correlations. Others adopting the same methods will succeed no better.

1872-3.—Nov. 11th.—Notes on the Geology of N. Scotia and Cape Breton. Author,—*Transactions.*

Having re-examined the supposed Laurentian rocks at Arisaig and investigated their relation to the other series, and not yet having had an opportunity of examining an acknowledged Laurentian series, I began to entertain doubts of their Laurentian age. To this was added the fact that the unquestionable evidence of relative position only shewed that they were older than the Mayhill Sandstone and Middle Silurian, and therefore might be Lower Silurian. In this state of indecision I thought it advisable to designate this series "The Lower Arisaig Series," and the other the Upper Arisaig Series, and I began to designate the lower series as Quebec rather than Laurentian. My recollections of the Quebec rock specimens of the Exposition de Paris 1876, and their many points of resemblance to the Laurentian specimens, with the descriptions of both in the Geology of Canada, 1863, led me to adopt this alternative. I may now anticipate and say that this change was only temporary.

The paper before us gives an account of the typical series at Arisaig and the discovery and examination of a series perfectly identical, occurring at George's River, Cape Breton, near the Little Bras d'Or, and underlying the Sydney Coal Field. Every characteristic rock found at Arisaig was found here. The specimens in the two collections in the museum* can only be distinguished by the labels. In such a case as this Lithology can be safely trusted in correlation. The intervening distance, also, is inconsiderable.

This discovery was important not only in itself and in its bearing on the Geology of Cape Breton, but we will yet see it having an important reflex influence in the process of the correlation of the type itself.

The rocks in this locality resembling the Arisaig rocks are Syenites, Diorites, Crystalline Limestone, Ophites, Ophicalcites. Arisaig rocks and those of George's River are both in contact with the Lower Carboniferous.

1872. "The History of a Boulder" the Author—*Transactions.* This Boulder is a large one of those already referred to as occurring to the east of Sutherland's River. In it was a *band* of fossils having Dalmania Logani, Hall. This shewed that it belonged to a rock of the Upper Ludlow period. Its position showed that it had been derived from rocks which outcrop at McBeath's, of Sutherland's River Basin. (Paper Feb. 19, 1871.) In this history allusion is made to the underlying Clinton of French River, the "Lingula nodule bed" of Barney's River underlying the Clinton, and the great band of Mayhill Sandstone discovered up Barney's River, extending eastward and westward on the flanks of the mountains and having the usual Diorite. This Mayhill Sandstone band when discovered yielded Petraia and trumpet-shaped cornulites in abundance, Calymene Blumenbachii, &c. In short a *fauna* nearly as numerous and varied as at Arisaig itself; with Lochaber additions.

1873. "On the metamorphism of Rocks in Nova Scotia and Cape Breton." Author,—*Transactions.* The most important part of this paper is that which refers to local metamorphism.

In my paper "On the Geology of Arisaig," 1864, I directed attention to the conversion of arenaceous strata into Porcellaneous rocks, by means of association with trap. At that time I thought that the porcellaneous rocks were, A, Mayhill Sandstone strata altered.

It so happened that the former appeared where the latter seemed to terminate; the last of the fossiliferous Mayhill Sandstone disappearing before reaching Frenchman's Barn (rock); this porcellaneous rock and similar rock seemed to be a continuation of the A. strata. In 1867, giving due attention to lithology and collecting specimens of rocks, I found near McNeil's brook, east of Doctor's brook, on the shore, trap with porcellaneous rock of quartz hardness associated with a soft rock, unctuous, variegated, easily cut with the knife, and susceptible of a beautiful polish. The same association was afterwards found at Arisaig pier and on either side of Frenchman's Barn. On the east of the barn this soft rock was of a bright orange colour, and connected with another green and brown rock which

I at first mistook for serpentine. The soft rock was afterwards quarried with the expectation of finding it massive and suitable for ornamental purposes. At Doctor's Brook the connection of these and McNeil's was found lying *between* the Mayhill Sandstone—fossiliferous—and the trap; so that it became evident that this was something *lower* than the May-hill Sandstone. Regarding the May-hill Sandstone as the equivalent of the Medina Sandstone, I considered that this might be the next in order, underlying, and I therefore named it Oneida; and considered that the rocks in question were Oneida conglomerate metamorphosed by the igneous rocks. It has been suggested by Mr. Selwyn that this may be part of a Lower Silurian series.

The latter rocks are Diorites, homogeneous, amygdaloidal and porphyritic.

The Amygdals with one exception, a small fortification agate, are Calcite.

There is also ash with Amygdals.

The Diorites are of precisely the same character and age, as similar rocks which I found associated with and penetrating Upper Silurian fossiliferous strata in the north of New Brunswick (Dalhousie), and which contained *corals* that had dropped into them before they had cooled and become solid.

I considered that the porcellaneous and other rocks had been acted upon by this igneous rock in the carboniferous period, and thus had local metamorphism superadded to prior metamorphism induced during Upper Silurian and Devonian time.

1873-4. " Geology of the Cobequid mountains," Two papers. Author,—*Transactions.*

These papers give the results of a course of examination of the Cobequid Mountains by crossings from south to north and *vice versa.*

1st.—Through the Intercolonial Railway Section.
2nd.—Great Village to Greenville.
3rd.—Greenville Cross Roads to West Chester.
4th.—Folly Lake and Wallace River.
5th.—Five Islands to Napan.

These are at intervals of 5 and 22 miles.

No. (1.) I. C. R. This Section from Folly River to Greenville station, cuts Triassic, Carboniferous, Middle Silurian, Laurentian, Lower Silurian, Middle Silurian (?) and Carboniferous formations.

(2.) Triassic, Carboniferous, Upper and Middle Silurian, Laurentian, Carboniferous.

(3.) Laurentian, Carboniferous.

(4.) Laurentian, Carboniferous.

(5.) Trap, Triassic, Carboniferous, Upper and Middle Silurian, (?) Laurentian, Carboniferous.

These indicate the same order and succession on the south side of the mountains, with questionable difference; with the exception of the I. C. R. Section all have on the north the *Lower Carboniferous* succeeding the Laurentian.

None of these Sections show an anticlinal arrangement on either side of the mountains like the mountains associated with the Pictou Coal Field. All, with the exception of the I. C. R., show an enormous break on the north side from Laurentian to Lower Carboniferous. There are wanting, Cambrian, Lower, Middle and Upper Silurian, and Devonian. It was observed that the Triassic at Five Islands had a synclinal arrangement, the trap on the south having given part of it a northerly dip. This shows that the trap is intrusive and therefore of *later* formation than the strata. The I. C. R. and the Great Village River Sections show that the lower part of the Triassic have conglomerate, and grits, as well as the lower strata of the Carboniferous. A quarry west of the latter section, shows that the lower member of the Carboniferous, is a limestone. Five Islands Section shows the lower part of the Triassic to be sandstone and of the Carboniferous, a ripple marked clay slate. Great Village river at Londonderry Mines, shows a greater thickness of the metamorphosed or "Upper Arisaig Series" than the I. C. R. The Iron Ores, for which the other is remarkable, do not appear in the I. C. R. Section, and therefore the latter seem to be a very low part of the Upper Arisaig Series.

The Lower Carboniferous on either side of the mountain, are nearly at the same elevation above the level, 450 feet, as shown from the exact measurements of the I. C. R. Section Books; this shows that they were unquestionably formed on approximate sea levels at the Lower Carboniferous period, and acquired their present position at the same time and by the same causes; that their present sequence is the result of the relative position of the Precarboniferous formation at the period when the Carboniferous Strata were formed. Irregularity of sequence here accords with the normal state of things, as regularity is certainly the exception having been only observed where Lower Carboniferous conglomerates are formed on Diorites of supposed Devonian age; some may be induced to account for irregularity of succession here by supposing faults. If this were adopted as a principle, there would be no end of fault finding in Nova Scotia.

We seem to have another approximate sea level on the I. C. R. in the Triassic conglomerate of the second cutting south of the Carboniferous of the Londonderry mine station. The difference between the height of this and the Lower Carboniferous Conglomerate is 150 feet.

Gravels were observed at Folly lake of such a character and in a position which led me to infer that they are *in situ*, being subaërial deposits formed in the Lake at a time when it had a greater extent and a higher level. These were regarded as having been formed in Oolitic, Cretaceous, Eocene, Miocene and Pliocene time.

The Pre-carboniferous formation of the centre and northern part of the I. C. R. Section and corresponding parts of the other courses are treated of in the papers. There are 1st "Lower Arisaig Series." 2nd, Wentworth (Lower Silurian) and Middle Silurian?

That the crytalline rocks of the I. C. R. and other sections correspond with the "Lower Arisaig Series" is evident from their Lithology. Here we have as at Arisaig and George's River, Syenites, Diorites, granitoid and homogeneous Gneisses, Petrosilex, Crystalline Limestones (marbles of Five Islands), and in addition Granites and Porphyries. The Granites are peculiar, especially the Maccan mountain granite. Specimens of similar granite have been brought to me from Cape North, Cape Breton. The Marble of Five Islands does not seem to have serpentine associated with it,but it has Syenitic gneiss—other evidence of identity follows :—Succeeding the red Syenite of the preceding formation is a mixed Crystalline series, having a width of 8,300 feet. This consists of crypto-crystalline Diorites of various shades of green; one part has crystals of red felspar; there are red porphyrie's and banded jaspideous rocks, purple grits, purple conglomerate with enclosed pebbles of scarlet jasper, purple jaspideous rocks and coarsely crystalline Diorites, besides other rocks which it is difficult to characterise. There is here a conglomerate which deserves special mention. It is very coarse consisting of pebbles of Jaspideous rocks of Diorites and Amygdaloids cemented by calcite, some of the Diorite boulders, are Amygdal-porphyritic, the amygdals being calcite and the crystals red felspar. Succeeding there is a closely connected band also mixed crystalline, this has crypto-crystalline diorites and porphyries with fossiliferous argillites and shales, a singular alternation of very hard and very soft rocks; a similar lithological arrangement is not met with in Nova Scotia. I have assigned the lower part of these to Bala of England or Cincinnati of United States, on account of the character of the *fauna* found in the claystones. In Wales is to be found an arrangement of rocks which very closely resemble that under consideration. Prof. Ramsay's great work " on the Geology of N. Wales," has a wood cut, section Fig. 20, page 90, which might represent the present section. It runs thus—1st, Syenite; 2nd, speckled felspathic and talcose flaggy beds, (Llandeilo and Bala beds); 3rd, Felspathic ashy Conglomerate; 4th, Slate; 5th, Felspar porphyry; 6th, Blue slate; 7th, Felspathic trap; 8th, Blue slate beds. Plate 28, Sec. No. 3, has the following explanation. The syenites, porphyries and greenstone (Diorite) are referred to the *Lower Silurian age.*

This seems to be another *Anglican* coincidence. This mixed crystalline series refers to and throws important light on a similar series at Arisaig, which had no counterpart at East River or elsewhere, and consequently, was a subject of perplexity and misunderstanding. When I surveyed Arisaig, in 1868, I observed in the Arisaig Mountains, what I considered to be an " Upper Arisaig Series" in a much altered condition. Continuing my Section, No. 2, of 1863—(which commenced with the Trap and Mayhill Sandstone of the Cove west of Doctor's Brook on the N., and ended with the Clinton of the south side of the Syncline, with a succeeding Lower Carboniferous limestone, conglomerate, trap and porphyry, in a small branch of Doctor's brook.)—I found slates succeeding a great Diorite of which the Porphyry of the preceding section is an accompaniment. This is a band of bright red and grey slates of considerable thickness, which at once suggested to me the great band of red and grey slates, on the east side of Lochaber Lake and opposite the fossiliferous Upper Arisaig Series already noticed in that locality. This is the top of the series which contains the copper ores of Polson's Lake and Lochaber, a series which was once regarded as Devonian? On the other side of this slate is also a Diorite, after this comes Quartzites and a Metamorphic band of rocks that weather white and adhere to the tongue; this is the summit of McDonald's mountain, having an elevation of 1000 feet, (Bayfield,) succeeding this, and having an elevation of about 900 feet, I found a Conglomerate, different from any other met with in N. S., it is composed of very *fine* gravel and is excessively hard. The position of it suggested *Oneida Conglomerate.* I regarded it as representing the porcellaneous rock of Arisaig pier, &c. This series is also bounded on the south by the crystalline rocks associated with the Syenite of McNeil's mountain. It corresponds very much in character, and also in relation with the mixed crystalline series of the Cobequids; so that the Arisaig Mountain Series is actually a Lower Silurian Series, intervening between the "Upper Arisaig Series" and the "Lower Arisaig Series," and may appropriately be called a "Middle Arisaig Series." This series having taken the position, at Arisaig, which I had assigned to the "Lower," we may now regard the *latter as of Cambrian age?* or lower part of the Lower Silurian age.

1874–5.—"A month among the Geological Formations of New Brunswick." Author,—*Transactions of the Institute.*

In this paper I gave the results of an examination of the Laurentian, Huronian and Primordial Formations of Saint John. I found the recognized Laurentian here, an exact counterpart of the "Lower Arisaig series" in Nova Scotia. In some respects it more nearly resembles the series in the Cobequids; in the variety of its Limestones it has a greater resemblance to the typical series at Arisaig and the series at George's River, C. Breton, so that, if there is no doubt of the Laurentian age of the Saint John series, there can be as little doubt of the Laurentian age of the "Lower Arisaig series." The Huronian of Saint John is also very like the "Middle Arisaig series." A *Diorite* associated with the Primordial at Saint John, is perfectly identical with the Diorites of the Bala or Cincinnati of Wentworth, I. C. R. section.

I would here refer to a case which seems to coincide with the views here stated in reference to the Huronian of Saint John and the Middle Arisaig series. In the same summer, not long after I left New Brunswick, Mr. Selwyn, the Director of the Geological Survey of Canada, discovered on the Louisburg railway, between Mira and Louisburg, C. B., a series of rocks which he considered to have a striking resemblance to the "volcanic accumulations of Snowdon and Cader Idris in Wales." I had compared the "Middle Arisaig series" in the Cobequids to the *same*, as represented in "Ramsay's Geology of N. Wales." Mr. Selwyn, from personal knowledge of the Geology of Wales, had come to a similar conclusion regarding the Louisburg rocks. I may also state that Mr. Selwyn had placed the Louisburg rocks in the Huronian division, along with the rocks of Saint John, in the "Centennial Exhibition," Stratigraphical collection of the Survey.

1876.—"Nova Scotian Geology at the Centennial Exhibition."

In my Nova Scotian rock collection, the rocks of the Lower Arisaig series, of Arisaig, George's River, C.B., and the Cobequid Mountains, were exhibited as Laurentian. In the Stratigraphical Collection of the Geological Survey of Canada, the rocks of George's River and corresponding rocks from St. Ann's, C. B., and Saint John, New Brunswick, were in the Laurentian division,—vide Catalogue of the Mineral Department of Canada,—A. R. C. Selwyn, Esq., F. R. S., &c., Director. In Dana's Manual of Geology, last edition, the *Laurentian* and *Cambrian* are included under the term *Archæan*. To this he refers my typical Lower Arisaig.

Canadian Journal, July and August. Outlines of the Geology of Canada. By Prof. Chapman, Ph.D., LL.D., of the University of Toronto.

The author of those outlines having examined the district of Campbelltown, Cape Breton, indicates the rocks underlying the Coal measures, i. e. St. Ann's rock as Pre-silurian, i. e. Cambrian or Laurentian.

Thus by a tedious and indirect process extending over seven years, we have arrived at the same conclusion regarding the age of the "Lower Arisaig series" that I had reached by direct correlation in the course of a day when first examining the rocks, and that Dr. Hunt had arrived at by examining the specimens of the rocks in his Laboratory in Canada.

In these investigations I have also connected the Laurentian of New Brunswick with Laurentian of Nova Scotia and Cape Breton, and therefore with the Laurentian of Newfoundland and the typical Laurentian of Labrador. The name Labrador directs attention to the suite of specimens in the Provincial Museum which the Rev. J. Campbell, now of the Canada mission in India, kindly collected for me, in the harbours of Labrador. I find these of great service in pointing out to students the marks of resemblance between the typical Laurentian and that of Arisaig, Cobequid mountains and Cape Breton.

In the stratigraphical collection of the Canadian Geological Survey, Mr. Selwyn pointed out to me specimens of rocks of supposed Potsdam Sandstone age, from the Little Bras d'Or in Cape Breton. Mr. H. Fletcher, of the Survey, who had discovered these rocks, subsequently pointed out to me the locality. I was astonished and gratified to find that they were from strata on the north side of my Laurentian rocks of St. George's, C. B., strata, which I had *hastily* concluded to be of Carboniferous age, from the arrangements of the formations in a coast section at George's River. Mr. Fletcher found in these strata, Lingulae, Dictyonema, &c., which Mr. Billings considered to be of probable Potsdam Sandstone age. This discovery, besides being important in itself, as of the first Silurian Fossils known to have been found in Cape Breton, is of very great importance in its relation to the Laurentian rocks of George's River. It does for this series what the Middle Arisaig series did for the Lower and typical Series; it makes the supposition of Quebec Lower Silurian age untenable, and therefore *per se* the Cambrian age probable. The lithology, corresponding with that of the Laurentian of Saint John, now makes its Laurentian age certain. Thus, we have the Cape Breton Series confirming our correlation of the typical series at Arisaig.

I would now observe, what will be readily admitted, that the township of Arisaig is remarkably favoured in the possession of three important (Typical) Series of Pre-carboniferous rocks. In fact, I believe, we are here furnished with the *data* for giving the solution, perfect or approximate, of every problem in Nova Scotian Pre-carboniferous Geology.

I would now take a look at the continuation of the I. C. R. Section in the Cobequids. Succeeding the igneous Conglomerate last referred to, we have, on the north side of the Wentworth station a remarkable section, as follows:—

	Obscure	feet
1.	Dark green crypto-crystalline diorites	30
2.	Black soft shale	20
3.	Diorites with shale parting	8
4.	Black shale	56
5.	Black slates and shales, very pyritous, having abundance of fossils, dip 45 N., 5 E.	40
6.	Diorite—pyritous	24
7.	Black slates with shales, dip 41 N., 5 W.	100
8.	Diorites—pyritous	14
9.	Shale	140
10.	Diorite	60
11.	Shale	6
12.	Diorite	30
13.	Shale	10
	Vertical thickness of the whole	615

The report of the discovery of this section and of my opinion that it was a *Lower Silurian* series of rocks made quite a sensation. This was so repugnant to the *grand ideal* of the structure of the Cobequid mountains,—igneous centre with Upper Silurian sides,—I was informed by authority that I was mistaken, and that the supposed Lower Silurian rocks were of *Clinton* age. Still considering that my views were in accordance with facts and reason, I maintained my position. Transactions, 1873.

From the very beginning I never saw any resemblance between the rocks in question and their fauna, with the acknowledged Clinton of Hall and Dawson, in the "Upper Arisaig series," either at Arisaig or elsewhere in Nova Scotia. This was enough to make me disregard the opinions of autherities in the matter. The only part of *this series* that did suggest itself in connection with the general aspect of the lithology of the section and the *fauna*, was the Doctor's section or B of my "Upper Arisaig Series" which is ignored or slightly favoured by the admission of possibly being a little lower than the recognized Clinton of Arisaig. Lingulæ seemed to be a characteristic feature here as at Doctor's brook, Barney's river and Sutherland's river, and Graptolites, not *Clintonensis,* but more slender in form, and diprionidean forms, diplograpsus and climacograpsus—such forms as caused perplexity in the correlation of the Doctor's brook or B. Arisaig, leading me, in my Transactions, 1865–6, to correlate it with the Hudson river; Palæontologists maintain that these forms do not occur after the Lower Silurian period. A closer examination of the lithology of the section led me to doubt the supposed resemblance and to consider that this was a normal case of *diprionidean graptolite* occurrence and not exceptional as at Doctor's brook, and to regard the series in question as of Bala or Hudson river or Cincinnati age. Its close connection with the preceding volcanic series as well as its lithology and palæontology suggested a Bala resemblance.

The two thus combine to form an almost exact counterpart of the series of Prof. Ramsay's *Section* already referred to. The Graptolites particularly suggest the Hudson River, and one peculiar form which will come under notice, suggests the Cincinnati. The arrangement here thus seems to be peculiarly "Anglo-American." The lithological characteristic of importance, which suggests an Anglican resemblance is certainly not in the black claystones which, for want of a better term, I call slates in No. 6 of the above Section, neither is it in any of the sedimentary rocks, but in the alternation of Diorites with the strata, and their *seeming* bedded character, as if they were co-temporaneous lavæ flows. The Diorites are different from the Diorites generally associated with the strata of the "Upper Arisaig series" to which I have already often referred, and shall have occasion yet to refer; the latter are coarser and more solid than the former, they have not the same beautiful lustrous green colour, besides they are always intrusive and have a marked influence in altering the character of the strata in contact. The Diorites of our section are not distinguishable from the homogeneous Diorites of the Laurentian centre of these mountains, and have their exact counterparts in the Huronian and Primordial Diorites of Saint John.

Another lithological peculiarity is referred to in No. 6 of the section, "very pyritous"—the rocks containing the fossils are very pyritous, joints are filled with crystals of pyrite, and the fossils when preserved, otherwise than as casts, are pyritous. Where we have Diorites in contact with the lower members of the "Upper Arisaig series" we occasionally have crystals of pyrite in the latter; two or three times I have found fossils pyritised, but the occurrence does not come into prominence as in the present case.

Mr. Selwyn in his Report,—Reports of the Geological Survey of Canada 1875--6—takes occasion to call in question my Lower Silurian correlation of this series.

He states that Mr. McOuat of the Survey collected 300 specimens from these fossiliferous rocks, i. e. from No. 6 of the Section. He finds the rock containing the fossils to resemble certain rocks of the Ludlow formation of England, and thence infers the Ludlow or Upper Silurian age of the rocks in question, and he informs us that Mr. Billings recognized certain forms in the same specimens which he considers as proving their Clinton or Middle Silurian age. I have more specimens than I would care about counting. Certainly more than 300 specimens out of the 40 feet of strata from which the said 300 specimens were taken; but the greater part of mine having the distinctive *fauna* of the series were taken from the lower part of the strata, whereas from the description of the rock given by Mr. Selwyn, and the *fauna* by Mr. Billings, the specimens of the Survey were taken from the upper part.

Mr. Selwyn in his lithological comparison ignores the striking lithological features of the section to which I have directed attention, and attaches importance to an obscure characteristic; a character of claystone which may be common to Lower, Middle or Upper Silurian rocks of any country. Mr. Billings' evidence of Clinton age, are 1st Graptolithus, like Clintonensis. 2. Strophomena corrugata. 3. Atrypa reticularis. 4. Lingula oblonga. 5. Rhynchonella Eva. 6. Leptæna transversalis. 1st—Graptolithus Clintonensis. This appears to be first in importance according to Mr. Billings, and to have suggested to him the Clinton age of the strata. From the observations that I have already made upon the synonyms of this *form*, when considering Prof. Hall's and Mr. Salter's correlation of B'. Arisaig, you may see that I have as much reason to assume that the graptolite referred to is Ludensis, or priodon. I therefore assume in accordance with lithology and apparent stratigraphical relations, that this graptolite is *graptolithus priodon* of Bronn and Salter.—Salter's Appendix to Ramsay's Geology,—and may therefore be an evidence of Bala age.

2nd—Strophomena corrugata. This form occurs in the Bala; Salter. It is abundant in the Mayhill Sandstone, Arisaig; it also abounds in B'. slates, Clinton, in C. Aymestry Limestone and in D. Upper Ludlow. The inference is obvious. Its existence does not necessarily indicate Clinton or Bala.

3rd—Atrypa reticularis. I do not find this occurring in Bala of Wales, nor in A. May-hill Sandstone of Arisaig. Its first appearance is in B or Doctor's brook, it does not occur in B' the recognized Clinton. Coarse and fine varieties occur in C. Aymestry limestone; this appears to be its climax at Arisaig and East River; it is also found in D. upper Ludlow. To affirm that a form so persistent may not occur in the Bala would be a hazardous position. However, grant that it does not occur in the Bala and occurs in the Clinton somewhere it occurs also in B. *under the Clinton* in Nova Scotia, therefore its existence in our Series does not prove that it is *not lower* than the Clinton.

4th—Lingula oblonga. The species is a Clinton form, according to Hall. It does not occur in Nova Scotia Clinton, or B′ Arisaig, it abounds in my Lingula nodule bed, B.

It is therefore not a Clinton form in Nova Scotia, and its existence does not prove that our series is not lower than the Clinton.

5th—Rhynchonella Eva. I have tried to inform myself regarding this form. Its specific name shows that it is one of Mr. Billings' own species. I cannot find it described anywhere.

6th—Leptæna transversalis. By referring to Salter, I find that this form occurs in the Bala. Hall does not refer to it as occurring in the Clinton of New York. It is included among his Niagara Limestone forms. It does not occur in any member of the Upper Arisaig Series. It is altogether new to Nova Scotia, and may without *impropriety* be assumed as of Bala age in Nova Scotia.

I think this examination of the supposed antagonistic evidence does not establish the Clinton age of the controverted series, but rather tends to show that it may be older than the Clinton. It is so, at least, Clinton as recognized in Nova Scotia. It will not now take much to bring down the scale. I consider that the lithology added to the palæontology has done this already. I also consider that Diplograpsus and Climacograpsus, a number of monoprionidean slender forms associated with graptolithus priodon, the number and variety of Lingulæ after Lower Silurian types, a great number of forms, new to Nova Scotian Geology, which I have not yet been able to identify, and last of all, the occurrence of Pholidops Cincinnatiensis, Hall, as figured by Meek in his Report of the Geological Survey of Ohio, Vol. I, Part II., Lower Silurian (Cincinnati group), plate Fig. 2, a. b., are sufficient evidence of Bala or Cincinnati age. Add to all this the succession of another group of harder argillaceous strata with crystalline rocks, Diorites and Porphyries. These are exposed in tunnels and sections north of the *Cincinnati strata* just examined. They too are fossiliferous—I found in them one large *Lingula*. Comparative lithology, even with one lingula, would make this Lower Silurian? giving the place which I was ready until now to assign to the other series. I therefore regard the Bala, Cincinnati or Hudson river age, of the Wentworth, Diorite, Argillaceous and Fossiliferous strata established as satisfactorily as any part of the "Upper Arisaig series." These affixed to the "Middle Arisaig series" seem to make the Lingula flags the conditional upper limit of the "Lower Arisaig series."

1875–6. Superficial Geology of Halifax County, read before the N. S. Institute of Natural Science and the American Philosophical Society, Philadelphia, May 16th, 1876. Author,—*Transactions of Institute.*

This paper contains an account of investigations in the superficial Geology of Halifax, extending over a period of three years. It shows that a very large proportion of the drift material had been collected from the Pre-carboniferous formations of the Cobequid mountains, from the Carboniferous and Triassic on the north side of Minas Basin, from the Triassic of King's County, especially from Blomidon, and from the Carboniferous formation of Hants Co., from the respective distances, 60, 55, and 30 miles.

It also shows that the boulders had been distributed along the Atlantic coast; from N. W. Arm, Halifax Harbour, to Three Fathom Harbour, a distance of about 20 miles. It points out enormous blocks of quartzite that had fallen from the drift bank sections on the shore. These show strikingly the results of rough and hard usage in the course of transportation. The underlying slates, quartzites and granites show extensive numerous and striking, polished, striated and furrowed surfaces, the effects of this transportation. The striation corresponds with the material of the drift in showing that the course of transportation had been from N. to S. It indicates that there had been two courses, 1st.—The course generally indicated in the peninsula of Halifax S. 30 E., to S. 20 E., a course which if extended includes Blomidon and seven or eight miles west of it. 2nd. Striation of considerable extent at Wellington Station, indicating a course S. 30 W. This course passes at no great distance west of Londonderry Mines. This and the other extended beyond Blomidon to the Cobequid Mountains will include about 65 miles of the mountains N. E. and S. W., from which material has been transported.

The two meeting some way near the Windsor and Truro Railroad Junction, seem to have exerted a reciprocal action so as to convert the two courses into one course S. 5 E. The line of junction of the two seems to pass through Halifax Harbour, hence we have the great drift accumulations, Navy Island, Bedford Basin; George's and McNab's Island in Halifax Harbour; a considerable part of Citadel Hill; and the accumulations of Dartmouth. One point which has to be noticed is this, that the resultant course S. 5 W. formed by the meeting of the two courses, accounts well, especially for the syenitic transportation and distribution from the Cobequids. But in order to meet the case of amygdaloidal transportation and distribution along the shore to Three Fathom harbour, a course S. 20 E., would be necessary. My investigations in Superficial Geology are still in progress (1878).

Centennial Exhibition, 1876. An illustrative Boulder Collection was exhibited by me, in the Nova Scotian contingent of the Canadian Mineral Collection, consisting of Syenites, Gneisses, Diorites and Granites from the Laurentian of the Çobequid Mountains. Amygdaloids with the usual minerals of Blomidon. Two Islands and Five Islands, *e. g.* Agates, Jasper, Chalcedony, Cacholong, Heulandite, Natrolite and Stilbite. From Cobequids: olive coloured Quartzite with casts of crinoid columns. From Hants—Carboniferous Limestones with fossils, Macrodon Athyris, Fenestella, &c. Sandstones with cast of stigmaria and rootlets, Lepidodendron and a calamite. This collection was awarded a *Medal* by the International Judges.

REPORTS OF THE GEOLOGICAL SURVEY OF CANADA, A. R. C. SELWYN, F. R. S., DIRECTOR.

Mr. Fletcher's Map and Report is, beyond exception, the best work that the Survey has executed in Nova Scotian Geology.

It is altogether up to the mark and time. Standing on the "Lower Arisaig" representative, the extremity of Mr. Fletcher's "Boisdale Mountains," an extremity which has been often referred to in this retrospect as "George's River." As far as the mountains appear the Laurentian is seen to extend, having on the right, in direct contact, the Lower Silurian, (Potsdam Sandstone,) with the Lower Carboniferous succeeding, and on the left, as far as the map indicates, the Lower Carboniferous Limestones, in direct contact with the Laurentian — the Carboniferous resting on either is unconformable. This takes us back to the close of the Devonian Period and beginning of the Lower Carboniferous, when the Boisdale, Cobequid, Arisaig and other mountains of Cape Breton and Nova Scotia were humbly raising their heads (lower than now by 470 feet) in the wild waste of waters, having Laurentian or Silurian slopes, where mechanical agencies are forming shingle beaches or sandbeds or Laurentian or Silurian walls, where organic agencies are at work, or organic and mechanical combined in forming clay beds or calcareous deposits—the mechanical products are seen converted into conglomerates, sandstones and claystones, and the organic into limestones. Our retrospect limits our view of this formation which includes the Sydney Coal Fields.

Mr. Fletcher made another very interesting discovery at McIntosh's Brook opposite *Escasomie*, East Bay, on the left side of the Boisdale mountains, and beyond the range of the map in the last Report. Here he found a section having a singular deposit of phosphatic limestone composed almost wholly of the crushed valves of lingula. The Potsdam sandstone on the opposite side of the mountain makes these represent the Upper Lingula Flags of Wales. This is also interesting in its relation to the "Lower Arisaig" of George's river. Making it lower than the Upper Lingula Flags gives it a primordial position, so that it is no longer to be regarded as of *Quebec age.* Palæontology and relative position have lowered it to the Upper Cambrian. We have here to look to the primordial, (Lower Lingula Flags, Upper Cambrian) to lower them to the Lower Cambrian or to the Laurentian, by the aid of lithology. This is all the proof we profess to give of the Laurentian age of the Lower Arisaig series. *Eozoon* is said to have been found in the Saint John Laurentian. Arisaig and Saint Ann's, Cape Breton have also been credited with *Eozoon;* the question of *tubulation* may make this palæontological aspect still *questionable.* I have no very great objection to allowing the matter to rest here, and to make the "Lower Arisaig series" Laurentian ? or Cambrian ? or with Dana to call it *Archæan.*

1877, August. Mr. Fletcher kindly sent to me specimens, the proof of another remarkable discovery that he had just made in a reputed carboniferous locality, Marion bridge, Mira river, Cape Breton, *vide Maps of Acadian Geology*, 1st and 2nd editions. The specimens are composed of broken trilobites, making a deposit analogous to the Lingula deposits of East Bay. These trilobites are altogether new to Nova Scotian Palæontology. Those that are distinguishable are *Olenus (sphaerophthalmus) alatus* Bœck. Salter's Appendix to Ramsay's Geology of Wales—plate 4, fig. 3. The head, eyes and scimitar-shaped cheek spines, are not to be mistaken. Its usual associate *Agnostus* is seen in accompanying black shale.

According to Salter this species of *olenus* is an "Upper Lingula Flag" form. This tends to confirm the correlation of the Boisdale, Lower Silurian, Potsdam Sandstone. Mr. Fletcher will soon inform us of the relation of these to the *Lower Silurian?* or *Huronian* of Louisburg, as the olenus strata seem to be on its border.

1877–8. On the Geology of Annapolis County. By the Author—present No.

The part of this beautiful county treated of in this paper is the S. Eastern, whose pre-carboniferous rocks have heretofore been considered to be of both Upper Silurian and Devonian age.—These contain as is well known beds of Iron ore, fossiliferous and magnetic, which have been considered to be of Devonian age. Granites, Gneissoid Rocks, &c., are also found associated The Granites have been regarded as igneous rocks of Devonian age, and the Gneissoid rocks as Devonian strata metamorphosed by Granitic igneous action. Acadian Geology 2nd Edition. The paper contains the results of a survey of these made in July 1877. The examination of the strata, and especially of localities having fossils, which are so distributed as to represent the whole field, Silurian and supposed Devonian, shew us unmistakably that the strata in question are Middle and possibly Upper Silurian, or A. and B'. and possibly C. of the "Upper Arisaig series." The Lithology of the A, Mayhill sandstone representative is highly characteristic, being in its lower part exceedingly arenaceous. In whatever part of the field these are prominent we have the usual association of *the East*, Diorites, which elevate, fold, tilt, and metamorphose the strata, converting arenaceous strata into quartzites, tilting the strata or giving them a dip of from 70 to 80, folding or faulting in such a manner as to make the apparent thickness of the strata enormous, and bring up older rocks, so as to make them appear as members of the newer series. In the region where the Diorites occur most frequently, the ores are magnetites. No part of the field has escaped the influence of these Diorites. The fossils have been almost wholly converted into casts, and crystals of Pyrite and Arsenopyrite are added. The fossils of the iron beds are often different from the Arisaig fossils of the east. Still Petraia of the Arisaig species abounds, and the genus Athyris is represented by a greater number of species than the Mayhill or Medina Sandstones of the east. The genus also occurs frequently in the iron beds. The fossiliferous iron bed has its course running indiscriminately through the Devonian and Silurian of Acadian Geology. The genus Strophodonta is represented by two large species. The Trilobites observed are Dalmanites Hausmanni? and Cheirurus? It was remarked as a coincidence that Strophodonta occurs in the same association here as Strophodonta prisca in Oneida County—with iron. The iron deposits in this locality are therefore of the same age as the fossiliferous bed of Arisaig brook, and the fossiliferous bed of Blanchard, East River, Pictou—Clinton age.

Granites.

Where the Middle Silurian approached to or appeared in actual contact with granite it was in no respect different from the same strata in the centre of the area, farthest removed from all crystalline rocks. The only effects apparently produced were tilting or confusion of stratification or lifting up. This seemed to be effect of the granite itself being lifted up, so that it was only a secondary agent in the process. This shewed conclusively that the granite is older than the Middle Silurian, and therefore at least of Lower Silurian Age.

GNEISSOID.

The relation of these to the Middle and Upper Silurian showed that they were underlying the Middle Silurian Strata. Diorite intervening between the two separates them, giving where distinctly intervening an opposite dip to the Middle Silurian, away from the Gneissoid, a northerly dip. The distribution and contortion of the Gneissoid, as well as lithological character indicated the age as of corresponding rocks at Halifax. They are often like the familiar *Ironstone* of N. W. Arm, Halifax Harbour. When not pyritous they are like the gneissoid in contact with the granite quarried at the back of York Redoubt. Where the Gneissoid of Halifax have accidental minerals, Andalusite and Chiastolite, the Nictaux Gneissoids have garnets. The phenomena of contact of the gneissoid and granite are similar to the phenomena of Halifax. Gneissoid fragments are seen imbedded in the granite, shewing a softening or apparent formation of the latter, subsequent to the consolidation of the former, and that the Gneissoid strata are older than the granite, *i. e.*, of the early Lower Silurian or the Cambrian. Mr. Selwyn was the first to maintain their Cambrian age. In the Stratigraphical Collection already referred to—the Quartzites, Gneissoid rocks and Argillites of the gold fields are arranged in the Cambrian division.

In conclusion I would observe that at Nictaux as elsewhere the Diorites seem to have been the agent in giving variety of position to the members of the "Upper Arisaig Series." Elevating action seems to have been at the same time generally prevalent, and hence the variety, irregularity and breaks at the junction of the Pre-carboniferous and Carboniferous formations.

The all prevalent Devonian of Nova Scotia, in 1855, is, in 1877, represented by, post Silurian and pre-Lower Carboniferous *Diorites.*

FIELD EXCURSIONS.

PLEASURE excursions to various points of attraction in the vicinity of Halifax, have of late years formed the staple of the summer amusements of its people. Obeying the prevailing instincts, but with a difference, and combining instruction with relaxation, the Council of the Nova Scotian Institute of Natural Science invited the members of that body to meet at Steele's Pond, on the morning of Saturday, Aug. 3, for a cursory examination, geological and otherwise, of that portion of the peninsula embraced between the place of meeting and the Point Pleasant ferry, crossing by which the intention was to travel along the shore to York Redoubt. They were kindly furnished by the military authorities with a pass, permitting entry to the forts on the route—a privilege which proved a very interesting feature of the day's proceedings.

The geological peculiarities of the harbour of Halifax on both sides are of much interest, and through the medium of the Institute and other sources, have been often noted. On the Halifax side the rock formation is a highly metamorphosed clay slate and quartzite, probably of an age below the Lower Silurian; but all organisms, if any ever existed*, are obliterated. From the starting point, as before mentioned, onward, the strata have been much disturbed, presenting a series of short synclinals and anticlinals, sufficiently conspicuous, with erratic boulders. The surface, wherever exposed, is found to have been denuded in a remarkable manner by the glacial action of a period ever so much more recent, which has smoothed and covered it with striæ—its compact hardness sustaining, first, the enormous pressure and the gradual south-easterly movement which have caused the striæ; and next, it refers us from the nineteenth century to evidence of a period when probably no living thing existed in this ice-clad region, save such arctic animals as the seal and polar bear. It tells also of another period, when possibly under circumstances of elevation or depression, and certainly of amelioration of

*Dr. Honeyman asserts that he has found tracks of annelids on the rocks below Fort Ogilvie.

climate, the ice disappeared, leaving as a legacy the present Nova Scotia, and progressive fauna, and probably the fishing banks off the coast, now teeming with their finny millions. Since then no further geological disturbance has taken place.

The gradual melting of the glaciers, which at one time must have given this region an appearance similar to that of Greenland at the present day, left also the boulder clay and drift deposits, by which the rock is more or less overspread. At Point Pleasant, just below Fort Cambridge, may be found by diligent seekers, specimens of amygdaloid and other minerals, which show that no small portion of the deposit has been borne by a long continued ice movement, from the trap districts of the Bay of Fundy, reaching the ocean by the coast, as the glaciers and icebergs of Greenland now do by Baffin's Bay and Davis' Straits.

A visit to the Forts, although not intimately connected with natural science, affords good evidence of the perfection to which *military* science has attained within a comparatively short period, and the permission was highly appreciated. Judging by their commanding position, and likewise by the support they would receive from McNab's Island and Fort Clarence, on the opposite shores, and from George's Island further on, to say nothing of modern torpedo warfare—the charge at Balaclava would be a small affair compared with the temerity that would attempt a hostile passage. It was thereupon agreed, *nem con,* that so far as Halifax is concerned, no one's sleep need be ever disturbed, by threats of, or actual invasion. The thought was also intruded, that we owe much to the Mother Country, which after such a fashion has ensured our safety, seeing that all the resources of the Dominion are scarcely adequate to fulfil that duty. Yet does our geographical and strategetical importance fully counterbalance the cost of these defences, and the enormous artillery and other warlike appliances which compose their armament; for Halifax, held by a first rate naval power, is the key, not alone of the Dominion, but also to the West Indies and the neighboring United States.

So far the excursion was all that could be desired; but here the pleasure was fated to come to a rather sudden termination.

The wind blew and the rain fell, while searching for *calluna vulgaris*, which it was understood grew hereabout. The plant may be found fringing the new road a little below Fort Cambridge. It is a vexed question whether it is indigenous or an exotic. Several papers have been read before the Institute by Professor Lawson and others, and these contain the best possible evidence on the subject. It is found in Newfoundland, Cape Breton, several parts of Nova Scotia proper, and also in some of the northern States of the adjacent Republic. It may be an imported plant, and meeting with congenial soil have spread; but nowhere in America does it present the expansive propensity of the heather of Scotland or the English heath. The evidence appears just as strong for its being indigenous. But as in connection with *our* heather we have a not very pleasing remembrance of a walk in heavy rain from Point Pleasant to the City, we must leave the further discussion of such a knotty point in botanical science to those who may choose to fight over it.

The party returned to the city at full speed, with a determination to carry out the second part of the programme at an early and more hopeful day.

In pursuance of the determination above expressed, another meeting was summoned to assemble at the Tower, Point Pleasant, on Saturday, the 24th ult., cross the Ferry, and work the shore onward to York Redoubt.

The day was beautifully fine, but a fewer number was present than on the previous occasion. There were, however, more pleasurable incidents connected with the jaunt. Mackerel had struck in to the mouth of the Arm, seines had been shot, and the fishermen were busy at work. One of these seines had stopped, by computation, eighty barrels of fish, and others were more or less expectant. It is to be hoped that a gracious Providence will realize to the fishermen an abundant harvest of the deep. With spirits raised by the prospect, the party landed at Purcell's Cove, when a beautiful aquatic vision met their gaze. The "Bellerophon," flag ship of Admiral Inglefield, was seen, steaming leisurely down the harbour, outward bound, attended by her consorts, the "Sirius" and "Argus," and followed by a part of the Halifax Yacht Squadron, intent on a kindly adieu for a season. In half an hour the Admiral had rounded Chebucto Head, out of sight, and the yachts were running back to their moorings with the accommodating westerly wind.

Following the shore, over rocks and boulders, attention was directed by Dr. Honeyman to a conglomerate recently formed by the accumulated debris of granite, gneiss and slate, cemented with oxide of iron derived from the pyritous gneissoid rocks. The kelp on the beach also attracted attention, with its clusters of *eschara* and *spirorbis*, and called forth interesting explanations from a member of the Institute. Proceeding along the shore, the granite appears *in situ* and in large boulders, coarsely porphyritic to the eye of the geologist, but a beautiful mixture of perfectly formed small crystals of quartz and felspar, intermingled with lustrous mica—doubtless the material, if fairy legends are worthy of credence, with which Poseidon embellishes his submarine palaces, and the nereides and mermaids their crystal grottos. We are not aware that it can be made useful in any other way.

Onward, scrambling over and leaping the granite and gneissoid boulders, at a little more than half way to Falkland village, a patch of gneissoid strata is conspicuous, lying directly on the granite, having by clinometer a dip 40° N. 10° W. It was noticed by Dr. Honeyman as important, confirming a geological theory connected with the locality, of which we shall probably hear more at the next ordinary session of the Institute. Ledges of gneissoid and quartzose rocks and heavy boulders, were continuous. In the former were observed numerous weathered cavities of pyritous crystals, and in the quartzose formation andalusite; at one spot the latter appeared ranged in groups, in stellar form—probably a not unfrequent occurrence.

We have read a good deal of Alpine climbing, but before the traveller takes too much credit for ascending Mont Blanc, should like him to try the shore line of Halifax Harbor, from Purcell's Cove to York Redoubt, without shirking the difficulties, or (in some few places) the peril of the undertaking. It is, however, far from impracticable, and when he arrives at the latter point (it took us *in all* three hours and a half to do so), if he then feels inclined he can go further, and will no doubt find objects of interest to compensate his energetic perseverance.

Here we scaled the heights, and soon found ourselves at York Redoubt, where, by virtue of the *pass*, we became at once free of the premises, and were showed round with much courtesy and attention. The most striking objects in the Fort are the heavy ordnance, those nineteen ton guns, which we were assured would carry the conical shot and shell piled around, across Thrum Cap and as far as Devil's Island, more than four miles distant, while they could be depressed to bear upon an object half a mile from the shore. We forgot to enquire how the guns got there, and are still somewhat anxious to learn the process, if they were first landed at the foot of this eminence. The knowledge may help to solve the problem of the mechanical appliances by which the old Egyptian engineers got their big stones to the top of the pyramids.

It now only remained to get back to the city by the easiest route. The main road from York Redoubt to the Ferry, barely, if at all passable, for a carriage, is susceptible of great improvement, which is certainly due to the inhabitants of the villages in this direction, who number several hundreds, and depend entirely upon their boats for communication with Halifax. It is not, however, bad exercise for the pedestrian, and will always be preferred to the boulder route by the shore. The ferry was soon gained, and crossing the party reached the city, delighted with the excursion, only regretting that a larger number of the members had not been present to share the pleasure, and so to manifest their approval of an enjoyable feature of the work of the Institute.

W. G.

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